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WATER RESOURCES OF DINOSAUR NATIONAL MONUMENT, COLORADO AND UTAH

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ENGLISH-TO-METRIC CONVERSION FACTORS

Most numbers are given in this report in English units followed by metric units. The conversion factors are shown to four significant figures. In the text, however, the metric equivalents are shown only to the number of significant figures consistent with the accuracy of the number in English units.

English Units (Multiply)	English Abbreviation	(by)	Metric Units (to obtain)	Metric Abbreviation
Acres		0.4047	Square hectometres	hm^2
Acre-feet	acre-ft	.001233	Cubic hectometres	hm^3
Cubic feet per second	ft^3/s	.02832	Cubic metres per second	m^3/s
Cubic feet per day per foot	$(ft^3/d)/ft$	0.0929	Cubic metres per day per metre	$(m^3/d)/m$
Feet	ft	.3048	Metres	m
Feet per mile	ft/mi	.1894	Metres per kilometre	m/km
Gallons	gal	3.785	Litres	l
Gallons per minute	gal/min	.06309	Litres per second	l/s
Gallons per minute per foot	(gal/min)/ft	.2070	Litres per second per metre	(l/s)/m
Inches	in	25.40	Millimetres	mm
Miles	mi	1.609	Kilometres	km
Square feet	ft^2	.0929	Square metres	m^2
Square miles	mi^2	2.590	Square kilometres	km^2

Chemical concentration and water temperature are given only in metric units. Chemical concentration is given in milligrams per litre (mg/l). For concentrations less than 7,000 mg/l, the numerical value is about the same as for concentrations in the English unit, parts per million.

Chemical concentration in terms of ionic interacting values is given in milliequivalents per liter (meq/l). Meq/l is numerically equal to the English unit, equivalents per million.

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit by the following equation: $°F = 1.8(°C) + 32$.

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ABSTRACT

Dinosaur National Monument, partly in the Rocky Mountain System and partly in the Colorado Plateaus physiographic province, covers an area of 322 square miles (834 square kilometres) in northwestern Colorado and northeastern Utah. The climate is generally cool and pleasant in May, early June, September, and October; winters are cold. Normal annual precipitation ranges from less than 8 to more than 16 inches (203 to 406 millimetres).

Geologic formations in the monument range in age from upper Precambrian to Holocene, but not all ages are represented. The monument is on the south limb of the east-trending regional fold representing the Uinta Mountains. Faults and subsidary folds on the south slope of the Uinta Mountains complicate the geology and hydrology of the area.

None of the surface streams in the monument are diverted for public supply, but the Green and Yampa Rivers are a recreational resource for boaters. The flow of the Green River is regulated by Flaming Gorge Reservoir; however, flood potentials are estimated for the Yampa River and three smaller streams. Facilities in the monument are not endangered by probable mean annual floods, but may sustain some damage to facilities by the 25- or 50-year floods.

Major aquifers in the monument are sandstone and limestone formations, but these formations are drained in the higher areas. Alluvium along the major stream channels yields small amounts of water to wells, but some of the water is not of suitable chemical quality for public supply. All public water supplies in 1971 were obtained from wells, and the use of water during 1970 was estimated to be 15 million gallons (46 acre-feet or 0.057 cubic hectometres). Most of the ground water obtained from sandstone and limestone is of suitable chemical quality for public supply.

INTRODUCTION

Purpose

The purpose of the investigation on which this report is based was to appraise the water resources of Dinosaur National Monument, Colorado and Utah. The need for information about water resources in the monument has become increasingly apparent due to expansion of facilities, the general aridity of the region, and the localized occurrence of potable water. The investigation was made by the U.S. Geological Survey, at the request of the U.S. National Park Service, during the period July 1967 to June 1970.

Previous investigations and acknowledgments

The earliest study in the area of Dinosaur National Monument was in connection with a regional geologic survey by Powell (1876). Other regional geologic and hydrologic investigations were made by Woolley (1930), Thomas (1952), Untermann and Untermann (1954), Kinney (1955), Sears (1962), Iorns, Hembree, and Oakland (1965), Feltis (1966), and Hansen (1969).

The assistance of personnel of the National Park Service during the investigation is gratefully acknowledged.

Well- and spring-numbering system

The system of numbering wells and springs in Utah is based on the cadastral land-survey system of the U.S. Government. The number, in addition to designating the well or spring, describes its position in the land net. By the land-survey system, the State is divided into four quadrants by the Salt Lake base line and meridian, and these quadrants are designated by the uppercase letters A, B, C, and D, indicating the northeast, northwest, southwest, and southeast quadrants, respectively. Numbers designating the township and range (in that order) follow the quadrant letter, and all three are enclosed in parentheses. The number after the parentheses indicates the section, and is followed by three letters indicating the quarter section, the quarter-quarter section, and the quarter-quarter-quarter section--generally 10 acres (4 hm^2);1/ the letters a, b, c, and d indicate, respectively, the northeast, northwest, southwest, and southeast quarters

1/ Although the basic land unit, the section, is theoretically 1 mi^2 (2.6 km^2), many sections are irregular. Such sections are subdivided into 10-acre (4-hm^2) tracts, generally beginning at the southeast corner, and the surplus or shortage is taken up in the tracts along the north and west sides of the section.

of each subdivision. The number after the letters is the serial number of the well or spring within the 10-acre (4-hm^2) tract; the letter "S" preceding the serial number denotes a spring. If a well or spring cannot be located within a 10-acre (4-hm^2) tract, one or two location letters are used and the serial number is omitted.

Thus (D-4-23)26bcd-1 designates the first well constructed or visited in the NW¼NE¼SW¼ sec. 26, T. 4 S., R. 23 E. Other sites where hydrologic data were collected are numbered in the same manner, but three letters are used after the section number and no serial number is used. The numbering system is illustrated in figure 1.

The system of numbering wells and springs in Colorado, as in Utah, is also based on the cadastral land survey system. The land survey system in Colorado is the same as in Utah, but in northern Colorado the quadrants are based on the base line and the Sixth principal meridian. The numbering system is illustrated in figure 1.

GEOGRAPHIC SETTING

Dinosaur National Monument covers an area of 322 mi^2 (834 km^2)--238 mi^2 (616 km^2) in Moffat County, Colo., and 84 mi^2 (218 km^2) in Uintah County, Utah (fig. 2) Monument Headquarters is adjacent to U.S. Highway 40, about 1 mi (1.6 km) east of Dinosaur, Colo., about 29 mi (47 km) southeast of the Dinosaur Quarry, and about 34 mi (55 km) southeast of Vernal, Utah.

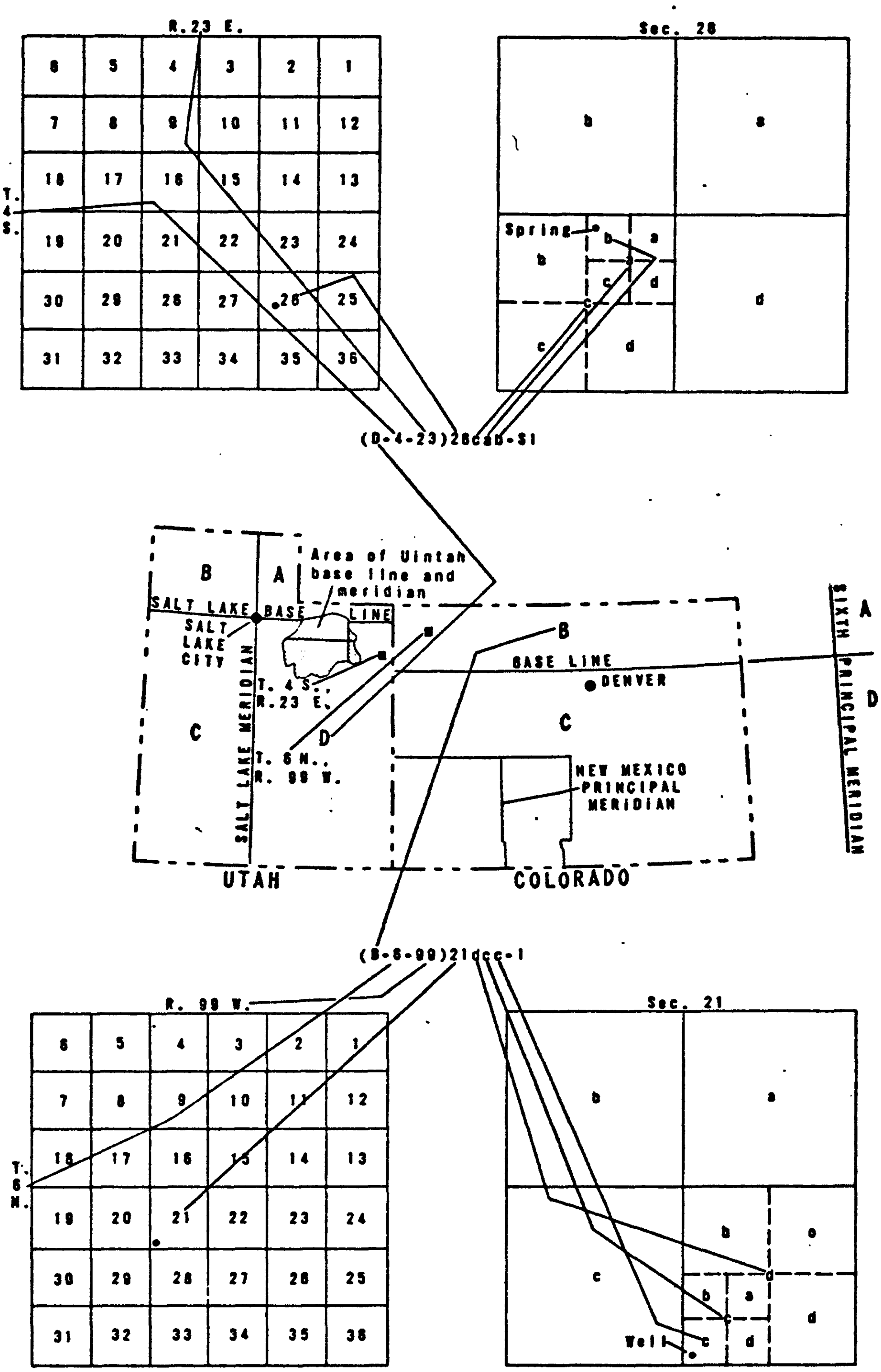


Figure 1.--Well- and spring-numbering system used in Utah and Colorado.

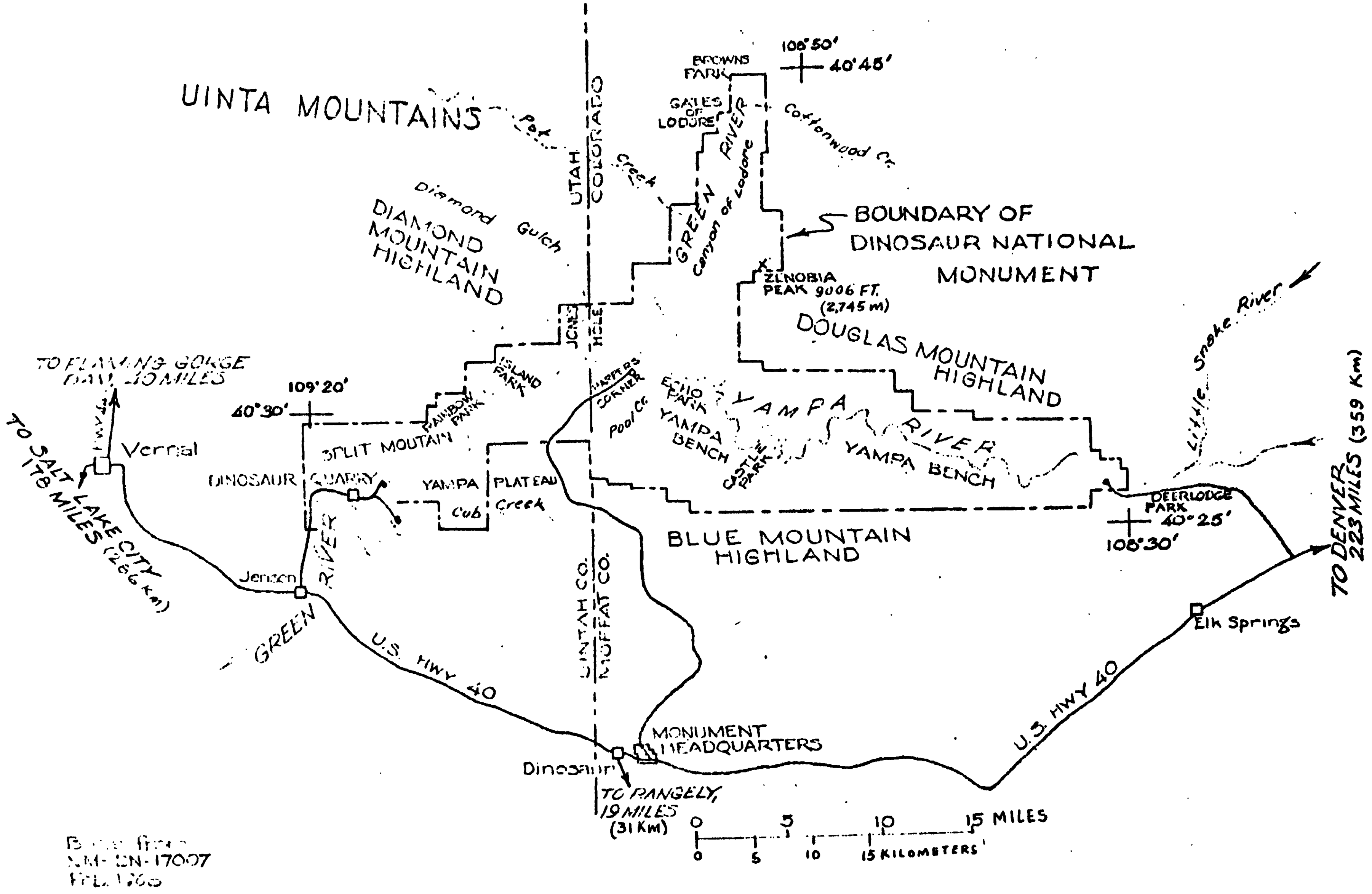


Figure 2.--Major geographic features of Dinosaur National Monument and vicinity.

Physiography and drainage

Dinosaur National Monument lies partly in the Middle Rocky Mountains of the Rocky Mountain System and partly in the Uinta Basin section of the Colorado Plateaus physiographic province (Fenneman and Johnson, 1946). The physiographic boundary of the Rocky Mountain System and the Colorado Plateaus province is not sharply defined in the monument area; it has been arbitrarily interpreted as the approximate line of contact of formations of Triassic age or younger with formations of Permian age or older.

The monument area is divided into three large highland areas separated by the canyons of the Green and Yampa Rivers--the Diamond Mountain highland, the Douglas Mountain highland, and the Blue Mountain highland (fig. 2). A complex geologic and physiographic history, in combination with wide variety of rock types, impart a diversity of landforms to the area (Hansen, 1969, p. 77-105). High plateaus, scarps, benches, cliffs, and isolated valleys characterize the highland areas. Zenobia Peak (9,005 ft or 2,745 m) in the Douglas Mountain highland is the highest point in the monument.

The Green River enters the northern part of the monument at Browns Park and flows southward through the precipitous gorge of the Canyon of Lodore. The Yampa River enters the eastern part of the monument at Deerlodge Park, flows through the deeply entrenched meanders of Yampa Canyon, and joins the Green River at Echo Park in the central part of the monument. The Green River leaves Split Mountain Canyon in the southwestern part of the monument at an altitude of about 4,730 ft (1,441 m), which is the lowest point in the monument.

Most tributaries to the Green and Yampa Rivers are intermittent or ephemeral. Only Pool and Jones Hole Creeks are perennial tributaries within the monument. Cub Creek is perennial, but it flows only a short distance within the monument and enters the Green River beyond the monument boundaries.

Climate

In Dinosaur National Monument the climate is generally cool and pleasant in May, early June, September, and October. On summer days the temperatures may exceed 100°F (38°C) in lower area but seldom rise above 80°F (27°C) in the highlands; temperatures at night are generally cool. The average annual temperature at the Dinosaur Quarry was 47.4°F (8.6°C) during 1958-70. Winters are cold, and subzero temperatures frequently occur.

The differences of altitudes and landforms cause local differences in climate in the monument area. The Uinta Mountains influence conditions locally by forcing approaching air masses upward or slightly deflecting the passage of frontal weather systems. Winter storms are produced by the passage of well-defined frontal weather systems. Summer storms are commonly local convective disturbances that are intense but brief. The average annual precipitation at the Dinosaur Quarry was 7.73 in(196 mm) during 1958-70. Precipitation generally increases with altitude; the highland areas of the monument receive a normal annual (1931-60) precipitation of more than 16 in (406 mm) (U.S. Weather Bureau, 1963). Average monthly temperatures and precipitation at the Dinosaur Quarry for the period 1958-70 are shown in figure 3.

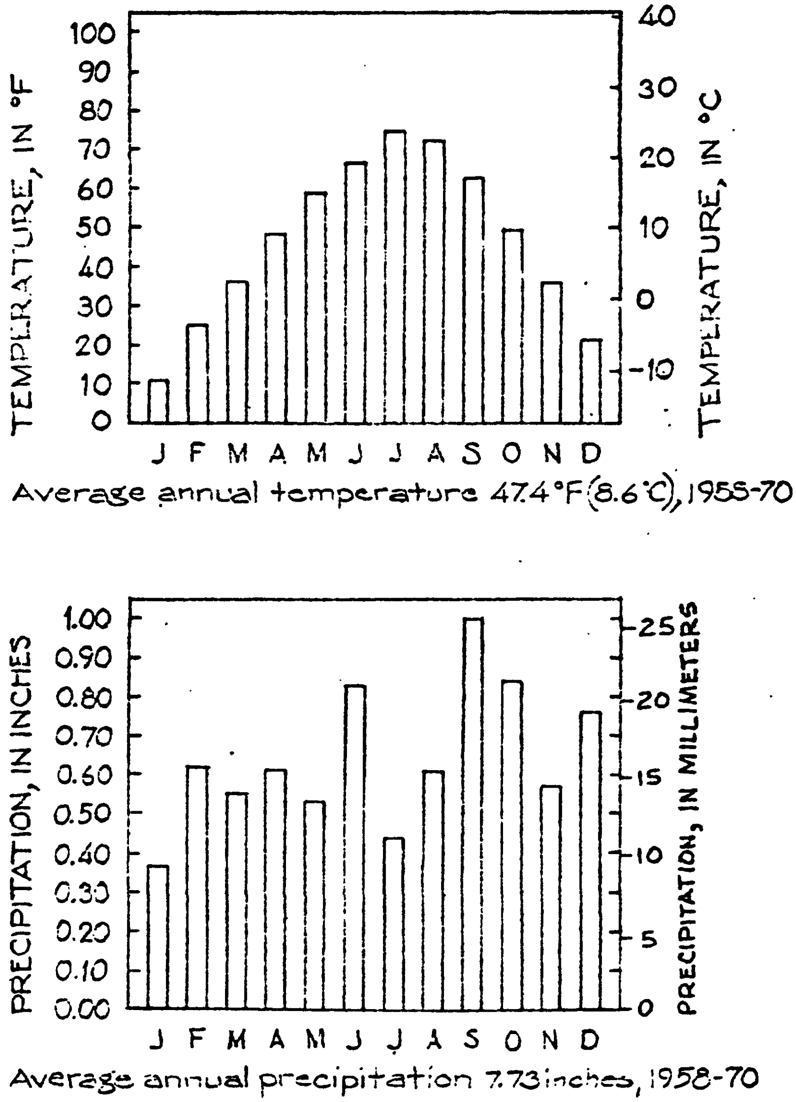


Figure 3.--Average monthly and annual temperatures and precipitation at Dinosaur Quarry, 1953-70.

Vegetation

In semiarid and arid regions, there is an intimate relation between the growth of certain types of vegetation and the presence, or absence of ground water. Where ground water is within reach of their root systems, phreatophytes flourish conspicuously; in areas where ground water is at greater depth, vegetation is sparse and is composed mainly of xerophytes or drought-resistant types. Only at high altitudes on north-facing slopes is sufficient soil moisture retained to support sparse stands of less drought-resistant trees and other similar vegetation. The plant communities in Dinosaur National Monument reflect the generally arid regional climate; their ranges of predominance are directly related to altitude, precipitation, and soil or geologic formation. The predominant plant communities, in order of greatest expanse, are pinyon-juniper, big sagebrush, and shadscale (Branson, *in* Iorns and others, 1965, pl. 7).

The pinyon-juniper community covers the low-mountain areas at altitudes of 4,000-6,000 ft (1,200-1,800 m). Utah juniper (*Juniperus osteospera*) is the most profuse member of its family; the most common pinyon is Colorado pinyon (*Pinus edulis*). Sand dropseed (*Sporobolus cryptandrus*) is the prevalent understory plant in this area.

The big sagebrush community is less restricted by altitude and is found at nearly all altitudes in the monument. A few of the many plants commonly associated with big sagebrush (*Artemesia tridentata*) are rabbitbrush (*Chrysothamnus* sp.), winterfat (*Eurotia lavata*), and blue grama (*Bouteloua gracilis*).

The shadscale community predominates in areas of lower altitudes, generally west of Island Park. Shadscale (Artriplex confertifolia) and its associated shrubs such as horsebrush (Tetradymia nuttalli and T canescens) and spiny hopsage (Graysia spinosa) prevail where slightly alkaline and relatively impermeable soils are found. Shadscale is found where ground water is more than 40 ft (12 m) below land surface. Its areas of occurrence are sharply divided from areas of greasewood.

Sparse stands of ponderosa pine (Pinus ponderosa), Douglas fir (Pseudosuga taxifolia), and quaking aspen (Populus tremuloides) are found at higher altitudes, particularly in sheltered areas on north-facing slopes.

Cottonwood (Populus sp.), willow (Salix sp.), boxelder (Acer negundo), and saltcedar (Tamarix gallica) grow along stream banks. Greasewood (Sarcobatus vermiculatus) is found on some of the low benches and on flood plains. Phreatophytes generally indicate the presence of relatively shallow water--depths of less than 60 ft (18 m), (Meinzer, 1927, p. 72-77; Robinson, 1958, p. 14-15).

Greasewood will survive and propagate where the depth to water may be as much as 60 ft (18 m) and where the water may be moderately saline (as much as 10,000 mg/l of dissolved solids). The growth, however, is thickest and healthiest where the ground water is shallow and of good chemical quality.

GEOLOGIC SETTING

Stratigraphy

The rocks exposed in Dinosaur National Monument range in age from upper Precambrian to Holocene, but not all ages are represented (pl. 1). The oldest rocks, resistant red quartzite and shale of the Uinta Mountain Group, are exposed mainly in the northern part of the monument where they have been deeply eroded by the Green River to form the precipitous stepped-cliff walls of the Canyon of Lodore. Younger strata find expression as the slopes, ridges, cliffs, and canyon wells above the Green and Yampa Rivers and as the prominent fault-line scarps of the monument area. The most recent deposits, of Holocene age, are alluvium that under valleys and flood plains of the larger streams.

The lithologic and water-bearing characteristics, succession, variations in thicknesses, and general topographic expression of the rocks in the monument are presented in table 1.

Table 1.--Topography, lithology, and water-bearing characteristics of deposits and formations in Dinosaur National Monument

Adapted from Untermann and Untermann (1965) and Cullins (1969).

System	Series	Group	Formation	Member	Thickness (ft)	Topographic expression	Lithology and water-bearing characteristics
Quaternary	Holocene		Alluvium		0 to 60	Flood plains and bank terraces along the Green and Yampa Rivers and some of their tributaries.	Alluvial clay, silt, and sand with lenticular beds of sandy gravel, all from diverse geologic sources; yield small amounts of water to shallow wells, and in a few places yield little or no water or water that is not potable.
	Pleistocene(?)		Terrace gravels				
			Unconformity				
Tertiary	Miocene		Browns Park Formation		0-300	Benches and terraces above the flood plains at the northern end of the monument, and thin scattered basal remnants elsewhere.	A basal conglomerate of red quartzite boulders in a coarse matrix of tan and white conglomeratic sandstone, overlain by white tuffaceous crossbedded sandstone with conglomeratic sandstone lenses; yields potable water to wells and springs.
			Unconformity				
Cretaceous	Upper Cretaceous		Mancos Shale	Main unit of Mancos Shale	4,000 to 5,000+	Flat barren surfaces or badland topography along the meanders of the Green River south of the Dinosaur Quarry, at the eastern end of the monument, and south of Monument Headquarters.	Brownish-gray massive strata of siltstone and clay shale with thin lenticular layers of tan-to-brown sandy limestone and gray calcareous sandstone; not known to yield water to wells or springs in this area; where present as the greater part of alluvium it degrades the chemical quality of ground water.
				Frontier Sandstone Member	225 to 260	Hogbacks on the south side of Split Mountain, northwest of Rainbow Park, at the east end of the monument, and at Monument Headquarters.	Yellowish-gray and tan fine- to medium-grained sandstone in crossbeds and medium tabular beds with some thin strata of tan-weathering lignitic shale; the basal part is conspicuously fossiliferous; yields unpotable water to a few seeps and small springs.
	Lower Cretaceous			Mowry Shale Member	75 to 125	Low rounded hills or as a thin gray strip between the Frontier Sandstone Member and the Dakota Sandstone.	Dark-gray and gray-green shale, hard and fissile with thin discontinuous bentonitic layers; not known to yield water in this area.
			Unconformity				
			Dakota Sandstone		70 to 100	Prominent hogbacks on the south slope of Split Mountain, northwest of Rainbow Park, at Monument Headquarters, and Deerlodge Park.	Gray-brown and rusty yellow medium- to coarse-grained lignitic sandstone with strata of black carbonaceous shale and lenses of conglomeratic sandstone; yields unpotable water to scattered seeps.
			Unconformity				
			Cedar Mountain Formation	Unnamed shale member	50 to 90	Composes the lower, less resistant part of the ridges formed mainly by the Dakota Sandstone; the Buckhorn Conglomerate Member is not everywhere present.	Gray-green and gray-to-red shale with thinly interstratified gray limestone and medium-grained gray sandstone; not known to yield water in this area.
				Buckhorn Conglomerate Member	0 to 80		Conglomeratic sandstona, grading from conglomerate at the base to crossbedded sandstone at the top; permeable but not known to yield water in this area.
			Unconformity				
Jurassic	Upper Jurassic		Morrison Formation		520 to 860	Sandstone units of this formation comprise a closely spaced series of low ridges interspersed with swales of finer material on the south slope of Split Mountain, northwest of Rainbow Park, at Monument Headquarters, and Deerlodge Park.	Gray-green, gray, and red shale, siltstone, and mudstone with lenticular layers of conglomeratic sandstone; permeable in part, yields potable water to wells from its sandstone units.
			Unconformity				
		San Rafael Group	Curtis Formation		105 to 260	Limestone strata of this formation form a conspicuous strike ridge below the Morrison Formation.	Gray and green siltstone, shale, limestone, and friable light-gray and green glauconitic sandstone; yields potable water to springs.
	Middle Jurassic		Entrada Sandstone		30 to 170	Forms short cliffs or low strike ridges topped by the more resistant basal glauconitic sandstone of the Curtis Formation.	Pale red and yellowish-orange fine-grained crossbedded sandstone in medium tabular sets; yields potable water to wells.

Table 1.--Topography, lithology, and water-bearing characteristics of deposits and formation in Dinosaur National Monument--continued

System	Series	Group	Formation	Member	Thickness (ft)	Topographic expression	Lithology and water-bearing characteristics
Jurassic	Middle Jurassic	San Rafael Group	Carmel Formation		90 to 120	Easily eroded, forming strike valleys between the Entrada and Glen Canyon Sandstones, best exposures on the south side of Split Mountain and north of Island Park.	Red siltstone, sandy shale, sandstone, thin light-gray limestone, and thin layers of gypsum; not known to yield water in this area.
			Unconformity				
	Lower Jurassic		Glen Canyon Sandstone		650 to 800	Gracefully rounded barren landforms on the south slope of Split Mountain and northeast of Island Park.	Tan to light-red medium and fine-grained crossbadded sandstone in massive tabular sets; yields potable water to springs and wells.
Triassic	Upper Triassic		Chinle Formation	Unnamed upper members undifferentiated	145 to 230	A red shale strike valley below the Glen Canyon Sandstone.	Red shale, marl, and siltstone with some thin beds of conglomeratic sandstone; not known to yield water in this area.
				Gartra Member	0 to 50	Forms a low ridge above the Moenkopi Formation, absent in the Dearlodge Park area.	Tan-to-yellow coarse-grained sandstone and sandy conglomerate; yields small quantities of potable water to springs.
			Unconformity				
	Lower and Middle(?) Triassic		Moenkopi Formation		475 to 970	Forms a strike valley about Split Mountain and shale slopes along the downthrown block of the Yampa fault.	Red gypsiferous shale, siltstone, and sandstone; not known to yield water in this area.
Permian			Park City Formation	Franson Member	65 to 100	Appear as a gray slope along the Yampa Bench or a strike valley around Split Mountain between the red Moenkopi Formation and the light-colored Weber Sandstone.	Thin gray strata of cherty phosphatic limestone and some gray-to-red siltstone and mudstone; yield small quantities of unpotable water to springs.
			Phosphoria Formation	Meade Peak Phosphatic Shale Member	15 to 25		
			Unconformity				
Permian / Pennsylvanian			Weber Sandstone		850 to 1,000	Spectacular sheer cliffs along the Yampa River, at Jones Hole, and parts of Split Mountain canyon.	Light-tan and light-gray fine-grained crossbedded sandstone in massive tabular sets, yields potable water to wells and springs.
Pennsylvanian	Lower and Middle Pennsylvanian		Morgan Formation		1,030 to 1,450	A series of stepped cliffs along the Green and Yampa Rivers, and as gentle slopes on the upthrown block of the Yampa fault.	Gray cherty thick-bedded limestone with interstratified gray and red sandy shale and gray sandstone; yields potable water to springs.
			Unconformity				
Mississippian	Lower and Upper Mississippian		Doughnut(?) Formation		540 to 1,485	A series of short stepped cliffs and steep slopes over scattered exposures in Zenobia Basin, Jones Hole, along the Green River, and on the upthrown block of the Yampa fault.	Predominantly black and dark-gray shale with greenish-tan sandy limestone and dark-gray and black limestone; not known to yield water in this area.
			Undifferentiated limestone unit (Madison Limestone equivalent?)				Dark-gray cherty limestone and gray sandy dolomitic limestone; yields potable water to springs.
			Unconformity				
Cambrian	Upper Cambrian		Lodore Formation		215 to 445	A series of steep slopes and short stepped cliffs at Jones Hole and eastward along the Green River to the Mitten Park fault.	Light-gray and green glauconitic sandstone and gray-pink arkosic sandstone with thin interstratified red and gray shale and siltstone; not known to yield water in this area.
			Unconformity				
Precambrian	Upper Precambrian	Uinta Mountain Group	Undifferentiated		3,000+	Massive stepped cliffs through the Canyon of Lodore and at scattered exposures along the upthrown block of the Yampa fault.	Red fine-to-coarse-grained quartzitic sandstone with interstratified red and gray shale and siltstone; yields small quantities of water to a few springs.

Structure

The Uinta Mountains are a regional east-trending asymmetrical anticlinal fold, having a relatively steeply dipping north limb contraposed to the gently dipping south limb which extends through Dinosaur National Monument. Associated with the south limb of the regional fold are several large subsidary folds, of which the Split Mountain anticline and its synclinal counterparts, the Island Park and Cub Creek synclines, are partly within the monument (pl. 1).

The Uinta Mountain regional fold is broken by major reverse faults of large displacement on both limbs. The major faults in Dinosaur National Monument are the Yampa fault with its conspicuous fault-line scarp, the Red Rock and Mitten faults branching from the Yampa fault, and the Island Park fault trending northeastward from Rainbow Park through the Jones Hole area (pl. 1).

In upland areas where permeable strata are exposed on anticlinal limbs, the strata accept recharge to the ground-water system. In lower areas where these same strata are interescted by perennial streams, the strata may discharge ground water to the streams. Faults with mylonitic gouge may serve to inhibit or dam ground-water movement; conversely, fault zones having open fractures may serve as conduits for ground-water movement. Within short distances a fault zone may possess both of these characteristics in varying degrees.

WATER RESOURCES

Surface water

The principal streams in Dinosaur National Monument are the Green and Yampa Rivers and Pool, Jones Hole, and Cub Creeks. Water from streams requires filtration and other treatment before use as drinking water, whereas most ground water can be used directly from wells and most springs with little or no treatment. Thus none of the streams in the monument are diverted for public supply. The streams are described herein because during the May-September season they are a recreational resource for boaters and they present a potential flood problem.

Among the characteristics of the streams that are considered separately in the following pages are average monthly stream discharge and temperature (tables 2-6) and flood-frequency relations (figs. 4-7). These figures show the average time in years, or recurrence interval, that will occur before a selected discharge is equaled or exceeded. The reciprocal of the recurrence interval is the probability of that particular discharge occurring or being exceeded in any given year. The stream discharges for floods with recurrence intervals of 2, 10, 25, and 50 years are given for comparison with bankfull discharge, which is defined as that discharge when stream water just begins to overflow onto the active flood plain. The active flood plain is defined as a flat area adjacent to the channel, constructed by the river, and overflowed by the river at a recurrence interval of about 2 years (Wolman and Leopold, 1957, p. 87). These flood discharges, when considered in conjunction with the ability of the channels to convey streamflow, will permit an evaluation of the potential flood hazard at selected reaches.

Green River

Streamflow and water-temperature data for the Green River near Greendale, Utah (about 47 mi [76 km] upstream from Dinosaur National Monument), and near Jensen, Utah, are presented in tables 2 and 3. Since November 1, 1962, the Green River has been regulated by Flaming Gorge Dam, about 47 mi (76 km) upstream from the monument boundary. The regulated flow of the river substantially reduces the possibility of flooding in the monument area.

The fall of the Green River through the Canyon of Lodore is about 270 ft (82 m) in 18 mi (29 km). From Echo Park (where the Green River is joined by the Yampa River) through Whirlpool Canyon the river has a fall of 98 ft (30 m) in 9 mi (14 km), and through Split Mountain Canyon the river falls 145 ft (44 m) in 7 mi (11 km). The Green River has an average fall of about 600 ft (180 m) in its length of 59 mi (95 km) through Dinosaur National Monument.

Water temperatures of the regulated river near the Flaming Gorge Dam range from 4° to 8°C (40° to 47°F) during May to September (table 2), but the river water is undoubtedly warmer in the Canyon of Lodore. The May-September water temperatures of the Green River near Jensen, Utah, range from 14° to 21°C (58° to 69°F) (table 3), and these water temperatures are probably representative of the river in Whirlpool and Split Mountain Canyons.

Table 2.--Average monthly and annual discharge and average monthly water temperature of the Green River near Greendale, Utah (Station 09234500)

Location. -- Lat 40°54'30", long 109°25'20", in NW¼NW¼SE¼ sec. 15, T. 2 N., R. 22 E., Daggett County, Ashley National Forest, on right bank 0.5 mi (0.8 km) downstream from Flaming Gorge Dam, 2 mi (3.2 km) south of Dutch John, 4 mi (6.4 km) northeast of Greendale (46.2 mi or 74.3 km northeast of Lodore Ranger Station), and 407.0 mi (654.9 km) from mouth.

Drainage area. -- 15,100 mi^2 (39,110 km^2), approximately.

Records available. -- October 1950 to September 1970.

Gage. -- Water-stage recorder. Datum of gage is 5,594.48 ft (1,705.20 m) above mean sea level. Prior to Sept. 2, 1959, water-stage recorder at site 2.2 mi (3.5 km) upstream at different datum.

Average discharge. -- 20 years, 1,988 ft^3/s (56.3 m^3/s) or 1,444,000 acre-ft per year (1.78 km^3/yr), unadjusted.

Extremes. -- Period of record: Maximum discharge, 19,600 ft^3/s (555 m^3/s) June 12, 1957 (gage height 10.60 ft or 3,231 m, site and datum then in use); minimum 2.3 ft^3/s (0.065 m^3/s) Mar. 20, 22, 27, 28, 1963 (regulated).

Water temperatures. -- October 1963 to September 1969; fragmentary records from October 1956 to September 1963.

Remarks. -- Records good. Transbasin diversions and diversions for irrigation above station. Flow completely regulated by Flaming Gorge Reservoir 0.5 mi (0.8 km) upstream, since Nov. 1, 1962. Records of chemical analyses are available.

Average monthly and annual discharge, in cubic feet per second and acre-feet (1962-70)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
1,696	1,611	1,910	1,849	1,921	1,601	2,223	2,057	2,273	2,229	1,980	1,851	1,933 cubic feet per second
104,280	95,860	117,500	113,700	107,400	98,430	132,300	126,500	135,200	137,100	121,700	110,100	1,400,000 acre-ft

Average monthly water temperatures, in °C and °F (1963-69)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
9	11	8	6	4	4	4	4	5	7	8	8	degrees Celsius
49	51	47	42	39	39	40	40	41	44	46	47	degrees Fahrenheit

Table 3:--Average monthly and annual discharge and average monthly water temperature of the Green River near Jensen, Utah (Station 09261000)

Location. -- Lat 40°24'34", long 109°14'05", in NE¼SW¼SE¼ sec. 5, T. 5 S., R. 24 E., Uintah County, Dinosaur National Monument, on right bank 300 ft (91 m) upstream from highway bridge, 1 mi (1.6 km) downstream for Cub Creek and Chew Ranch, 4 mi (6.4 km) southeast of Dinosaur Quarry of Dinosaur National Monument, 6.5 mi (10.5 km) northeast of Jensen, 12 mi (19 km) upstream from Brush Creek, and 313.9 mi (505.1 km) from mouth.

Drainage area. -- 25,400 mi^2 (65,800 km^2) approximately.

Period of record. -- October 1903 to December 1904, June to August 1905 (gage heights only), March to September 1906, July to October 1914, August to December 1915, October 1946 to September 1970. Prior to October 1946, published as "at Jensen", except October to December 1903, which was published as "at Vernal".

Gage. -- Water-stage recorder. Altitude of gage is 4,758 ft (1,450.2 m) (from river-profile map). Prior to Oct. 1, 1946, nonrecording gages at site 15 mi (24 km), downstream at different datums. Dec. 13, 1946, to Sept. 30, 1948, water-stage recorder at present site at datum 1.50 ft (0.457 m) higher.

Average discharge. -- 25 years (1903-04, 1946-70), 4,307 ft^3/s (122.0 m^3/s) or 3,120,000 acre-ft per year (3.85 km^3/yr), unadjusted.

Extremes. -- Period of record: Maximum discharge, 36,500 ft^3/s (1,030 m^3/s) June 16, 1957 (gage height 13.22 ft (4.029 m); minimum observed, 102 ft^3/s (2.89 m^3/s) Dec. 6, 1904.

Water temperatures. -- October 1962 to September 1964; other fragmentary records March 1949 to September 1959, October 1966 to September 1969.

Remarks. -- Records good. Transbasin diversions and diversions for irrigation above station. Flow partly regulated by Flaming Gorge Reservoir since Nov. 1, 1962. Records of chemical analyses are available.

Average monthly and annual discharge, in cubic feet per second and acre-feet (1962-70)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
2,338	2,179	2,364	2,361	2,799	2,834	5,759	10,010	9,504	4,232	2,602	2,292	4,106 cubic feet per second
143,700	129,700	145,300	145,100	156,300	174,300	342,700	615,300	565,500	260,200	160,000	136,400	2,975,000 acre-feet

Average monthly water temperatures, in °C and °F (1962-64)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	
14	6	1	0	1	4	9	14	18	21	20	17	degrees Celsius
57	43	33	32	33	39	49	58	64	69	68	63	degrees Fahrenheit

Yampa River

The Little Snake River joins the Yampa River about 4 mi (6.4 km) upstream from Deerlodge Park (fig. 2). Streamflow and water-temperature data for both streams are presented in tables 4 and 5. Flood-frequency curves for the Yampa and Little Snake Rivers are shown in figure 4.

The discharge of the Yampa River with a recurrence interval of 2 years is 9,300 ft^3/s (263 m^3/s). However, because of localized conditions, bankfull discharge at Deerlodge Park is only about 5,000 ft^3/s (142 m^3/s) and is exceeded nearly every year (fig. 4). The discharges of the Yampa River with recurrence intervals of 10, 25, and 50 years are about 13,000 ft^3/s (368 m^3/s), 15,000 ft^3/s (425 m^3/s), and 16,000 ft^3/s (453 m^3/s), respectively (fig. 4). Discharges of these magnitudes will flood low-lying areas; but the water will not reach any permanent installations, such as the paved access road to Deerlodge Park.

The fall of the Yampa River from Deerlodge Park to Echo Park is about 530 ft (160 m) in nearly 47 mi (76 km).

Table 4.--Average monthly and annual discharge and average monthly water temperature of the Yampa River near Maybell, Colo. (Station 09251000)

Location.--Lat 40°30'10", long 108°01'45", in NW¼SE¼NW¼ sec. 2, T. 6 N., R. 95 W., Moffat County, on left bank 100 ft (30 m) downstream from bridge on U.S. Highway 40, 2 mi (3.2 km) downstream from Lay Creek, 3 mi (4.8 km) east of Maybell (42 mi or 67.6 km east of Deerlodge Park).

Drainage area.--3,410 mi^2 (8,830 km^2), approximately.

Period of record.--April 1904 to October 1905, June 1910 to November 1912, April 1916 to September 1970. Monthly discharge only for some periods, published in U.S. Geological Survey (1954). No winter records prior to 1917.

Gage.--Water-stage recorder. Datum of gage is 5,900.23 ft (1798.39 m) above mean sea level. (See U.S. Geological Survey, 1964, for history of changes prior to Mar. 9, 1937.)

Average discharge.--54 years (1916-70), 1,543 ft^3/s (43.70 m^3/s) or 1,118,000 acre-ft per year (1.38 km^3/yr).

Extremes.--Period of record: Maximum discharge, 17900 ft^3/s (507 m^3/s) May 19, 1917 (gage height 10.4 ft (3.17 m) from floodmarks, site and datum then in use), from rating curve extended above 12,000 ft^3/s (340 m^3/s); minimum daily, 2 ft^3/s (0.057 m^3/s) July 17-19, 1934.

Water temperatures.--October 1951 to September 1956, October 1962 to September 1964, October 1965 to September 1966, October 1967 to September 1968; other fragmentary records from November 1950 to September 1969.

Remarks.--Records good except those for winter period, which are fair. Natural flow of stream affected by transbasin diversions, numerous storage reservoirs, and diversions above station for irrigation of about 65,000 acres (263 km^2) above and about 800 acres (3.24 km^2) below station.

Average monthly and annual discharge, in cubic feet per second and acre-feet (1916-70)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year
345	344	298	269	319	664	2,613	6,242	5,453	1,316	380	246	1,543 cubic feet per second
21,210	20,470	18,320	16,540	17,870	40,830	155,500	383,800	324,500	80,920	23,370	14,640	1,118,000 acre-feet

Average monthly water temperatures, in °C and °F (1951-56, 1962-64, 1964-66, 1967-68)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
12	4	1	1	1	2	7	12	16	21	21	19 degrees Celsius
54	40	34	33	33	35	45	53	60	70	70	66 degrees Fahrenheit

Table 5.--Average monthly and annual discharge and average monthly water temperature of the Little Snake River near Lily, Colo. (Station 09260000)

Location. -- Lat 40°32'50", long 108°25'25", in SE¼NW¼NE¼ sec. 20, T. 7 N., R. 98 W., Moffat County, on left bank 170 ft (52 m) downstream from highway bridge, 6 mi (9.7 km) north of Lily, 10 mi (16 km) upstream from mouth (14.3 miles or 23.0 km upstream from Deerlodge Park).

Drainage area. -- 3,730 mi^2 (9,660 km^2) approximately.

Period of record. -- June to August 1904, (published as "near Maybell"), October 1921 to September 1970. Monthly discharge only for some periods, published in U.S. Geological Survey (1954).

Gage. -- Water-stage recorder. Altitude of gage is 5,685 ft (1,733 m) from river-profile map. June 9 to Aug. 14, 1904, nonrecording gage, and May 5, 1922, to Nov. 30, 1935, water-stage recorder at site 300 ft (91 m) upstream at different datums.

Average discharge. -- 49 years (1921-70), 563 ft^3/s (15.94 m^3/s) or 407,900 acre-ft per year (503.1 hm^3/yr).

Extremes. -- Period of record: Maximum discharge, 14,200 ft^3/s (402.1 m^3/s) May 27, 1926 (gage height 10.5 ft or 3.20 m, site and datum then in use), from rating curve extended above 3,600 ft^3/s (102.0 m^3/s); no flow at times in most years.

Water temperatures. -- October 1952 to September 1956; other records fragmentary from December 1950 to September 1960 and October 1961 to September 1969.

Remarks. -- Records good except those for winter period, which are fair. Diversions for irrigation of about 21,000 acres (85 km^2) above station.

Average monthly and annual discharge, in cubic feet per second and acre-feet (1921-70)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The Year
107	110	91.5	82.1	104	370	1,139	2,571	1,804	249	66.6	56.1	564 cubic feet per second
6,579	6,546	5,626	5,048	5,828	22,750	67,780	158,100	107,300	15,310	4,095	3,338	408,600 acre-feet

Average monthly water temperatures, in °C and °F (1952-56)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
5	1	0	0	0	2	7	11	16	21	19	12 degrees Celsius
41	34	32	32	32	35	45	52	60	69	66	54 degrees Fahrenheit

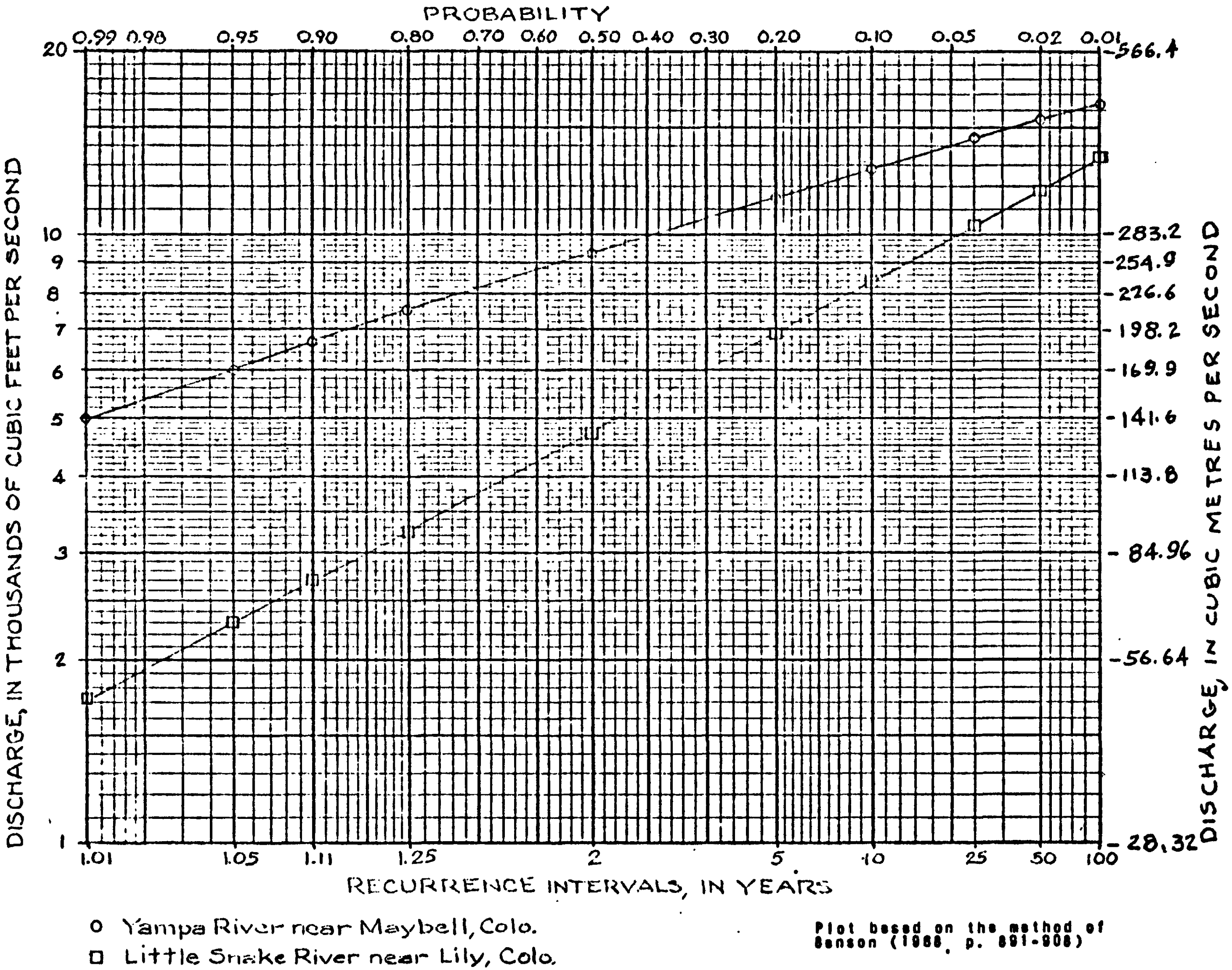


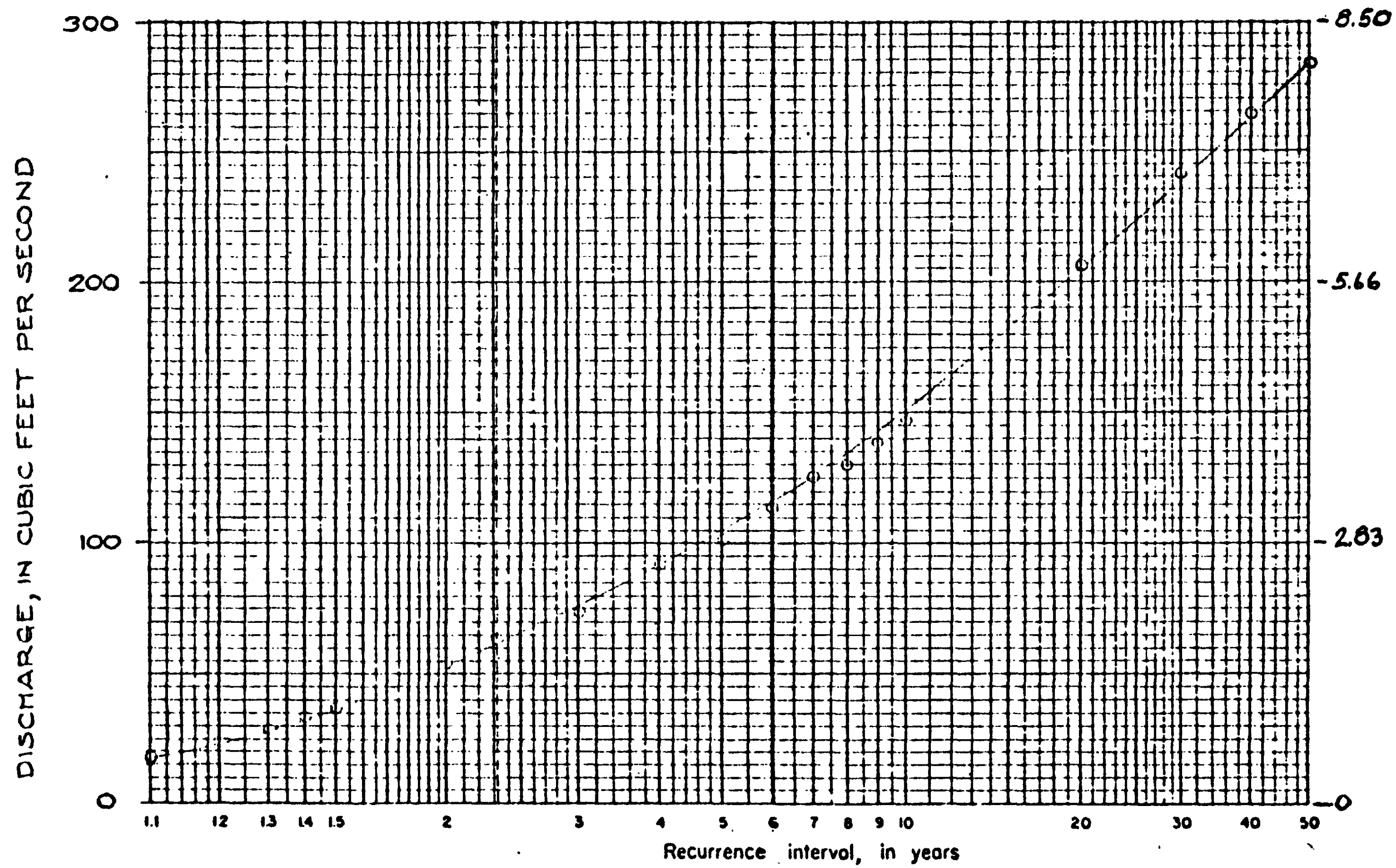
Figure 4.--Flood-frequency curves, Yampa River near Maybell and Little Snake River near Lily, Colo.

Water temperatures measured at the Yampa River near Maybell during May-September range from 12° to 21°C (53° to 70°F) (table 5). These temperatures are probably representative of the river from Deerlodge Park to Echo Park.

Pool Creek

Pool Creek is about 14 mi (23 km) in length, with a total drainage area of about 22 mi^2 (57 km^2). It rises on the Yampa Plateau and enters the Green River at Echo Park. Only about 5 mi (8.0 km) of the lower part of the stream is within the monument, and less than 4 mi (6.4 km) of the lower reach is perennial. The perennial flow originates at Pool Creek Spring and has a relatively stable discharge of about 0.5 ft^3/s (0.014 m^3/s).

A flood-frequency curve for Pool Creek is shown in figure 5. The discharge of Pool Creek with a recurrence interval of 2 years is about 55 ft^3/s (1.6 m^3/s), which is not sufficient to attain bankfull stage. The discharges with recurrence intervals of 10, 25, and 50 years are 150 ft^3/s (4.2 m^3/s), 225 ft^3/s (6.4 m^3/s), and 285 ft^3/s (8.1 m^3/s), respectively. Discharges of these magnitudes will result in overbank flooding along Pool Creek. The only facility that might sustain damage is the unpaved access road to Echo Park.



Plot based on the method of Patterson and Somers (1966, p. 13-14)

Figure 5.--Flood-frequency curve, Pool Creek at Echo Park, Colo.

Jones Hole Creek

Jones Hole Creek is the lower 4-mi (6.4-km) perennial reach of Diamond Gulch, which has a total drainage area of about 121 mi^2 (313 km^2) and is about 35 mi (56 km) long. Thus Diamond Gulch is tributary to the Green River in Whirlpool Canyon as Jones Hole Creek. The streamflow data for Jones Hole Creek in table 6 show a remarkably constant discharge, which reflects the discharge at Jones Hole Springs. The springs are about 0.50 mi (0.8 km) north of the monument boundary, and the creek is perennial below the point where the spring discharge enters the creek channel.

A flood-frequency curve for Jones Hole Creek is shown in figure 6. The discharge of Jones Hole Creek with a recurrence interval of 2 years is about 560 ft^3/s (16 m^3/s). Discharge at this rate will cause overbank flooding at some of the low-lying reaches of the creek, including the campground at the mouth of Jones Hole Creek. The discharges with recurrence intervals of 10, 25, and 50 years are about 880 ft^3/s (25 m^3/s), 1,030 ft^3/s (29 m^3/s), and 1,140 ft^3/s (32 m^3/s), respectively. There are no permanent installations except the campground that would be damaged by these floods.

Table 6.--Average monthly and annual discharge of Jones Hole Creek near Jensen, Utah (Station 09260500)

Location.--Lat 40°33'33", long 109°03'15", in NE¼NW¼SE¼ sec. 13, T. 3 S., R. 25 E., on left bank 1.5 mi (2.4 km) south of Dinosaur National Monument boundary line, 5 mi (8.0 km) northeast of Ruple Ranch (Island Park Ranch) and 20 mi (32 km) northeast of Jensen.

Drainage area.--120 mi² (310 km²), approximately.

Records available.--October 1950 to September 1956, October 1960 to September 1961.

Gage.--Water-stage recorder. Altitude of gage is 5,200 ft (1,585 m) (from topographic map).

Average discharge.--7 years, 36.3 ft³/s (1.028 m³/s) or 26,280 acre-ft (32.4 hm³/yr).

Extremes.--Period of record: Maximum discharge 968 ft³/s (27.4 m³/s)Apr. 26, 1952 (gage height 5.40 ft or 1.645 m), from rating curve extended above 320 ft³/s (9.06 m³/s) on basis of slope-area measurement of peak flow; minimum daily recorded 32 ft³/s (0.91 m³/s) Feb. 3, 4, Sept. 11-30, 1956.

Remarks.--No diversions above or below station for period of record; diversions for fish hatchery above station since October 1969.

Average monthly and annual discharge, in cubic feet per second and acre-feet (1950-56, 1960-61)

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	The year	
34.6	34.9	34.5	33.7	33.3	35.9	49.2	39.5	35.7	35.0	35.0	34.5	36.3	cubic feet per second
2,130	2,070	2,120	2,070	1,870	2,210	2,920	2,920	2,120	2,150	2,150	2,060	26,310	acre-feet

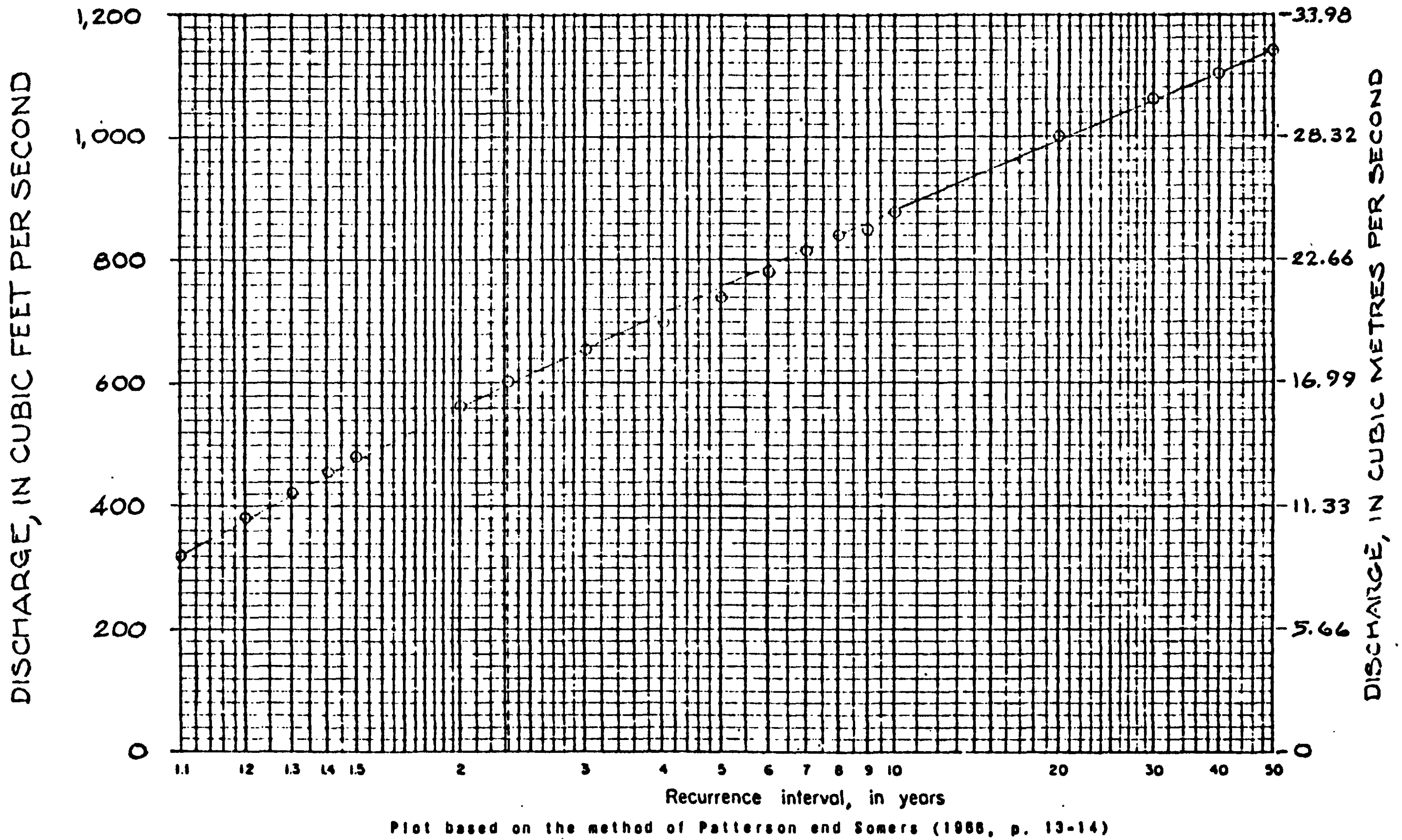


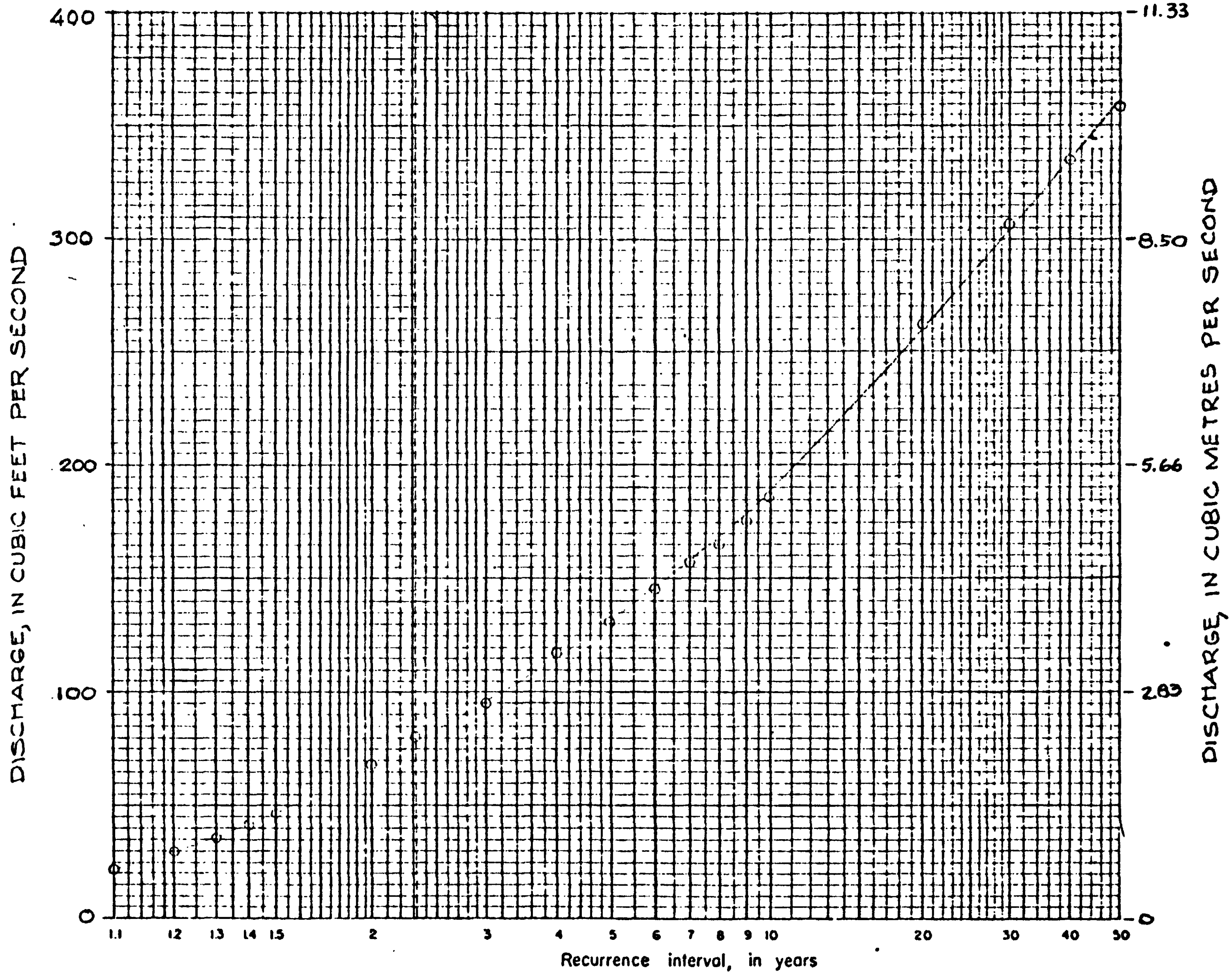
Figure 6.--Flood-frequency curve, Jones Hole Creek near Jensen, Utah.

Cub Creek

Cub Creek, which rises on the Yampa Plateau and joins the Green River about 2 mi (3.2 km) south of Split Mountain Canyon, is 15 mi (24 km) long and has a drainage area of about 33 mi^2 (85 km^2). About 6 mi (9.7 km) of the lower reach of Cub Creek is perennial, its discharge originating from springs about 0.25 mi (0.4 km) east of the monument boundary. On the basis of a small number of measurements, it is believed that the average discharge of Cub Creek probably does not vary widely from about 0.3 ft^3/s (0.008 m^3/s).

A flood-frequency curve for Cub Creek is shown in figure 7.

The discharge of Cub Creek with a recurrence interval of 2 years is about 68 ft^3/s (1.9 m^3/s). This rate of discharge will not cause overbank flooding within the monument. The discharges with recurrence intervals of 10, 25, and 50 years are about 190 ft^3/s (5.4 m^3/s), 285 ft^3/s (8.1 m^3/s), and 360 ft^3/s (10 m^3/s), respectively. Discharges of these magnitudes will result in overbank flooding. There are presently (1971) no permanent facilities in the area that would sustain flood damage at these rates of discharge.



Plot based on the method of Patterson and Somers (1966, p. 13-14)

Figure 7.--Flood-frequency curve, Cub Creek near Jensen, Utah.

Ground water

Ground water originates as precipitation, mainly snow, that infiltrates permeable rocks of the monument and the surrounding highlands. (See table 1.) Much of the recharge to the ground-water system takes place outside the monument boundary. The geology and hydrology of the recharge areas are complex, and the annual amount of recharge cannot be assessed. Ground water generally moves from recharge areas through permeable zones toward discharge areas at springs and the channels of the rivers, where it contributes to the streamflow. In the Island Park-Rainbow Park area some ground water probably moves westward out of the monument, and at the Monument Headquarters area some ground water moves southward out of the area. Ground-water inflow to the rivers is believed to take place along the Yampa River, mainly from Deerlodge Park to Echo Park, and along the Green River, mainly in Whirlpool and Split Mountain Canyons and for a short distance through lower Canyon of Lodore. The ground-water inflow in these areas is mainly from the Weber Sandstone and the Morgan Formation.

All water used at present (1971) for public supply and other facilities is from wells. Drilled wells with powered pumps supply water to the Monument Headquarters area, Dinosaur Quarry, Lodore Ranger Station and campground, and Split Mountain, Green River, and Echo Park campgrounds. Shallow wells with hand pumps furnish water at Anderson Hole, Bull Park, and Box Elder Park. Locations of wells are shown on plate 1. Records of selected wells are presented in table 7 and chemical analyses of water from selected wells in table 8.

Table 7.--Records of selected wells

Location: See figure 1 for description of numbering system.
Altitude: Above mean sea level as indicated from topographic maps.
Water level: Reported unless indicated m, measured.
Yield: Reported unless indicated m, measured.
Remarks and other data available: C, chemical analysis in table 10.

Name	Location	Altitude (ft)	Depth (ft)	Aquifer	Water level below or above (+) land surface datum	Yield (gal/min)	Specific capacity	Date of measurement	Remarks and other data available
					Colorado				
Headquarters well	(B-3-103)5dcc-1	6,170	800	Glen Canyon Sandstone	212	92	0.68	2-6-62	C.
Disappointment well	(B-6-99)20dda-1	5,620	14	Park City Formation	Dry	-	-	5-20-70	Abandoned.
Deerlodge Park well 1	(B-6-99)21dcc-1	5,600	77	Glen Canyon Sandstone	See remarks	50	-	9-18-62	Flowed 2 gal/min; capped; C.
Deerlodge Park well 2	(B-6-99)21dcc-2	5,600	34	Alluvium	12	10	-	9-19-62	Abandoned.
Anderson Hole well	(B-6-100)13dbd-1	5,570	17	do	13	15	-	8-5-62	C.
Baker Cabin well	(B-6-101)30bba-1	6,120	20	Park City Formation	19m	-	-	5-19-70	Abandoned.
Bull Park well	(B-6-102)15dca-1	5,210	33	Alluvium	13	12	-	8-15-62	C.
Echo Park well 1	(B-7-103)28ccb-1	5,080	22	do	16	15	-	1956	Abandoned.
Echo Park well 2	(B-7-103)28ccb-2	5,080	58	do	16	7	-	9-16-62	Abandoned ; C.
Echo Park well 3	(B-7-103)32adb-1	5,085	300	Weber Sandstone	+2.43m	130m	66.3	7-9-70	Flows 150 gal/min at land surface; C.
Box Elder well	(B-7-103)34abc-1	5,085	46	Alluvium	18	22	-	8-27-62	C.
Lodore well 4	(B-9-102)20bda-1	5,355	48	do	30	15	-	2-12-64	Abandoned; C.
Lodore well 5	(B-9-102)21bbc-1	5,380	50	Browns Park Formation	27	35	-	2-12-64	C.
					Utah				
Ruple Ranch well	(D-3-25)32bab-1	4,950	13	Alluvium	12m	-	-	5-21-70	Abandoned.
Quarry well 1	(D-4-23)26bcd-1	4,950	168	Entrada Sandstone	4	10	.13	12-15-51	Do.
Quarry well 2	(D-4-23)26bcd-2	5,025	965	Glen Canyon Sandstone	+5	33	.06	10-29-60	C.
Riverbank well	(D-4-23)35bbb-1	4,750	50	Alluvium	12	60	4.8	11-18-58	Used for irrigation; C.
Rainbow Park test well	(D-4-24)2ddd-1	4,950	110	(1/)	Dry	-	-	5-1-65	
Split Mountain North well	(D-4-24)30add-1	4,775	33	Alluvium	17	20	-	8-29-57	Abandoned; C.
Split Mountain South well	(D-4-24)30ddc-1	4,800	32	do	8	38	2.7	4-9-60	C.
Green River well	(D-4-24)32cca-1	4,790	81	Morrison Formation	10	25	.6	7-7-63	C.
Cub Creek well 1	(D-4-24)35dad-1	5,360	300	Weber Sandstone	+3	30	10.0	9-10-56	Flowed 18 gal/min 6-11-68; C.
Cub Creek well 2	(D-4-24)35dad-2	5,360	300	do	Flows	20	-	9-12-56	Capped.

1/ Bottomed in clay of Morrison Formation.

Table 8.--Selected chemical analyses of water from selected wells

Location: See figure 1 for description of numbering system.

Name	Location	Date of collection	Temperature (°C)	Specific conductance (micromhos/cm at 25°C)	Milligrams per litre												Hardness as $CaCO_3$		pH
					Dissolved silica (SiO_2)	Dissolved iron (Fe)	Dissolved calcium (Ca)	Dissolved magnesium (Mg)	Dissolved sodium (Na)	Dissolved potassium (K)	Bicarbonate (HCO_3)	Dissolved sulfate (SO_4)	Dissolved chloride (Cl)	Dissolved fluoride (F)	Dissolved nitrate (NO_3)	Dissolved solids (residue)	Carbonate	Noncarbonate	
Colorado																			
Headquarters well	(B-3-103)5dcc-1	5-26-69	13.0	614	14	0.20	57	39	22	2.0	303	72	20	0.1	1.3	371	302	54	7.9
Deerlodge Park well 1	(B-6-99)21dcc-1	9-18-62	-	301	15	1.2	29	12	19	-	173	19	2.0	.1	.2	175	123	0	7.7
Anderson Hole well	(B-6-100)13dbd-1	8-5-62	-	422	10	-	53	10	22	-	200	42	10	.2	.5	237	174	10	7.6
Bull Park well	(B-6-102)15dca-1	8-15-62	-	945	12	.29	154	35	14	-	350	249	9.0	.2	.1	667	528	241	7.4
Echo Park well 2	(B-7-103)28ccb-1	5-27-69	12.0	511	7.8	.10	51	29	14	2.3	230	68	14	.4	2.3	304	246	58	7.9
Echo Park well 3	(B-7-103)32adb-1	7-9-70	13.5	576	10	.04	66	36	7.8	1.9	239	108	7.5	.4	.5	373	312	-	7.6
Box Elder well	(B-7-103)34abc-1	8-28-62	-	666	11	-	64	15	59	-	214	102	48	-	.2	396	220	45	7.9
Lodore well 4	(B-9-102)20bda-1	2-12-64	12.0	1,200	37	-	26	16	242	-	372	222	78	2.3	2.5	809	128	0	8.2
Lodore well 5	(B-9-102)21bbc-1	9-24-69	12.0	733	44	.02	67	36	39	6.7	301	115	30	.7	1.5	521	316	69	8.0
Utah																			
Quarry well 2	(D-4-23)26bcd-1	5-27-69	12.0	462	10	0.04	33	23	35	3.6	242	45	9.4	0.3	1.2	270	176	0	8.0
Riverbank well	(D-4-23)35bbb-1	11-18-58	12.0	4,400	16	.15	361	216	532	-	212	2,590	55	1.8	.8	3,870	1,790	1,620	7.5
Split Mountain North well	(D-4-24)30add-1	2-28-59	13.5	1,630	24	-	228	91	49	-	306	730	27	-	-	1,300	942	691	7.3
Split Mountain South well	(D-4-24)30ddc-1	5-27-69	15.0	823	9.4	.25	46	46	66	2.6	241	202	18	.4	16	544	304	106	7.9
Green River well	(D-4-24)32cca-1	5-27-69	11.0	718	9.2	.25	1.2	.9	164	.6	231	137	21	.4	.5	451	6	0	8.2
Cub Creek well 1	(D-4-24)35dad-1	9-12-67	13.5	522	9.4	.00	56	33	4.5	1.4	243	86	4.5	.4	.8	332	277	78	7.6

About 15 million gal (46 acre-ft or 0.057 hm^3) (G. A. Liles, maintenance supt., oral commun., 1971) was withdrawn from wells during 1970 --nearly all at the Monument Headquarters and Dinosaur Quarry.

Springs in the monument have not been developed for public supply, although some of the springs have such potential. Records of selected springs are presented in table 9, and chemical analyses of water from selected springs are given in table 10.

The specific occurrence, use, and development of ground water within Dinosaur National Monument are discussed by areas.

Monument Headquarters area

The Monument Headquarters area is about 2 mi (3.2 km) east of Dinosaur, Colo., (fig. 2), and it includes about 0.75 mi^2 (1.9 km^2). Formations exposed in the area are shown on plate 1 and described in table 1. The principal aquifer underlying the area is the Glen Canyon Sandstone; it contains ground water under artesian conditions and yields water to wells from fractures in the sandstone.

Table 9.--Records of selected springs

Location: See figure 1 for description of numbering system.
Discharge: Measured unless indicated r, reported.
Other data available: C, chemical analysis in table 10.

Name	Location	Discharge (gal/min)	Date of measurement	Aquifer	Other data available
			Colorado		
Bobcat Spring	(B-5-103)1aac-S1	5r	8- 3-62	Alluvium	C.
Bill White Spring	(B-6-99)28bad-S1	.1	5-20-70	Curtis Formation	C.
Disappointment Spring	(B-6-99)29bdb-S1	3	5-20-70	Park City Formation	C.
Corral Spring	(B-6-100)10dac-S1	3	9-24-69	Browns Park Formation	
Baker Spring	(B-6-101)30bcd-S1	12	5-19-70	Gartra Member, Chinle Formation	C.
Castle Park Spring	(B-6-102)18add-S1	15	5-27-69	Weber Sandstone	C.
Bull Park Spring	(B-6-102)22baa-S1	2r	5-16-61	do	
The Seeps	(B-6-102)23ccc-S1	.3	5-19-70	Gartra Member, Chinle Formation	C.
Serviceberry Spring	(B-6-102)27dcd-S1	2	5-19-70	Alluvium	
Marthas Spring	(B-6-102)28cdc-S1	2	5-19-70	do	
Pool Creek Spring	(B-6-103)7bbb-S1	270	6-13-68	Weber Sandstone	C.
Red Rock Ranch Spring	(B-6-103)15dbb-S1	3	5-19-70	Gartra Member, Chinle Formation	C.
Canyon Overlook Spring	(B-6-103)20ccb-S1	.1	5-21-70	Alluvium	C.
Surveyor Spring	(B-6-103)29aad-S1	3	5-20-70	do	
Limestone Spring	(B-7-103)1bbd-S1	2	6-19-70	Mississippian strata, undifferentiated	
Rippling Brook Spring	(B-7-103)6aca-S1	1	9-24-69	Browns Park Formation	
East Hackings Spring	(B-7-103)7dca-S1	1	9-24-69	do	
West Hackings Spring	(B-7-103)7dcb-S1	1	9-24-69	do	
Mitten Fault Spring	(B-7-103)20dbc-S1	580r	9-14-48	Morgan Formation	C.
Warm Springs	(B-7-103)25bcc-S1	20r	5-17-61	do	C.
North Burnt Spring	(B-7-104)13bca-S1	50	9-24-69	do	
South Burnt Spring	(B-7-104)13bcd-S1	50	9-24-69	do	
Dripping Rock Spring	(B-8-102)5dab-S1	2	9-24-69	Browns Park Formation	
Bassett Camp Spring	(B-8-102)19dda-S1	2	9-24-69	Alluvium	
Buffhams Spring	(B-8-102)30bbd-S1	2	6-19-70	do	
Chokecherry Spring	(B-8-102)31bca-S1	2	6-19-70	do	
R. Buffhams Spring	(B-8-102)31daa-S1	3	6-19-70	do	
Wade Curtis Spring	(B-9-102)31dbb-S1	2r	9-30-63	do	C.
			Utah		
Jones Hole Spring (uppermost spring)	(D-3-25)1bda-S1	200	6-13-68	Morgan Formation	C.
Big Draw Spring	(D-3-25)11dcc-S1	100	9-24-69	Weber Sandstone	C.
Ely Creek Spring	(D-3-25)12cca-S1	10	9-24-69	do	
Garden Creek Spring	(D-3-25)19bdc-S1	18	5-21-70	Glen Canyon Sandstone	C.
Sage Creek Spring	(D-3-25)22dda-S1	100r	9-10-48	Weber Sandstone	C.
Red Wash Spring	(D-4-23)23dda-S1	4	8- 3-70	Park City Formation	C.
Quarry Spring	(D-4-23)26bdc-S1	10r	10-4-60	Entrada Sandstone	C.
Orchard Draw Spring	(D-4-23)27bba-S1	15	9-23-69	Glen Canyon Sandstone	C.
Wildlife Spring	(D-4-24)2ccc-S1	0.7	9-12-67	do	C.
McKee Spring	(D-4-24)3baa-S1	0.1	5-21-70	Frontier Sandstone Member, Mancos Shale	C.
Split Mountain Warm Spring	(D-4-24)16cdd-S1	2,700r	9-19-48	Mississippian strata, undifferentiated	C.
Morris Ranch Spring	(D-4-24)35dad-S1	23	6-11-68	Weber Sandstone	
Hog Canyon Spring	(D-4-24)36bdc-S1	56	6-11-68	do	C.

Table 10.--Selected chemical analyses of water from selected springs

Location: See figure 1 for description of numbering system.

Name	Location	Date of collection	Temperature (°C)	Specific conductance (micromhos/cm at 25°C)	Milligrams per litre: Dissolved silica (SiO_2)	Dissolved iron (Fe)	Dissolved calcium (Ca)	Dissolved magnesium (Mg)	Dissolved sodium (Na)	Dissolved potassium (K)	Bicarbonate (HCO_3)	Dissolved sulfate (SO_4)	Dissolved chloride (Cl)	Dissolved fluoride (F)	Dissolved nitrate (NO_3)	Dissolved solids (residue)	Hardness as $CaCO_3$: Carbonate	Hardness as $CaCO_3$: Noncarbonate	pH
Colorado																			
Bobcat Spring	(B-5-103)1aac-S1	8-3-62	-	380	10	0.02	52	16	4.1	-	227	7	5.5	0.2	2.9	198	195	9	7.7
Bill White Spring	(B-6-99)28bad-S1	5-20-70	10.0	341	13	.00	38	16	9.9	1.7	194	15	6.0	.2	4.7	194	162	3	7.5
Disappointment Spring	(B-6-99)29bdb-S1	5-20-70	9.5	1,450	12	.02	253	54	16	.7	274	608	3.1	.3	.0	1,260	850	625	7.8
Baker Spring	(B-6-101)30bad-S1	5-19-70	8.5	437	8.5	.00	56	22	4.2	1.6	280	10	4.7	.2	4.0	254	232	2	7.7
Castle Park Spring	(B-6-102)18add-S1	5-27-69	13.5	751	11	.18	104	39	7.1	2.5	319	159	6.5	.4	.8	520	417	155	7.9
Bull Park Spring	(B-6-102)22baa-S1	5-16-61	7.0	884	9.3	-	113	54	9.9	-	296	263	6.5	-	.3	-	504	261	7.6
The Seeps	(B-6-102)23ccc-S1	5-19-70	9.0	573	13	.02	50	29	35	3.7	338	30	16	.4	3.2	337	244	0	7.8
Pool Creek Spring	(B-6-103)7bbb-S1	9-13-67	12.0	437	10	.01	59	22	3.5	.3	244	35	5.2	.3	3.2	248	240	40	7.8
Red Rock Ranch Spring	(B-6-103)15dbb-S1	5-19-70	9.5	654	12	.01	85	29	16	1.8	313	92	11	.5	3.4	422	330	73	7.7
Canyon Overlook Spring	(B-6-103)20ccb-S1	5-21-70	9.0	123	3.0	.29	10	3.4	2.4	20	68	11	1.6	.1	3.4	90	40	0	7.2
Mitten Fault Spring	(B-7-103)20dbc-S1	9-14-48	-	-	13	-	74	29	237	-	239	94	370	-	3.0	938	304	-	-
Warm Springs	(B-7-103)25bcc-S1	5-17-61	15.5	1,640	11	-	72	24	230	-	243	84	349	-	2.1	-	280	81	7.6
Wade Curtis Spring	(B-9-102)31dbb-S1	9-30-63	12.0	307	16	-	47	8.3	6.6	.8	166	21	10	.3	-	180	152	16	7.6
Utah																			
Jones Hole Spring	(D-3-25)1bda-S1	6-13-68	11.5	320	13	0.06	38	18	2.7	.9	204	8.8	2.2	0.4	0.1	178	172	5	7.7
Big Draw Spring	(D-3-25)11dcc-S1	9-24-69	12.0	439	11	.03	46	28	4.8	1.6	237	42	4.4	.3	.8	280	232	38	8.2
Garden Creek Spring	(D-3-25)19bdc-S1	5-21-70	10.5	405	15	.00	40	26	6.7	1.4	254	12	5.0	.2	1.0	228	208	0	7.7
Sage Creek Spring	(D-3-25)22dda-S1	9-10-48	14.5	905	15	-	143	42	4.1	-	189	363	4.0	-	.1	-	530	374	-
Red Wash Spring	(D-4-23)23dda-S1	11-18-58	15.5	1,000	11	-	140	53	15	-	284	345	6.0	-	2.1	-	568	335	7.5
Quarry Spring	(D-4-23)26bdc-S1	10-4-60	-	575	9.0	.01	67	31	17	1.9	302	65	13	.3	.1	348	296	48	8.1
Orchard Draw Spring	(D-4-23)27bba-S1	10-1-58	16.0	529	11	-	67	26	11	-	223	102	5.0	.0	.6	-	273	-	7.8
Wildlife Spring	(D-4-24)2ccc-S1	9-12-67	16.0	476	9.7	.00	36	27	26	2.1	233	55	9.0	.5	3.5	282	199	8	7.7
McKee Spring	(D-4-24)3baa-S1	5-21-70	10.0	3,580	8.8	.01	144	78	661	3.4	716	1,440	40	2.8	1.3	2,860	680	93	7.7
Split Mountain Warm Spring	(D-4-24)16cdd-S1	9-14-48	30.0	1,570	18	-	97	32	193	-	198	212	291	-	1.2	-	374	212	-
Hog Canyon Spring	(D-4-24)36bdc-S1	6-11-68	11.5	366	10	.12	38	24	4.0	1.1	208	26	5.4	.4	3.5	198	196	25	8.0

In 1962, the National Park Service drilled the Headquarters well (pl. 1 and table 7), which yields potable water from the Glen Canyon Sandstone (table 10). The rate of pumping is 50 gal/min (3.2 l/s) when the well is used. In the event of pump or power failure during the period of peak demand, a 200,000 gal (760 m^3) storage tank is estimated to be able to serve the facilities for about 1 week. A second well could serve as an alternate source of water in the event of pump failure and as a supplementary source of water at periods of peak demand. A well site is shown on plate 1 where the depth to the Glen Canyon Sandstone should be approximately the same as at the Headquarters well. This site is within the exposure of the Entrada Sandstone. (See pl. 1.) South of the ridge of Entrada Sandstone, the aquifer would be encountered at increasingly greater depths. To minimize interference between wells when they are pumped simultaneously, the distance between wells should be at least 1,000 ft (300 m).

There are no springs in the Monument Headquarters area or the near vicinity that could serve as sources of water supply.

Gates of Lodore area

The Gates of Lodore area is in the northernmost part of Dinosaur National Monument near the head of the Canyon of Lodore (fig. 2).

South of the Gates of Lodore, the canyon walls rise in a series of stepped cliffs, and about 2 mi (3.2 km) downstream from the Lodore Ranger Station, the canyon rim is more than 1,000 ft (300 m) above the river (pl. 1). The Uinta Mountain Group, Browns Park Formation, and alluvium of the Green River underlie the campground and ranger station at the Gates of Lodore area (table 1). The Browns Park Formation is the principal aquifer; locally it probably does not exceed 300 ft (90 m) in thickness and dips gently northeastward, overlapping the Uinta Mountain Group.

The present (1971) source of water supply for the area is Lodore well 5. It is 50 ft (15 m) deep and yields about 35 gal/min (2.2 l/s) of potable water from the Browns Park Formation (table 7). A second well would provide an alternate and supplementary source of water. A well site is shown on plate 1 about 1,000 ft (300 m) west of Lodore well 5, on the left bank of Cottonwood Creek. At this site, the depth to a water-bearing zone should be similar to that at Lodore well 5.

There are no springs near the Lodore Ranger Station that could serve as sources of water supply.

Zenobia Basin area

The Zenobia Basin area is southeast of Canyon of Lodore and northwest of Zenobia Peak (fig. 2 and pl. 1). The area is underlain by quartzitic sandstone and shale of the Uinta Mountain Group, covered by the basal remnants of the Browns Park Formation over most of the area. In upland areas, generally south of Zenobia Basin, the Uinta Mountain Group is overlapped in turn by the Lodore Formation and undifferentiated strata of Mississippian age (pl. 1 and table 1). These formations strike generally southeastward and dip gently southwestward.

There are no wells in the Zenobia Basin area; it is high and drained of ground water. Except for a few small springs (table 9) that discharge from small perched aquifers, there are no potential sources of water supply. The small springs in the area diminish to seeps in the late summer and become dry in years of subnormal precipitation.

Deerlodge Park area

The Deerlodge Park area here defined includes Deerlodge Park, at the easternmost end of Dinosaur National Monument (fig. 2), and Disappointment Draw and the Vale of Tears, both west of Deerlodge Park (pl. 1). The campground at Deerlodge Park is on the left bank of the flood plain of the Yampa River.

Rocks in the Deerlodge Park area are exposed in a northeast-trending monoclinal fold in which strata are breached by the Yampa River. The principal aquifers underlying the area are the Glen Canyon and Weber Sandstones (table 1).

At the present time (1971) water supplies for visitors are not available. Deerlodge Park well 1, drilled in 1962 to a reported depth of 77 ft (23 m), encountered potable water in the Glen Canyon Sandstone (table 8). The well was reported to yield about 50 gal/min (3.2 l/s) but it is capped and unused.

Additional wells in the Deerlodge Park campground could obtain water from the Glen Canyon Sandstone, whereas wells in Disappointment Draw and the Vale of Tears would more likely obtain water from the Weber Sandstone. Optimum drilling depths in these latter two areas would be from 400 to 600 ft (120 to 180 m) because of the relatively steep dips of the aquifers.

There are no springs in the Deerlodge Park area that might serve as satisfactory sources of water for public supply. Two small springs are listed in table 9 --Bill White Spring yields only 0.1 gal/min (0.0063 l/s); Disappointment Spring yields 3 gal/min (0.19 l/s), but the water contains more than 1,000 mg/l of dissolved solids (table 10).

Castle Park area

Castle Park is a flood-plain terrace within one of a series of deeply entrenched meanders along the the left bank of the Yampa River about 11 mi (17.7 km) upstream from its confluence with the Green River (fig. 2). Hells Canyon, a small ephemeral tributary, joins the Yampa River at Castle Park. Nearly vertical cliffs of Weber Sandstone rise above the flood-plain terrace at Castle Park. The principal aquifer underlying the area is the Weber Sandstone, but the Morgan Formation may also be an aquifer in this area.

At the present time (1971) there are no facilities for visitors at the Castle Park area. Castle Park Spring, which has a measured discharge of 15 gal/min (0.95 l/s) (table 9), is a source of drinking water for occasional visitors. The water is potable (table 10), but it may be subject to surface sources of contamination because of its broadly exposed discharge area.

A water supply in the Castle Park area might be developed from wells drilled in fractured zones of the Weber Sandstone and the underlying Morgan Formation. If fractured zones are exposed at an outcrop of the Weber Sandstone, they may be projected on strike for short distances where the sandstone is concealed by alluvium.

Echo Park area

The Echo Park area includes Echo Park, a flood-plain terrace at the confluence of the Green and Yampa Rivers (pl. 1), Pool Creek Spring, and the perennial reach of Pool Creek. Echo Park lies within a deeply incised meander of the Green River where nearly vertical cliffs of Weber Sandstone rise abruptly above the valley floor. The Weber Sandstone is the principal aquifer underlying the area, but the Morgan Formation may also be water bearing.

Echo Park wells 1 and 2 were originally constructed in the flood-plain terrace at Echo Park campground to tap alluvium which was found to be as much as 58 ft (18 m) thick (table 7). Both wells were subsequently abandoned because of insufficient supply. A third well was drilled in 1970 about 0.50 mi (0.8 km) south-southeast of the campground at a site recommended by the Geological Survey.

Echo Park well 3 was drilled to a total depth of 300 ft (90 m), penetrating 58 ft (18 m) of alluvium before entering the Weber Sandstone. The sandstone was fractured for nearly the entire depth penetrated except for the uppermost 33 ft (10 m), and water began to flow from the well when it was about 97 ft (30 m) deep. As the well was deepened, the flow of water gradually increased; and on completion of drilling, the discharge was 150 gal/min (9.5 l/s) at land surface. The well was cased, and the casing was perforated from 165 to 300 ft (50 to 90 m), the interval where the driller reported the greatest yield.

A field flow test of the well was made according to the method described by Lohman (1965, p. 95-96). The discharge valve was closed, and the rate of rise of water level was measured. After 17 hours and 20 minutes, the water level was 2.43 ft (0.74 m) above land surface and was believed to be near static level (fig. 8).

The discharge valve was then opened and the well allowed to flow, reaching 35 gal/min (2.2 l/s) within 2 minutes. From these data, the transmissivity of the Weber Sandstone was calculated to be 4,000 $(ft^3/d)/ft$ [$(370\ m^3/d)/m$] (fig. 9).

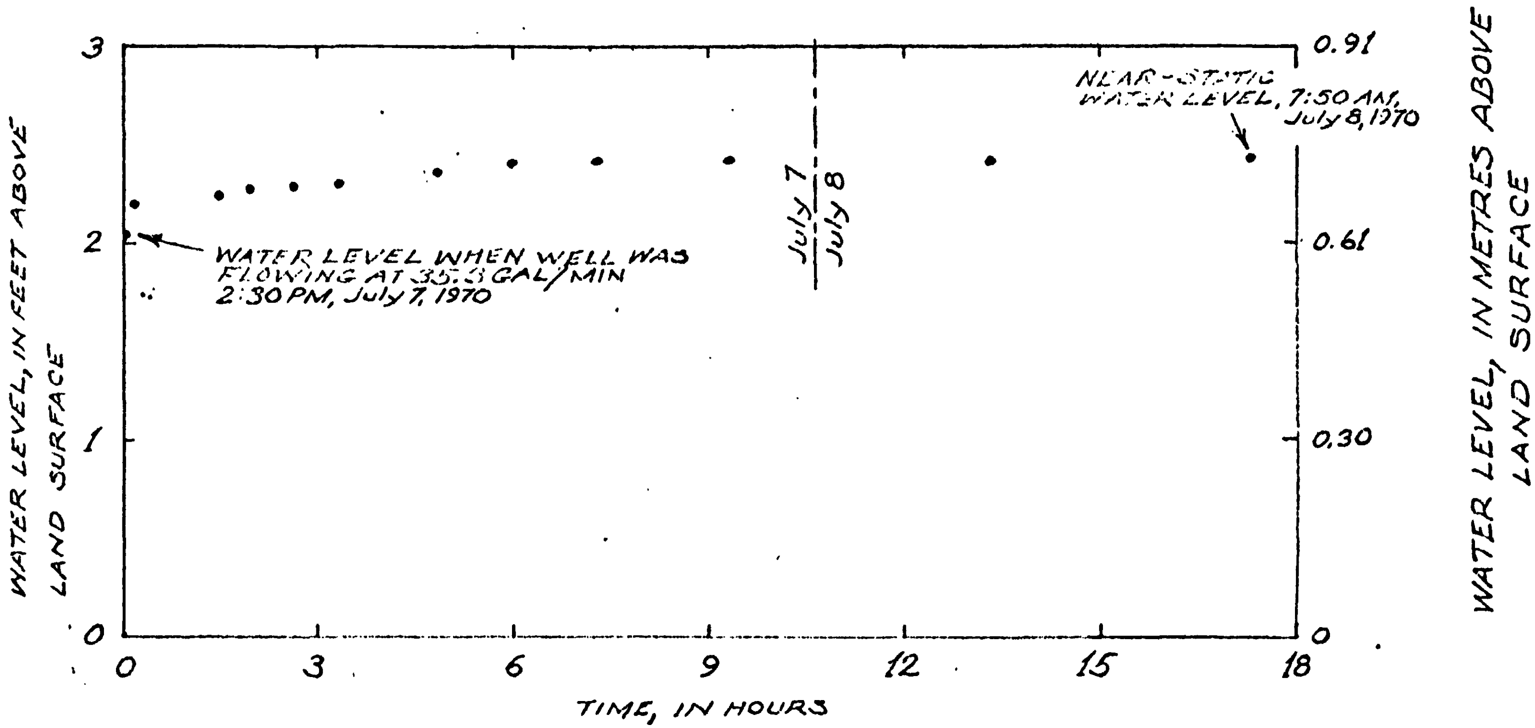
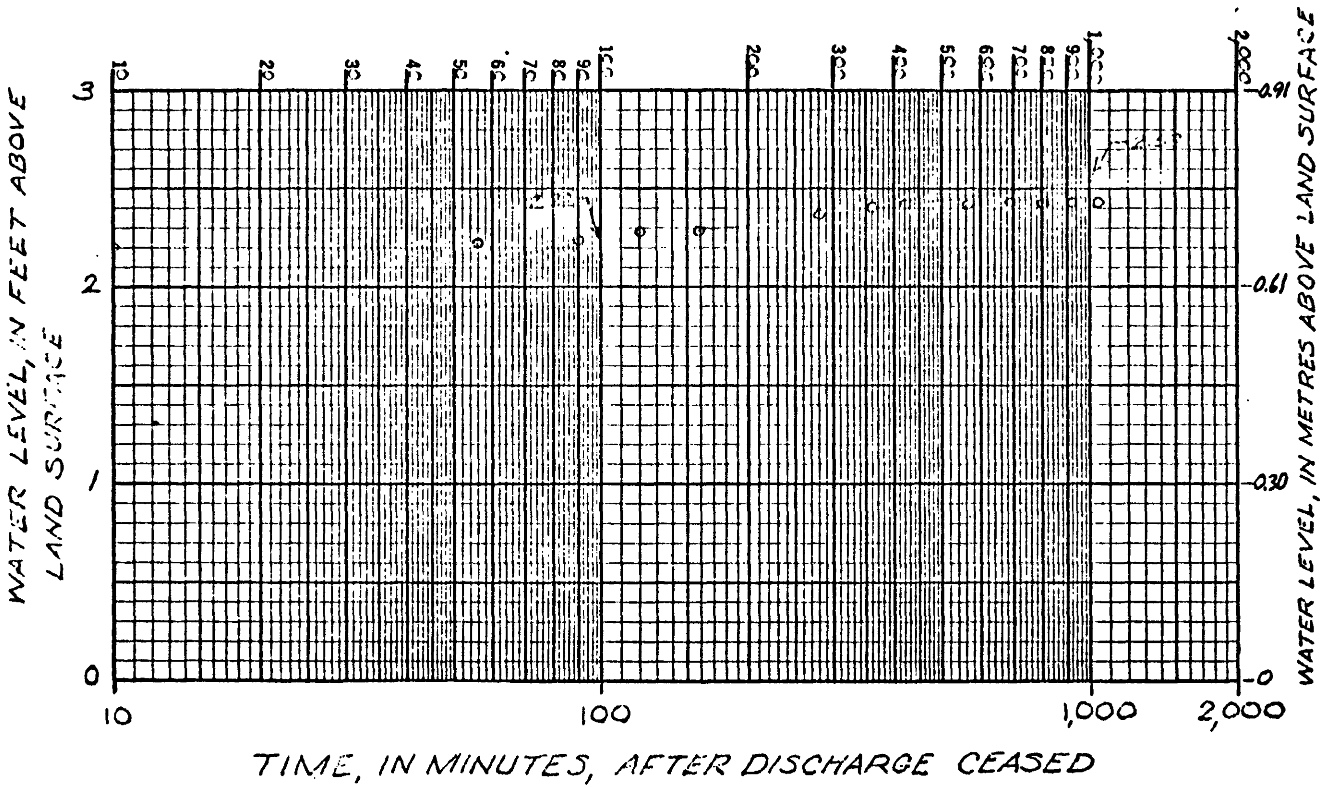


Figure 8.--Recovery of artesian pressure at Echo Park well 3, July 7-8, 1970.



$$T = \frac{35.2\ Q}{\Delta s}$$

$$T = \frac{35.2 \times 35}{2.53 - 2.22}$$

$$T = 4{,}000\ ft^2 day^{-1}$$

Q = discharge, in gallons per minute

Δs = change in head during one cycle

T = transmissivity, in cubic feet per day per foot

35.2 converts gallons per minute to cubic feet per day

Transmissivity (T) is the rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient

Figure 9.--Recovery curve at Echo Park well 3 showing calculation of transmissivity.

A stepped pumping test was then made at the well at pumping rates of 64 gal/min (4.0 l/s), 100 gal/min (6.3 l/s), and 130 gal/min (8.2 l/s) over a period of 8 hours (fig. 10). The maximum drawdown observed was 1.96 ft (0.60 m) and no change in water level was observed during the final 2 hours of the test. Specific capacity of the well when pumped at the rate of 130 gal/min (8.2 l/s) was 66 (gal/min)/ft [13.7 (l/s)/m]. After pumping ceased, the water level rose almost instantaneously to 2.03 ft (0.62 m) above land surface. The discharge valve was then opened and the well flowed at the rate of 30 gal/min (1.9 l/s) from 2.01 ft (0.61 m) above land surface. The relation of discharge of water level in Echo Park well 3 is shown in figure 11. Artesian discharge from the well increased from 30 gal/min (1.9 l/s) at 2.01 ft (0.61 m) above land surface to 38 gal/min (2.4 l/s) at 2.04 ft (0.62 m) above land surface during the 23 hours and 35 minutes that followed the end of the pumping test (fig. 12).

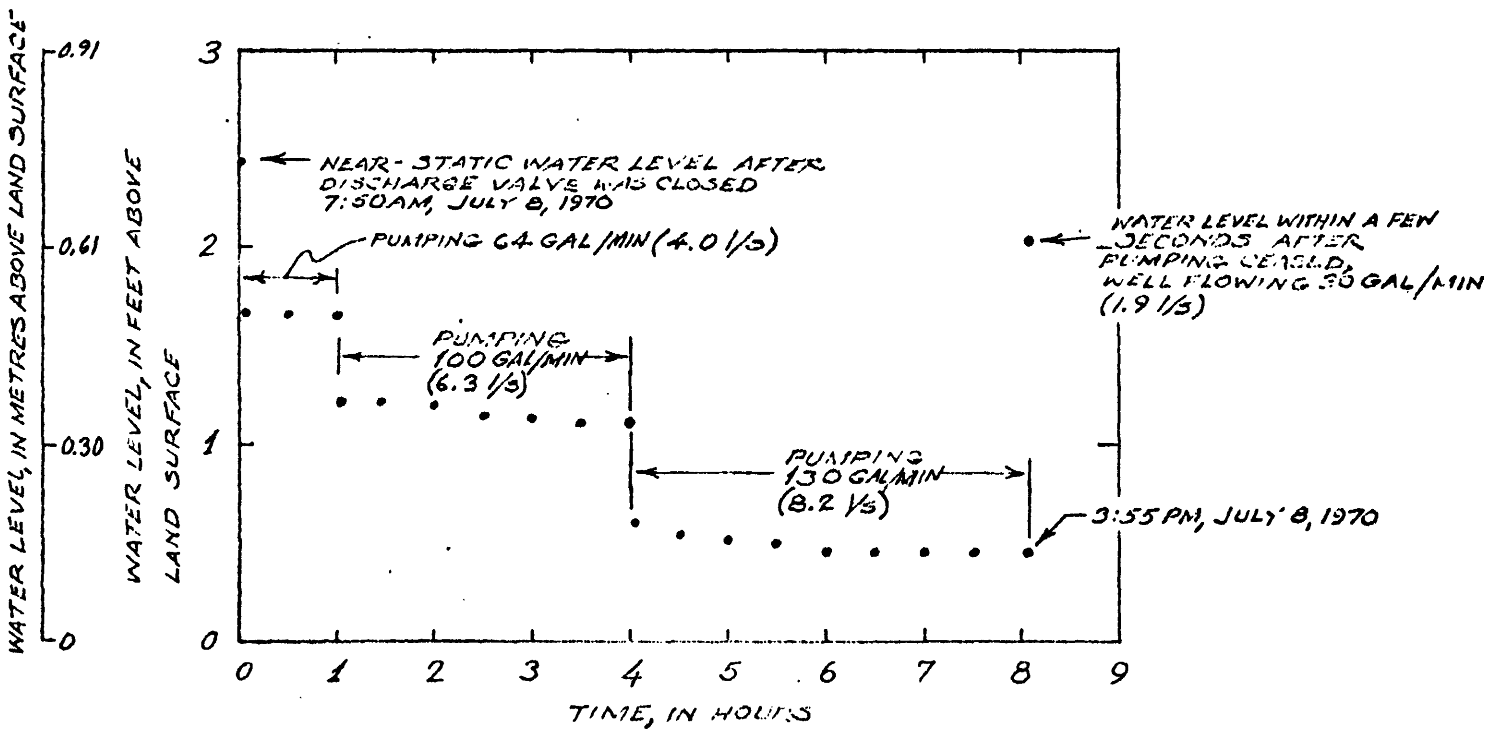


Figure 10.--Drawdown while pumping and recovery of the water level after Pumping ceased at Echo Park well 3.

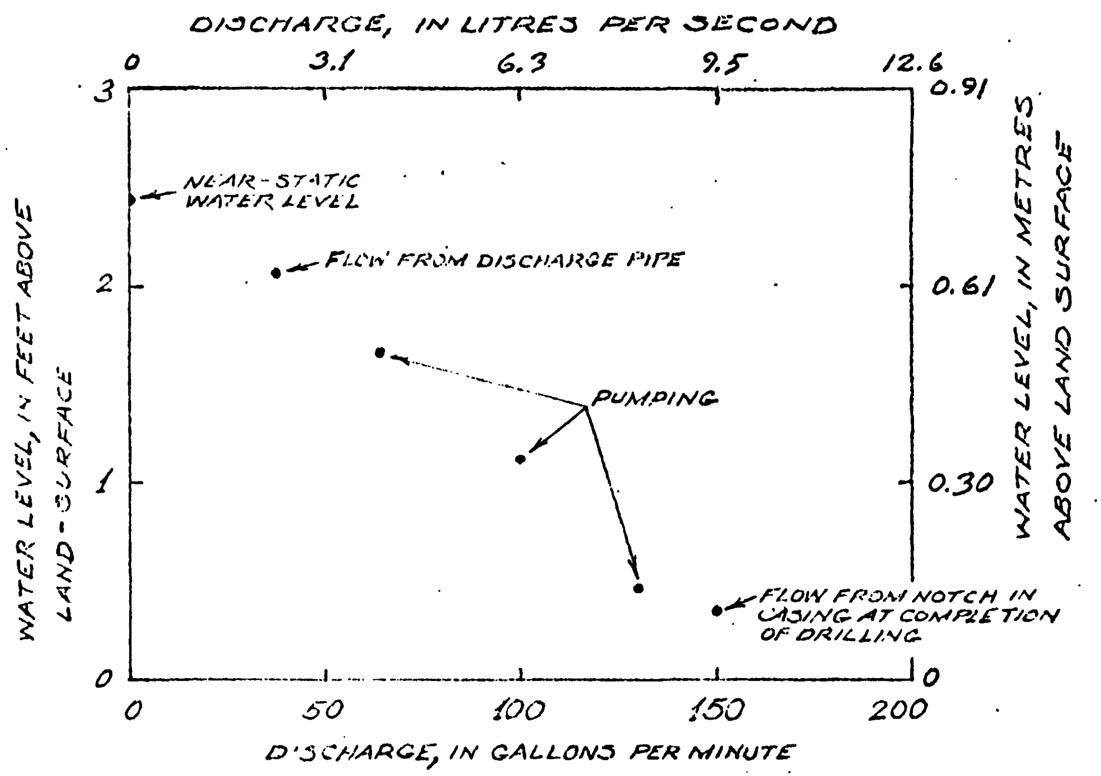


Figure 11.--Relationship of discharge to water level in Echo Park well 3.

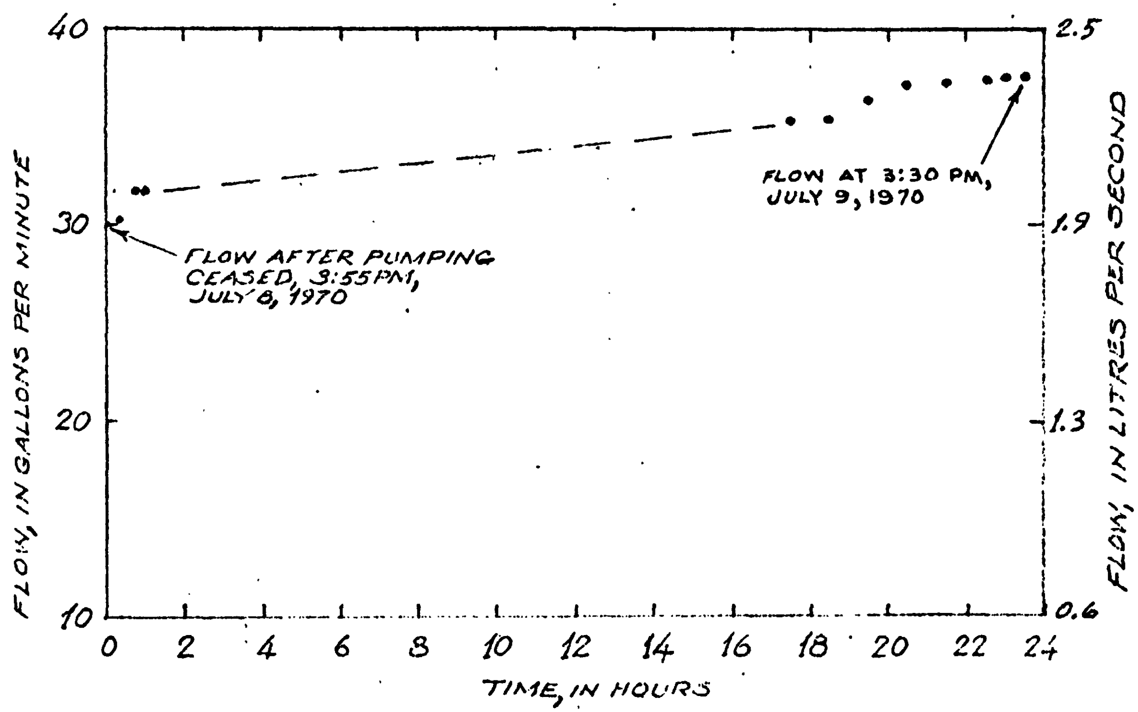


Figure 12.--Increase in artesian flow after pumping ceased at Echo Park well 3.

Pool Creek Spring, about 2.5 mi (4.0 m) southwest of Echo Park, at the head of the perennial reach of Pool Creek, has a measured discharge of 270 gal/min (17.0 l/s), and the water is of suitable chemical quality for public supply (table 10). There are no other springs in the area that could serve as sources of satisfactory public-water supply.

Blue Mountain area

Harpers Corner, Canyon Overlook, and Round Top Lookout are in the Blue Mountain area (pl. 1). Formations exposed in the Blue Mountain area dip gently southwestward. Harpers Corner is underlain by the Weber Sandstone and a veneer of basal conglomerate of the Browns Park Formation. Canyon Overlook is underlain by the Weber Sandstone, and Round Top Lookout is underlain by the Morgan Formation (pl. 1). The highland area is generally drained of ground water, and none of these formations are aquifers in the Blue Mountain area.

A few small springs and seeps discharge from perched water-bearing zones in the area. The springs generally discharge less than 1 gal/min (0.063 l/s) and become dry in the latter part of the summer and during years of subnormal precipitation; consequently, they are not reliable sources of public-water supply. Thus there are no potential sources of reliable public-water supply in the Blue Mountain area.

Jones Hole area

The Jones Hole area is north of the Green River in Whirlpool Canyon (pl. 1). Jones Hole Creek rises at Jones Hole Springs, about 0.5 mi (0.8 km) north of the monument boundary. A boat landing and campground are at the mouth of Jones Hole Creek.

Cliff-forming strata of the Lodore Formation, undifferentitated strata of Mississippian age, the Morgan Formation, and the Weber Sandstone rise in vertical steps above Jones Hole Creek. The Island Park fault, trending southwestward, transects the central part of the canyon of Jones Hole Creek (pl. 1). Except where locally deformed by the fault, strata in the Jones Hole area dip gently southwestward. The principal potential aquifers in the Jones Hole area are the Weber Sandstone and the Morgan Formation.

Visitors to the area have taken water directly from Jones Hole Creek, but with the increasing use of the stream for a fish hatchery upstream, the water may become unsuitable for drinking. An alternate source of water is Big Draw Spring, about 2 mi (3.2 km) northwest of the campground (pl. 1 and table 9). Water might also be obtained from wells drilled to depths of 300-600 ft (90-180 m), to tap the Morgan Formation, north of the Island Park fault.

The water from Jones Hole and Big Draw Springs is of suitable chemical quality for public supply (table 10).

Island Park area

Island Park lies adjacent to the Green River between Whirlpool and Split Mountain Canyons in the western part of Dinosaur National Monument. The Island Park area includes Rainbow and Little Rainbow Parks, which lie north of the river and immediately downstream from Island Park (pl. 1). These parks along this tranquil reach of the Green River represent flood-plain terraces. There is a boat ramp at Rainbow Park.

The Island Park fault bounds the area on the south, beyond which the upthrown block presents steeply northward-dipping strata of Weber Sandstone (pl. 1). Formations in the Island Park area dip gently toward the west-northwest trending Island Park syncline, except where locally deformed by the Island Park fault. The principal aquifers underlying the area are the Weber and Glen Canyon Sandstones.

No development of water for public supply exists at the present time (1971) in the Island Park area. In the vicinity of the old Ruple Ranch, the Glen Canyon Sandstone probably would yield water to wells drilled to depths of about 600 ft (180 m). At the south end of the Little Rainbow Park, the Weber Sandstone probably would yield water to wells that were drilled approximately to the same depth.

Wildlife Spring and McKee Spring yield small amounts of water north of Rainbow and Little Rainbow Parks. Garden Creek Spring rises north of the monument boundary from the Glen Canyon Sandstone. The spring has a measured yield of 18 gal/min (1.1 l/s) of water that is of suitable chemical quality for public supply.

Cub Creek area

The Cub Creek area lies southwest of the Yampa Plateau and east of the Green River (pl. 1). At the present time (1971) the Cub Creek area is undeveloped but has a site potential for a campground near the old Morris Ranch.

Geologic formations in the area dip steeply southwestward from the Yampa Plateau, but the dip is more gentle in the southern part of the area beneath Cub Creek (pl. 1). The principal aquifer in the Cub Creek area is the Weber Sandstone, which yields water to two flowing wells at the old Morris Ranch (pl. 1 and table 7). The wells and springs that discharge from the Weber, near the wells, all yield potable water (tables 7-10). Additional wells of similar depth could be drilled at sites along the foot of the Yampa Plateau in the Cub Creek area. The Glen Canyon Sandstone in the southwesternmost part of the Cub Creek area has a potential for yielding water to drilled wells, but drilling depths might be as great as 600 ft (180 m).

Dinosaur Quarry area

The Dinosaur Quarry is near the southwest corner of Dinosaur National Monument, north of the Green River (fig. 2). The quarry is in an outcrop of the Morrison Formation, one of several stratigraphic units exposed as ridges on the south limb of the Split Mountain anticline (pl. 1). The strata dip steeply southwestward in the vicinity of the quarry. The principal aquifers underlying the area are the Weber, Glen Canyon, and Entrada Sandstones.

A spring and two wells (tables 7 and 9) have provided water for facilities at the quarry at various times in the past. At present (1971), Quarry well 2, which is 965 ft (294 m) deep, supplies water from the Glen Canyon Sandstone. In 1971, plans were approved for obtaining water from the municipal supply at Jensen.

Split Mountain and Green River campgrounds

Split Mountain campground is on the right bank of the Green River, near the mouth of Split Mountain Canyon (pl. 1). Green River campground, also on the right bank, is about 1 mi (1.6 km) downstream from Split Mountain campground.

The campgrounds are on flood-plain terraces of the Green River; and they are underlain by compacted alluvium, consisting of silt, sand, and gravel. Aquifers beneath the alluvium are the Weber, Glen Canyon, and Entrada Sandstones and sandstone units of the Morrison Formation.

A well at the south end of the campground in alluvium is the source of water supply at Split Mountain campground (table 7). A well at the north end of the campground, also in alluvium, was abandoned because the water was of poor chemical quality (tables 7 and 8). At the north end of the Green River campground, a well supplies water from sandstone units of the Morrison Formation (tables 7 and 8).

SUMMARY

There are five perennial streams in Dinosaur National Monument--the Green and Yampa Rivers and Pool, Jones Hole, and Cub Creeks. These streams are not used for public water supply, but the Green and Yampa Rivers are valued as a recreational resource during the May-September season. The average fall of the Green River through the monument is about 10 ft/mi (1.9 m/km) and that of the Yampa about 11 ft/mi (2.1 m/km). The fall is greatest in Split Mountain Canyon, where it is about 21 ft/m (4.0 m/km). Seasonal floods may occur on the Yampa River and some larger tributaries of the Green River; the Green River is regulated by Flaming Gorge Reservoir.

At the present time (1971), all public-water supply in the monument is obtained from wells. The estimated annual use of water was 15 million gal (46 acre-ft or 0.057 hm^3) in 1970. Aquifers underlie much of the monument except for the well-drained highlands, and additional water could be obtained from wells at most developed areas or areas of potential development.

The ground water in most of Dinosaur National Monument is of chemical quality that is suitable for public supply. Water of the best chemical quality is from sandstone and limestone aquifers. Alluvium may yield unpotable water, and some shallow wells have been abandoned because of this reason. With only a few exceptions, water from springs in the monument is potable.

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