Colorado Geological Survey
Department of Natural Resources
John W. Rold, Director

Map Series 16
Plate 1
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INTRODUCTION

The ground-water resources of the nation are a valuable resource which in some instances are becoming imperiled by the actions of man. Over 50% of the nation's population depends upon ground-water as their source of drinking waters. In many instances these sources have become polluted and contaminated by indiscriminate disposal of liquid and toxic wastes. To prevent this contamination from continuing the U.S. Congress in 1974 passed Public Law 93523, the Safe Drinking Water Act. One of the provisions of this law called for the regulation of underground injection of liquid wastes. To meet this requirement the U.S. Environmental Protection Agency was enpowered to promulgate rules and regulations regulating underground injection of liquid wastes. The law also allowed the individual States to administer the permitting program if they could meet certain requirements.

As part of the requirements to acquire primacy in administration of the Underground Injection Control Program in Colorado, the Colorado Department of Health in 1979 contracted with the Colorado Geological Survey to construct a series of hydrogeological maps and cross sections depicting the hydrogeological conditions of all aquifers in Colorado found at a depth of less than 2,000 feet below the surface and whose waters contain less than 10,000 mg/l of total dissolved solids. This atlas reports the findings of that effort.

Due to the short period of time alloted to this effort, one year, it was decided that no new data would be collected and that only all published and unpublished data that could be found would be utilized. To accomplish this task copies of the U.S. Geological Survey, Division of Water Resources WATSTORE computer computer tapes were acquired. These tapes contained over 45 pieces of information on the quality of the waters and other factors relating to 7,000 water wells and springs within Colorado. A search for all published and unpublished water-quality data in Colorado provided information on an additional 4,000 wells and springs. To handle this large amount of information a computer program was developed for the Colorado Geological Survey WANG 2200 MVP word processor/ computer by Schalphoff and Associates, Denver. The reader is referred to the Reference section for a complete listing of all sources of data used in compiling this atlas.

In consultation with the Colorado Department of Health and the U.S. Environmental Protection Agency it was decided that the most meaninful method of portraying the hydrogeological data would be to construct hydrogeological maps of individual aquifers on a basin-by-basin basis when ever practical. A map scale of 1:500,000 was decided upon. It soon became apparent that if the deadline of the project was to be met, and to provide uniformity, that maps based on the amount of total dissolved-solids (T.D.S.) contained in the waters should be constructed for all basins. For those other basins where more information was available other hydrogeological maps and cross sections would be constructed. In western Colorado, with the exception of the Piceance Creek basin in northwestern Colorado, due to complexity of the geologic structure and lack of data no attempt was made to construct water-quality maps for each aquifer. Instead one map was made, (Plate 7) upon which all available water-quality information for all the individual aquifers in western Colorado is shown. Also this plate (Plate 7) water-quality for the alluvial aquifers of eastern Colorado is plotted. In addition a simplified geologic map of the State is provided to help the reader interpret the subsurface conditions. To facilitate the preparation of the maps no attempt was made to show the chemical water type in each aquifer.

The quality of the ground waters within Colorado varies widely from aquifer to aquifer and within the same aquifer. While the total dissolved mineral matter in most aquifers is less than 500 mg/l., which generally indicates that the water is suitable for drinking purposes, there are some instances where some of the waters contain excessive amounts of dissolved solids. For example the ground-waters associated with the Paradox formation, in Paradox Valley in extreme western Colorado, contain over 80,000 mg/l of total dissolved solids. In addition some of the waters associated with oil fields contain even more dissolved mineral matter. These waters are not shown in this Atlas because of their excessive depth and total dissolved solids,

The ground-waters of the State are used for a wide variety of purposes. With the greatest uses being made for domestic and aguircultural purposes. The use of ground water in Colorado is anticipated to increase in the future with the population of the State increasing. Care should be taken to protect this natural resource.

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REFERENCES

1. Barrett, J. K., and Pearl, R. H., 1976, Hydrogeologic data of thermal springs and wells in Colorado: Colorado Geol. Survey Inf. Ser. 6, 124 p.
2. Bjorkland, L.J, and Brown, R.F., 1957, Geology and groundwater resources of the lower South Platte River valley between Hardin, Colorado and Paxton, Nebraska, with a section on chemical quality of the ground water by H.A. Swenson: U.S Geol. Survey Water-Supply Paper 1378, 427 p.
3. Boettcher, A.J., 1962, Records, logs, and water-level measurements of selected wells and test holes, and chemical analyses of ground water in eastern Cheyenne and Kiowa Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 13, 18 p.
4. ___1964, Geology and ground-water resources in eastern Cheyenne and Kiowa Counties, Colorado, with a section on chemical quality of the ground water by C.A. Horr: U.S. Geol. Survey Water-Supply Paper 1779-N, 32 p.
5. ___1966, Ground water development in the High Plains of Colorado, with a section on the chemical quality of ground water by Robert Brennan: U.S. Geol. Survey Water-Supply Paper 1819-J, 22 p.
6. ___1972, Ground water occurrence in northern and central parts of western Colorado: Colorado Water Conserv. Board Water Res. Circ. No. 15, 25 p.
7. Braddock, W.A. and Cole, J.D., 1978, (Unpub) Preliminary geologic map of the Greeley 1 x 2 degree Quadrangle, Colorado.
8. Brogden, R. E., and Giles, T. F., 1976, Availability and chemical characteristics of ground water in Central La Plata County, Colorado - May 1976: U.S. Geol. Survey Water Resources Invest. Open-File Rept. 76-69, Lakewood, CO.
9. ___1976, Availability and chemical quality of ground water in the Crystal River and Cattle Creek drainage basins near Glenwood Springs - West Central, Colorado: U.S. Geol. Survey Water Resources Inv. Open-File Rept. 76-70.
10. Cardwell, W.D.E. and Jenkins, E.D., 1963, Ground-water geology and pump irrigation in Frenchman Creek basin above Palisade, Nebraska, with a seciton on the chemical quality of the water by E.R. Jochens and R.A. Krieger: U.S. Geol. Survey Water-Supply Paper 1577, 472 p.
11. Cashion, W. B., 1973, Geology and structure map of the Grand Junction Quadrangle, Colorado and Utah: U.S. Geol. Survey Misc. Geol. Invest. Map I-736.
12. Chase, G.H., Burtis, V.M., and Major, T.J., 1962, Records, logs, and water-level measurements of selected wells and test holes, description of the physical properties of representative materials, and chemical analyses of ground water in Kit Carson County, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 10, 69 p.
13. Coffin, D.L., 1962, Records, logs, and water level measurements of selected wells and test holes, physical properties of unconsolidated materials, chemical analyses of ground water, and stream flow measurements in the Big Sandy Creek Valley in Lincoln Cheyenne, and Kiowa Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 12, 25 p.
14. ___1967, Geology and ground-water resources of the Big Sandy Creek valley, Lincoln, Cheyenne and Kiowa Counties, Colorado; with a section on the chemical quality of the ground water by C.A. Hurr: U.S. Geol. Survey Water-Supply Paper 1843, 49 p.
15. Cyprus Mines Corp./Wyoming Mineral Corp., 1979, Environmental report Appendix, Hansen Project -- Fremont County, CO: Appendix D-7.
16. D'Lugosz, Joseph, 1978, Unpublished field notes: U.S. Geol. Survey, Div. of Water Resources, Denver, Colo.
17. Emery, P.A., Boettcher, A.J., Snipes, R.J. and McIntyre, H., 1969, Hydrology of the San Luis Valley, south-central Colorado: U.S. Geol. Survey Hyd. Atlas HA-381.
18. Emery, P.A., Snipes, R.J., Dumeyer, J.M. and Klein, J.M., 1963, Water in the San Luis Valley, south-central Colorado: Colorado Water Conserv. Board Colo. Water Res. Circular 18, 26 p.
19. Ficke, J. F., Weeks, J. B., and Welder, F. A., 1974, Hydrologic data from the Piceance Basin, Colorado: Colorado Water Conserv. Board Water Res. Basic-Data Release 31, 246 p.
20. Finch, W. I., 1959, Geology of Uranium Deposits in Triassic Rocks of the Colorado Plateau Region: Bull. 1074-D, U.S. Geological Survey.
21. Gaca, J.R., 1965, Gravity studies in the San Luis Valley area, Colorado: Unpublished M.S. Thesis No T-1021 Colorado School Mines Dept. of Geophysical Engineering.
22. Giles, T. F., and Brogden, R. B., 1976, Water quality data for the Eagle River Valley in the vicinity of Eagle and Vail, west central Colorado: U.S. Geol. Survey Open-File Rept. 76-812.
23. Goddard, K.E., 1978, Availability and quality of groundwater in the Lake George area, southeastern Park County, Colorado: U.S. Geol. Survey, Water Resources Invest. Open-File Rept. 78-50.
24. Hall, D.C., Boyd, E.L. and Cain, Doug, 1979, Hydrogeologic data for wells, springs and streams in Boulder County, Colorado: U.S. Geol. Survey Open-File Report 79-979.
25. Haynes, D. D., Vogel, J. D., and Wyant, D. G., 1972, Geology, structure, and uranium deposits of the Cortez Quad, Colorado and Utah: U.S. Geol. Survey Misc. Invest. Ser. Map I-764.
26. Hem, J.D., 1970, Study and interpretation of the chemical characteristics of natural water, 2nd. Ed.: U.S. Geol. Survey Water-Supply Paper 1473, 363 p.
27. Hershey, L.A. and Schneider, P.A. Jr., 1964, Ground-water investigations in the lower Cache la Poudre River basin, Colorado: U.S. Geol. Survey Water-Supply Paper 1669-X, 22 p.
28. Hershey,L.A.and Hampton, E.R., 1974, Geohydrology of Baca and Southern Prowers Counties, southeastern Colorado: U.S. Geol. Survey Open-File Rept. 16-74.
29. Hillier, D.E. and Schneider, P.A., Jr., 1979, Well yields and chemical quality of water from water-table aquifers in the Boulder-Fort Collins-Greeley area, Front Range Urban Corridor, Colorado: U.S. Geol. Survey Map I-855 J.
30. Hofstra, W.E. and Hall, D.C., 1975, Hydrogeological and water-quality data in western Jefferson County, Colorado: Colorado Geol.Survey Basic-Data Release No. 36 Colorado Geol. Survey, 51 p.
31. Hofstra, W.E., Major, T.J. and Luckey, R.R., 1972, Hydrogeologic data for the northern High Plains of Colorado: Colorado Water Conserv. Board Basic-Data Release No. 23, 123 p.
32. Hubbell, R. C., 1956, History of Southeastern Colorado in Guidebook to the Geology of the Raton Basin, Colorado: Rocky Mountain Assoc. of Geologist, Denver, Colorado, pp. 8-13.
33. Huntley, David, 1976, Ground water recharge to the aquifers of the northern San Luis Valley, Colorado: Unpublished PhD Thesis, Colorado School Mines, Dept. of Geological Engineering.
34. Hurr, R. T.and Schneider, T. A., Jr., 1975, Hydrology of the South Platte River Valley, Northeastern Colorado: Colorado Water Conserv. Board Water Res. Cir. 28, 24 p.
35. Hurr, R.T. and Moore, J.E., 1972, Hydrogeologic characteristics of the valley fill aquifer in the Arkansas River valley, Bent County, Colorado: U.S. Geol. Survey Hyd. Inv. Atlas HA 461.
36. Iorns, W. V., Hembree, C. H., Phoenix, D. A., and Oakland, G. L., 1964, Water resources of the Upper Colorado River Basin - Basic Data: U.S. Geol. Survey Prof. Paper 442, pp. 676-701.
37. Irwin, Dennis, editor, 1978, Subsurface cross-sections of Colorado: Rocky Mountain Assoc. of Geologists Sp. Pub. #2, Denver, Colorado.
38. Irwin, James H., 1967, Geology and availability of ground water on the Ute Mountain Indian Reservation, Colorado and New Mexico: U.S. Geol. Survey Water-Supply Paper 1576-G, 109 p.
39. Jenkins, E.D., 1961, Records, logs, and water-level measurements of selcted wells and test holes, and chemical analyses of ground water in Fountain, Jimmy Camp, and Black Squirrel Creek Valleys, El Paso County, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 3, 25 p.
40. Johnson, R.B., 1969, Geologic map of the Trinidad Quadrangle, south central Colorado: U.S. Geol. Survey Mis. Geol. Investigations Map I-558, Scale 1:250,000.
41. Jordon, J.M., 1974, Geothermal investigations in the San Luis Valley, south central Colorado: Unpublished M.S. Thesis No. 1478, Colorado School Mines Dept. of Geophysical Engineering.
42. Kirkham, R.M., O Leary, W., and Warner, J.W., 1980, Hydrogeologic and stratigraphic data pertinent to uranium mining, Cheyenne Basin, Colorado: Colorado Geol. Survey Info. Series No. 12, 31 p.
43. Klein, J. M., Goddard, K. E. and Livingston, R. K., 1978, Appraisal of the water resources of Park and Teller Counties, Colorado: Colorado Water Conserv. Board Water Res. Circ. No. 36, 79 p.
44. Lohman, S. W., 1965, Geology and artesian water supply - Grand Junction area, Colorado: U.S. Geol. Survey Prof. Paper 451, 149 p.
45. McGovern, H.E., 1961, Records, logs, and water-level measurements of selected well and test holes, and chemical analyses of ground water in Washington County, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 6, 26 p.
46. ___1964, Geology and ground-water resources of Washington County, Colorado: U.S. Geol. Survey Water-Supply Paper 1777, 46 p.
47. McGovern, H.E. and Jenkins, E.D., 1966, Groundwater in Black Squirrel Creek valley, El Paso County, Colorado: U.S. Geol. Survey Hyd. Inv. Atlas HA-236.
48. McLaughlin, T.G., 1946, Geology and ground water resources of parts of Lincoln, Elbert, and El Paso Counties, with a special reference to Big Sandy Creek Valley above Limon: Colorado Water Conserv. Board Ground-Water Ser. Bull. 1, 35 p.
49. ___1954, Geology and groundwater resources of Baca County, Colorado: U.S. Geol. Survey Water-Supply Paper 1265, 232 p. and Colorado Water Conserv. Board Ground-Water Ser. Bull. 2 (1955).
50. ___1966, Ground water in Huerfano County, Colorado: U.S. Geol. Survey Water-Supply Paper 1805, 91 p.
51. McLaughlin, T.G., Burtis, V.M. and Wilson, W.W., 1961, Records and logs of selected wells and test holes, and chemical analyses of ground water from wells and mines, Huerfano County, Colorado: Colorado Water Conserv. Board Basic-Data Rep. 4, 26 p.
52. Owens, Willard, 1979, Proposed program for exploration and development of groundwater beneath state lands -- submitted to Colorado Board of Land Commissioners: Project No. 9110, Willard Owens Assoc., Denver, Co.
53. Pearl, R. H., 1974, Geology of Ground Water Resources in Colorado -- An Introduction: Colorado Geol. Survey Inf. Series 4, 47 p.
54. Phillips, E.H, 1974, Hydrogeology of Conejos and Costilla Counties, Colorado: Unpub. Preliminary Report, Colorado Div. of Water Resources.
55. Powell, W.J., 1952, Ground water in the vicinity of Trinidad, Colorado: Colorado Water Conserv. Board Circ. 3, 30 p.
56. Richards, D.B., Hershey, L.A., and Glanzman, R.K., 1968, Hydrogeologic data for Baca and southern Prowers Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 19, 119 p.
57. Robson, Stan, 1980, Unpublished data: U.S. Geol. Survey, Denver, Colo.
58. Robson, Stan and Romero, J.C., 1978, Geologic, structure, hydrology and water quality of the Arapahoe Formation in the Denver Basin, Colorado: Unpub. Prel. Map, U.S. Geol. Survey.
59. Romero, J. C., 1975, Ground water investigations of the Denver Basin: Colo. Div. of Water Resources, Denver, Colo., 109 p.
60. Rowley and Others, 1979, Geologic map of the Vernal 1 x 2 degree Quadrangle, Colorado, Utah and Wyoming: U. S. Geol. Survey Misc. Field Studies Map MF-1163, Scale 1:250,000.
61. Schneider, P.A., Jr. and Hershey, L.A., 1961, Records and logs of selected wells and test holes, and chemical analyses of groundwater in the lower Cache la Poudre River basin, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 8, 63 p.
62. Scott, G. R., Taylor, R. B., Epis, R. C., and Wobus, R. A., 1978, Pueblo 1° x 2° Quadrangle: U.S. Geol. Survey Misc. Invest. Ser. Map I-1022.
63. Scott, G.R., 1968, Geologic and structure contour map of the La Junta Quadrangle, Colorado and Kansas: U.S. Geol. Survey Misc. Geol. Investigatins Map I-560, Scale 1:250,000.
64. ___1978, Map showing geology, structure and oil and gas fields in Sterling 1 x 2 degree Quadrangle Colorado, Nebraska, and Kansas: U.S. Geol. Survey Map I-1092 scale 1:250,000.
65. Smith, R.O., Schneider, P.A. and Petri, L.R., 1964, Groundwater resources of the South Platte River basin in western Adams and southwestern Weld Counties, Colorado: U.S. Geol. Survey Water-Supply Paper 1658.
66. Staughton, Dean, 1977, Interpretation of seismic reflection data from the San Luis Valley, south central Colorado: Unpublished M.S. Thesis No. 1960 Colorado School Mines Dept. of Geophysical Engineering.
67. Stevens, T. A., Lipman, P. W., Hail, W. J., Jr., Barker, Fred, and Luedke, R. G., 1974, Geologic map of the Durango Quadrangle, southwestern Colorado: U.S. Geol. Survey Misc. Invest. Ser. Map I-764.
68. Tweto, Ogden, compiler, Geologic map of the Craig 1° x 2° Quad: U.S. Geol. Survey Map I-972.
69. ___1979, Geologic map of Colorado.
70. Tweto, Ogden, Moench, R. H., and Reed, J. C., Jr., 1978, Geologic map of the Leadville 1° x 2° quad sheet, northwestern Colorado: U.S. Geological Survey, Misc. Inv. Ser. Map I-999.
71. Tweto, Ogden, Steven, T. A., Hail, W. J., Jr., and Moench, R. H., 1976, Preliminary geologic Map Montrose 1° x 2° Quad, southwestern Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-761.
72. U.S. Geological Survey, 1980, WATSTORE--Water Quality Data Files: Reston, VA.
73. Vinckier, T. A., 1978, Hydrogeology of the Dakota Group Aquifer with emphasis on Radium-226 content of its contained groundwater, Canon City embayment, Fremont and Pueblo Counties: Univ. of Colorado, Dept. Geol. Sciences, M.S. Thesis.
74. Voegeli, P. T., Sr., 1965, Ground-water resources of North Park and Middle Park, Colorado--A reconnaissance: U.S. Geol. Survey Water-Supply Paper 1809-G, 54 p.
75. Voegeli, P.T., Sr., and Hershey, L.A., 1960, Records and logs of selected wells and test holes, and chemical and radiometric analyses of ground water, Prowers County, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 1, 52 p.
76. Waltz, J.P., and Sunada, D.K., 1972, Geohydraulics at the unconformity between bedrock and alluvial aquifers: Colo. State Univ. Env. Resources Center, Completion Report Series No. 30, 169 p.
77. Weeks, J.B. and Welder, F.A., 1974, Hydrologic geophysical data from the Piceance Basin, Colorado: Colorado Water Conserv. Board Water Resources Basic-Data Release No. 35, 121 p.
78. Weeks, J.B., Leavesley,G.H., Welder, F.A., and Saulnier, G. J., 1974, Simulated effects of Oil-Shale development on the hydrology of Piceance Basin, Colorado: U.S. Geol. Survey Prof. Paper 908, 84 p.
79. Weimer, R.J., and Hauhn, J.D.(eds), 1960, Guide to the geology of Colorado: Guidebook, Rocky Mountain Assoc. of Geologists and Geol. Soc. America.
80. Weist, W.G., Jr., 1960, Records and logs of selected wells and test holes, and chemical analyses of ground water, Yuma County, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 2, 41 p.
81. ___1962, Records, logs and water-level measurements of selected wells, springs, and test holes, and chemical analyses of ground water in Otero and southern part of Crowley Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 11, 54 p.
82. ___1964, Geology and ground-water resources of Yuma County, Colorado: U.S. Geol. Survey Water-Supply Paper 1539-J, 56 p.
83. ___1964, Hydrogeologic data from parts of Larimer, Logan, Morgan, Sedgwick and Weld Counties, Colorado: Colorado Water Conserv. Board Basic-Data Rept. 16, 30 p.
84. ___1965, Reconaissance of ground-water resources in parts of Larimer Logan, Morgan, Sedgwick and Weld Counties, Colorado; with a section on the chemical quality of the water by Robert Brennan: U.S. Geol. Survey Water-Supply Paper 1809-L.
85. ___1965, Geology and occurrence of ground water in Otero County and southern part of Crowley County, Colorado, with sections on Hydrology of the Arkansas River Valley in the project by W.G. Weist, Jr. and E.D. Jenkins; Hydraulic properties of the water-bearing materials by E. D. Jenkins; and Quality of the ground water by C. A. Horr: U.S. Geol. Survey Water-Supply Paper 1799, 90 p.
86. Williams, P. L., 1964, Geology, structure, and uranium deposits of the Moab Quadrangle, Colorado and Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-360.
87. Woodward Clyde Shepard and Assoc., 1966, Geology and groundwater study of the northern High Plains: Woodward Clyde Sheppard and Assoc,, Denver, Colorado.
88. Wright Water Engineers, 1979, Garfield County Report 1979 (unpub. report): Wright Water Engineers, Denver, Colo.

TABLE 1. Description of Geologic Units and Their Hydrologic Properties in Eastern Colorado

SYSTEM	FORMATION	BRIEF LITHOLOGY	THICKNESS (FT.)	TOTAL DISSOLVED SOLIDS	HYDROGEOLOGIC CHARACTERISTICS
Quaternary	Alluvium (Pleistocene)	Unconsolidated sand, silt, gravel and clay, commonly lenticular.	0-400	100-4,000 mg/l	Important source of water along the river valleys. Supplies large quantities of water to irrigation and public water supplies. Transmissivity 21,000-260,000 gpd/ft. Approximate well yields 500-1,000 gpm.
	Terrace Deposits	Sand and gravel with some cemented zones.	0-130	100-4,000 mg/l	Yields moderate to large quantities of fair to poor quality water to irrigation and domestic wells. Yields and transmissivity coinside with the above characteristics.
Tertiary	Intrusive and Extrusive Rocks	Basalts and other igneous rocks.		200-5,000 mg/l	Limited areal extent, mostly unsaturated, therefore, does not yield water to wells in this region.
	Ogallala Fm. (Miocene and Pliocene.)	Sand, gravel, clay and calliche. Generally grades from fine sediments near the surface to sand and gravel at the base. Locally beds of sand and gravel are cemented by calcium carbonate.	0-400+	220-1,000 mg/l	Important source of water on the high plains, especially for irrigation, domestic and stock wells. Well yields average 600 gpm and some reported yields as high as 3,000 gpm. The Ogallala Formation is an important source of water north of the Arkansas River and in parts of Prowers and Baca Counties. Transmissivity 8,000 gpd/ft.
	Arikaree	This sandstone appears to be present only in extreme northeastern Colorado.	0-80	200-1,000 mg/l	May yield small quantities of water to stock and domestic wells.
	(Oligocene) White River Group	Silt with fine sand and clay. Some channel deposits of sand and gravel. Brule Fm. has some joint systems in massive clay zones. Chadron Fm. is semiconsolidated to orthoquartzite.	0-600	500-1,000 mg/l	Generally not an important source of water. Brule Fm. locally yields a moderate amount of water from porous and jointed zones. Due to the Chadron Formations low permeability, it acts as a lower confining bed for valley-fill alluvium. Transmissivity approximately 350 gpd/ft.
	Huerfano Fm. (Eocene)	Variegated maroon, gray and green shale with red and white shalv sandstone and tan conglomeratic sandstone near the base.	0-2,000	305-620 ppm	Yields small amounts of water to wells and springs locally. The formation has low permeability, and although it covers a broad area the formation yields water to only a very few wells and springs in Huerfano County. Thus, the Huerfano cannot be expected to yield much water in Huerfano County, except perhaps from the conglomeratic sandstone near the base.
	Cuchara Fm. (Eocene)	Red, pink and white massive sandstone. Commonly medium to coarse grained, friable in places and generally lenticular.	0-5,000	129-462 mg/l	In areas of dissection, numerous small springs and seeps issue from the beds of sandstone. These natural discharges supply most of the domestic and stock needs of the area. Wells and stock ponds have been constructed to supplement the springs. Where the area is highly dissected the formation may be dry to a depth of 200 ft.
	Poison Canyon Fm. (Paleocene)	Arkosic conglomerate, sandstone and siltstone. Equivalent to part of Dawson Fm. of the Colorado Springs area. This formation is a buff to red massive sandstone and conglomerate with thin beds of shale and siltstone.	2,500	241-2,630 mg/l	Locally yields small amounts of water to wells in southern part of area. Important source of water in the Colorado Springs area.
Upper	Dawson Arkose	Arkosic sandstone, conglomerate, and shale. Includes the Green Mountain Conglomerate south of Golden. Individual beds are generally less that 200 feet thick and commonly are lenticular. The Raton Fm. is equivilent to the Dawson Fm. in Colorado Springs Area.	800-1,100	100-400 ppm	Yields small to moderate quantities of water except near outcrops where upland areas occur. The deeper horizons have supported sustained yields of 300 gpm. Water is generally of good quality although there are local reports of high concentrations of iron, magnesium, calcium, and in test area radioactive constituents. Transmissivity approximately 2,500 gpd/ft.
	Denver Fm.	Clay, shale, and siltstone with sandstone and conglomerate. Locally beds of volcanic ash, bentonite clay and lignite coal beds.	400	200-600 ppm	Yields small quantities of water to a large number of domestic and stock wells. The best aquifer material occurs in the region around Golden, Morrison and Littleton. Eastward the formations aquifer characteristics diminish. The aquifer water is of good to fair quality, with a few local exceptions. Transmissivity approximately 1,000 gpd/ft.
	Arapahoe Fm.	Sandy to clayey shale and clay with a few beds of sandstone. Lower part contains sand, gravel and conglomerate.	300	250 ppm	Yields moderate quantities of water except near outcrops or where possibly affected by structural phenomena. The principal water bearing zone is the basal part. Sustained well yields of 200-300 gpm are not uncommon. The aquifer characteristics diminish near the southern edge of the outcrop area. Water is generally only slightly mineralized and satisfactory for most uses. Transmissivity 10,500 gpd/ft.
	Laramie	Silty shale, contains lenticular beds of sandstone, clay, and seams of coal. Lower 200 feet contain beds of subbituminous coal, variegated shale and a massive sandstone unit.	0-600	500-2,000 mg/l	Yields small quantities of water to stock and domestic wells. Water quality is generally poor. Lower 150-200 feet of Laramie Fm. and Fox Hills sandstone are collectively referred to as the Laramie-Fox Hills aquifer. Transmissivity 500 gpd/ft. within the Laramie-Fox Hills aquifer.
	Fox Hills Sandstone	Sandstone, massive, silty, fine- to medium-grained, buff to light-yellow. Contains medium to dark-gray sandy shale near base.	0-200+	500-2,000 mg/l	Important source of water in the Denver Basin.
Cretaceous	Vermejo Fm.	Sandstone, siltstone, shale and coal. Equivalent to part of Laramie Fm. of the Colorado Springs area.	400+	480-3,050 mg/l	Yields small quantities of water to wells and springs and moderate quantities to mines. Quality may vary locally.
	Trinidad Sandstone	Light-gray to buff medium-grained sandstone. It thins generally northward along the east edge of the coal basin and pinches out near the Black Hills northwest of Walsenburg. The Trinidad underlies most of the Raton Basin.	300+	2,670 mg/l	Only a few wells now obtain water from the Trinidad Sandstone in Huerfano County. The few domestic and stock wells that tap the formation reportedly are dependable and the water is moderatly to highly mineralized. Water in the outcrops may be hard to find as the formation may be largely drained. Wells near the Trinidad-Vermejo contact are most likely to succeed. The Trinidad is potentially capable of yielding water for small scale irrigation, moderate quantities of 25-250 gpm if the well is constructed properly. Source of much of the water is the mines that exploit the lower coal seams in the Trinidad.
	Pierre Shale	Shale and silt interbedded with sandstone lenses.	2,500-6,500	708-1,740 mg/l	Not an important source of water. Locally may yield moderate amounts of water to wells. Water is very poor quality. Low permeability, generally acts as a lower confining bed for valley-fill alluvium in Morgan and Logan Counties.
	Niobrara Fm.	Marl shale in upper part (Smoky Hill Marl) containing thin beds of limestone in lower part and locally at top. The lower 20-50 ft. is a light gray limestone with thin chalky shale partings; (Fort Hays Limestone).	300-700+	661-6,110 mg/l	Not an important source of water. Fractured limestone locally will yield small amounts of poor quality water to stock wells and springs.
	Carlile Greenhorn Graneros	Shale with some sandstone lenses. Limestone. Shale with some thin limestone berls.	290+ 120+ 235+	1,000-1,500 mg/l	These Middle Cretaceous Formations are not an important source of water.
	Dakota Sandstone (South Platte Fm. Lytle Fm.)	Thin-bedded to massive fine-grained sandstone containing clayey and sandy shale. Crossbedding occurs.	150-300	140-1,800 mg/l	Yields adequate quantities of water for domestic and stock use. In some areas yields are high enough for municipal and industrial use. In northeastern Colorado the water may have high iron content. Transmissivity 500 gpd/ft. Approximate well yields are 100 gpm.
Lower	Cheyenne Sandstone	Massive white to buff fine-grained sandstone with some limestone and siltstone.	up to 135	210-1,250 mg/l	Yields varying amounts of water to wells up to 600 gpm. Transmissivity 4,400 gpd/ft.
Triassic	Morrison Fm.	Sandstone, marlstone, limestone, mudstone, and locally gypsum beds.	300+	130-4,690 mg/l	Not an important source of water. Sandstone beds might contain small amounts of water, but the quality is questionable.
Jurassic	Entrada Sandstone	White to buff massive fine to medium grained quartzose sandstone that contains some frosted, coarse grains.	380	400-600 mg/l	Locally yields small quantities of water to wells.
	Dockum Group	Conglomerate, sandstone and red clay, some limestone.	up to 150	280-1,250 mg/l	Good source for irrigation wells in S.E. Baca Co. Yields average 1,500 gpm.
Permian	Sangre de Cristo	Sandstone, conglomerate, limestone and shale	3,000	300-2,080 mg/l	Yields water to springs and seeps, generally in mountainous areas.
and	Lyons Sandstone (Permian)	Type section is composed of grayish-orange-pink and light-brown fine to medium-grained well-sorted sandstone with minor units of reddish siltstone. Basal part is conglomeritic. High angle cross laminae are more common in the upper part than the lower part of the formation	200	99-1,000 mg/l	Yields small to moderate amounts of water to wells.
Pennsylvanian	Fountain Fm. (Pennsylvanian)	Conglomeratic sandstone, mudstone and shale. Reddish in color.	1,000	300-2,080 mg/l	Yields small quantities of water locally.
	Unnamed Marine Rocks	Gray, carbonaceous, conglomerate, sandstone, limestone and shale.	5,000+	---	Yields water to springs in mountain areas.
Pre-Cambrian		Igneous and Metamorphic rocks.	---	36-4,758 mg/l	Locally yields very small to moderate amounts of water to domestic and stock wells from fractured and faulted zones. Quality is usually good but locally may be highly mineralized. Mostly yields to springs in mountainous areas.

TABLE 2. Description of Geologic Units and Their Hydrologic Properties in Western Colorado

SYSTEM	FORMATION	BRIEF LITHOLOGY	THICKNESS (FT.)	TOTAL DISSOLVED SOLIDS	HYDROGEOLOGIC CHARACTERISTICS
Quaternary	Alluvial Deposits	Channel and floodplain deposits of major drainages. May be partly of Pleistocene Age. Gravel, sand, silt and clay in stream valleys and alluvial fans. Generally grades from coarse materials at the headwaters to finer materials downstream.	0-140	50-8,000 mg/l	Yields as much as 1,000 gpm. Water quality variable depending on underlying rock and source of alluvial material. Transmissivity ranges from 20,000 to 150,000 gpd/ft.
	Colluvium, landslide debris, glacial moraines and terrace deposits and older alluvial deposits.	Channel and flood plain stream deposits. Includes alluvial slopewash and colluvium, earthflows and rotational slumps on steep slopes, debris piles and cones. Glacial outwash, till, unsorted gravels and sand. Silt and clay also occur.	10-100	245-1,600 mg/l	Yields less than 20 gpm usually at the base of these deposits.
Tertiary	Volcanic Rocks	Pleistocene basalts, lava flows, breccias, tuffs and other related materials. The basalts are usually jointed and fractured and weather to a reddish-brown.	variable up to 1,000	111-475 mg/l	Source of water for domestic and stock supplies; generally yields less than 10 gpm, except where large faults occur and yield will increase.
	Browns Park Fm. (Miocene)	Fine grained grayish sandstone, gravels, cobbles, chert, freshwater limestone and a conglomerate at the base.	as thick as 1,800	95-950 mg/l	Source of water for stock and domestic wells. Maybe a potential source of water for large capacity wells. Locally the water is highly alkaline. Approximate transmissivity is 1,500 gpd/ft.
	Uinta Fm.	Brown, red and green sandstone, siltstone and shales.	approx. 200	600-8,100 mg/l	Transmissivity is 2,100 gpd/ft. (Piceance Basin).
	Green River Fm. Douglas Creek Member	Intertonguing lenses of siltstone, marlstone, sandstone, limestone and shales.	as thick as 3,500	250-63,000 mg/l	Wells derive water largely from fractures and solution openings. Sandstone is relatively impermeable. Yields as much as 1,000 gpm. Transmissivity 3,200.
	Wasatch Fm.	Clay, shale, and lenses of sandstone, limestone and conglomerate. Beds of clay and shale are the main constituents. Local gypsum deposits.	300-5,000	338-2,500 mg/l	Yields water to stock and domestic wells; reported to yield as much as 900 gpm to two irrigation wells. The gypsum contributes sulfate to both surface-water and ground-water supplies.
Upper	Mesa Verde Group Cliff House Sandstone Menefee Fm.	Mudstone, shale, carbonaceous shale, coal and varicolored crossbedded sandstone. Coals are economically important.	1,500-5,300	181-3,350 mg/l	Source of water to many springs and large-capacity wells. Yields as much as 800 gpm. Transmissivity approximately 20,000 gpd/ft.
Cretaceous	Mancos Shale Pierre Shale Niobrara Fm.	Gray to black shale and thin fossiliferous zones of calcareous concretions, grayish-brown sandy limestone and shaly sandstone.	3,500-5,000	207-4,820 mg/l	Supplies water to stock and domestic wells locally where it contains fractures or weathered zones. The water is generally highly mineralized. Not generally considered a source of water. Reported well yields are as much as 10 gpm. The highest well yields are developed on landslides and slump blocks.
Lower	Dakota Sandstone and Burro Canyon Fm.	Predominantly light-gray, very fine to medium, well-sorted, well cemented, sandstone with shale and siltstone interbeds. Chert-pebble conglomerates are common. Thin beds of coal. The sandstone weathers to a rust-brown color and forms cliffs and ridges.	300	57-5,380 mg/l	Source of water to stock and domestic wells; yields as much as 40 gpm. Wells may be flowing where sandstone is overlain by Mancos Shale. Locally the water can be saline. The Dakota is a principal aquifer in western Colorado. Transmissivity 500 gpd/ft.
Jurassic	Morrison Fm. Brushy Basin and Salt Wash Members	Varicolored shale with interbedded light gray sandstone and siltstone and dark-gray limestone. Sandstone beds are prominent.	250-600	211-296 mg/l	Source of water to stock and domestic wells locally. Reported yields are approximately 25 gpm. Local concentrations of iron may occur.
	Entrada Sandstone	Sandstone, yellowish-gray to gray, very fine to medium, well-sorted, spectacular crossbedding and calcareous cementation, friable. Weathers to an orangish color; forms ridges.	50-200	245-3,800 mg/l	Source of water for stock and domestic use. Local yields more than 25 gpm. May be an aquifer in outcrop area.
Triassic	Wingate Sandstone	Buff, reddish-brown, and grayish-orange fine grained and massive and predominantly crossbedded sandstone. In most exposures it forms vertical cliffs and exhibits dark-brown desert-varnish on the weathered surfaces. Wingate occurs in western Colorado.	300-400	268-3,550 mg/l	Source of water for stock and domestic use. Chemical quality of the water is generally very good. Wells yield as much as 30 gpm from flowing artesian wells at 10-1,600 feet deep. The Entrada and Wingate Sandstones together have reportedly yielded 120-350 gpm to wells.
	Chinle Fm.	Red and reddish-brown siltstone interbedded with lenses of red sandstone and shale, limestone-pebble and shale-pellet conglomerate; lenses of grit and quartz-pebble conglomerate near base.	As thick as 1,000	1,000-1,800 mg/l	Generally not water bearing in the Grand Junction area, because its predominantly siltstone with low permeability. Small springs occur at the basal contact in canyons at Colorado National Monument, but this water is from the underlying weathered Precambrian rocks.
Permian and Pennsylvanian	Permian and Pennsylvanian Rocks	Generally shales, limestone, dolomites, arkose, conglomerates, and sandstones. often reddish in color. Eagle Valley Evaporite is a gypsiferous sandstone, interbedded with shale and siltstone, This early Pennsylvanian Fm. weathers to a yellow gray color.	As thick as 13,000	194-2,630 mg/l	Sandstone beds commonly yield, saline water. Not generally considered a source of water to wells. The Maroon Formation has been reported to yield 5-25 gpm. The Maroon Fm. is an important source of water around Carbondale.
Mississippian	Leadville Limestone	Grayish limestone, coarse crystals, oolites, gray chert nodules, few fossils, grades into a fine grained limestone and some dolomite with gray chert lenses and nodules. There are several disconformities.	50-200	234-20,000 mg/l	The largest yields in Colorado appear to come from wells which tap caverns and fractures. Some wells yield as much as several thousand gpm by natural flow, but the flow generally varies considerably. Chemical quality is generally poor, but ranges from poor to usable. Fractures in the Leadville Formation serve as conduits for water from adjacent formations.
Early Paleozoic Devonian, Ordovician and Cambrian	Pre-Mississippian Rocks	Dolomite, limestone, quartzite, sandstone, conglomerate, shale and chert.	As thick as 25,000	100-4,000 mg/l	Yields small supplies of potable water at depths less than 2,000 ft. The dolomite and limestone have fracture or solution permeability at places and may yield significant quantities of water to wells. The Sawatch Quartzite of Cambrian Age, supplies numerous small springs.
Pre-cambrian	Precambrian Crystalline Rocks	Crystalline rocks include intrusive igneous rocks, such as, granite, pegmatite, gabbro, and metamorphic rocks such as schists and gneiss.	---	30-1,200 mg/l	Significant amounts of water occur in crystalline rocks only where they are fractured or weathered. If water is found above 300 feet, larger yields might be obtainable by drilling deeper. However, if no water is found above 300 feet, water is unlikely to be found deeper.

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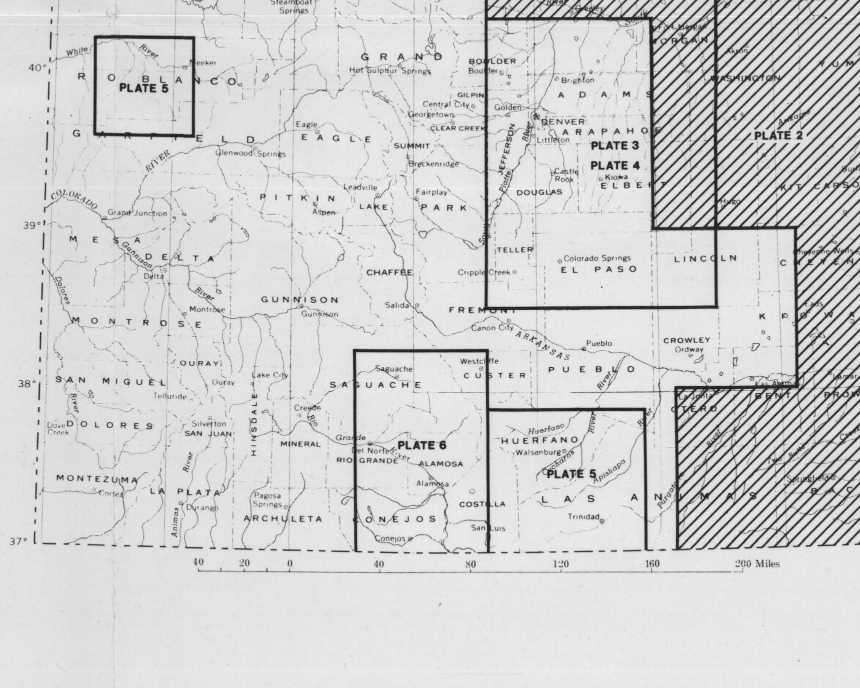
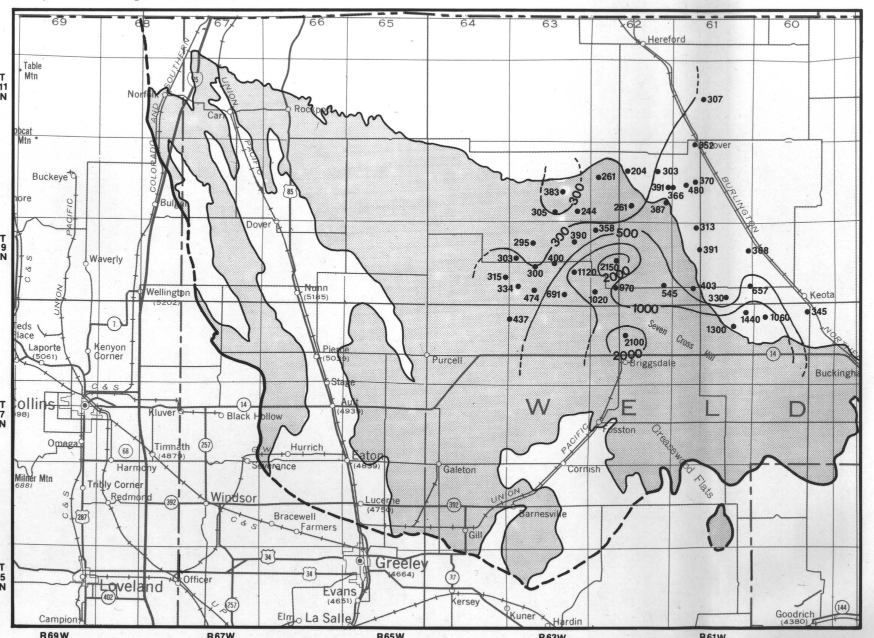
Drafting by Cornelia B. Sherry

Index Map of Plates 2 thru 6



Colorado Geological Survey
Department of Natural Resources
John W. Rold, Director

Map A. Cheyenne Basin – Laramie Formation – Total Dissolved Solids



EXPLANATION

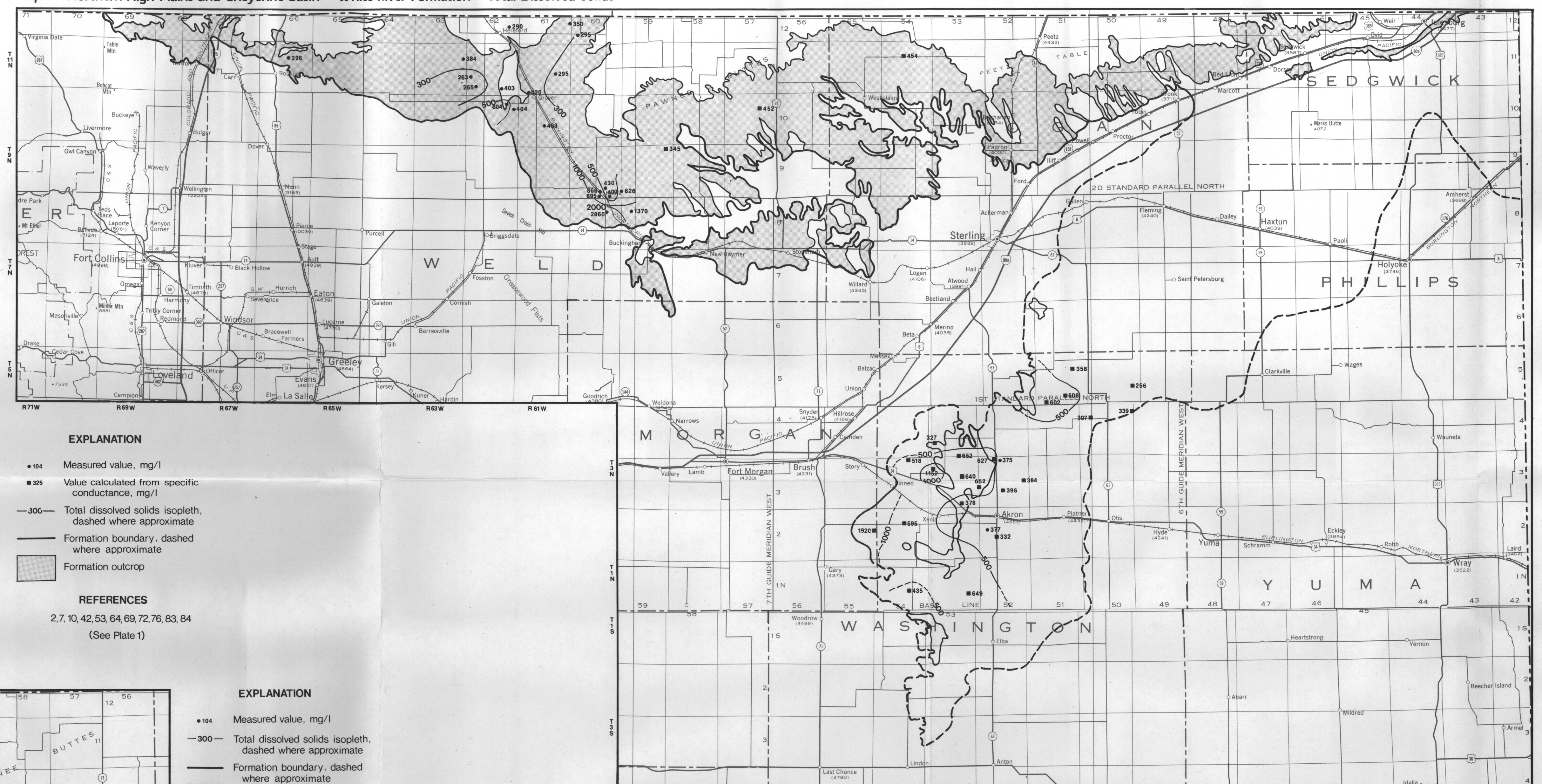
- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- Formation boundary, dashed where approximate
- Formation outcrop

REFERENCES

2,7,53,69,72,83,84

(See Plate 1)

Map B. Northern High Plains and Cheyenne Basin – White River Formation – Total Dissolved Solids



EXPLANATION

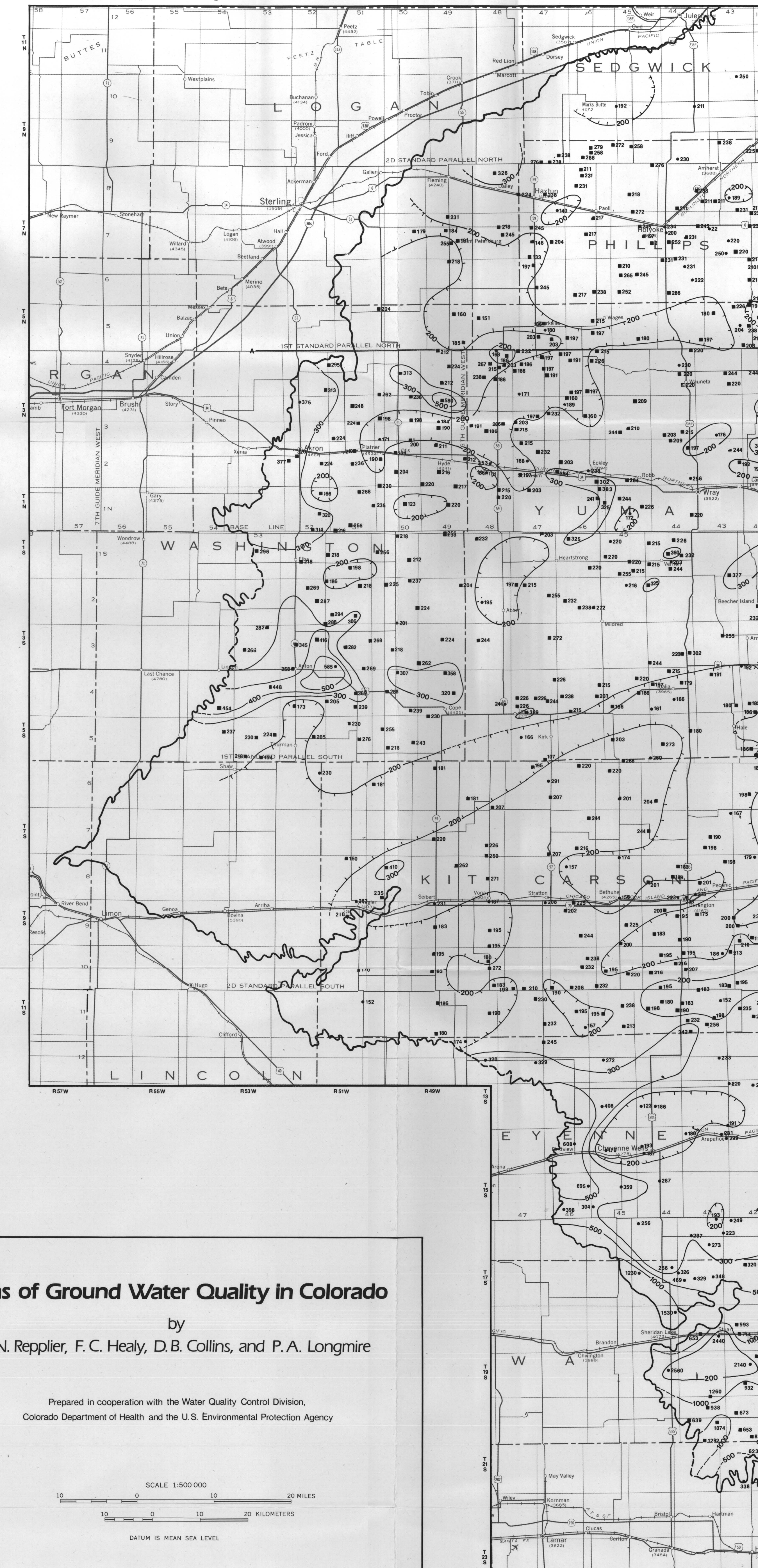
- •104 Measured value, mg/l
- ■325 Value calculated from specific conductance, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- Formation boundary, dashed where approximate
- Formation outcrop

REFERENCES

2,7,10,42,53,64,69,72,76,83,84

(See Plate 1)

Map C. Northern High Plains – Ogallala Formation – Total Dissolved Solids



EXPLANATION

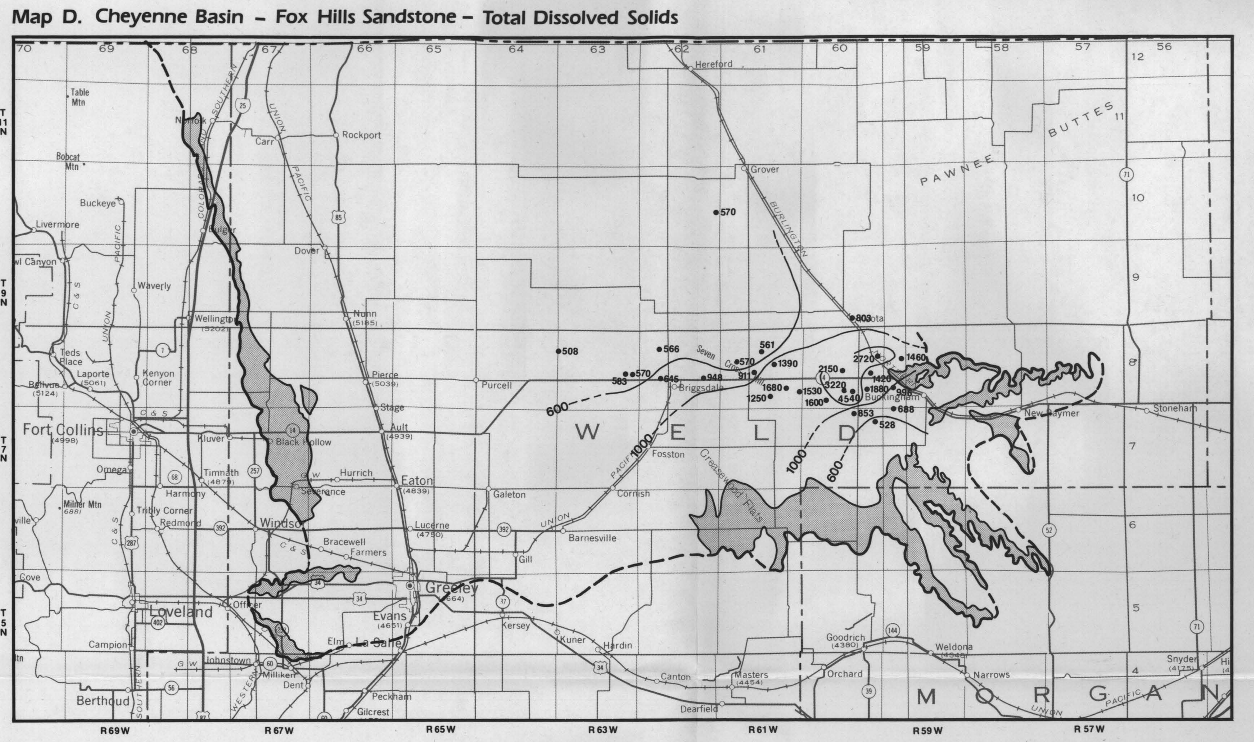
- •104 Measured value, mg/l
- ■325 Value calculated from specific conductance, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- Formation boundary, dashed where approximate
- A——A' Cross section line

REFERENCES

2,3,4,5,10,12,13,14,31,45,46,52,53,64,69,72,75,76,80,81,82,87

(See Plate 1)

Map D. Cheyenne Basin – Fox Hills Sandstone – Total Dissolved Solids



EXPLANATION

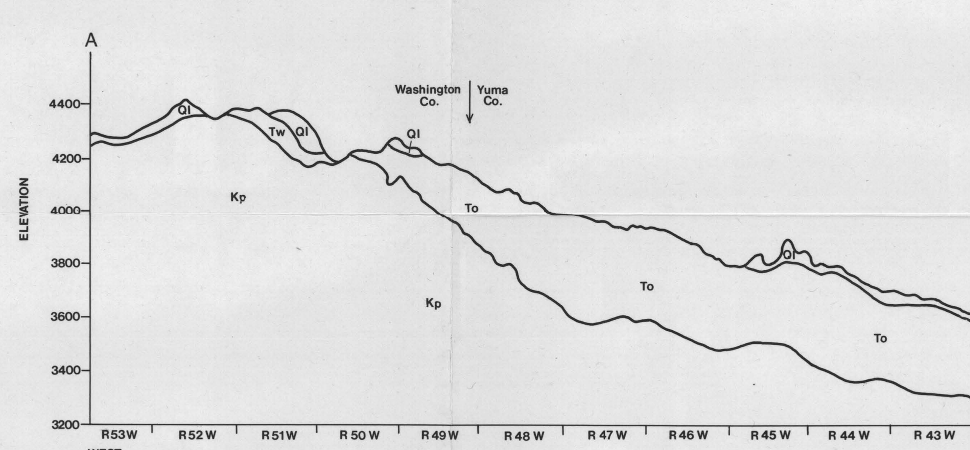
- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- Formation boundary, dashed where approximate
- Formation outcrop

REFERENCES

7,42,53,64,69,72,83,84

(See Plate 1)

Northern High Plains – East-West Stratigraphic Cross Section



EXPLANATION

- Ql Quaternary landslide deposits
- To Tertiary Ogallala Fm.
- Tw Tertiary White River Fm.
- Kp Cretaceous Pierre Shale

SCALE

Horizontal 1:500,000

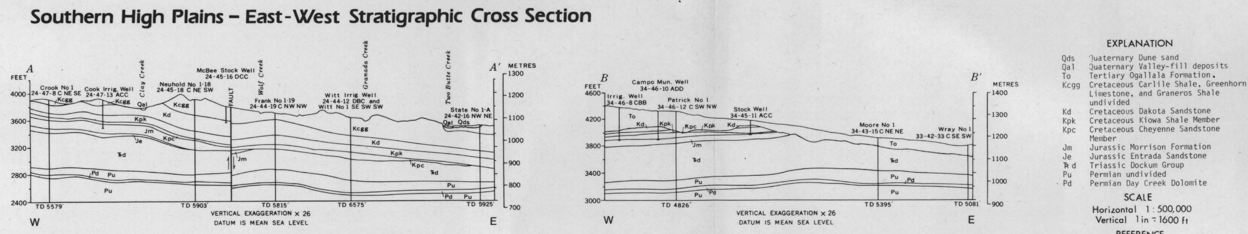
Vertical 1 in = 400 ft

REFERENCE

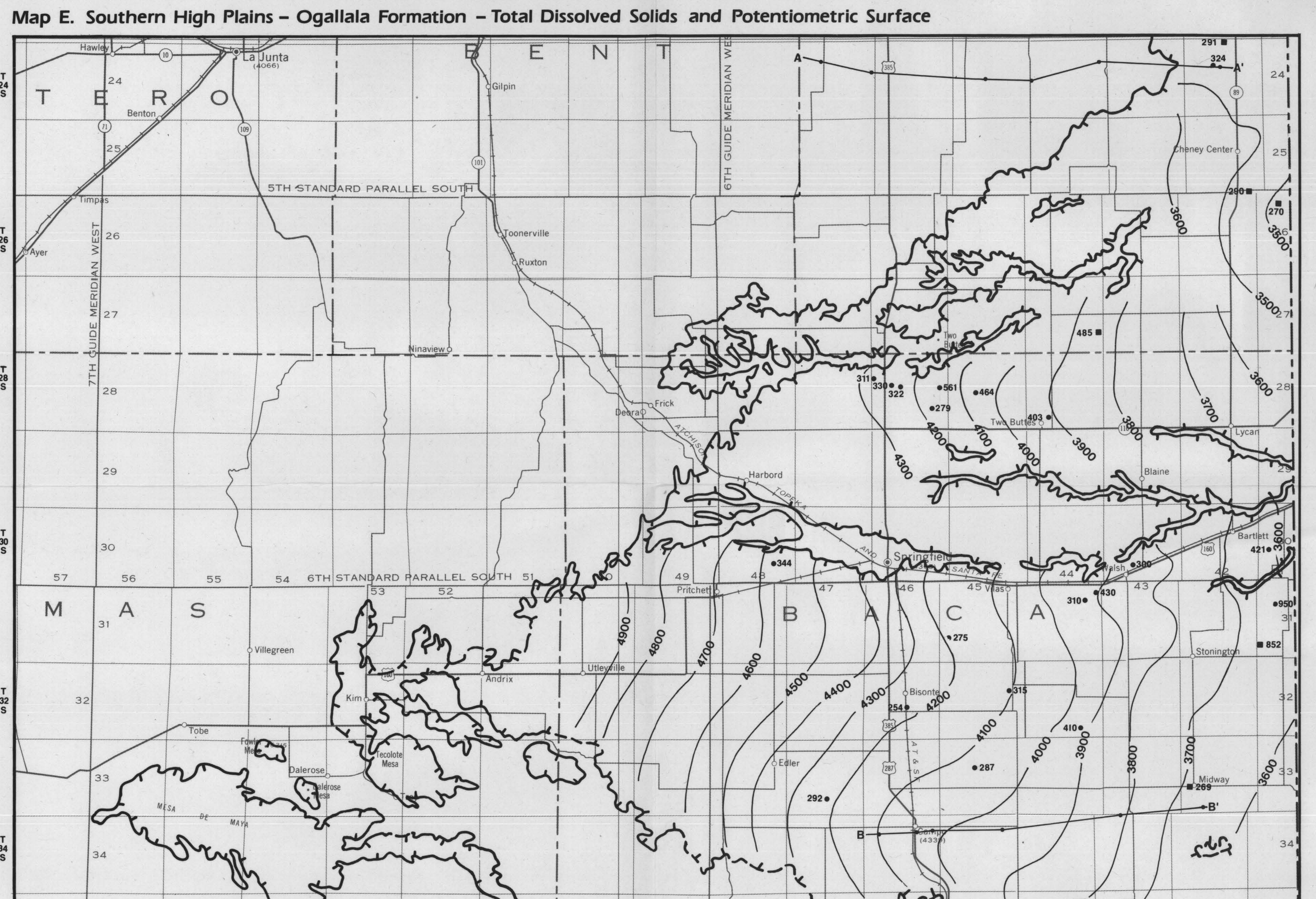
87

(See Plate 1)

Southern High Plains – East-West Stratigraphic Cross Section



Map E. Southern High Plains – Ogallala Formation – Total Dissolved Solids and Potentiometric Surface



EXPLANATION

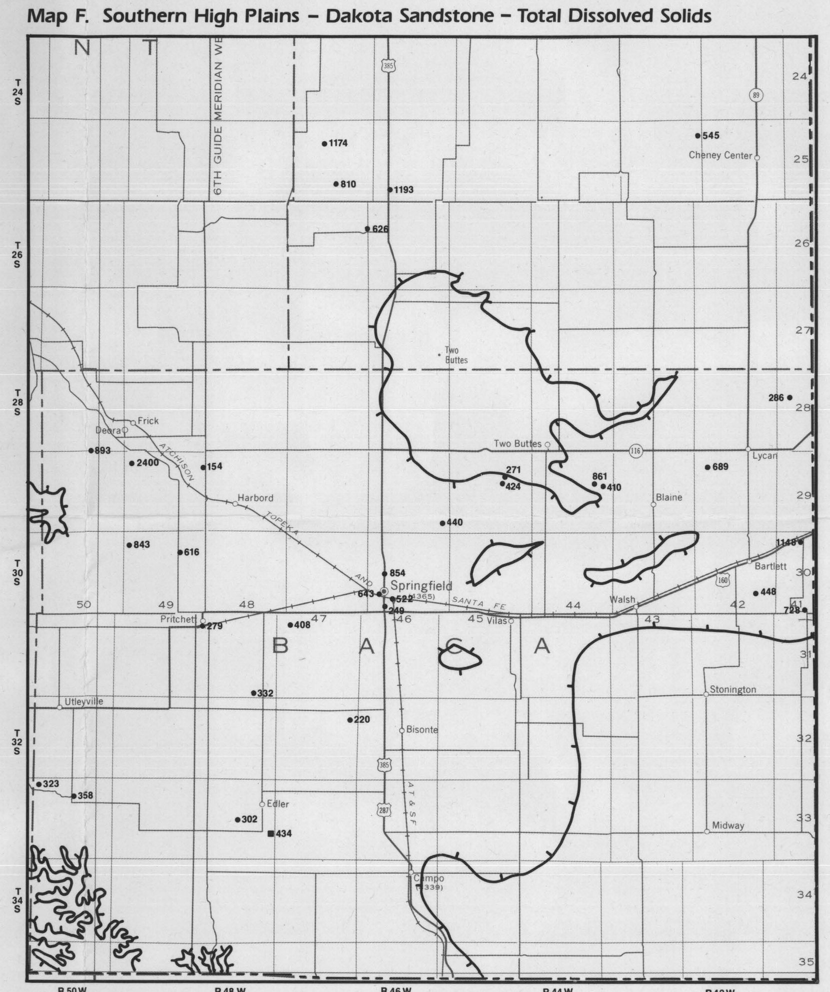
- •104 Measured value, mg/l
- ■325 Value calculated from specific conductance, mg/l
- —3100— Potentiometric contour, contour interval 100 feet, datum is mean sea level
- Formation boundary, dashed where approximate, tick marks where present
- A——A' Cross section line

REFERENCES

28,49,53,56,63,69,72

(See Plate 1)

Map F. Southern High Plains – Dakota Sandstone – Total Dissolved Solids



EXPLANATION

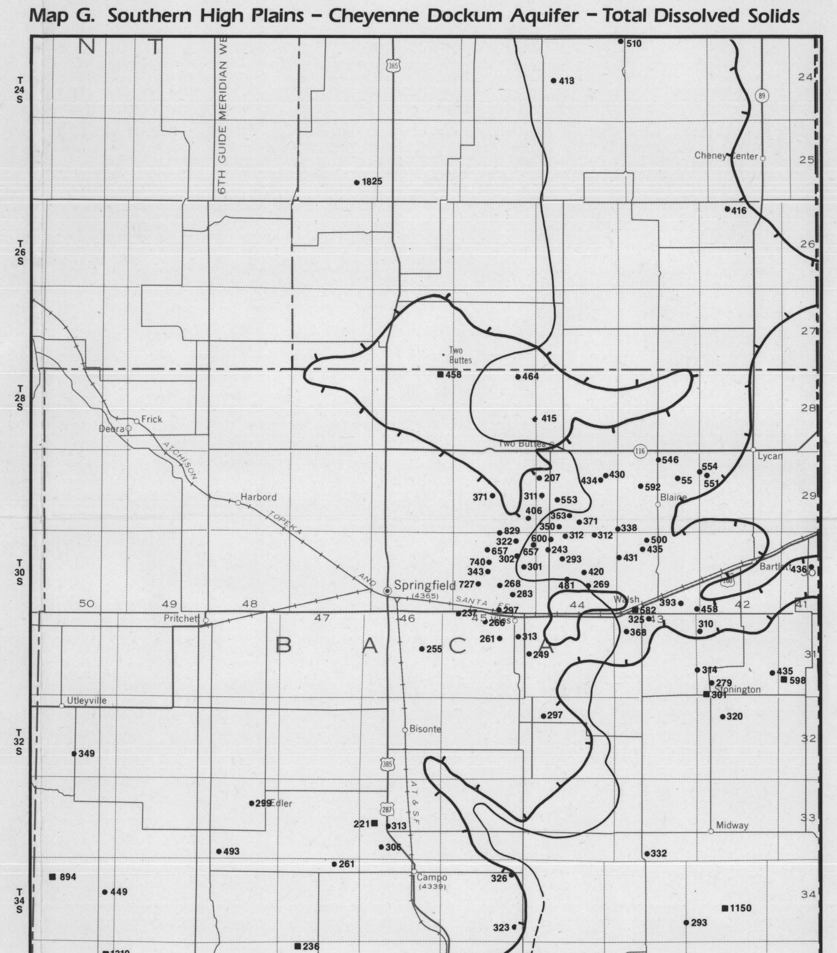
- •104 Measured value, mg/l
- ■325 Value calculated from specific conductance, mg/l
- Aquifer boundary, tick marks where present

REFERENCES

28,49,53,56,63,69,72

(See Plate 1)

Map G. Southern High Plains – Cheyenne Dockum Aquifer – Total Dissolved Solids



EXPLANATION

- •104 Measured value, mg/l
- ■325 Value calculated from specific conductance, mg/l
- Cheyenne member of the Purgatoire Fm. boundary, tick marks where present
- Geohydrologic boundary which marks the eastern extent of the Morrison Fm.; beyond this the Cheyenne and Dockum are hydrologically connected, dashed where approximate

REFERENCES

28,53,56,63,72

(See Plate 1)

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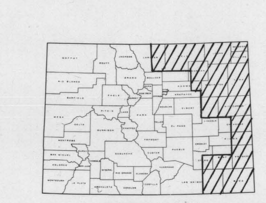
SCALE 1:500 000

10 0 10 20 MILES

10 0 10 20 KILOMETERS

DATUM IS MEAN SEA LEVEL



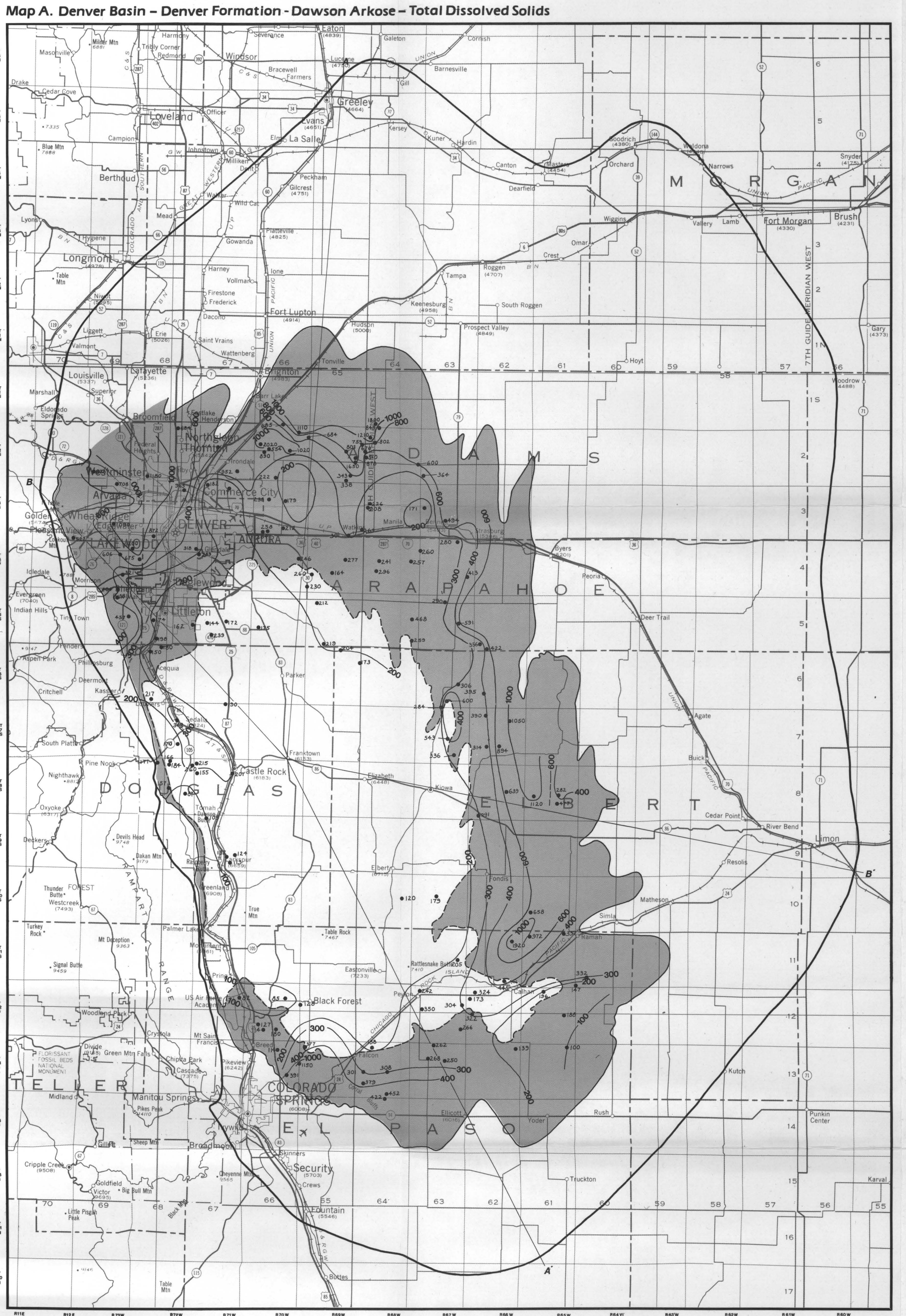
INDEX MAP

N

Base maps from the U.S. Geological Survey

Drafted by Cheryl Brchan

Map A. Denver Basin – Denver Formation - Dawson Arkose – Total Dissolved Solids



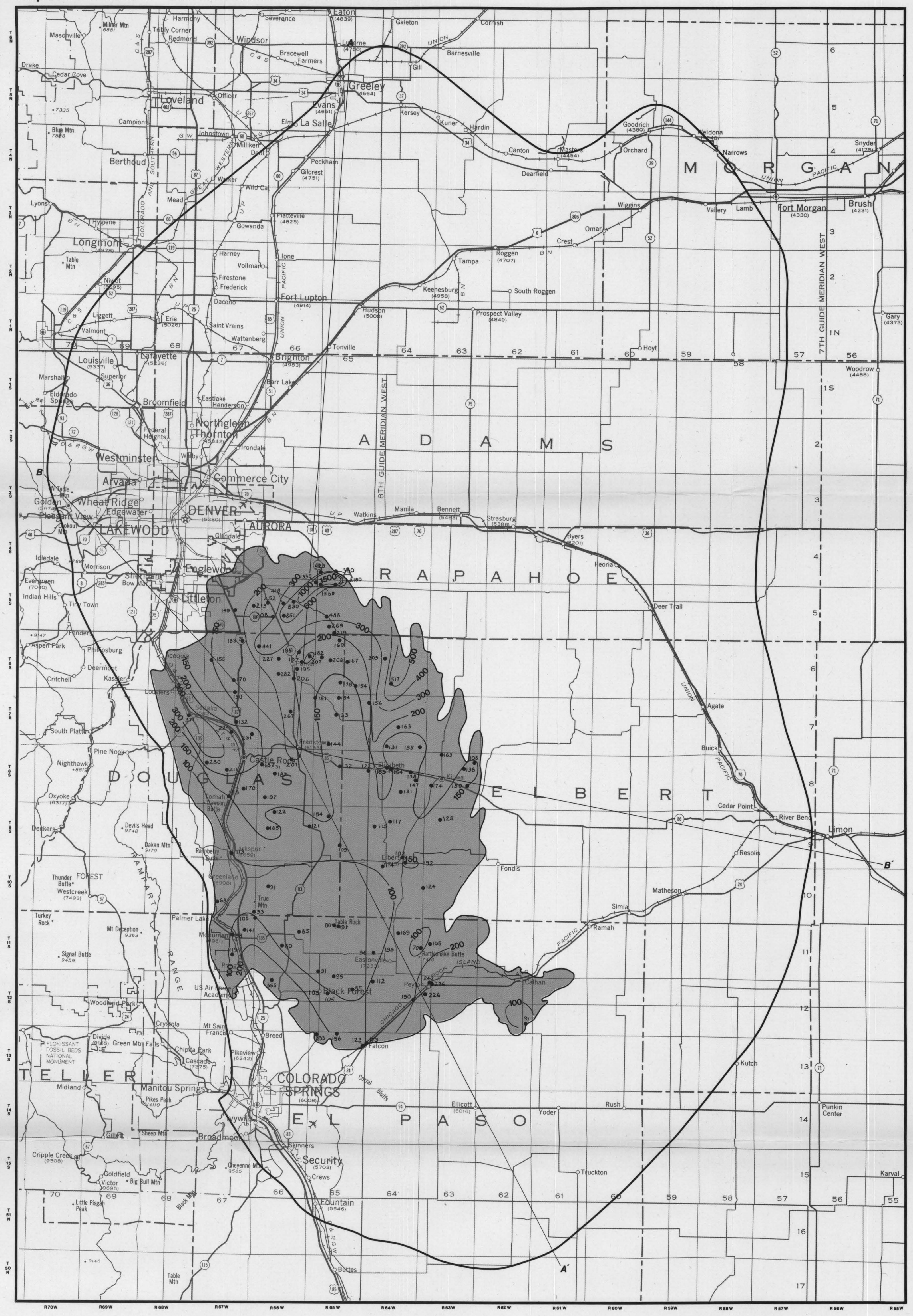
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth
- Denver Formation boundary
- Dawson Arkose boundary
- Denver Basin boundary
- A—A′ Cross section line
- Formation outcrop

REFERENCES

7, 57, 59, 62, 64, 67, 69, 72
(See Plate 1)

Map B. Denver Basin – Dawson Arkose – Total Dissolved Solids

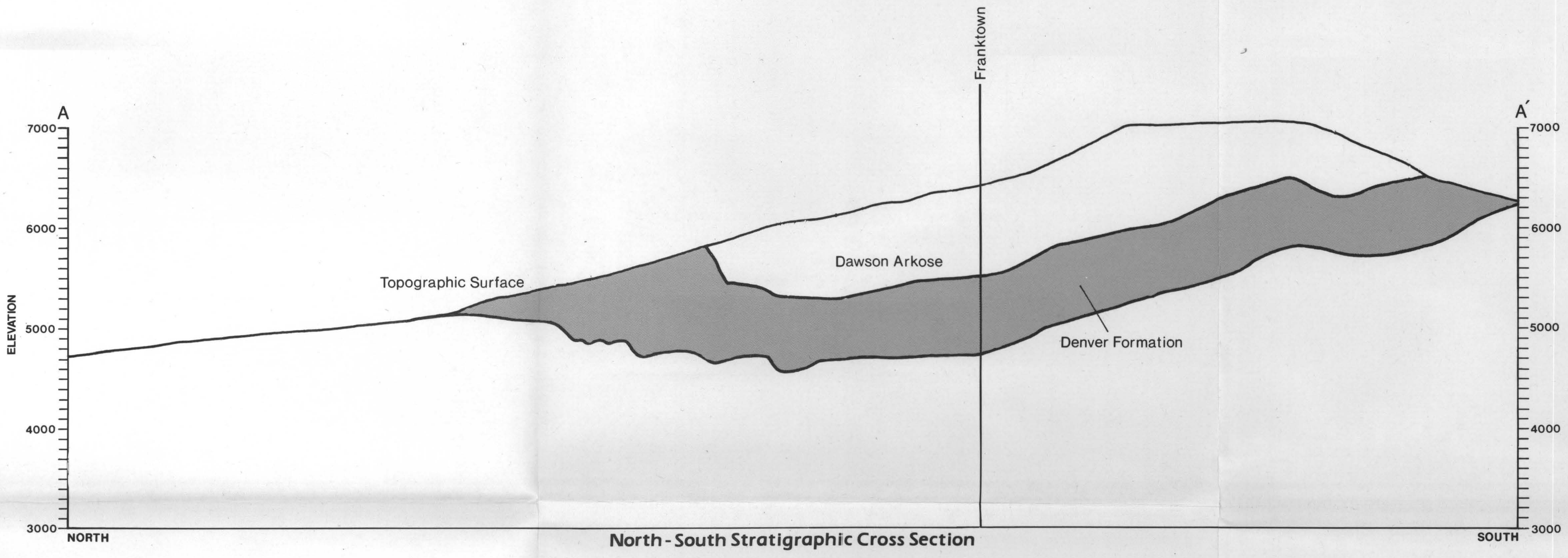


EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth
- Dawson Arkose boundary
- Denver Basin boundary
- A—A′ Cross section line
- Formation outcrop

REFERENCES

7, 57, 59, 62, 64, 67, 69, 72
(See Plate 1)



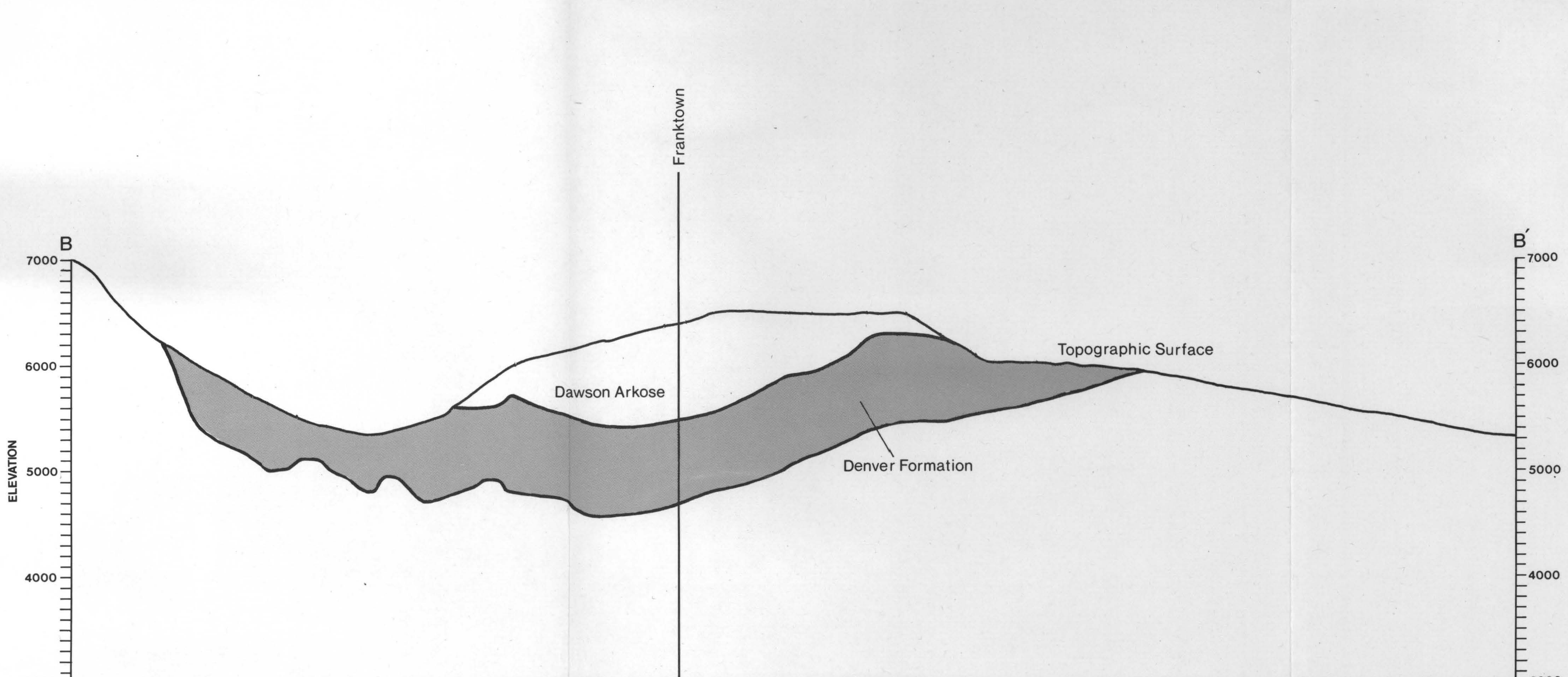
North - South Stratigraphic Cross Section

SCALE

Horizontal 1″= 8 miles
Vertical 1″= 1000 feet

REFERENCES

37, 59
(See Plate 1)



East - Northwest Statigraphic Cross Section

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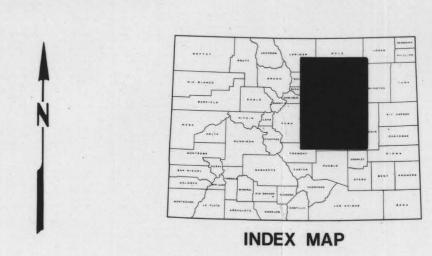
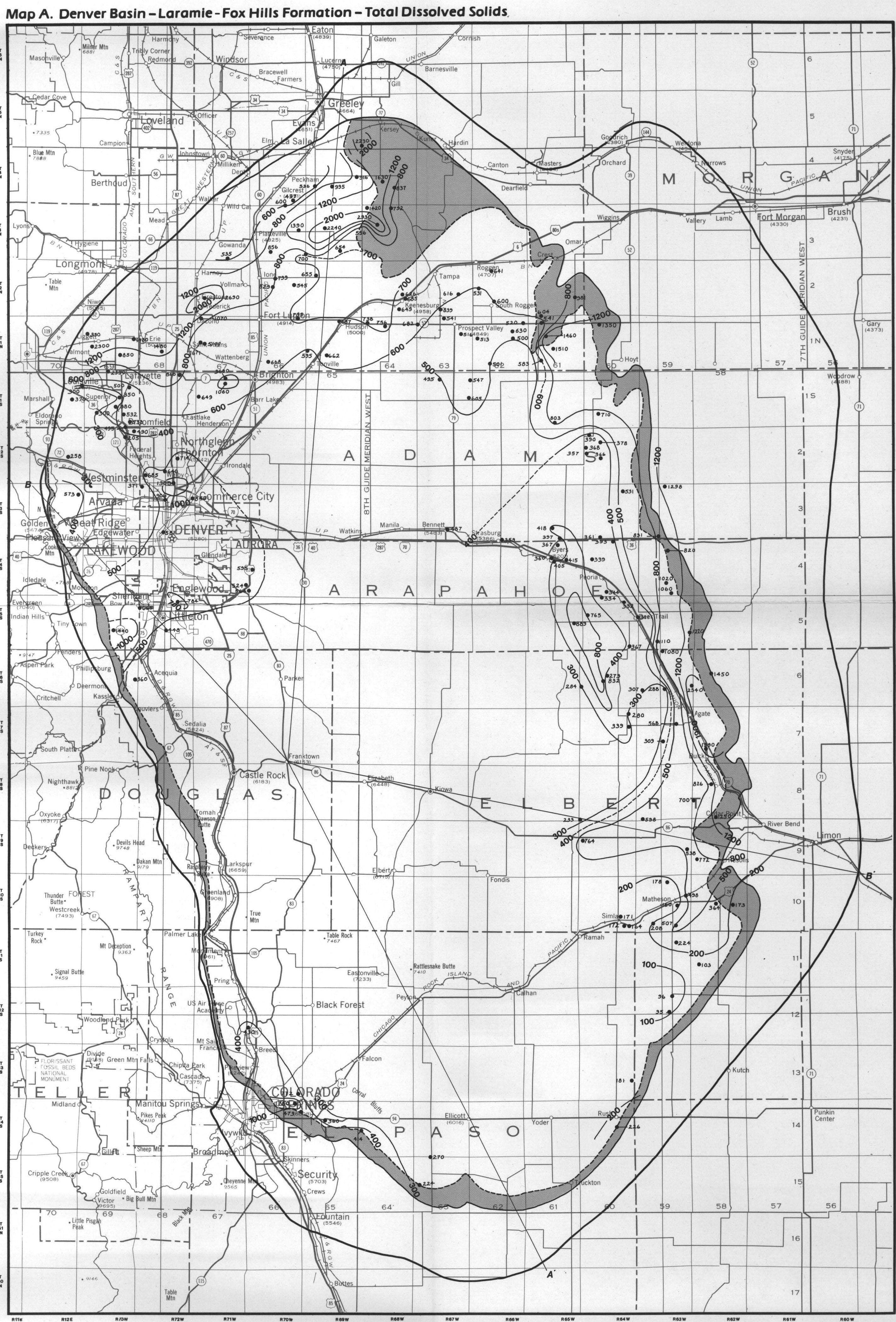


SCALE 1:500 000
10 0 10 20 MILES
10 0 10 20 KILOMETERS
DATUM IS MEAN SEA LEVEL

Base maps from the U.S. Geological Survey

Drafting by Cornelia B. Sherry

Map A. Denver Basin – Laramie - Fox Hills Formation – Total Dissolved Solids



EXPLANATION

• 104 Measured value, mg/l

—300— Total dissolved solids isopleth, dashed where approximate

Laramie - Fox Hills Formation boundary

Arapahoe Formation boundary

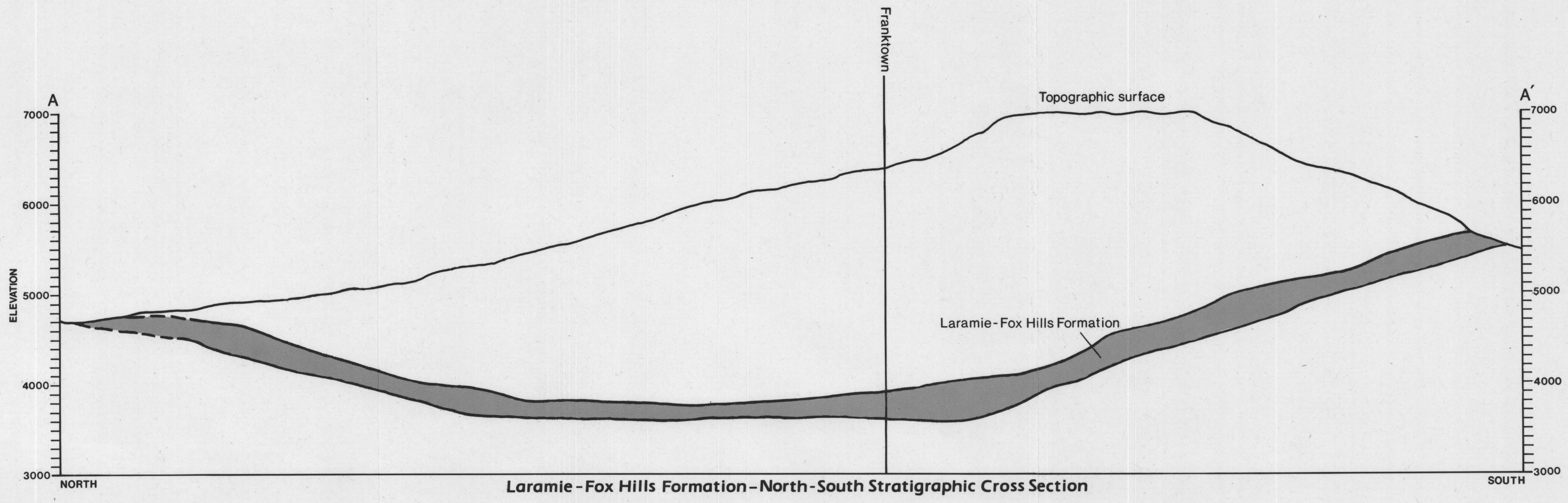
Denver Basin boundary

A——A′ Cross section line

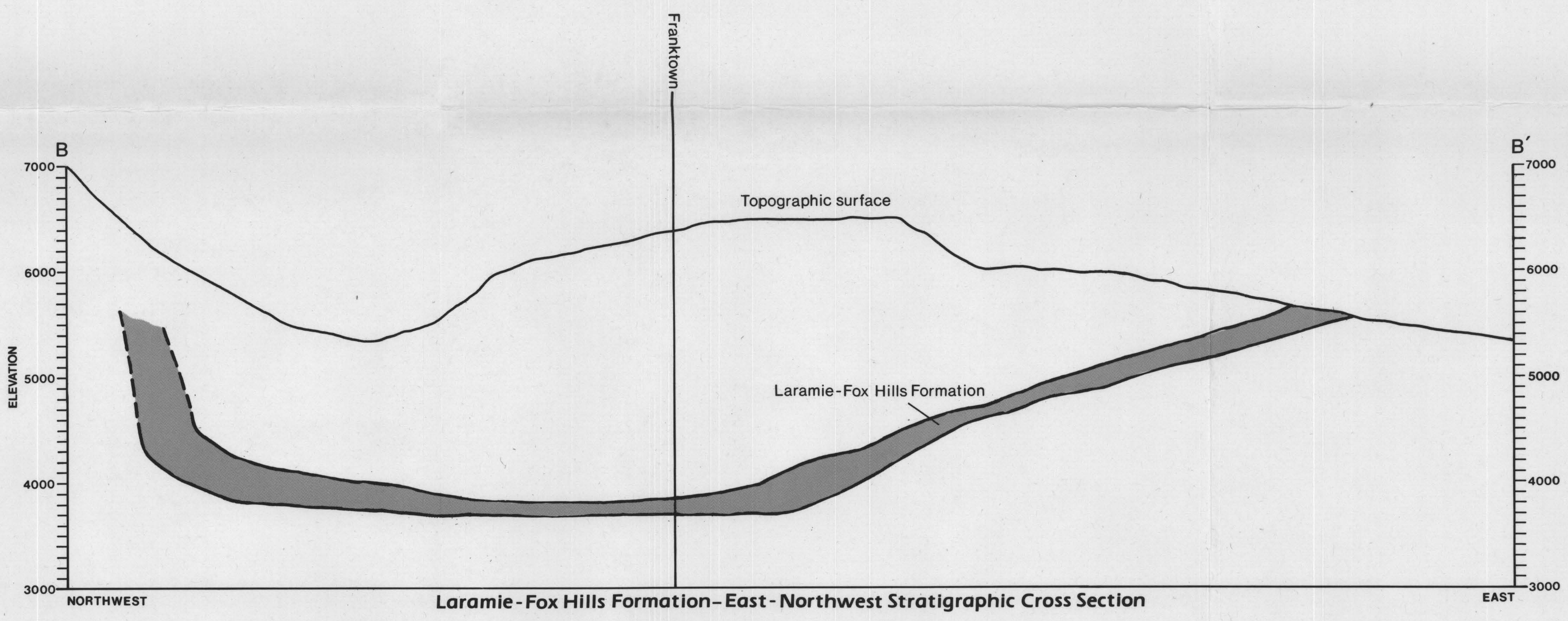
Formation outcrop

REFERENCES

7, 57, 58, 59, 62, 64, 67, 69, 72
(See Plate 1)



Laramie - Fox Hills Formation – North - South Stratigraphic Cross Section



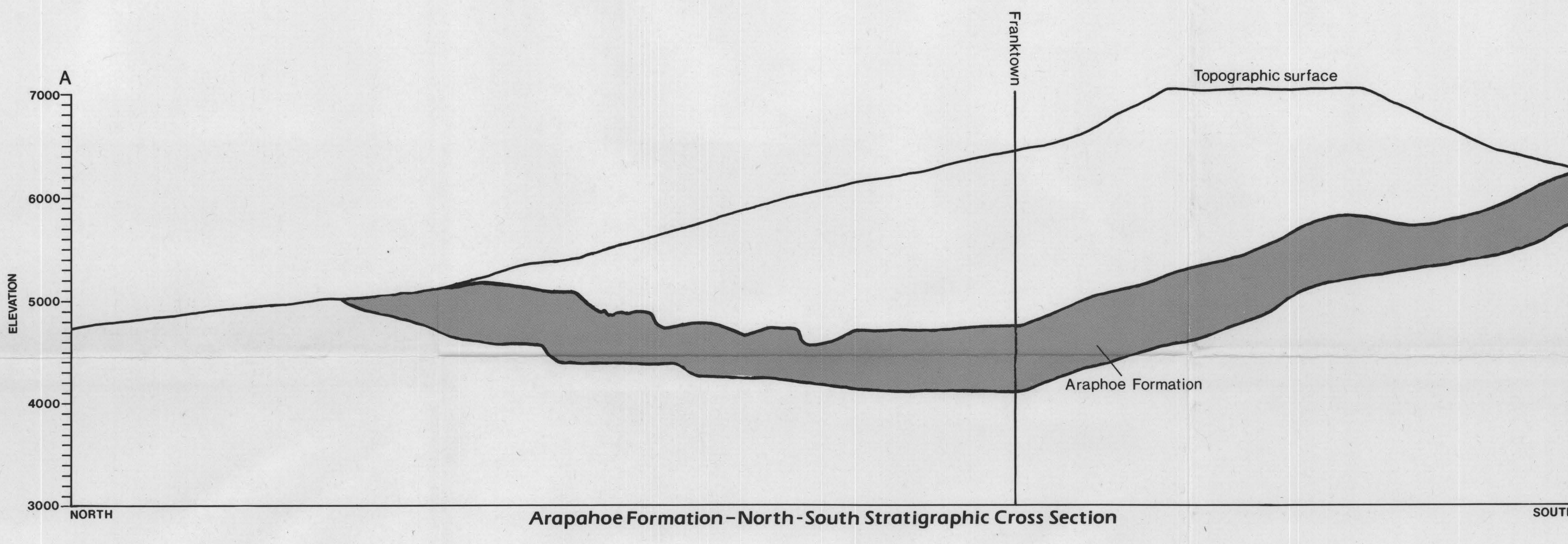
Laramie - Fox Hills Formation – East - Northwest Stratigraphic Cross Section

SCALE

Horizontal 1" = 8 miles
Vertical 1" = 1000 feet

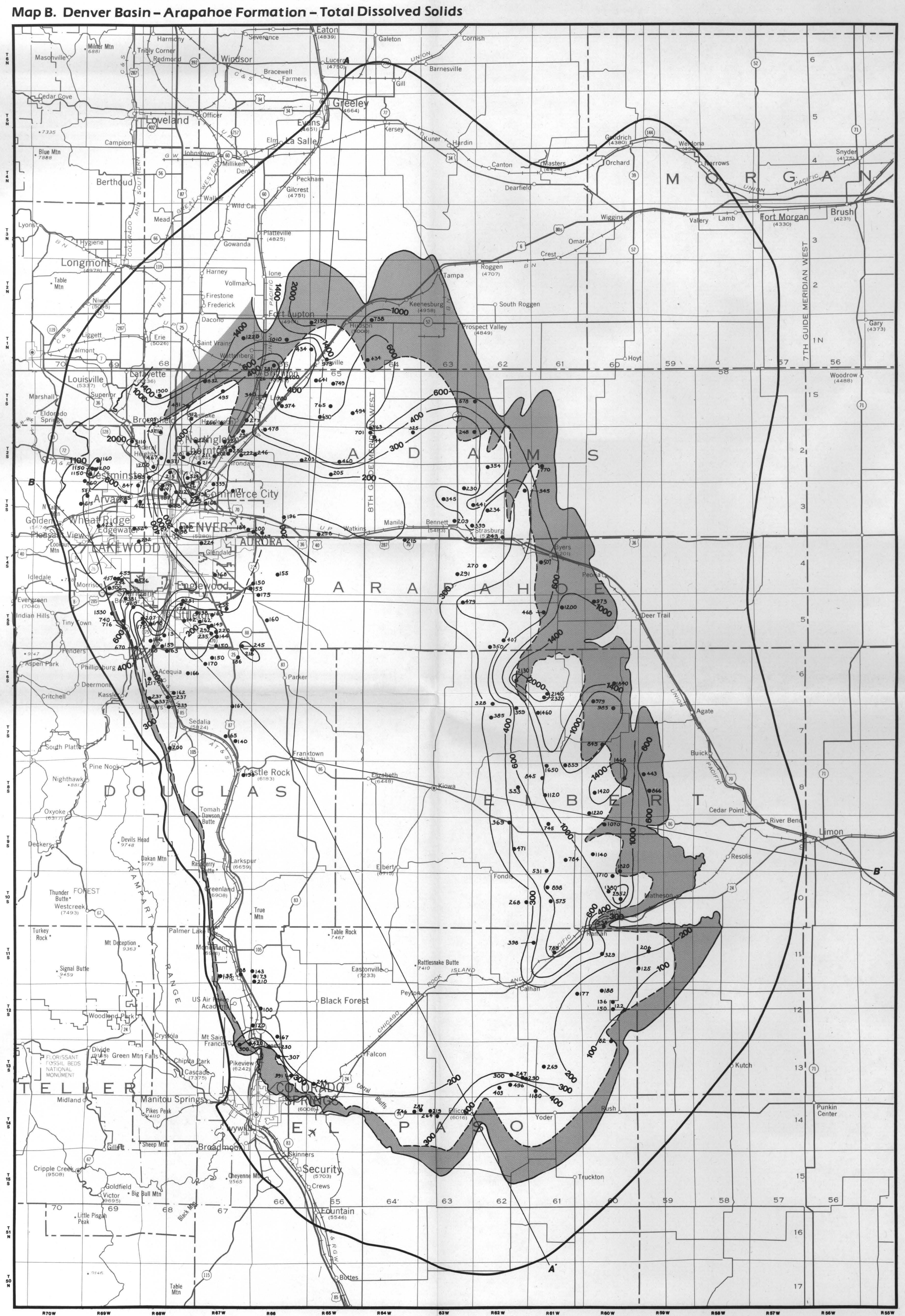
REFERENCES

37, 58, 59
(See Plate 1)



Arapahoe Formation – North - South Stratigraphic Cross Section

Map B. Denver Basin – Arapahoe Formation – Total Dissolved Solids



EXPLANATION

• 104 Measured value, mg/l

—300— Total dissolved solids isopleth, dashed where approximate

Arapahoe Formation boundary

Denver Formation boundary

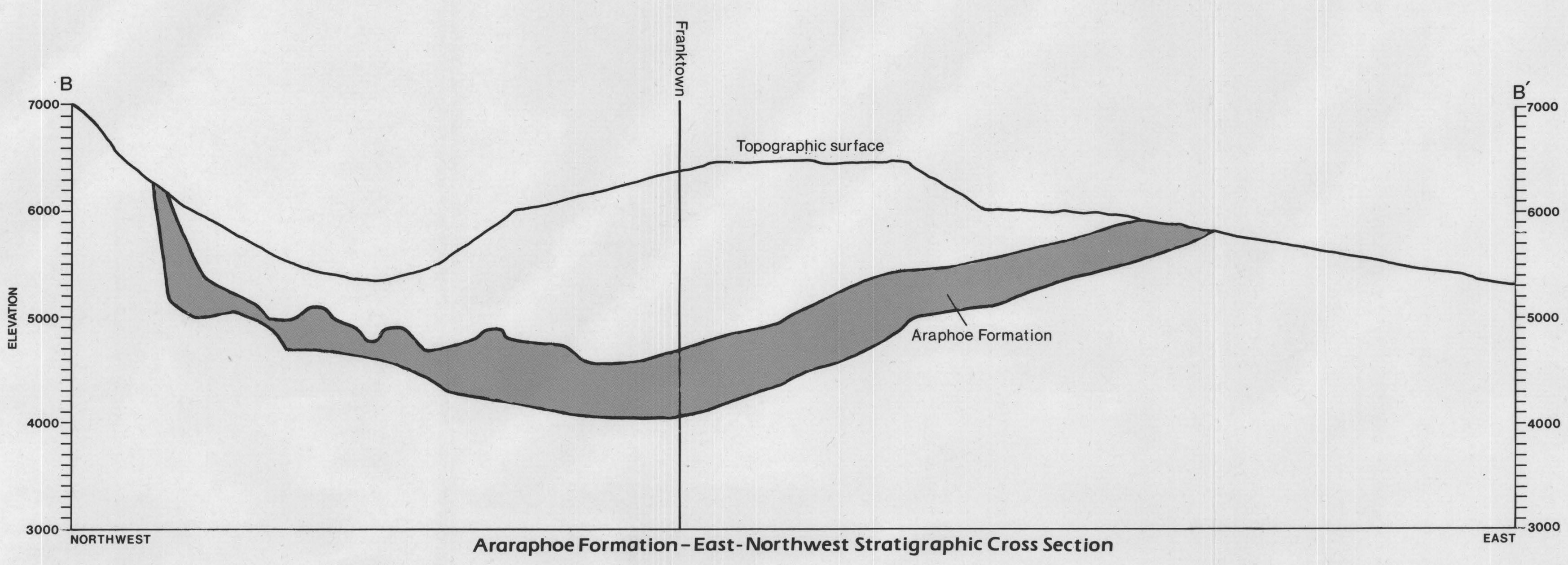
Denver Basin boundary

A——A′ Cross section line

Formation outcrop

REFERENCES

7, 57, 59, 62, 64, 67, 69, 72
(See Plate 1)



Araraphoe Formation – East - Northwest Stratigraphic Cross Section

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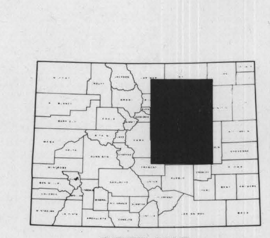


INDEX MAP

Prepared in cooperation with the Water Quality Control Division, Colorado Department of Health and the Environmental Protection Agency

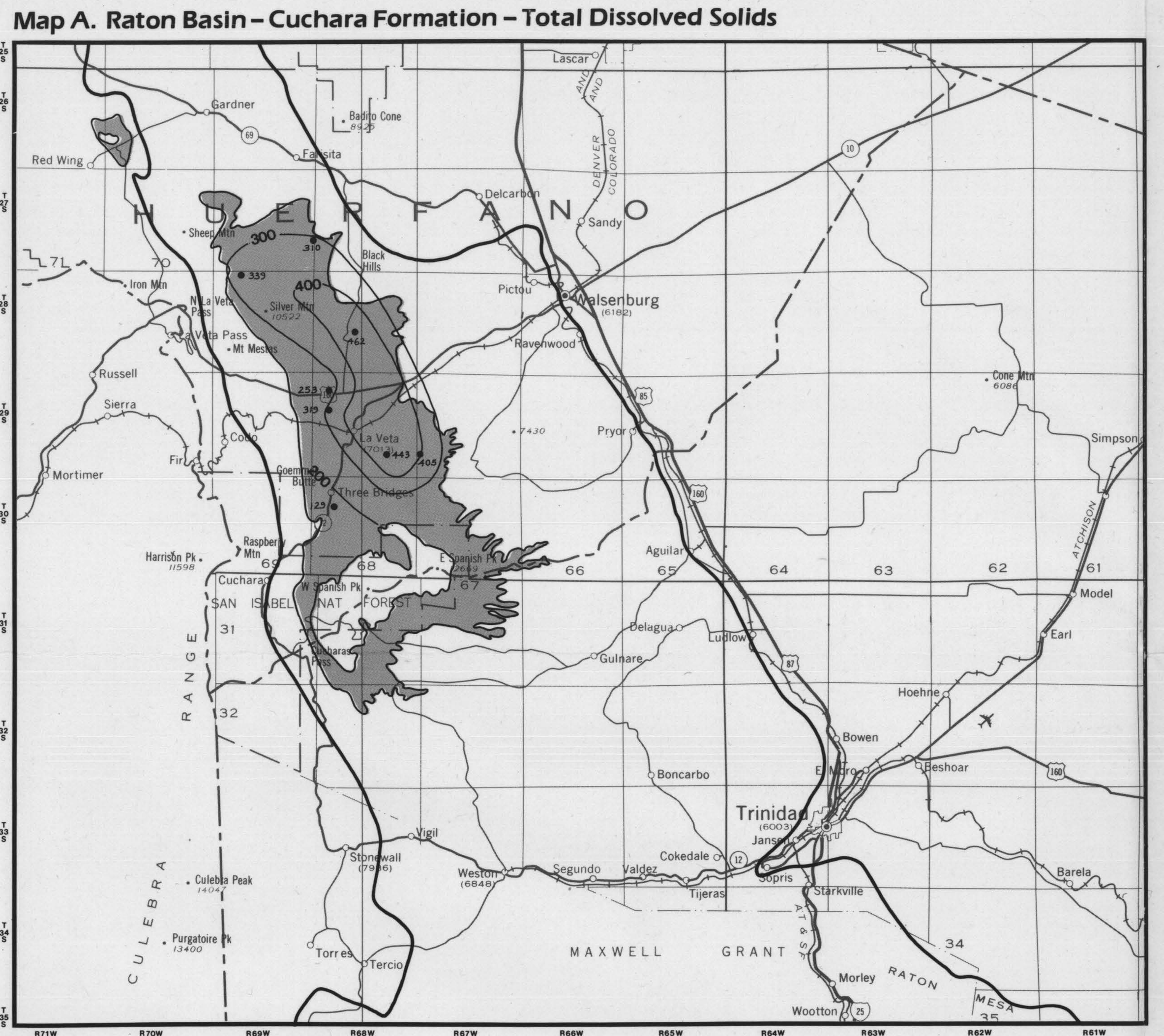
Base Maps from the U.S. Geological Survey

Drafting by Cornelia B. Sherry

SCALE 1:500 000
10 0 10 20 MILES
10 0 10 20 KILOMETERS
DATUM IS MEAN SEA LEVEL

Colorado Geological Survey
Department of Natural Resources
John W. Rold, Director

Map A. Raton Basin – Cuchara Formation – Total Dissolved Solids



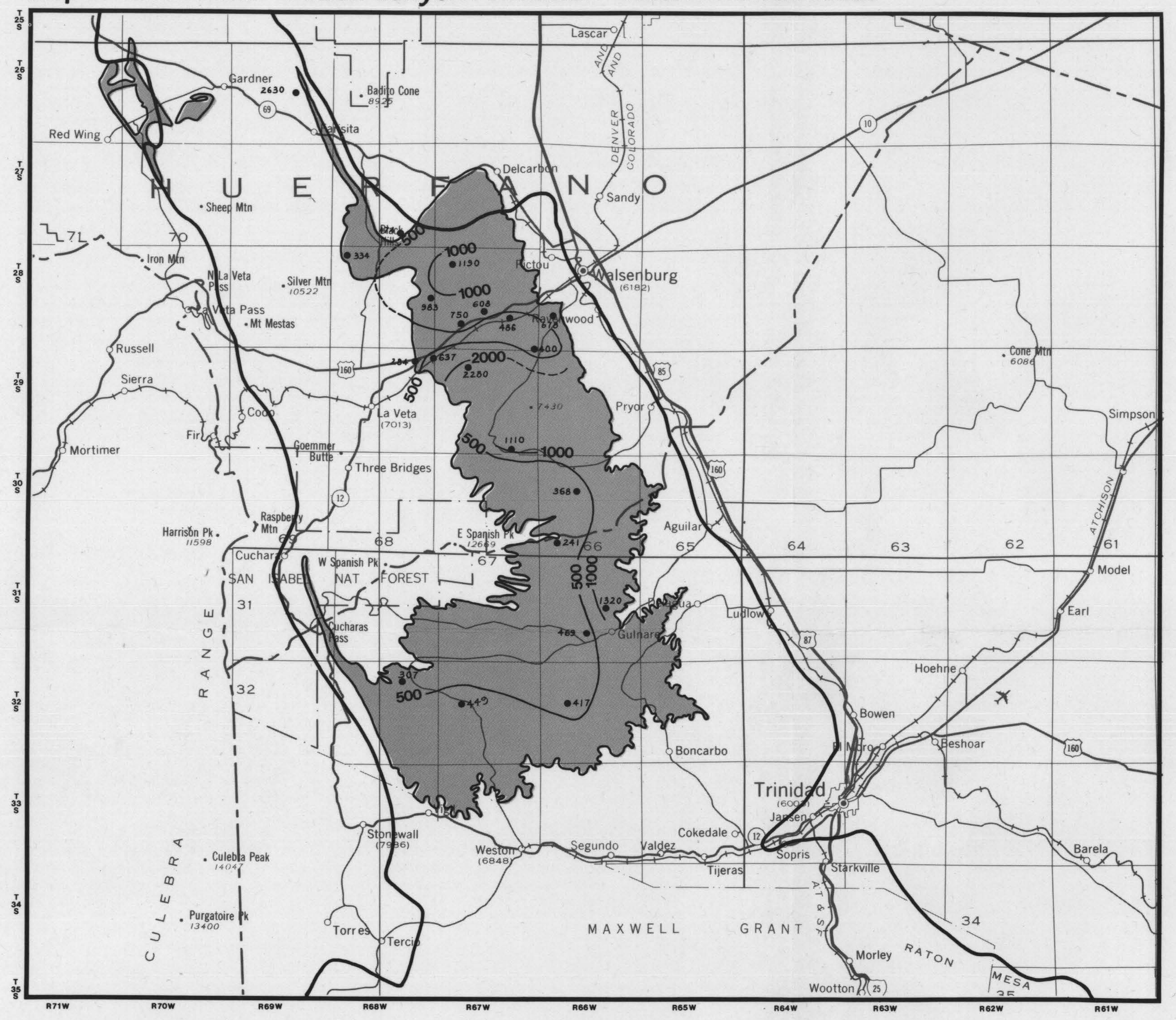
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth
- —— Formation boundary
- Formation outcrop

REFERENCES

16, 40, 53, 72
(See Plate 1)

Map B. Raton Basin – Poison Canyon Formation – Total Dissolved Solids



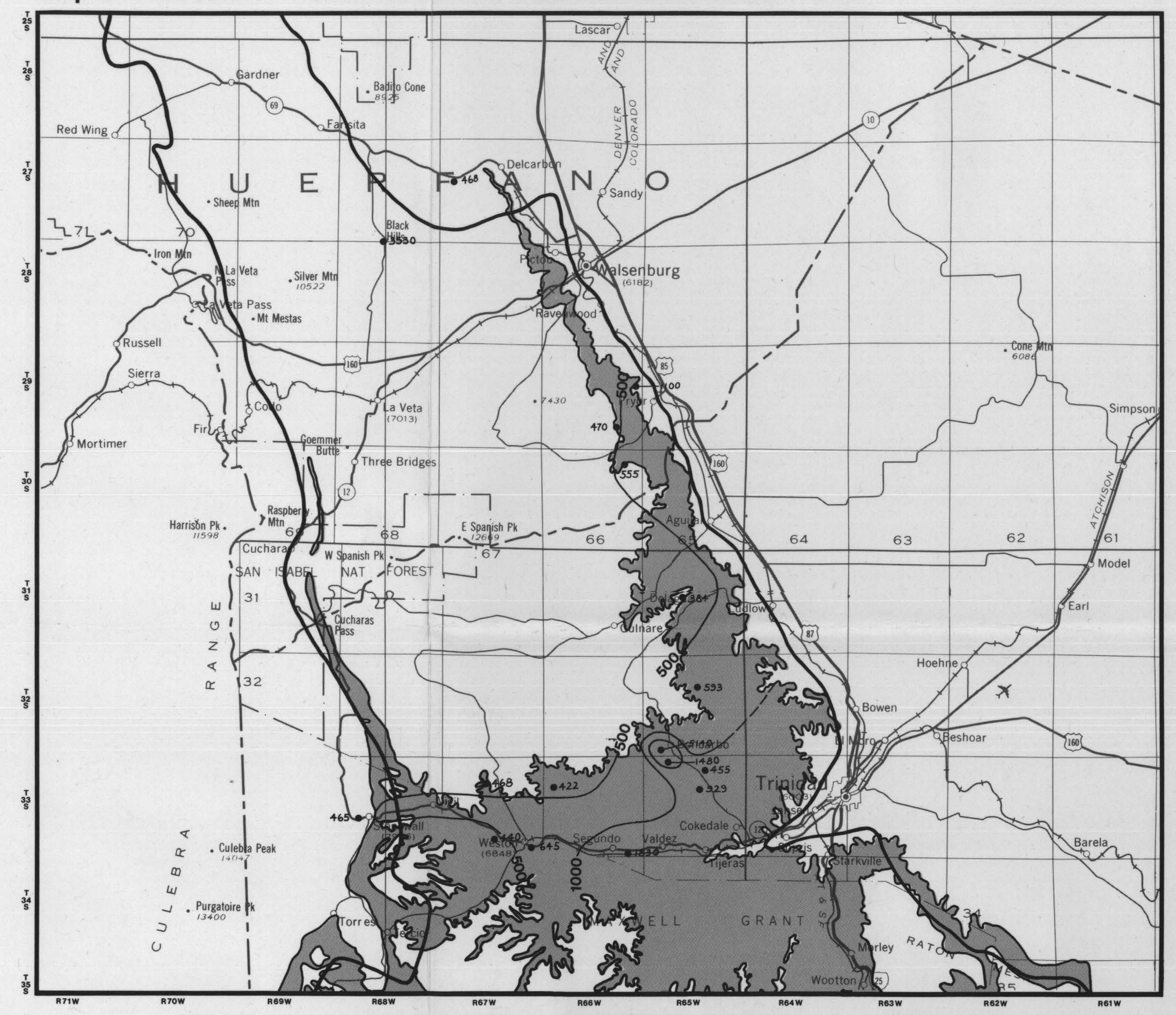
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- —— Formation boundary
- Formation outcrop

REFERENCES

16, 40, 53, 72
(See Plate 1)

Map C. Raton Basin – Raton Formation – Total Dissolved Solids



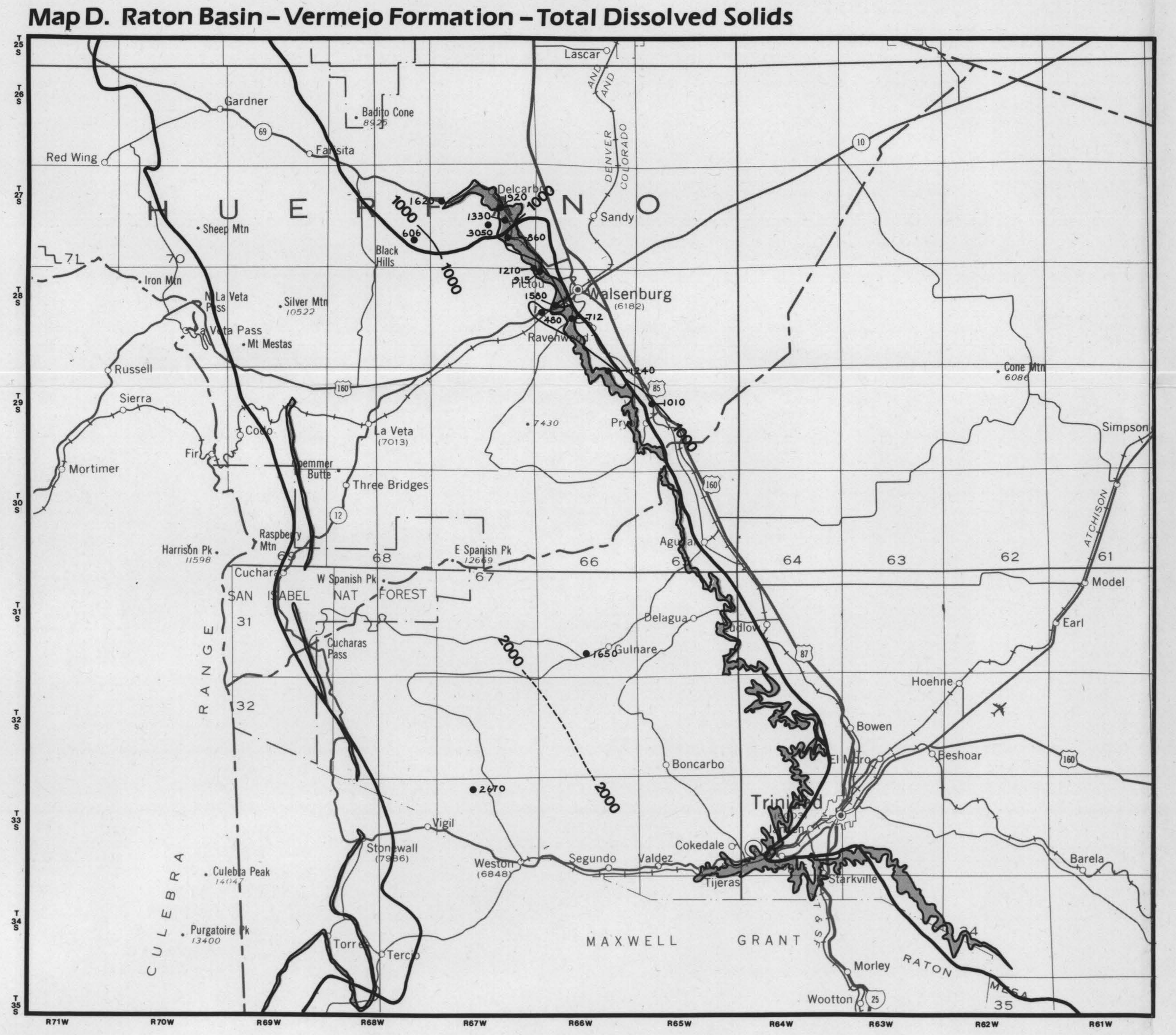
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- —— Formation boundary
- Formation outcrop

REFERENCES

16, 40, 53, 72
(See Plate 1)

Map D. Raton Basin – Vermejo Formation – Total Dissolved Solids



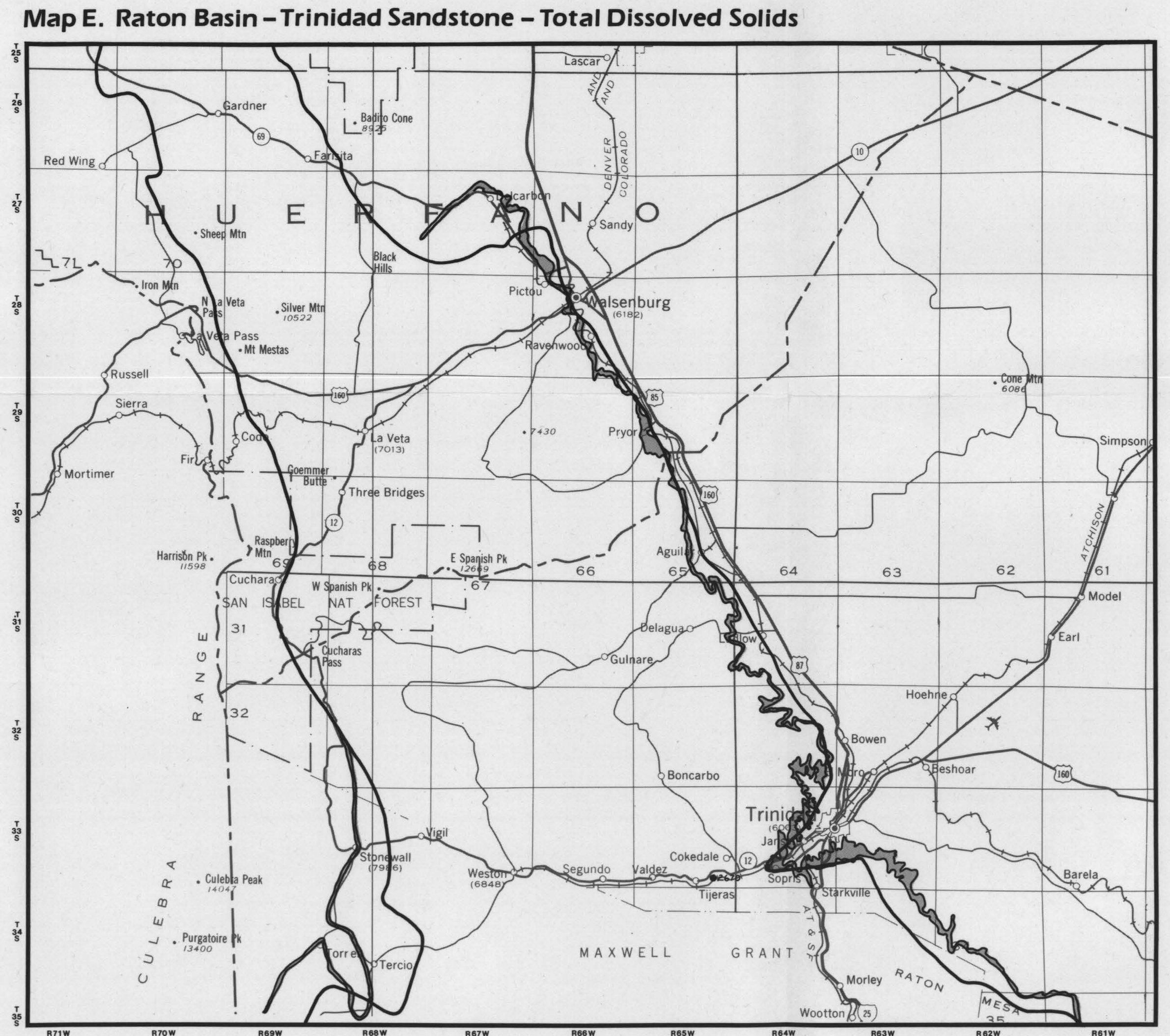
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- —— Formation boundary
- Formation outcrop

REFERENCES

16, 40, 53, 72
(See Plate 1)

Map E. Raton Basin – Trinidad Sandstone – Total Dissolved Solids

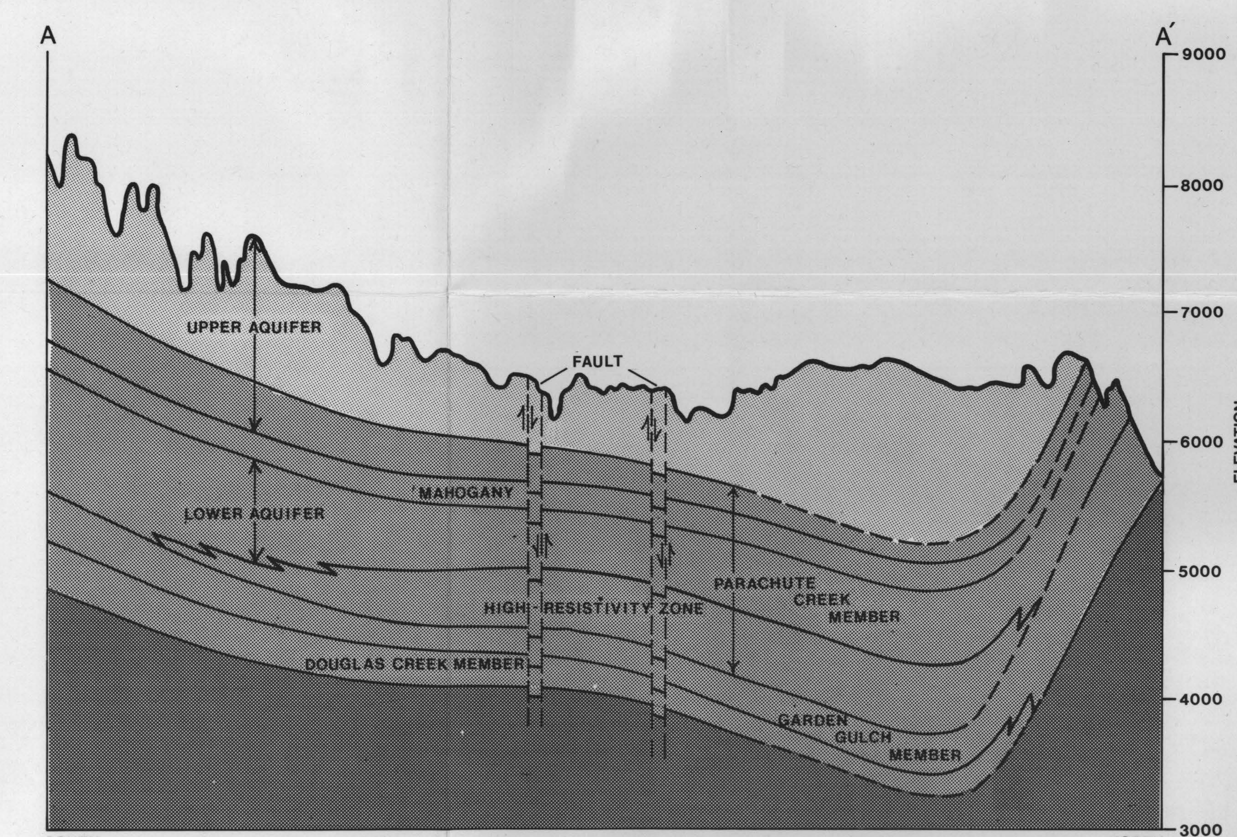


EXPLANATION

- •104 Measured value, mg/l
- —— Formation boundary
- Formation outcrop

REFERENCES

16, 40, 53
(See Plate 1)



Piceance Basin – North-South Stratigraphic Cross Section

EXPLANATION

- Uinta Formation
- Green River Formation
- Wasatch Formation

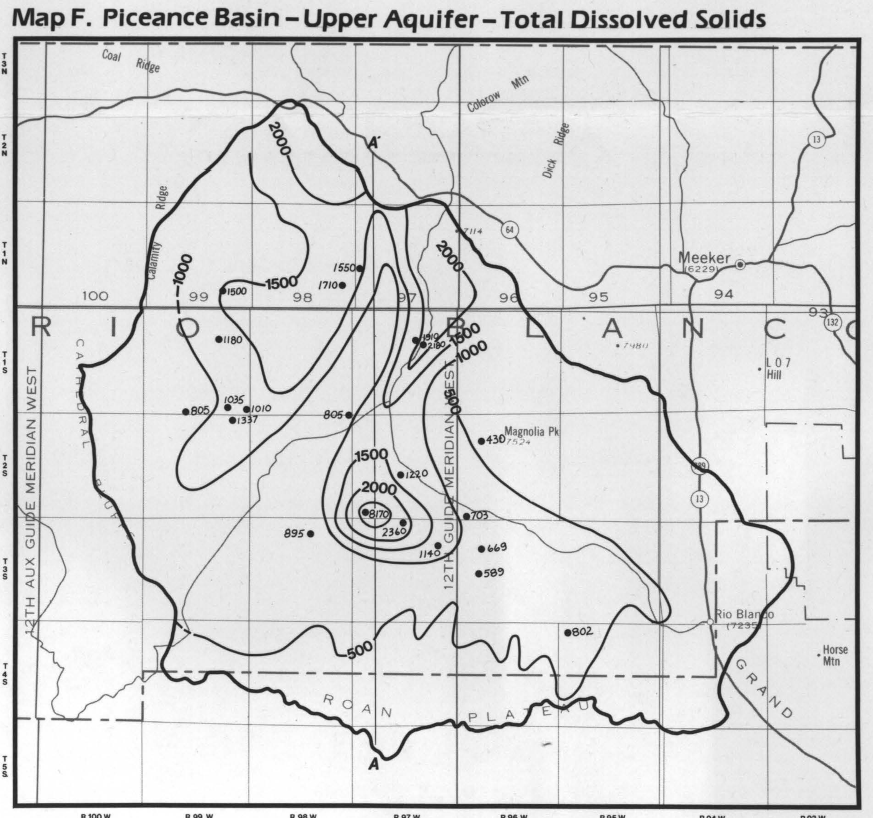
SCALE

Horizontal 1″ = 8 miles
Vertical 1″ = 1000 feet

RERERENCES

78
(See Plate 1)

Map F. Piceance Basin – Upper Aquifer – Total Dissolved Solids



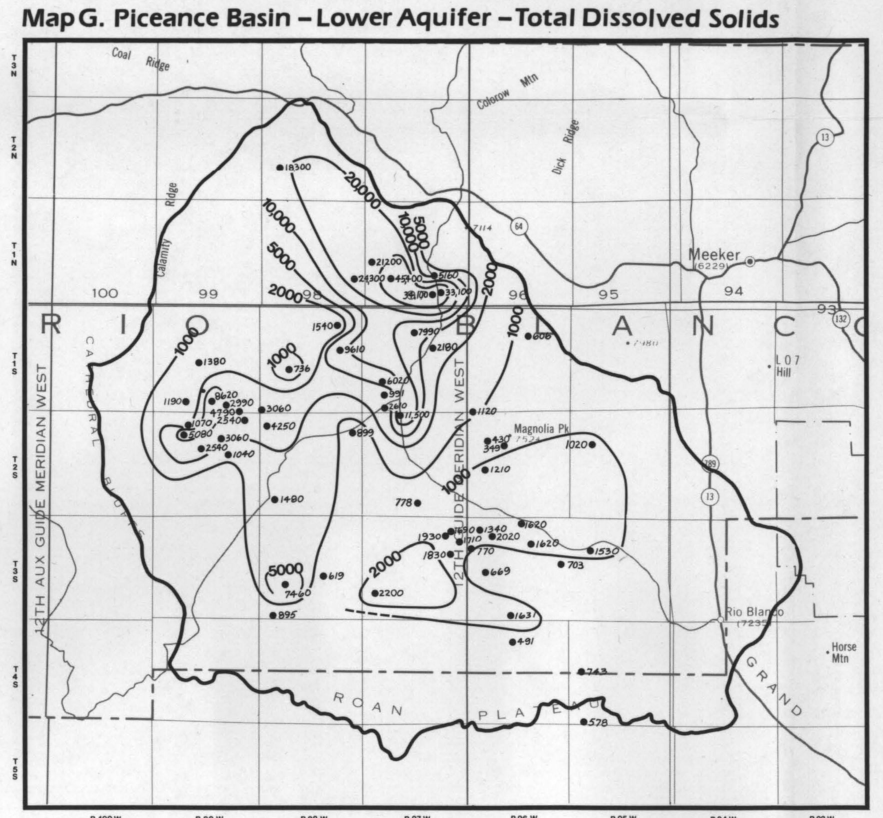
EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- —— Formation boundary
- A——A′ Cross section line

REFERENCES

11, 19, 36, 44, 53, 60, 69, 70, 72, 77, 78, 88
(See Plate 1)

Map G. Piceance Basin – Lower Aquifer – Total Dissolved Solids



EXPLANATION

- •104 Measured value, mg/l
- —300— Total dissolved solids isopleth, dashed where approximate
- —— Formation boundary

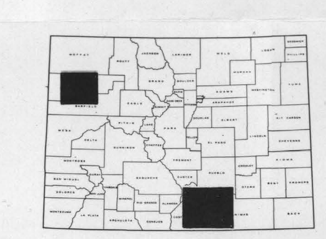
REFERENCES

11, 19, 36, 44, 53, 60, 69, 70, 72, 77, 78, 88
(See Plate 1)

Atlas of Ground Water Quality in Colorado

by

F.N. Repplier, F.C. Healy, D.B. Collins, and P.A. Longmire



INDEX MAP

Prepared in cooperation with the Water Quality Control Division, Colorado Department of Health and the Environmental Protection Agency

Base maps from the U.S. Geological Survey

Drafting by Cornelia B. Sherry

SCALE 1:500 000

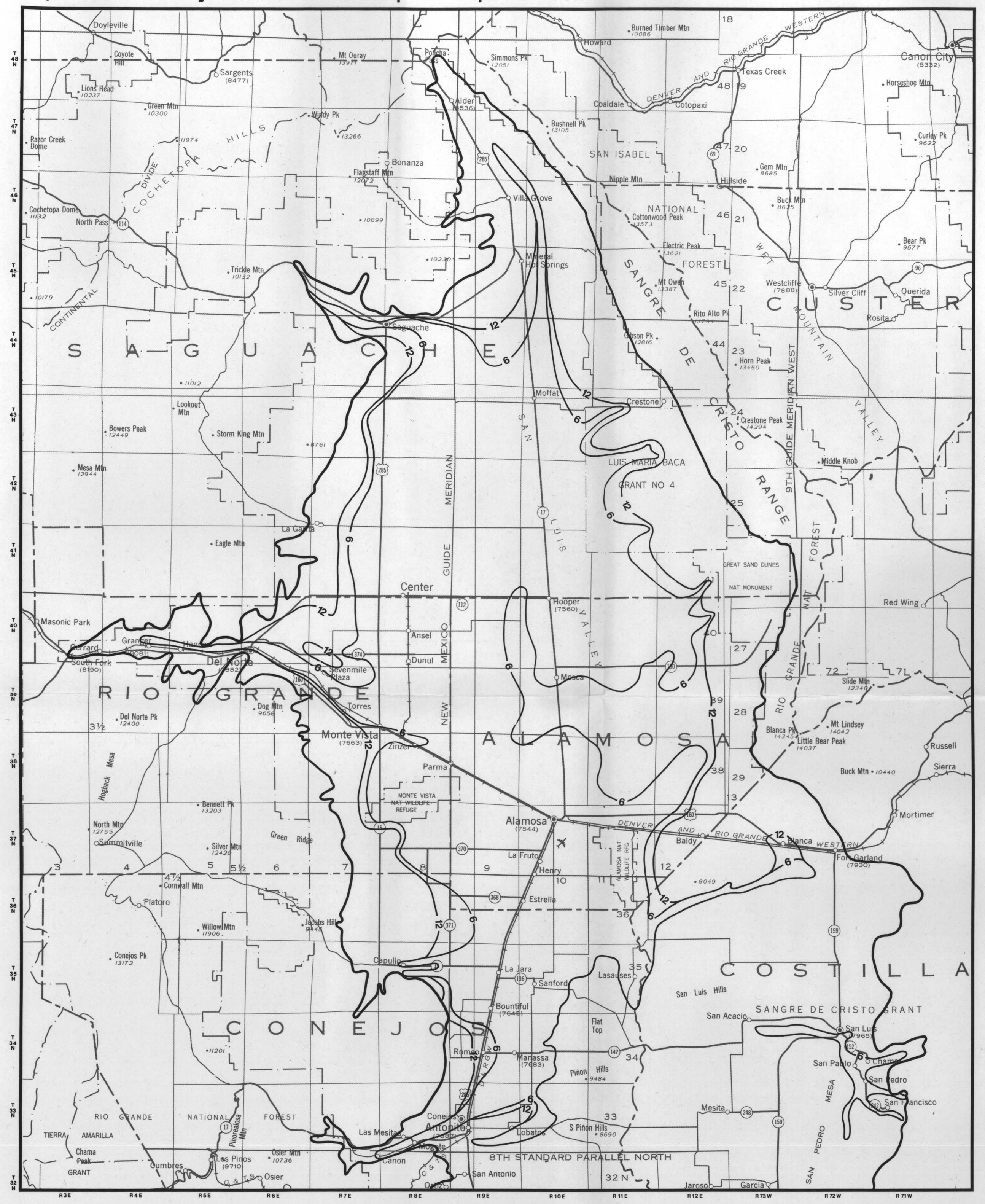
10 0 10 20 MILES

10 0 10 20 KILOMETERS

DATUM IS MEAN SEA LEVEL

Colorado Geological Survey
Department of Natural Resources
John W. Rold, Director

Map A. San Luis Valley Basin – Unconfined Aquifer – Depth to Water



EXPLANATION

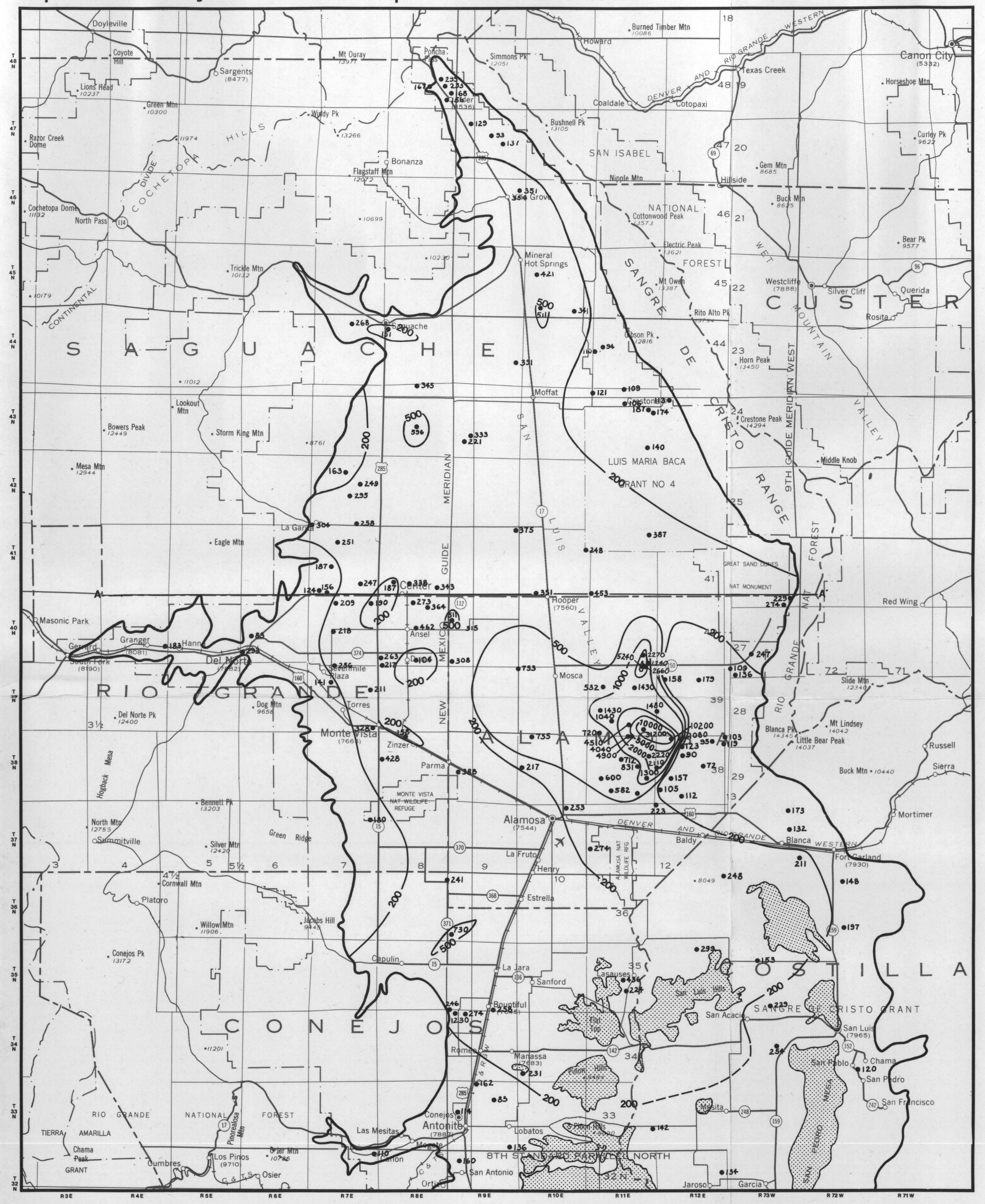
—12— Depth to water, in feet

—— Aquifer boundary

REFERENCES

18
(See Plate 1)

Map B. San Luis Valley Basin – Unconfined Aquifer – Total Dissolved Solids



EXPLANATION

• 104 Measured value, mg/l

—200— Total dissolved solids isopleth, dashed where approximate

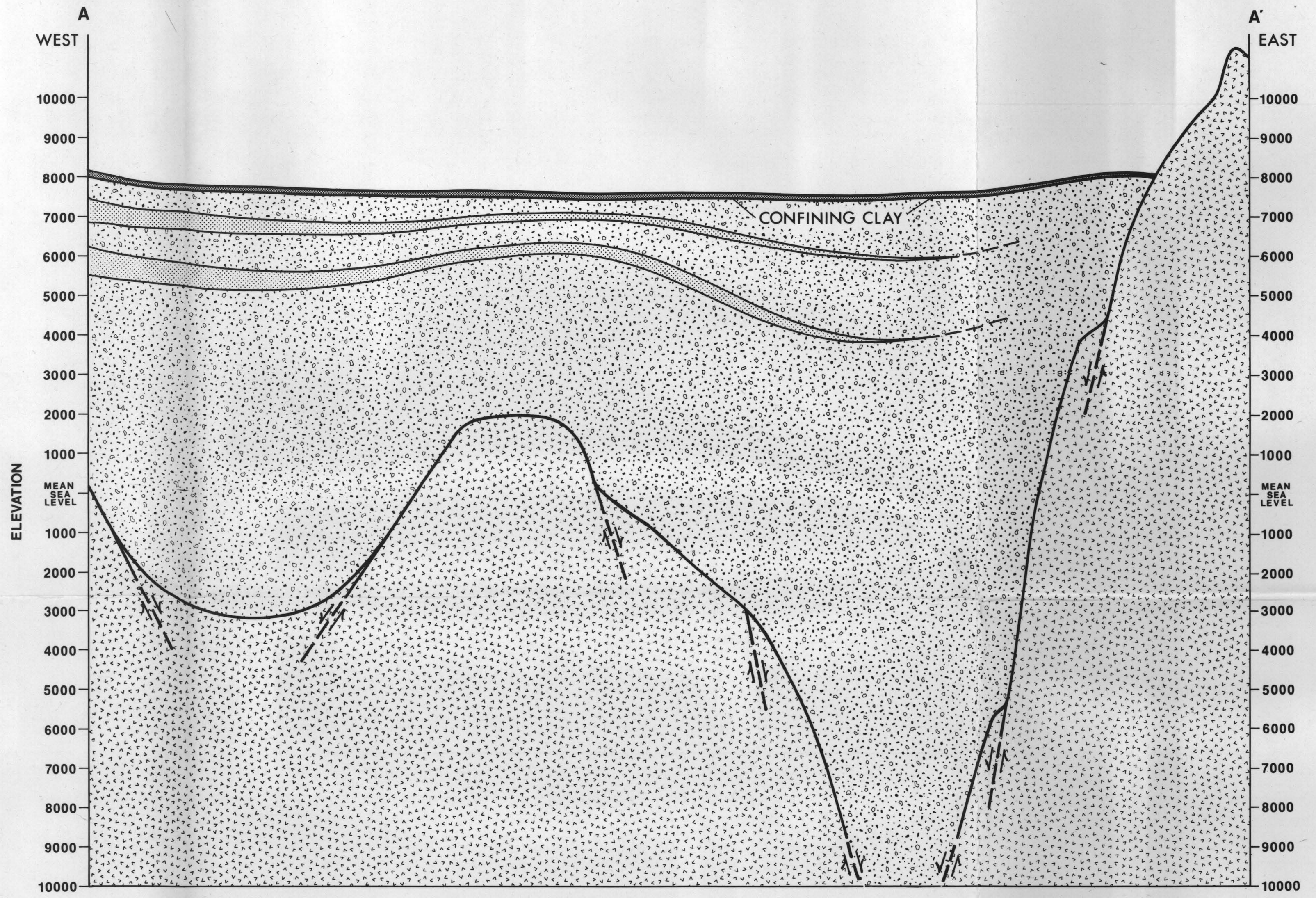
—— Aquifer boundary

Volcanic undifferentiated

A—A' Cross section line

REFERENCES

1,17,18, 40, 53.54,62,67,72
(See Plate 1)



Raton Basin – East-West Stratigraphic Cross Section

EXPLANATION

Unconfined aquifer

Volcanic rocks

Confined aquifer

Crystalline rock

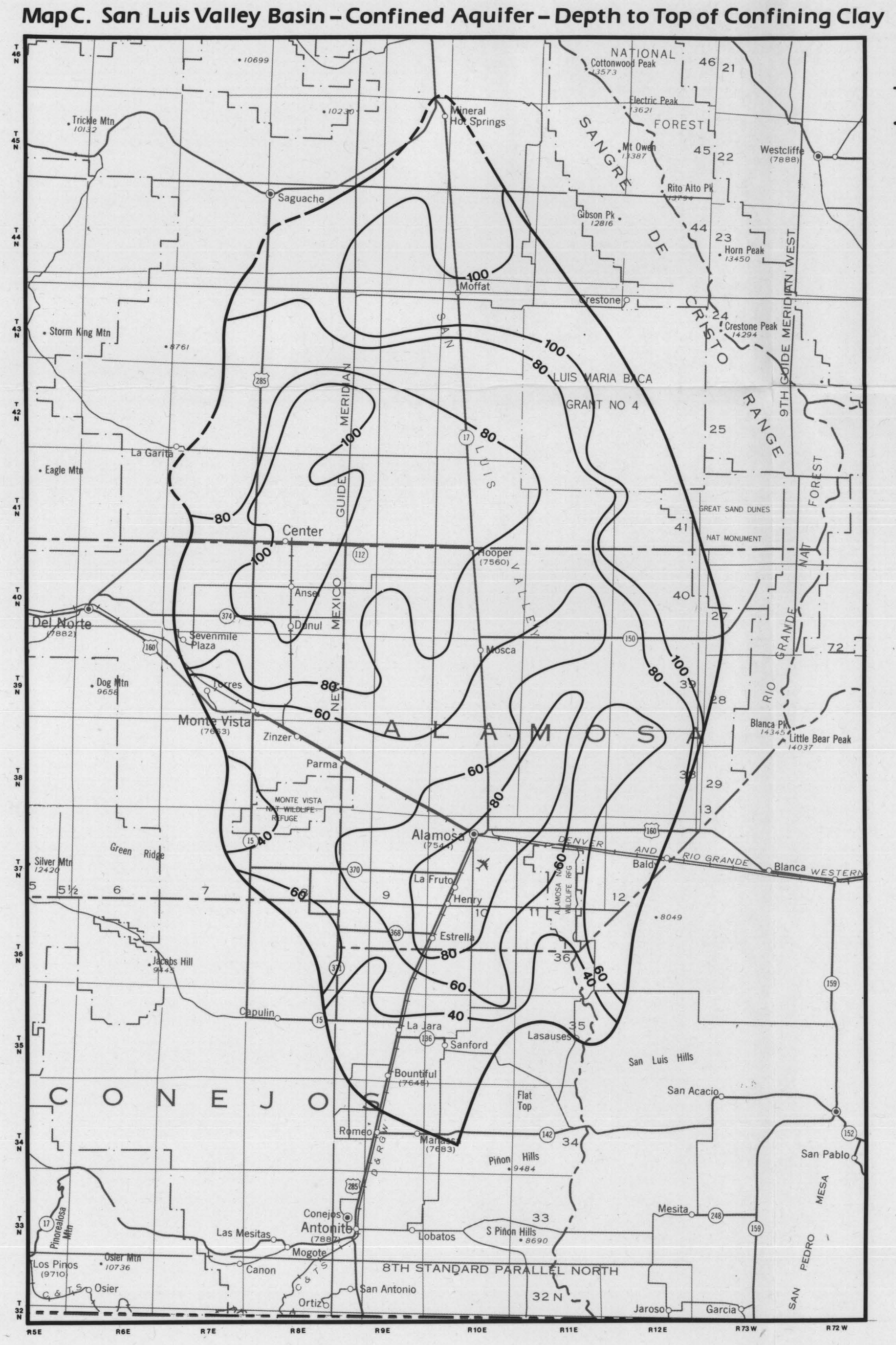
SCALE

Horizontal 1" = 8 miles
Vertical 1" = 2500 feet

REFERENCES

18,21,33,41,53,66
(See Plate 1)

Map C. San Luis Valley Basin – Confined Aquifer – Depth to Top of Confining Clay



EXPLANATION

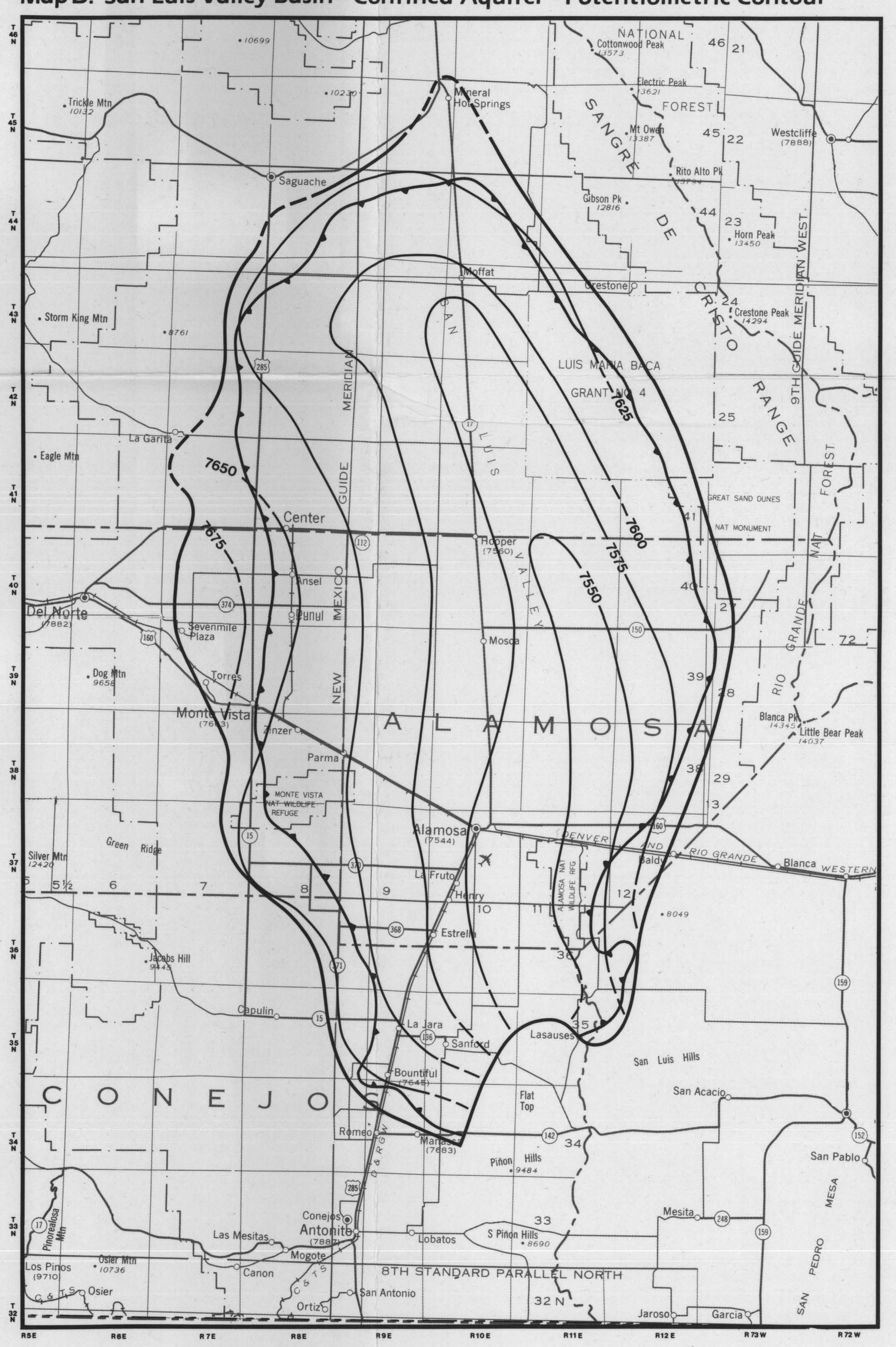
—100— Depth to top of confining clay

—— Aquifer boundary, dashed where approximate

REFERENCES

18
(See Plate 1)

Map D. San Luis Valley Basin – Confined Aquifer – Potentiometric Contour



EXPLANATION

—7600— Potentiometric contour dashed where approximate

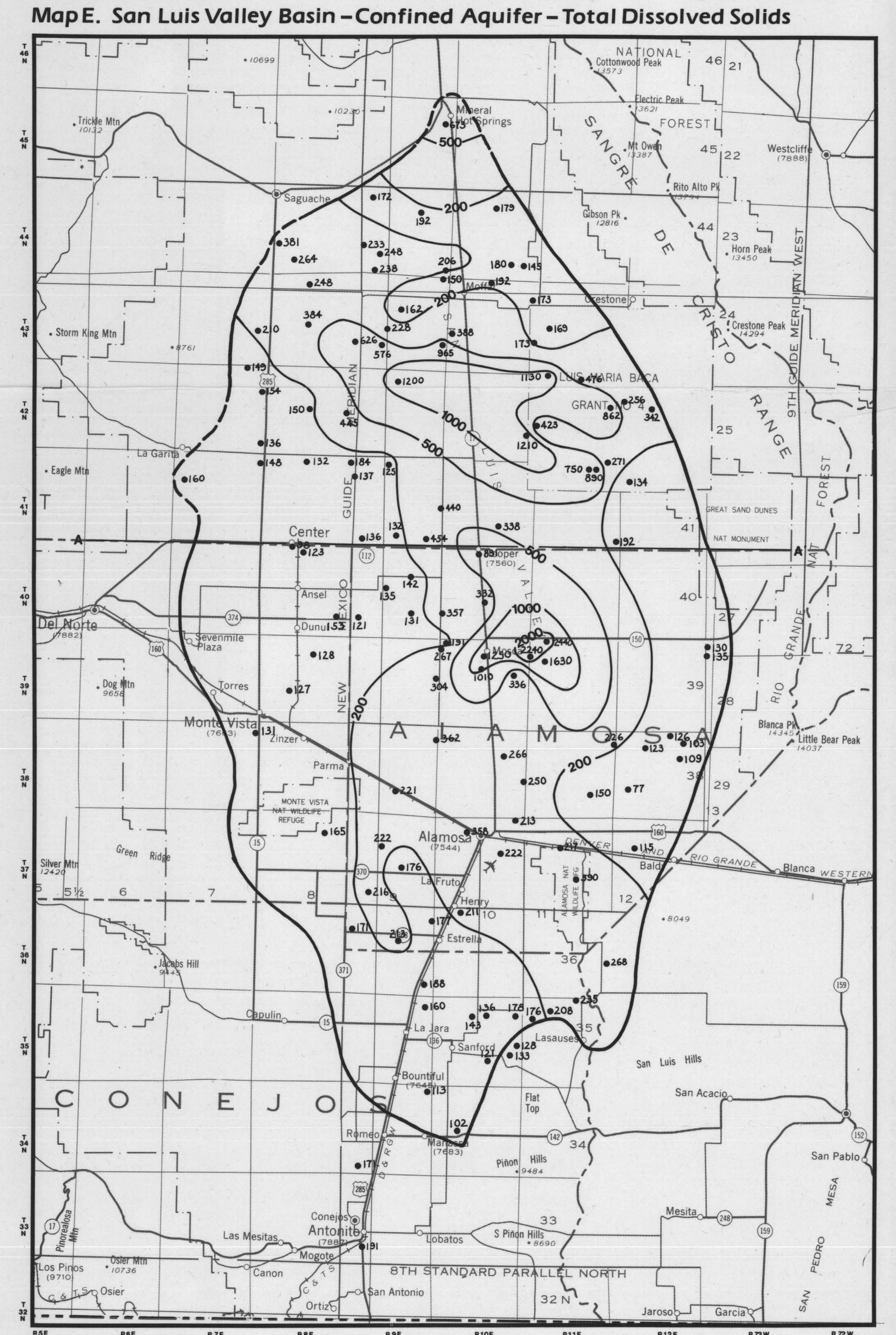
Area of flowing wells

—— Aquifer boundary, dashed where approximate

REFERENCES

18
(See Plate 1)

Map E. San Luis Valley Basin – Confined Aquifer – Total Dissolved Solids



EXPLANATION

• 104 Measured value, mg/l

—200— Total dissolved solids isopleth

—— Aquifer boundary, dashed where approximate

A—A' Cross section line

REFERENCES

1,17,18, 40, 53, 54, 62, 67, 72
(See Plate 1)

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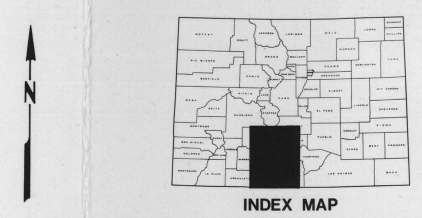
SCALE 1:500 000

10 0 10 20 MILES

10 0 10 20 KILOMETERS

DATUM IS MEAN SEA LEVEL



INDEX MAP

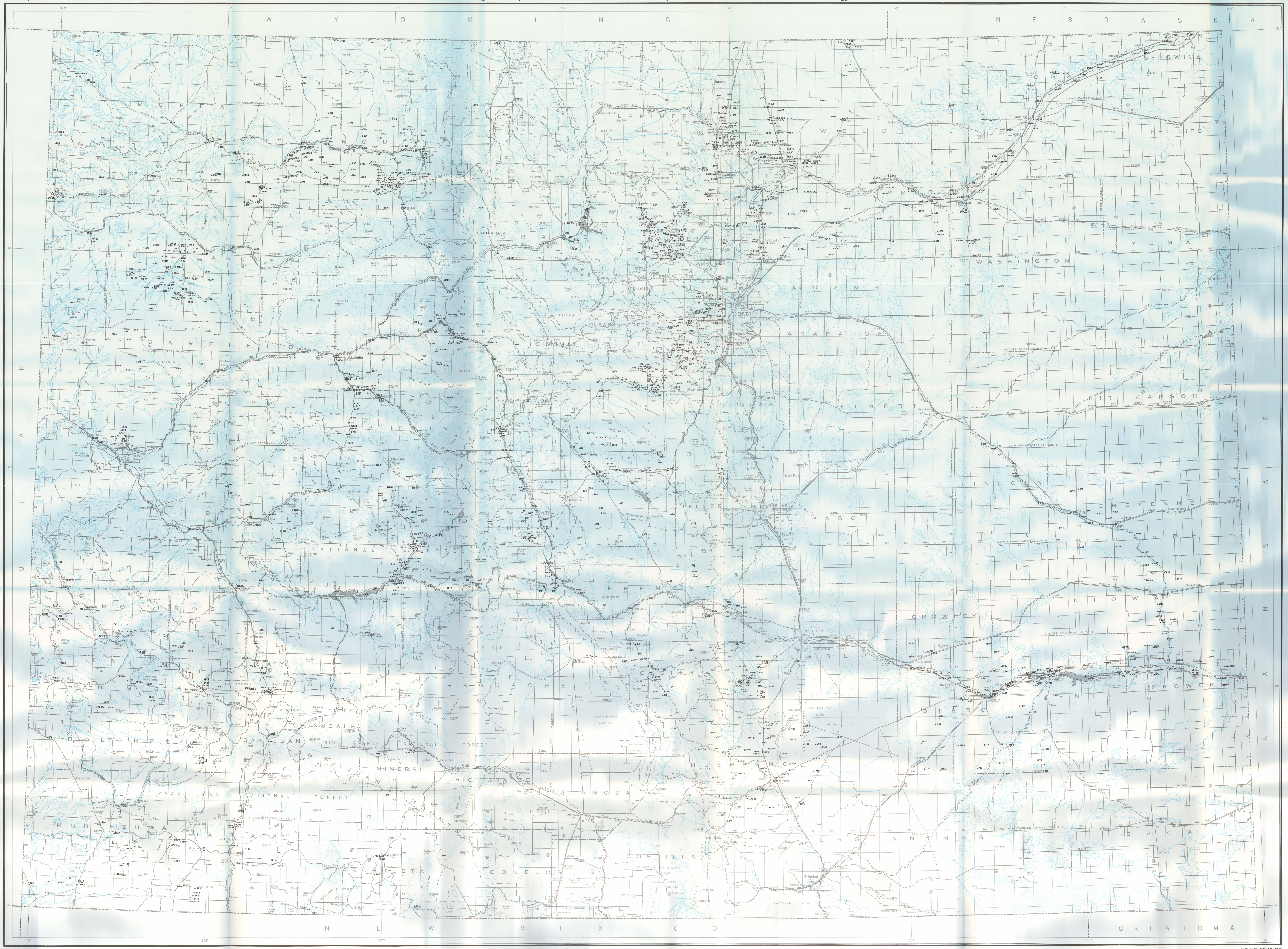
Base maps from U.S. Geological Survey

Drafting by Cornelia B. Sherry

Colorado Geological Survey
Department of Natural Resources
John W. Rold, Director

Water Quality of the Aquifers of Western Colorado and Alluvial Aquifers of Eastern Colorado with Generalized Geology

Map Series 16
Plate 7
1980



Base from U.S. Geological Survey

SCALE 1:500,000

DATUM IS MEAN SEA LEVEL

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Atlas of Ground Water Quality in Colorado

By F. N. Repplier, F. C. Healy,
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Prepared in cooperation with the Water Quality Control Division, Colorado Department of Health, and Environmental Protection Agency.

EXPLANATION*

	WESTERN COLORADO**	EASTERN COLORADO**
	QUATERNARY	
●	Quaternary undivided Pleistocene series Terrace deposits Alluvial deposits Valley fill deposits Glacial deposits	Quaternary undivided Pleistocene series Terrace deposits Alluvial deposits Valley fill deposits Glacial deposits
	TERTIARY	
		North Park Formation Dry Union-Santa Fe. Formations
○	Tertiary undivided Brown's Park Formation Unita Formation Green River Formation Douglas Creek Formation San Jose-Wasatch Formations Eocene Series undivided	Tertiary undivided Ogallala Formation White River Formation Devils Hole Formation Huerfano-Cuchara Fms Poison Canyon Fm. Eocene Series undiv.
■	Volcanics and intrusives undivided Oligocene Series undivided	Vol. and intrusives undivided Oligocene Series und.
	CRETACEOUS	
△	Ft. Union Formation Kirtland shale Mesa Verde Group Menefee Formation Cliff House member	
□	Animas Formation Lewis shale Mancos shale Niobrara Formation	Middle Park Fm. Denver-Dawson Fms. Arapahoe Formation Laramie-Fox Hills Fm. Trinidad sandstone Pierre Shale Hygiene sandstone Niobrara Formation Smoky Hill member Ft. Hays Limestone Carlile shale Greenhorn limestone
▲	Dakota sandstone Burro Canyon Formation	Dakota sandstone Purgatoire sandstone
	JURASSIC – TRIASSIC	
▼	Jurassic-Triassic undivided Morrison Formation Brushy Basin member Saltwash member Entrada sandstone	Jurassic-Triassic Morrison Formation Entrada sandstone
▽	Glen Canyon Group Navajo sandstone Wingate sandstone Chinle Formation	Cheyenne sandstone Jelm Formation Dockum Group
	PERMIAN – PENNSYLVANIAN	
◆	Hermosa Gp.-Maroon Fm.-Weber ss. Permain undivided Pennsylvanian undivided	Lykins Formation Lyons sandstone Fountain Formation Permian undivided Pennsylvanian und.
	EARLY PALEOZOIC	
✱	Leadville limestone Mississippian undivided	Mississippian und.
◇	Ouray-Chaffee Group Sawatch sandstone Devonian undivided Early Paleozoic undivided	Manitou Formation Devonian undivided Early Paleozoic und.
	PRECAMBRIAN	
*	Igneous and metamorphic rocks	Igneous and metamorphic rocks

*The below divisions are based on hydrogeological and lithological characteristics; therefore, some of the age relationships and correlations are not exactly correct.

**Western Colorado refers to that part of the State west of the Continental Divide and Eastern Colorado refers to that part of the State east of the Continental Divide.

GEOLOGIC SYMBOLS

Qa	Alluvium
Qu	Quaternary undivided
Tu	Tertiary undivided
Ku	Cretaceous undivided
JTR	Jurassic-Triassic undivided
PIP	Permian-Pennsylvanian undivided
Pe	Early Paleozoic undivided
p€	Precambrian

SYMBOLS

●320	T.D.S.--milligrams per liter (mg/l)
	Contact
	Fault-- dotted where concealed. Bar and ball on downthrown side
	Low-angle thrust fault. Sawteeth on upper plate
	Inferred fault
	Anticline-- Dotted where concealed
	Syncline-- Dotted where concealed
	Monocline-- Dotted where concealed

REFERENCES

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16, 19, 20, 22, 23, 24, 25, 27, 28, 29, 30, 31, 34, 35, 36, 38, 39, 40, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 54, 55, 56, 57, 60, 61, 62, 63, 64, 65, 67, 68, 69, 70, 71, 72, 73, 74, 75, 77, 78, 80, 81, 82, 83, 84, 85, 86, 88

(See Plate 1)

N