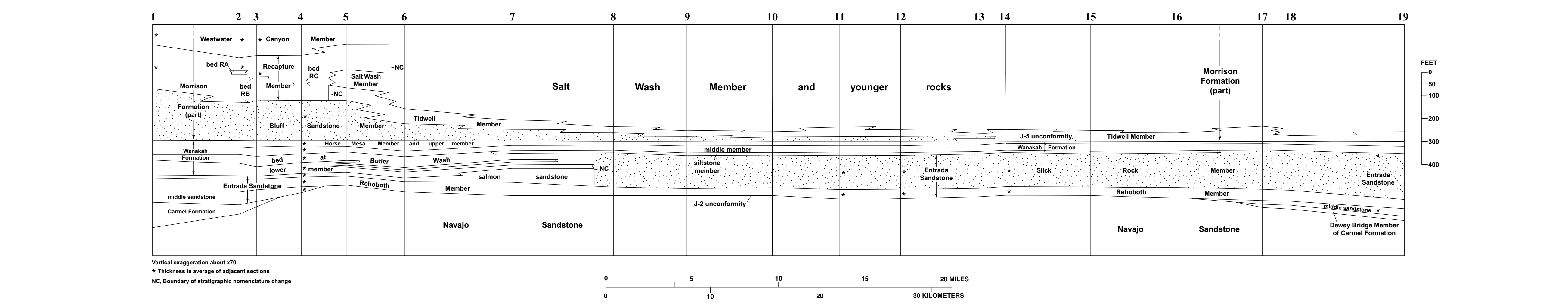


Figure 1. Index map showing locations of drill holes and measured sections. Distribution of Recapture Member and approximate northern limit of Westwater Canyon Member of Morrison Formation from Haynes and others (1972).

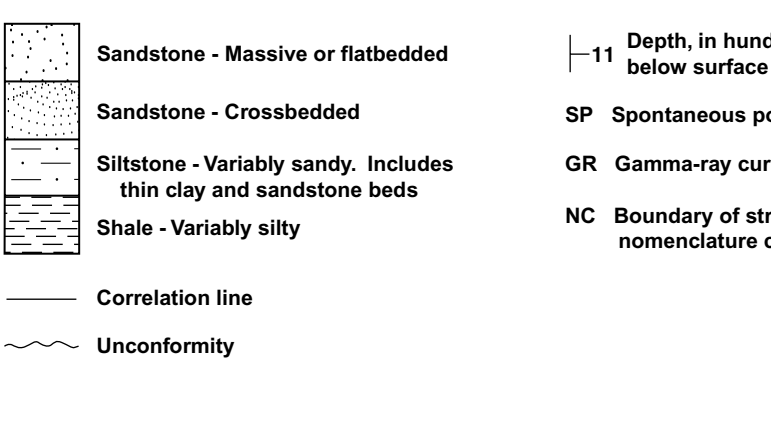


Figure 2. Map showing location of study area. DB, Dewey Bridge; DNM, Dinosaur National Monument; SRS, San Rafael Swell.



LINE OF SECTION (No horizontal scale)

EXPLANATION FOR LINE OF SECTION



**NOTE**

The Middle Jurassic San Rafael Group and the Upper Jurassic Morrison Formation consist mainly of sandstone and shale. The San Rafael Group is widely displayed around Bluff (fig. 1) in the southern part of the study area and along Harts Draw and Dry Valley in the northern part. Along Montezuma Canyon, which is almost 1,500 ft deep, the upper part of the group crops out for about 10 mi. at one locality (sec. 13, fig. 1) all of it is exposed. Elsewhere in the study area, younger rocks conceal the San Rafael Group. The Morrison Formation is also generally well exposed throughout the area. From near Monticello to Harts Draw, outcrops of rocks conceal the Morrison Formation.

In the study area, two unconformities are associated with the rocks described herein. One at the base of the San Rafael Group (J-2) at the contact with the Lower Jurassic Navajo Sandstone and the other at the top (J-5) at the contact with the overlying Morrison Formation. The J-5 unconformity is the datum used to construct the line of graphic section and the restored stratigraphic diagram of this report. The locations of drill holes and measured sections are given in table 1.

**NAVAJO SANDSTONE**

The Navajo Sandstone, of eolian origin, underlies the San Rafael Group throughout the area. Near Bluff, the Navajo Sandstone is about 300 ft thick (Seam, 1952, p. 196-198). The Navajo Sandstone is about 350 ft thick in Montezuma Canyon Huff and Lesure, 1965, p. 11) and to about 250-400 ft thick in the southern part of Dry Valley (Weir and others, 1994).

**SAN RAFAEL GROUP**

The San Rafael Group consists of, in ascending order, the Carmel Formation, Entrada Sandstone, and Wanakah Formation. Several subdivisions are recognized within the Entrada and Wanakah throughout the study area. The Carmel Formation, however, contains no subdivisions at Bluff (fig. 1) and only one member is recognized north of Monticello. The thickness of the San Rafael Group averages about 250 ft and ranges from 194 ft at the Shell Oil Co. drill hole (sec. 5) to 379 ft at the Bluff measured section (sec. 1).

The Entrada Sandstone contains four subdivisions, but not in any one locality. Near Bluff, the formation is made up of middle sandstone at the base, the recently named Rehoboth Member (Robertson and O'Sullivan, in press), and the salmon sandstone at the top. In Montezuma Canyon, the Rehoboth and Slick Rock Members. The lower member and the bed at Butler Wash of the Wanakah grade into the Slick Rock Member of the Entrada in the subsurface in exposures at Marcos Jim Butte (O'Sullivan, 1969), about 6 mi northwest of Blanding.

An ancient, structurally high positive area covered part of southeastern Utah and affected disposition of the lower part of the San Rafael Group. In the Abajo Mountains area west of Monticello, Wilford (1964, p. 53) found "a low, shortly after the Carmel sea advanced across the mapped area, an ancestral highland began to rise near the locality now occupied by the Caseway. This absence from this general locality of strata "deposited during this phase of the advance of the Carmel sea, implies that the rapid elevation of the ancestral highland restricted the waters of the Carmel sea. The ancestral highland is termed the "Caseway High" (O'Sullivan, 1996, p. 191) from its surface expression near the Caseway, a topographic feature in the Abajo Mountains. The Caseway High in the Bluff-Monticello area is defined by the landward limits of the Carmel Formation and middle sandstone of the Entrada Sandstone.

**CARMEI FORMATION**

The Carmel Formation in the Bluff-Monticello area is largely of marginal marine origin. The formation is absent over a large area of the Caseway High but is present near Bluff in the south and near Monticello in the north. Near the Bluff measured section (sec. 1), the Carmel is as much as 110 ft thick and consists mostly of red siltstone and shale that forms layers and interbedded thin sandstone that forms ledges. At exposures along Comb Ridge, the red siltstone and shale grade northward toward the Abajo Mountains into thick-bedded gray sandstone that probably was eroded from the Navajo Sandstone exposed

nearly on the ancient Caseway High, and these strata may also grade northward into similar beds of sandstone in the subsurface. The formation thus northward and is now not recognized as far north as the Shell Oil Co. drill hole (sec. 5), 9 mi northeast of Bluff. The Carmel Formation north of Monticello consists solely of strata that are laterally equivalent to the Dewey Bridge Member, hereof the Entrada. In the San Rafael Swell (fig. 2) of east-central Utah, the formation comprises gray and red siltstone and shale and subordinate gray sandstone, gypsum, and massive limestone. Eastward from the San Rafael Swell, the upper part disappears by progressivelylapping onto the J-2 unconformity. The upper part grades into the Dewey Bridge Member in a transition zone 2-5 mi wide about 35 mi northeast of Moab. Near Monticello, the Dewey Bridge Member consists mainly of dark reddish-brown siltstone and sandy siltstone, parts of which tend to form spherulitic-weathering features known as hoodoos, stone lobes, or spires. The member is 16 ft thick on the outcrop at the Harts Draw measured section (sec. 19, and 18 ft and 13 ft thick at the Mountain States Resources drill holes (sec. 17 and 18), respectively. The member laps out southward near Monticello onto the ancient Caseway High.

The strata that form the Dewey Bridge Member have undergone different stratigraphic assignments. Wright and others (1962, p. 2059) stated "We propose to include strata previously included in the Carmel Formation in the Entrada Sandstone and to distinguish them as the Dewey Bridge Member." They (Wright and others, 1962, p. 2062) further stated "The spire of its partial line equivalence to the Carmel Formation, we believe that the worthy strata should be included in the Entrada Sandstone as the Dewey Bridge Member." Some authors disagree. Alvarez and others (1998, fig. 2), for example, assigned the Dewey Bridge Member to the Carmel Formation in the Moab area. Lucas and Anderson (1997, p. 116) noted "Clearly, the Dewey Bridge Member is in part laterally (and temporally) equivalent to the Carmel Formation." H.H. Dowling of the Utah Geological Survey (oral commun., June 14, 1999) stated that the Dewey Bridge Member should best be recognized as a member of the Carmel Formation.

In the present study, the Dewey Bridge Member is assigned to the Carmel Formation, following the usage of Alvarez and others (1998, fig. 2), and is removed from the Entrada Sandstone. The member is recognized in an area of about 5,000 mi<sup>2</sup> mainly in east-central Utah but extends a short distance into west-central Colorado. The distribution of the Dewey Bridge Member (fig. 2) is from Piñon and O'Sullivan (1978, pl. 1) as modified by O'Sullivan (1996, fig. 1). The member grades to the west and northwest into marine parts of the Carmel Formation. To the east and south, it laps out onto the J-2 unconformity.

**ENTRADA SANDSTONE**

The revised Entrada Sandstone conformably overlies the Carmel Formation near Bluff and also north of Monticello, and unconformably overlies the Navajo Sandstone in the intervening area. Throughout the study area, the formation averages about 160 ft in thickness but varies in thickness because of pronounced stratigraphic changes from place to place; the range in thickness is from 57 ft at the Shell Oil Co. drill hole (sec. 5) to 247 ft at the Harts I measured section (sec. 19).

The middle sandstone, probably of dune and interdune origin, is the basal unit of the Entrada at Bluff and north of Monticello. The middle sandstone consists of yellowish-gray, fine-grained, crossbedded sandstone. It commonly forms a ledge above the Carmel Formation. The member averages about 37 ft in thickness and ranges from 15 ft at the Mountain States Resources Inc. drill hole (sec. 17) to 57 ft at the Pan American Corp. drill hole (sec. 2). As shown on the line of section, the middle sandstone overlies the underlying Carmel Formation in the subsurface, in exposures in Dry Valley, north of Bluff. The Carmel also overlaps the underlying Dewey Bridge Member of the Carmel Formation.

The subsurface extent of the Carmel Formation and the middle sandstone of the Entrada is somewhat uncertain. In the subsurface north of Bluff, the Carmel is probably mostly sandstone as it is in surface exposures. The sandstone in the Carmel and the middle sandstone of the Entrada are difficult to distinguish in the subsurface on geophysical well logs. Future analysis of the well logs may alter the extent of the Carmel and middle sandstone as shown on the line of section. A useful stratigraphic control point is found at Montezuma Canyon HL measured section (sec. 13). There, the upper part of the Navajo Sandstone is exposed and it directly overlies by the Rehoboth Member; no Carmel Formation or middle sandstone is present.

The Rehoboth Member, possibly of marginal marine origin, is present throughout the Bluff-Monticello area and overlies either the middle sandstone of the Entrada or the Navajo Sandstone. It consists mostly of reddish-brown siltstone or silty sandstone, parts of which tend to form hoodoos, stone lobes, or spires. The thickness of the Rehoboth Member averages about 45 ft and ranges from 28 ft at the Champlin Petroleum Co. drill hole (sec. 9) to 65 ft at the Bluff measured section (sec. 1). It is 19 ft thick at the Shell Oil Co. drill hole (sec. 7) and the Harper Oil Co. drill hole (sec. 8).

The Slick Rock Member overlies the Rehoboth Member throughout much of the study area. The member is mainly a fine-grained to very fine grained sandstone, but it contains disseminated sparse, coarse to very coarse, well-rounded grains of clear quartz. The coarse grains which are informally termed "Entrada boulders," contrast with the fine-grained matrix. The Slick Rock Member was deposited in a sequence of alternating crossbedded and flatbedded units. The crossbedded units are eolian dunes (Shaw and others, 1968, p. 443-464). The member averages about 102 ft in thickness, ranging from 145 ft at the Houston Oil and Gas and Minerals Corp. drill hole (sec. 15) to 206 ft at Harts I measured section (sec. 19).

**WANAKAH FORMATION**

The Wanakah Formation, possibly of marginal marine origin, makes up the upper part of the San Rafael Group. The formation, comprising six subdivisions, overlies or laterally replaces the upper part of the Entrada Sandstone. Throughout the study area the Wanakah averages about 90 ft in thickness, ranging from 36 ft at the Mountain States Resources Inc. drill hole (sec. 17) to 166 ft at the Continental Oil Co. drill hole (sec. 6).

Four of the subdivisions of the Wanakah Formation are red bed units: the lower, middle, upper, and siltstone members. These units are mostly red siltstone and thin red gray sandstone with minor thin red clay beds, all members tend to form ledges. The lower member (6 ft thick at the Bluff measured section (sec. 1), 11 ft in the northward by interfingering with the overlying bed at Butler Wash and possibly with the underlying Entrada Sandstone. The lower member merges, in the subsurface, with the Slick Rock Member of the Entrada near the Harper Oil Co. drill hole (sec. 8) about 25 mi northeast of Bluff. The middle member averages about 30 ft in thickness, ranging from 24 ft at the Shell Oil Co. drill hole (sec. 7) to 44 ft at the Davis Oil Co. drill hole (sec. 3). Where present, the upper member averages about 5 ft in thickness and is as much as 8 ft thick at both the Continental Oil Co. drill hole (sec. 6) and the Montezuma Canyon 94-1 measured section (sec. 11). The siltstone member, where present, averages about 9 ft in thickness, and thickness varies at the expense of the underlying Slick Rock Member, at a number of localities, and this bed of red clay is a minor but common constituent. At Harts I measured section (sec. 19), the Tidwell includes a lenticular bed of gray chert that is 2.8 ft thick and lies 14 ft above the siltstone member. Thicknesses of the member, which vary because of interfingering with the overlying Salt Wash Member and, where present, the underlying Bluff Sandstone Member, range from 19 ft at Montezuma Canyon HL measured section (sec. 13) to 65 ft at the Continental Oil Co. drill hole (sec. 6), and average about 40 ft.

Bed A, a conspicuous member at the base of the Tidwell Member where it rests on the Wanakah Formation, crops out at three localities (sec. 13, 14, 19) in the study area. Bed A is a gray, banded or mottled reddish-tan, fine-grained, flatbedded sandstone that contains coarse to very coarse grains of quartz and chert at most localities. Small green clay galls are present at Harts I measured section (sec. 19). The thickness ranges from 0.5 ft at Montezuma Canyon HL measured section (sec. 13) to 1.8 ft at Harts I measured section (sec. 19). The basal contact is sharp and bed A generally forms an overhanging ledge, particularly where underlain by the upper member of the Wanakah at Harts I measured section (sec. 19). In the subsurface, bed A cannot be separately recognized at four localities (sec. 15, 16, 17, 18) because it is indistinguishable from the Horse Mesa Member of the Wanakah on geophysical logs.

**RECAPTURE MEMBER**

The Recapture Member comprises interbedded gray and light brown, fine- to medium-grained sandstone and reddish-tan silty to sandy mudstone. According to Gregory (1938, p. 158) the amount of sandstone in the Recapture Member is generally about 15 percent. Sedimentary structures are usually obscured but, where visible, the sandstones are lenticular, crossbedded, some fill similar to sandstones in the Salt Wash Member. Sandstone and mudstone beds are notably friable and the member generally is eroded to form a steep, cobble-banded slope defined by the cliff formed by the Westwater Canyon Member and above the bench formed at the top of the Bluff Sandstone Member. Along Recapture Creek, the Recapture Member is about 200 ft thick (Fred Peterson, oral commun., 1999).

The Recapture Member, along the line of section, contains three sandstone lenses that differ from typical sandstone beds in the member. These sandstones, found at three different localities, are termed beds 2, 2B (sec. 2), 2B (sec. 3), and RC (sec. 4). The sandstone lenses are fine to coarse grained and contain chert pebbles as much as 3/8 in. across. The sandstone beds are crossbedded and well cemented, and weather to square faced ledges. Bed 2 is 16 ft thick, and bed 2B is 10 ft thick; both are overlain by Quaternary cobble and gravel and their full extent and thickness is uncertain. Bed RC is 19 ft thick and is lenticular on the outcrop (Fred Peterson, oral commun., 1999). Bed 2A is 123 ft thick and is 93 ft, and bed RC is 63 ft, respectively, above the Bluff Sandstone Member. The member names used for Bluff, Salt Wash, and Brushy Basin Members. The Brushy Basin is the same as the medial silt member of the Recapture Member. The Recapture is also mapped as grading into the Salt Wash Member in exposures near Black Mesa Butte. The northward of Bluff (Haynes and others, 1972). Where the Salt Wash Member is present, it is underlain by the Tidwell Member, which is an equivalent of the lower part of the Recapture Member. The Westwater Canyon Member thus northward from Bluff, and its member, where present, is the Horse Mesa Member. The Horse Mesa Member is a gray and reddish-tan, fine-grained, flatbedded sandstone that contains coarse to very coarse grains of quartz and chert at most localities. Small green clay galls are present at Harts I measured section (sec. 19). The thickness ranges from 0.5 ft at Montezuma Canyon HL measured section (sec. 13) to 1.8 ft at Harts I measured section (sec. 19). The basal contact is sharp and bed A generally forms an overhanging ledge, particularly where underlain by the upper member of the Wanakah at Harts I measured section (sec. 19). In the subsurface, bed A cannot be separately recognized at four localities (sec. 15, 16, 17, 18) because it is indistinguishable from the Horse Mesa Member of the Wanakah on geophysical logs.

**MORRISON FORMATION**

The Morrison Formation, deposited in fluvial, flood-plain, lacustrine, and eolian environments, unconformably overlies the Wanakah Formation. The Bluff, the formation consists of (in ascending order) the Bluff Sandstone, Recapture, Westwater Canyon, and Brushy Basin Members. In the subsurface between Bluff and Montezuma Canyon, another unit—the Salt Wash Member—replaces most of the Recapture Member. The Recapture is also mapped as grading into the Salt Wash Member in exposures near Black Mesa Butte. The northward of Bluff (Haynes and others, 1972). Where the Salt Wash Member is present, it is underlain by the Tidwell Member, which is an equivalent of the lower part of the Recapture Member. The Westwater Canyon Member thus northward from Bluff, and its member, where present, is the Horse Mesa Member. The Horse Mesa Member is a gray and reddish-tan, fine-grained, flatbedded sandstone that contains coarse to very coarse grains of quartz and chert at most localities. Small green clay galls are present at Harts I measured section (sec. 19). The thickness ranges from 0.5 ft at Montezuma Canyon HL measured section (sec. 13) to 1.8 ft at Harts I measured section (sec. 19). The basal contact is sharp and bed A generally forms an overhanging ledge, particularly where underlain by the upper member of the Wanakah at Harts I measured section (sec. 19). In the subsurface, bed A cannot be separately recognized at four localities (sec. 15, 16, 17, 18) because it is indistinguishable from the Horse Mesa Member of the Wanakah on geophysical logs.

**SALT WASH MEMBER**

The Salt Wash Member is well exposed in Montezuma Canyon and consists of gray sandstone interbedded with red mudstone and siltstone. According to Huff and Lesure (1965, p. 21), "Cliff forming massive sandstone in lenticular beds or lenses makes up about

one-half to two-thirds of the Salt Wash. Between these sandstone lenses are red mudstone units containing some thin beds of very fine grained sandstone. This alternation of beds of resistant sandstone and debris-covered slopes underlain by less resistant mudstone units produces a step-like cliff characteristic of the Salt Wash Member." In Montezuma Canyon, the Salt Wash Member ranges in thickness from 320 to 520 ft (Huff and Lesure, 1965, p. 24); in Dry Valley, the member is 350-425 ft thick (Weir and others, 1994).

**BLUFF SANDSTONE MEMBER**

The Bluff Sandstone Member, a gray, crossbedded sandstone of eolian origin, forms bold cliffs along the San Juan River. Just north of the town of Bluff, the sandstone is about 230 ft thick, and from exposures along Comb Ridge, it thins northward to 160 ft near Black Mesa Butte 16 mi north of Bluff. The member wedges out into the Tidwell Member in outcrops about 2 mi south of Black Steer Knoll.

**BRUSHY BASIN MEMBER**

The Brushy Basin Member is concealed northward by younger rocks but reappears in Montezuma Canyon 25 mi north of the San Juan River. In Montezuma Canyon, it consists of reddish-tan and gray, fine-grained to very fine grained, flatbedded sandstone containing sparse to abundant coarse grains. The member forms a cliff broken into ledges separated by thin layers of reddish-brown siltstone. The Bluff is 0-18 ft thick at exposures in Montezuma Canyon and represents deposition on the margin of a dune field, the bulk of which lay to the southeast.

**TIDWELL MEMBER**

The color, lithology, and thickness of the Tidwell Member are varied. The member consists primarily of red and gray, slope-forming siltstone and mudstone. Gray, ledge-forming sandstone in which bedding is flat or not apparent crops out at many localities, and this bed of red clay is a minor but common constituent. At Harts I measured section (sec. 19), the Tidwell includes a lenticular bed of gray chert that is 2.8 ft thick and lies 14 ft above the siltstone member. Thicknesses of the member, which vary because of interfingering with the overlying Salt Wash Member and, where present, the underlying Bluff Sandstone Member, range from 19 ft at Montezuma Canyon HL measured section (sec. 13) to 65 ft at the Continental Oil Co. drill hole (sec. 6), and average about 40 ft.

**BURRO CANYON FORMATION**

The terrestrial Burro Canyon Formation, considered by Early Entozoans, overlies the Morrison Formation throughout the study area. The Burro Canyon consists of gray, massive beds of conglomerate and sandstone and interbedded green mudstone and red siltstone. It is about 130 ft thick along Recapture Creek (Fred Peterson, written commun., 1999), and in Montezuma Canyon thicknesses range from 119 to 186 ft (Huff and Lesure, 1965, p. 30). The formation is poorly exposed in southern Dry Valley but is probably 100-150 ft thick (Weir and others, 1994).

**OTHER INTERPRETATIONS**

The San Rafael Group has been divided into sequences separated by widespread bounding surfaces by Carr-Crabugh and Kocurek (1998). The sequences are interpreted as a product of a wet eolian system related to fluctuating water tables. In the Bluff-Dry Valley area, most of the San Rafael Group is divided into four complete sequences of regional extent. According to Carr-Crabugh and Kocurek (1998, p. 222), the thin uppermost part of the Wanakah "probably represents the basal portion of a fifth sequence." This fifth sequence either never developed fully or was removed by erosion associated with the formation of the J-5 surface. "Four surfaces bounding the sequences have been correlated for a distance of 225 mi from Bluff to Dinosaur National Monument near Vernal in northeastern Utah (Carr-Crabugh and Kocurek, 1998, p. 222 and fig. 11).

Different nomenclature has been used in Montezuma Canyon. The red siltstone unit directly above the Navajo Sandstone according to Huff and Lesure (1965, p. 12) "is possibly the Carmel Formation" because the exposures in Montezuma Canyon are isolated geographically, the siltstone is here called Carmel Formation. The unit they described is now designated the Rehoboth Member of the Entrada (Robertson and O'Sullivan, in press), and is younger than the Carmel Formation.

In Montezuma Canyon, Huff and Lesure (1965, p. 16-19) also applied the name Sumnerville Formation to the strata between the Entrada Sandstone and the Salt Wash Member of the Morrison Formation. The Sumnerville Formation at the type locality in the San Rafael Swell in Utah is separated from the Entrada Sandstone by the Curtis Formation—a marine sandstone unit about 200 ft thick. The Wanakah Formation, however, was defined by Burbank (1930, p. 171-177) as beds directly overlying the Entrada Sandstone. Consequently the term "Sumnerville" seems inappropriate for strata directly above the Entrada. In addition, new drill hole data permit the recognition of the Tidwell and Bluff Sandstone Members at the base of the Morrison Formation as well as several subdivisions within the Wanakah Formation.

The Morrison Formation and underlying rocks in the Bluff area were interpreted in a different way by Anderson and Lucas (1998), as follows: (1) the name Sumnerville Formation was used in place of the Wanakah Formation; (2) the Bluff Sandstone Member was raised to formal rank and assigned to the San Rafael Group; (3) the Recapture Member, along Recapture Creek, was restricted to the stratigraphic interval from the Bluff Sandstone Member to bed RC (sec. 4) of the present report; (4) bed RC and the overlying upper part of the Recapture Member, as well as the Westwater Canyon Member

name they redefined, were assigned to the Salt Wash Member; (5) a restricted Recapture Member—a section that reduced the member to about 30 percent of the unit defined by Gregory (1938, p. 58)—was included in the Bluff Sandstone of their revised San Rafael Group; and (6) the Tidwell Member, in the San Rafael Swell where it directly overlies the Sumnerville, was assigned to the Sumnerville Formation.

In contrast, the nomenclature of the Morrison as used herein follows that originally described by Gregory (1938). The Recapture and Westwater Canyon Members are retained as mapped in the Bluff-Montezuma Canyon area by Cooley and others (1969), Haynes and others (1972), Huff and Lesure (1965), and O'Sullivan (1965).

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Table 1. Number, name, and location of drill holes and measured sections [The following U.S. Geological Survey topographic maps, scale 1:62,500, were used to locate sections measured in the field: Blanding (1957); Bluff (1962); Montezuma Creek (1962); Monticello (1957); Monument Canyon (1957).]

Section No.	Name	Location
1	Bluff, composite	Carmel Formation and Entrada Sandstone measured in SW1/4 sec. 29 and SE1/4 sec. 20, T. 46 S., R. 21 E., Wanakah Formation measured in SW1/4 sec. 19 and NW1/4 sec. 20, T. 46 S., R. 22 E., Bluff Sandstone Member thicknesses calculated from topographic map in NW1/4 sec. 18, T. 46 S., R. 22 E.
2	Pan American Corp. Geophysical Section 1	SW1/4 sec. 24, T. 46 S., R. 22 E. Part of Bluff Sandstone Member and part of Recapture Member measured east of drill hole location.
3	DeWey Oil Co. McCracken Point Federal-1	SW1/4 sec. 18, T. 46 S., R. 22 E. Part of Bluff Sandstone Member and part of Recapture Member measured east of drill hole location. Recapture Member measured by Fred Peterson (written commun., 1999). NE 1/4 sec. 11, T. 46 S., R. 22 E. and SW1/4 sec. 11, T. 46 S., R. 22 E.
5	Shell Oil Co. Bluff Unit 1	NE 1/4 sec. 11, T. 35 S., R. 23 E.
6	Continental Oil Co. Hatch Unit 15-1	NW1/4 sec. 11, T. 35 S., R. 23 E.
7	Shell Oil Co. P. J. Part 1	NW1/4 sec. 31, T. 35 S., R. 24 E.
8	Harper Oil Co. Champlin Petroleum Co. Chaplain	SW1/4 sec. 22, T. 35 S., R. 24 E.
9	Oil Development Co. of Utah Pickett Corral Federal Unit 2	SW1/4 sec. 28, T. 35 S., R. 25 E.
11	Montezuma Canyon 94-1	NW1/4 sec. 14, T. 35 S., R. 24 E.
12	Montezuma Canyon HL	NW1/4 sec. 31, T. 35 S., R. 24 E.
13	Houston Oil and Minerals Corp. Wildmeyer 43-7	SW1/4 sec. 7, T. 34 S., R. 25 E.
15	Byrd Four Incoy Ranch 1	SW1/4 sec. 21, T. 35 S., R. 24 E.
17	Mountain States Resources Inc. Nelson 61-1	SW1/4 sec. 11, T. 35 S., R. 24 E.
18	Mountain States Resources Inc. Redd 11-1	SW1/4 sec. 11, T. 35 S., R. 22 E.
19	Harts I	NW1/4 NW1/4 NW1/4 NE1/4 sec. 35, T. 32 S., R. 22 E.

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