Appendix A

Senate Bill 06-193

CHAPTER 269

WATER AND IRRIGATION

SENATE BILL 06-193

BY SENATOR(S) Wiens, Brophy, Dyer, Entz, Evans, Groff, Grossman, Hagedorn, Isgar, Johnson, Kester, Lamborn, Shaffer, Taylor, and Williams;
also REPRESENTATIVE(S) May M., Berens, Carroll T., Clapp, Crane, Hodge, Hoppe, Jahn, Kerr J., Knoedler, Paccione, Rose, Schultheis, Stafford, Stengel, Sullivan, and Welker.

AN ACT

CONCERNING THE DEVELOPMENT OF UNDERGROUND WATER STORAGE, AND, IN CONNECTION THEREWITH, MAKING AN APPROPRIATION.

Be it enacted by the General Assembly of the State of Colorado:

SECTION 1. 37-60-115, Colorado Revised Statutes, is amended BY THE ADDITION OF A NEW SUBSECTION to read:

37-60-115. Water studies - repeal. (5) (a) THE BOARD SHALL CONDUCT A STUDY OF THE MOST ECONOMICALLY AND TECHNICALLY FEASIBLE AND ECOLOGICALLY SOUND UNDERGROUND STORAGE SITES LOCATED IN THE SOUTH PLATTE AND ARKANSAS RIVER BASINS, TAKING INTO CONSIDERATION:

(I) THE STUDY ENTITLED "ARTIFICIAL RECHARGE OF GROUND WATER IN COLORADO - A STATEWIDE ASSESSMENT", COMPLETED IN 2004, REFERRED TO IN THIS SUBSECTION (5) AS THE "ASSESSMENT";

(II) THE COSTS AND BENEFITS, INCLUDING THE ENVIRONMENTAL COSTS AND BENEFITS, OF SELECT SITES WITHIN THOSE AQUIFERS TO WHICH THE ASSESSMENT ASSIGNED THE HIGHEST RANKING VALUE; AND

(III) AN ANALYSIS OF SITE OWNERSHIP ISSUES, AQUIFER CHARACTERISTICS, PROXIMITY OF THE SITES TO AREAS OF WATER SUPPLY AND DEMAND, AND EXISTING WATER INFRASTRUCTURE.

(b) IN CONDUCTING THE STUDY, THE BOARD MAY CONSULT WITH THE INTERBASIN COMPACT COMMITTEE, STATE ENGINEER, AND STATE GEOLOGIST AS DEEMED NECESSARY.

(c) THE BOARD SHALL SUBMIT A REPORT CONTAINING ITS CONCLUSIONS TO THE GENERAL ASSEMBLY BY MARCH 1, 2007.

(d) THIS SUBSECTION (5) IS REPEALED, EFFECTIVE JULY 1, 2008.

SECTION 2. Appropriation - adjustments in 2006 long bill. (1) In addition to any other appropriation, there is hereby appropriated, out of any moneys in the operational account of the severance tax trust fund created in section 39-29-109, Colorado Revised Statutes, not otherwise appropriated, to the department of natural resources, Colorado water conservation board, for the fiscal year beginning July 1, 2006, the sum of one hundred twenty-five thousand dollars ($125,000), or so much thereof as may be necessary, for the implementation of this act.

(2) For the implementation of this act, appropriations made in the annual general appropriation act to the department of natural resources, geological survey, for the fiscal year beginning July 1, 2006, shall be adjusted as follows:

(a) The cash fund appropriation from fees shall be decreased by twenty-one thousand dollars ($21,000).

(b) The cash fund appropriation from the operational account of the severance tax trust fund created in section 39-29-109, Colorado Revised Statutes, shall be increased by twenty-one thousand dollars ($21,000).

SECTION 3. Safety clause. The general assembly hereby finds, determines, and declares that this act is necessary for the immediate preservation of the public peace, health, and safety.

Approved: May 26, 2006

Capital letters indicate new material added to existing statutes; dashes through words indicate deletions from existing statutes and such material not part of act.

Appendix B

SB06-193 Study Participants

Appendix B
SB06-193 Study Participants

Report Developers
Andy Moore, CWCB
Gordon McCurry, CDM
Andy Horn, CDM
Nathan Smith, CDM

Technical Advisors
Ralf Topper, Colorado Geological Survey
Robert Longenbaugh, retired, State Engineer's Office

Basin Experts (listed alphabetically within a grouping)

Interbasin Compact Committee Groundwater Subcommittee Members
Arkansas Basin
Gerald Barber, El Paso County
James Broderick, Southeastern Colorado Water Conservancy District
Reeves Brown, At-Large Representative
Dan Henrichs, At-Large Representative
Larry Reeves, Elbert County
John Reid, Lincoln County
Terry Scanga, Upper Arkansas Water Conservancy District
Dennis Smith, Lake County
Frank Wallace, Bent County
Jay Winner, Lower Arkansas Valley Water Conservancy District

South Platte Basin
Cortney Brand, Non-Voting At Large Member
Joe Frank, Lower South Platte Water Conservancy District
Bruce Gerk, Sedgwick Muni
Greg Kernohan, Recreational Representative
Richard Mann, Kit Carson Municipalities
John Stencel, Legislative Appointment

Metro Area
Tom Acre, At-Large Representative
Larry Cerrillo, Non-Voting At Large Member
Mark Harding, Non-Voting At Large Member
John Hendrick, At-Large Representative
Julio Iturreria, Arapahoe County
Julia Murphy, At-Large Representative

Appendix B
SB06-193 Study Participants

Contributing via Questionnaires

Jon Altenhofen, Northern Colorado Water Conservancy District
Janet Dash, SEO Division 2, Pueblo
Deanna Durnford, Colorado State University Engineering Dept.
Pat Edelmann, United States Geological Survey, Pueblo
Mary Halstead, Colorado Divion of Wildlife
Cathy Hare, Upper Black Squirrel Creek Water Management District
Courtney Hemenway, Hemenway Groundwater Engineering
Bruce Lytle, Lytle Water Solutions
Dave McElhaney, SEO Divison 1, Denver
Scott Mefford, Hydrokinetics
Suzanne Paschke, United States Geological Survey, Lakewood
Terry Scanga, Jr., Upper Arkansas Water Conservancy District
Chris Schuyler-Rossie, Denver Water
Steve Spann, Upper South Platte Water Conservancy District
Lorenz Sutherland, Natural Resource Conservation Service, La Junta
Ivan Walter, Ivan's Engineering, Inc.
Alan Ward, Pueblo Board of Water Works
Ken Watts, United States Geological Survey, Pueblo
Walter Welton, Consolidated Mutual Water Company
Dave Wissel, Upper South Platte Water Conservancy District

Other Local Experts Who Contributed to the SB-193 Project

Jim Culichia, Felt, Monson & Culichia, LLC
Mike Eytle, SEO Division 1, Fairplay
Jerry Fifield, HydroDynamics
Timothy Gates, Colorado State University Engineering Dept.
Jim Hall, SEO Division 1, Greeley
Roy Heald, Security Colorado Water and Sanitation District
Theresa Jehn-Dellaport, Jehn Water Engineering
Russell Livingston, Livingston Professional Services, LLC
Daniel Niemela, Bishop Brogden Associates
Kip Petersen, Cherokee Metropolitan District
Chris Sanchez, Bishop Brogden Associates
Gary Thompson, W.W. Wheeler and Associates
Steve Witte, SEO Division 2, Pueblo

Appendix C

SB06-193 Project Questionnaire

and

Basin Expert Response Summary

Appendix C
SB06-193 Project Questionnaire and Basin Expert Response Summary

C.1 SB06-193 Project Questionnaire

Name _____

Organization_____

Phone _____

Address_____

Email_____

Project Objective:
The objective of this task is to identify and perform an evaluation of potential underground water storage sites within the South Platte and Arkansas River Basins (Water Divisions 1 and 2), taking into account technical, economic and ecological considerations.

Questions:
1. What are your general thoughts on aquifer recharge and underground storage? Do you see this as being useful in managing water resources in your area?

2. Do you have any data sources or GIS coverages that might be helpful to the project?

3. What should be the minimum aquifer storage volume or enhanced yield to consider at an individual site?

4. Should this study consider recharge for augmentation or only longer-term storage?

5. What is your opinion regarding the use of slurry walls to enhance underground water storage?

6. Can you suggest specific locations of potential underground storage sites? If so, please respond to any of the following for which you have knowledge.

6.1 Provide brief site summary and any relevant data sources:

6.2 Are there any potentially adverse hydrogeologic aspects (travel time to river, potential waterlogging, etc.) that should be considered in evaluation of this site?

6.3 Do you know any information relating to the approximate available storage volume, e.g., depth to water or areal extent?

6.4 Are there any water quality, habitat, or wetland issues?

6.5 What existing infrastructure (e.g., canals, pipelines, wells, etc.) is nearby?

6.6 Do you know of any potential sources of water for recharge at this location?

6.7 Are there any significant potential flaws (ability to recharge, land ownership, endangered species, water quality, etc)?

6.8 Additional information regarding this site?

7. Can you recommend any other experts to speak with in your basin?

C.2 SB06-193 Basin Expert Response Summary

Twenty-one technical experts with experience working with groundwater in the South Platte and Arkansas River Basins were contacted and asked to complete the questionnaire provided above in Appendix C.1. Twenty of the experts either completed and returned the questionnaire or provided responses to the questions via telephone interview. Each of the technical experts who were interviewed concluded that, overall, aquifer recharge and underground storage can be used successfully as a management tool in the study area. However, most stated that the effectiveness of these programs is directly dependent on the geologic conditions and the specific needs of the water users within a region. If suitable geologic conditions are identified then artificial recharge could be an efficient and economic supplement or alternative to surface water storage.

According to the technical experts there are a number of locations throughout the study area, both bedrock and alluvial, which could be suitable for underground storage sites. In the alluvial areas of the basins, locations with high hydraulic conductivity and showing larger drawdowns associated with pumping would be ideal as potential underground storage sites. Sites with these characteristics would have the greatest available aquifer storage and could receive recharge water efficiently. While no specific new sites within the Denver Basin were identified, according to one expert, the upper Dawson and the lower Arapahoe bedrock aquifers south of Denver are best suited to artificial recharge.

Most experts stated that potential underground water storage sites should not require a minimum volume because volume storage requirements vary at each individual recharge or storage location. The storage amount required is dependent on several factors specific to individual locations. The requirements of the water user and the source of the water are the items that dramatically affect the volume requirements at each site. Additionally, several storage locations within a region could be used in combination by water users. As stated by one expert, depending on aquifer characteristics, several smaller storage volumes within close proximity could cumulatively be as effective as a larger volume.

On the question of slurry walls the experts agreed this technology could yield significant benefit where suitable hydrogeologic conditions exist. However, the concern was raised that use of slurry walls, which seal off segments of an aquifer, can affect the flow of groundwater through an aquifer and be detrimental to other groundwater users in the vicinity. According to one expert, "the use of slurry walls to contain artificially recharged water is being proven effective at the City of Aurora Prairie Waters site," which is completed in alluvial aquifer in the South Platte River Basin

In general the experts agreed that aquifer recharge and underground water storage could be a beneficial and a viable option both for augmentation purposes and for longer-term underground water storage. Currently there is a larger focus within these river basins on the

use of recharge for augmentation because it is an immediate concern for meeting water rights requirements; but, as one expert stated, using aquifers for longer term storage could be effective and should be further explored.

Appendix D

Data and Calculations Used in Recharge Area Evaluations

SB06-193 Study
Appendix D
March 1, 2007

Appendix D.1

Water Table and Potentiometric Surface Maps

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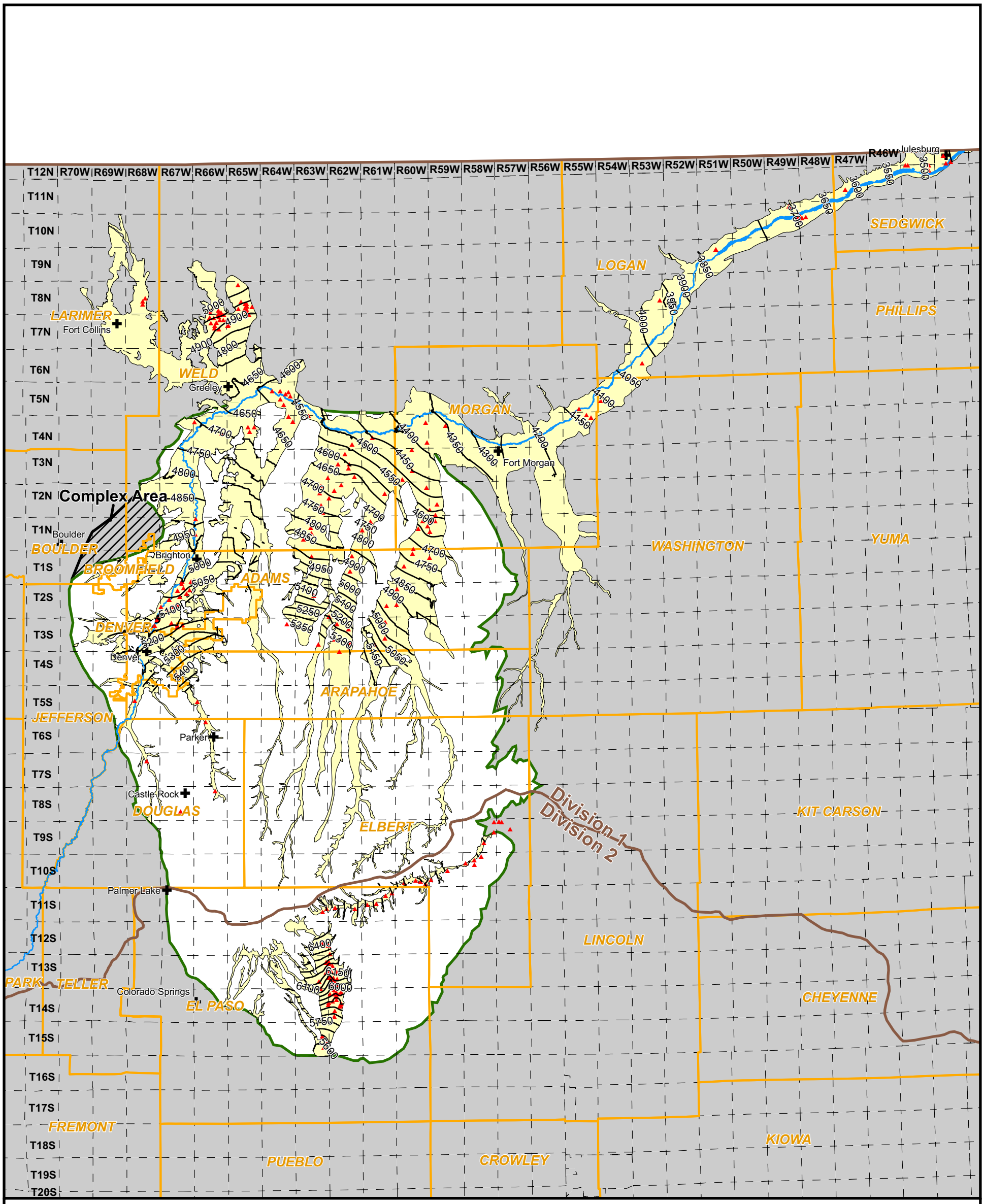
March 1, 2007

Appendix D.1 Water Table and Potentiometric Surface Maps
List of Figures

SPDSS Phase 3 Task 44.3

SB06-193 Study
Figure D.1-1

Figure 9: Water Level Elevation in the Alluvial Aquifer 2005



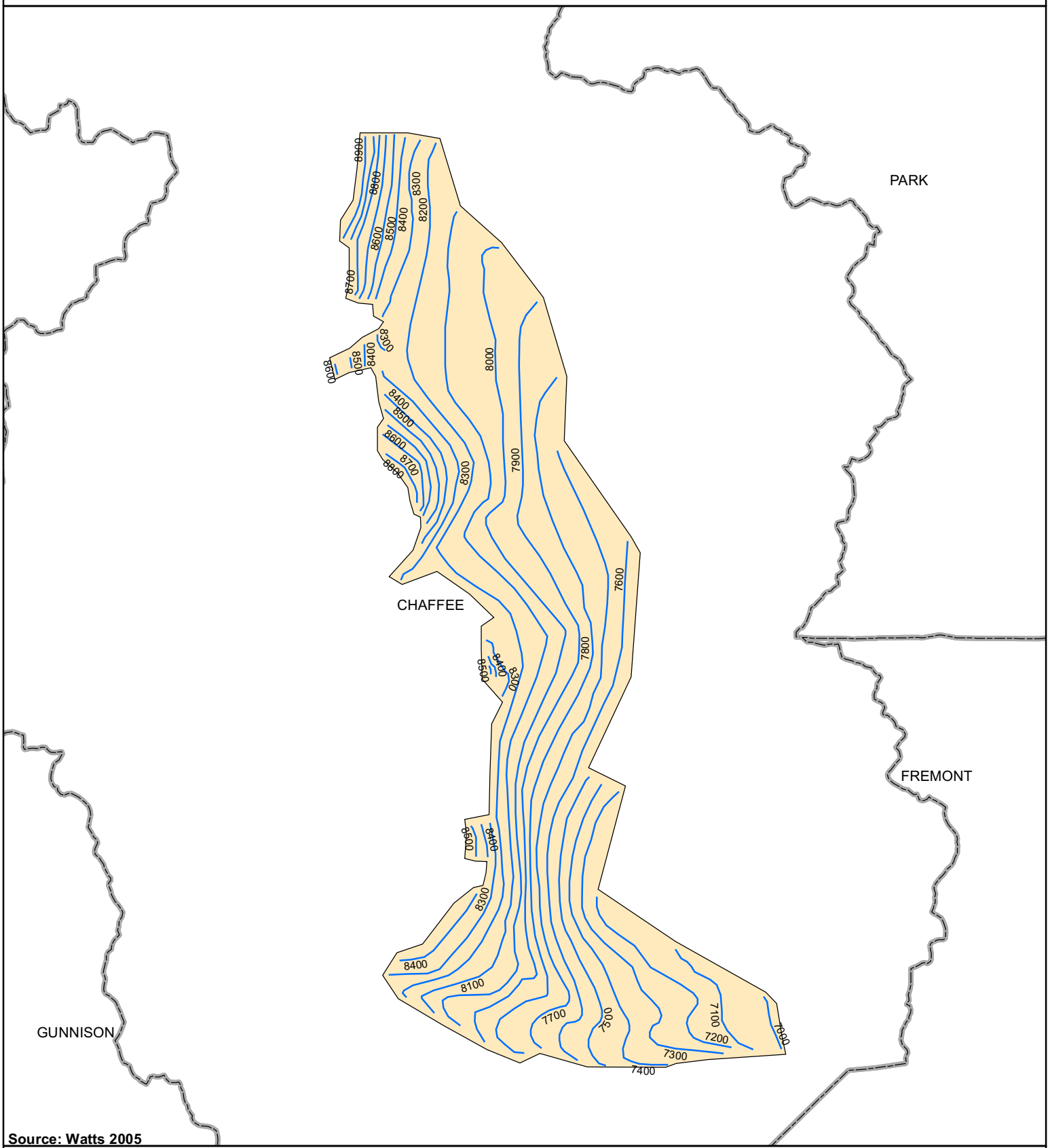
State of Colorado
Department of Natural Resources
Colorado Water Conservation Board
Division of Water Resources

Prepared by: CDM

SB06 - 193 Underground Water Storage Study

SB06-193 Study
Figure D.1-2

Upper Arkansas Alluvial Aquifer Potentiometric Surface Elevations



Source: Watts 2005

N
W E
S
Scale: 1:250,000
2 1 0 2 Miles

- City
- Highway
- County
- Upper Arkansas Water Level Contours
- Upper Arkansas Alluvial Aquifer Extent

Colorado Water Conservation Board

Prepared by: CDM

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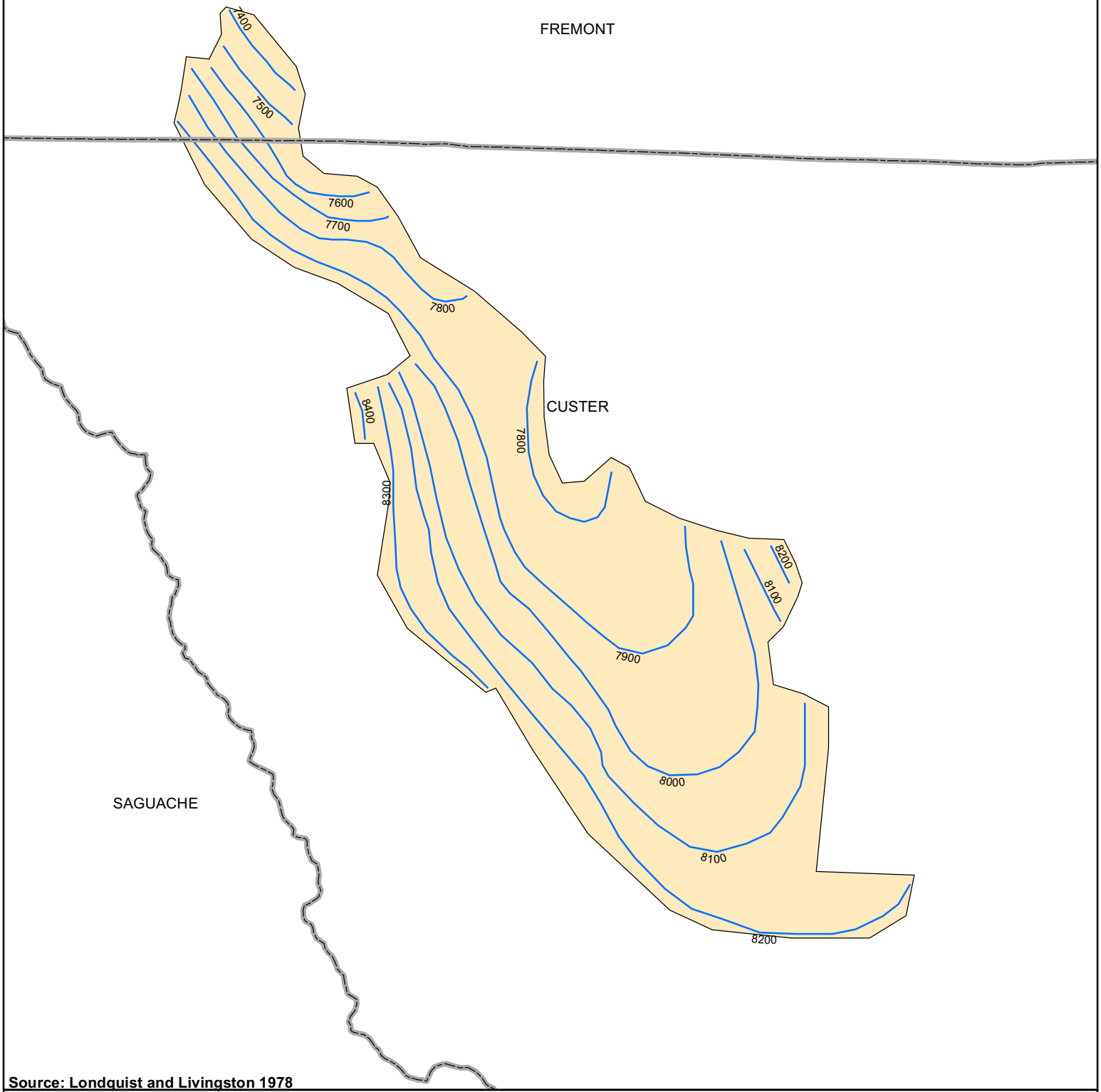
Figure D.1-3

Wet Mountain Valley Alluvial Aquifer Potentiometric Surface Elevations



Source: Londquist and Livingston 1978

N
W
E
S
Scale: 1:200,000
2 1 0 2
Miles

- City
- Highway
- County
- Wet Mountain Valley Water Level Elevations
- Wet Mountain Valley Alluvial Aquifer Extent

Colorado Water Conservation Board

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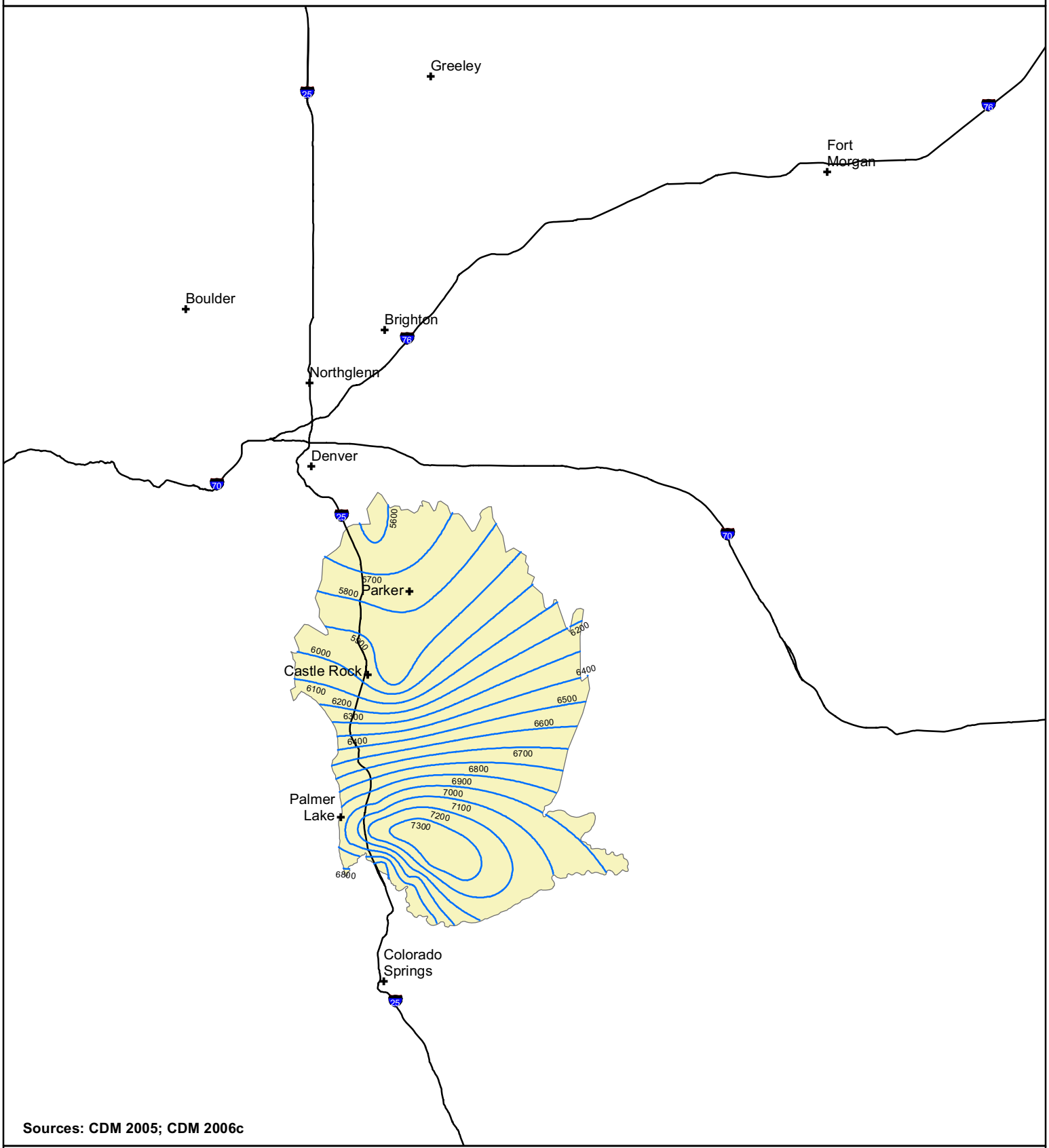
SB06-193 Underground Water Storage Study

SB06-193 Study
Figure D.1-4

Dawson Aquifer Potentiometric Surface Elevations



Sources: CDM 2005; CDM 2006c

N
W E
S

Scale: 1:1,000,000

10 5 0 10 Miles

- City
- Highway
- Dawson Aquifer Base
- Dawson Water Level Contours

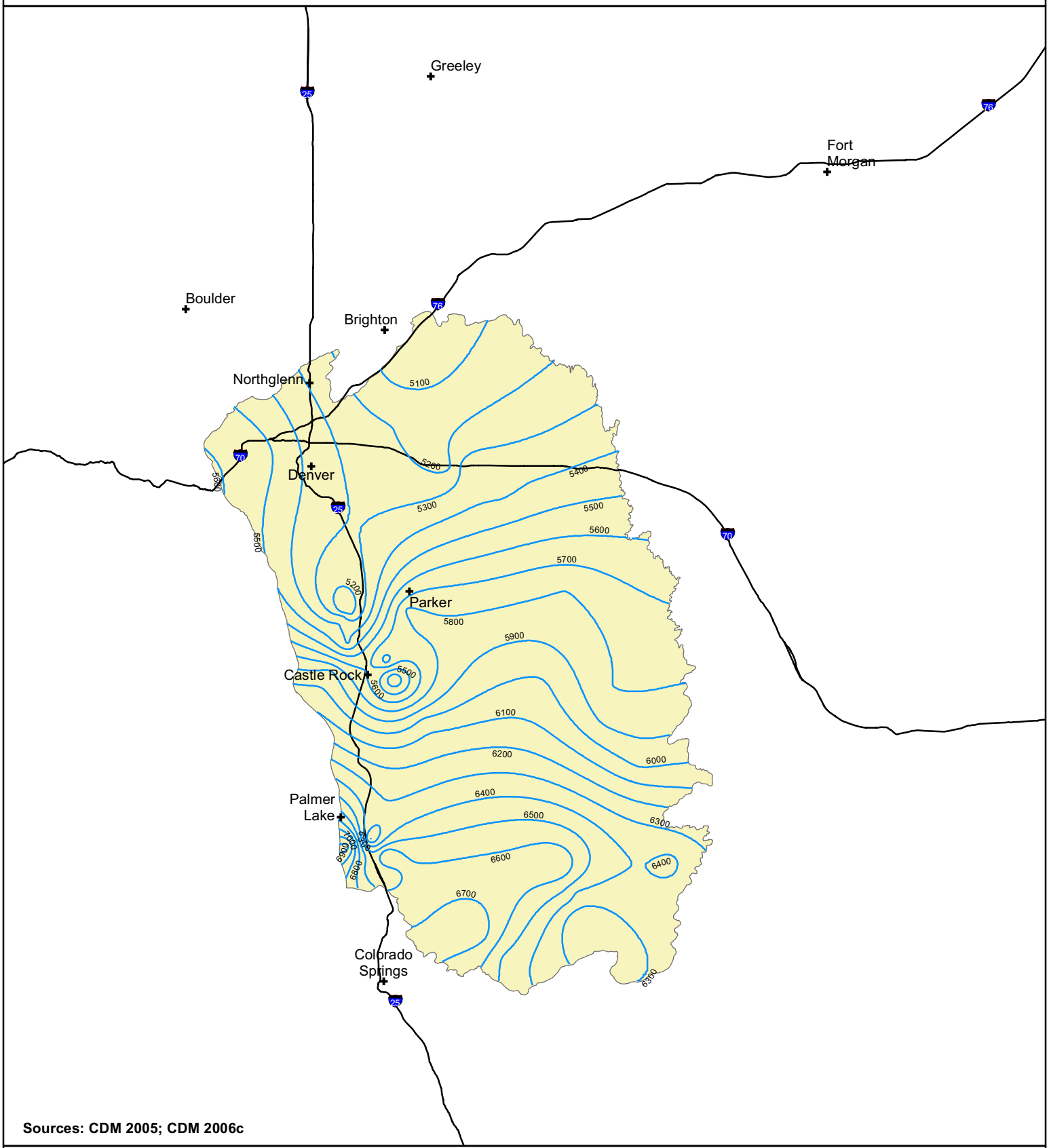
Colorado Water Conservation Board

Prepared by: CDM

SB06-193 Underground Water Storage Study

SB06-193 Study
Figure D.1-5

Denver Aquifer Potentiometric Surface Elevations



Sources: CDM 2005; CDM 2006c

N
W E
S

Scale: 1:1,000,000

10 5 0 10 Miles

- City
- Highway
- Denver Water Level Contours
- Denver Aquifer Base

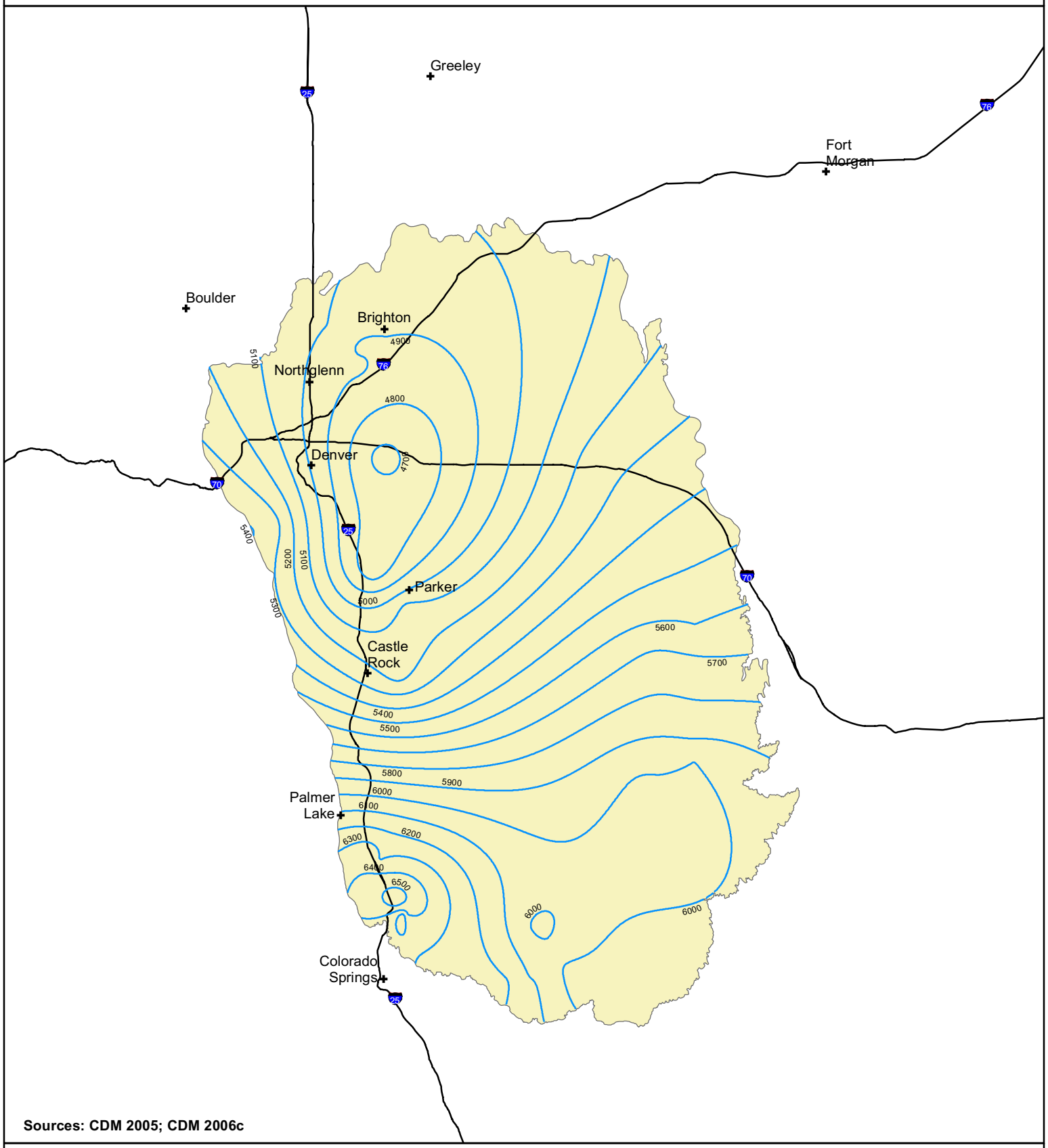
Colorado Water Conservation Board

Prepared by: CDM

SB06-193 Underground Water Storage Study

SB06-193 Study
Figure D.1-6

Arapahe Aquifer Potentiometric Surface Elevations



Sources: CDM 2005; CDM 2006c

N
W E
S

Scale:
1:1,000,000

10 5 0 10
Miles

- City
- Highway
- Arapahoe Water Level Contours
- Arapahe Aquifer Base

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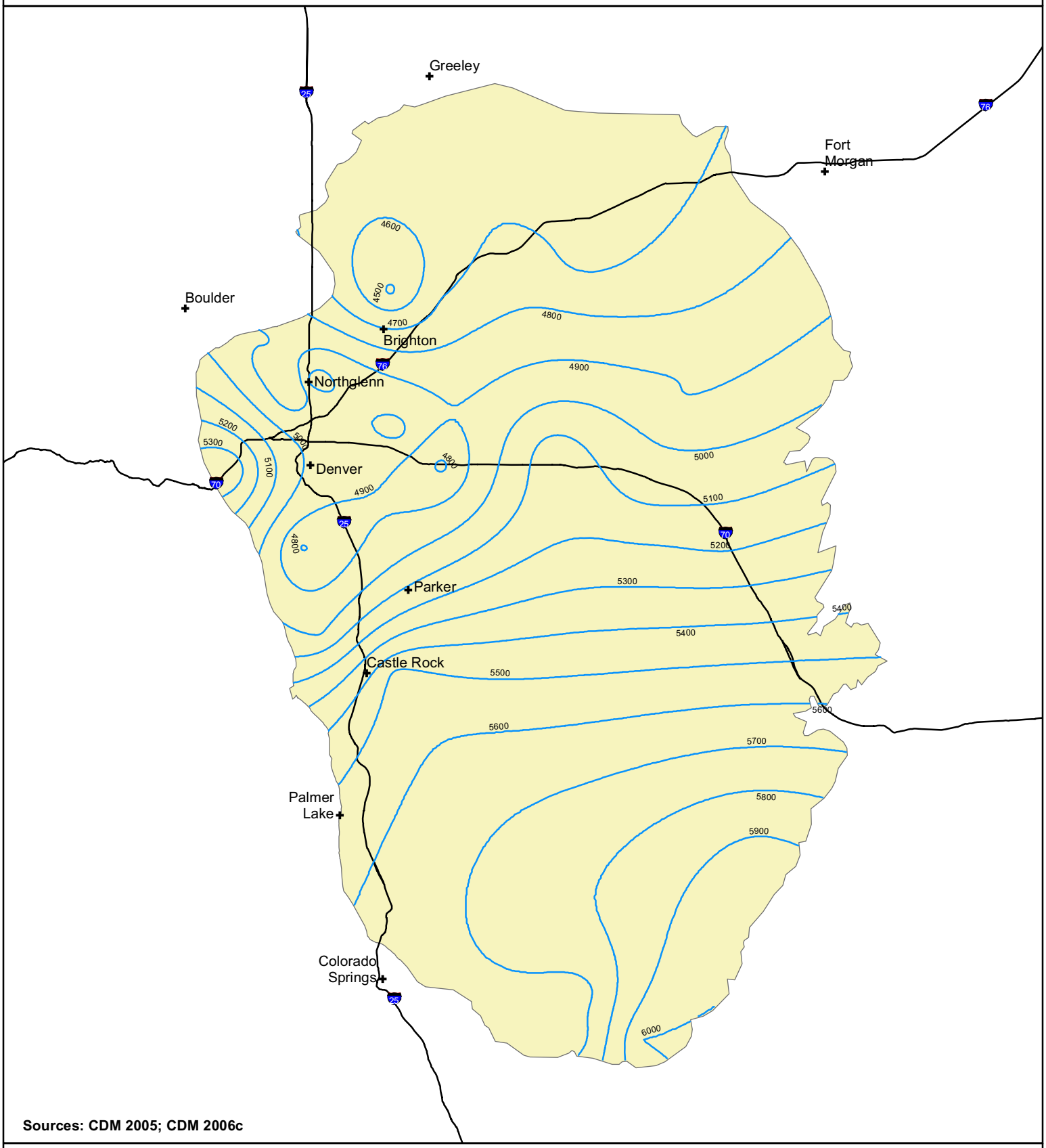
SB06-193 Underground Water Storage Study

SB06-193 Study
Figure D.1-7

Laramie-Fox Hills Aquifer Potentiometric Surface Elevations



Sources: CDM 2005; CDM 2006c

N
W E
S

Scale: 1:1,000,000

10 5 0 10 Miles

- City
- Highway
- Laramie-Fox Hills Water Level Contours
- Laramie-Fox Hills Aquifer Base

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Prepared by: CDM

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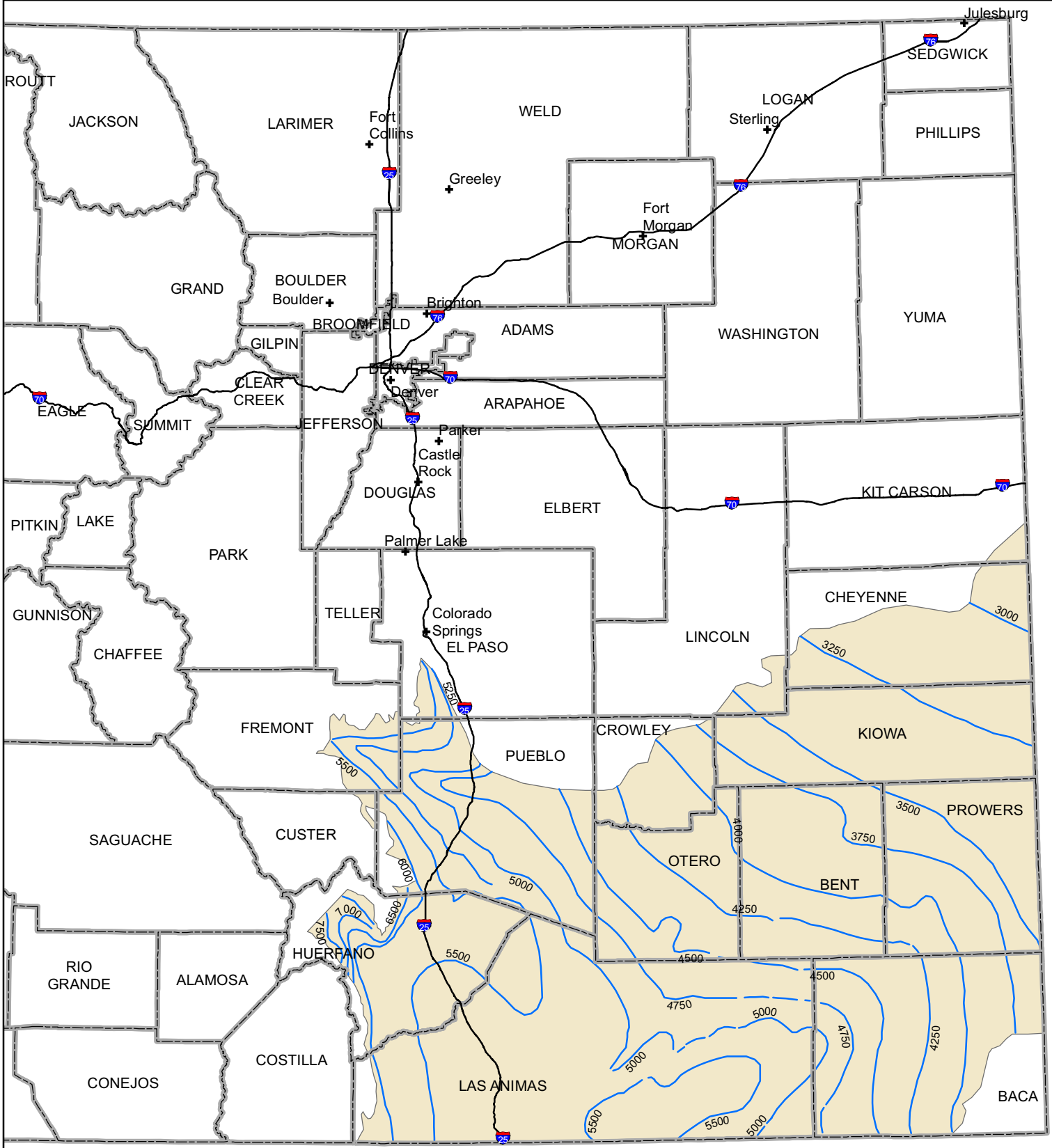
Figure D.1-8

Dakota Aquifer Potentiometric Surface Elevations



Source: Robson and Banta 1987

Scale: 1:2,100,000

10 5 0 10 Miles

- City
- Highway
- County
- Dakota Water Level Contours
- Dakota Extent

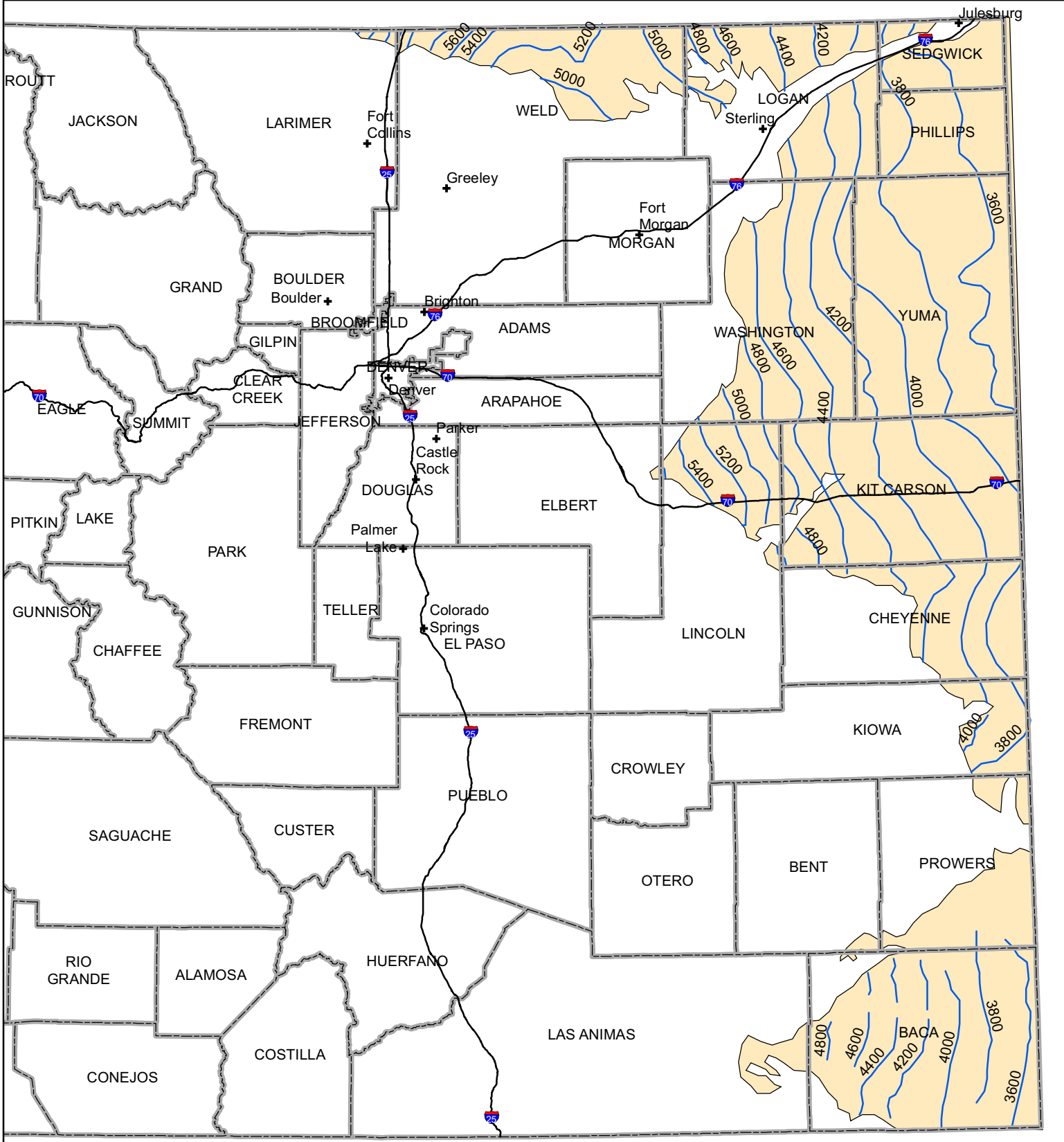
Colorado Water Conservation Board

Prepared by: CDM

SB06 - 193 Underground Water Storage Study

SB06-193 Study
Figure D.1-9

Ogallala Aquifer Potentiometric Surface Elevations



Source: Robson and Banta 1995

N
W
E
S

Scale: 1:2,100,000

10 5 0 10 Miles

- City
- Highway
- County
- Ogallala Aquifer Water Level Elevations
- Ogallala Aquifer Extent

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Prepared by: CDM

Appendix D.2

Calculation of Aquifer Available Storage Volumes

SB06-193 Study
Appendix D
March 1, 2007

Appendix D.2 Calculation of Aquifer Available Storage Volumes

List of Figures

Appendix D.2, Table 1
Calculation of Available Storage Capacity
South Platte River Basin

Subregion Number	Subregion Name	Total Volume in Unsaturated Zone (excluding <10' unsaturated) (Acre-feet)	Aquifer Porosity	Available Storage Capacity (Acre-feet)	Total Area (acres)	Area of <10' Unsaturated Zone (acres)	Area for Acre ft/ac Calculation (acres)	Available Storage Capacity (Acre-feet/acre)
1	SP - Metro	1,763,866	0.2	352,773	138,477	20,993	117,484	3.0
2	SP - Metro to Greeley	845,964	0.2	169,193	158,343	56,040	102,303	1.7
3	Poudre	1,455,049	0.2	291,010	215,069	56,152	158,917	1.8
4	Upper Beebe/Box Elder Ck	1,340,728	0.2	268,146	89,260	12,813	76,447	3.5
5	Lower Beebe/Box Elder Ck	304,394	0.2	60,879	30,749	6,045	24,704	2.5
6	SP - Greeley to Ft Morgan	468,068	0.2	93,614	99,358	32,118	67,240	1.4
7	Upper Lost Creek	6,298,259	0.2	1,259,652	126,744	7,585	119,159	10.6
8	Lower Lost Creek	782,939	0.2	156,588	34,003	6,579	27,424	5.7
9	Upper Kiowa Creek	1,168,155	0.2	233,631	54,985	8,368	46,617	5.0
10	Lower Kiowa Creek	4,032,145	0.2	806,429	87,395	2,439	84,956	9.5
11	Upper Bijou Creek	2,328,553	0.2	465,711	69,775	6,578	63,197	7.4
12	Lower Bijou Creek	5,334,380	0.2	1,066,876	132,665	7,464	125,201	8.5
13	Badger/Beaver Creek	1,555,910	0.2	311,182	73,545	3,168	70,378	4.4
14	SP - Ft Morgan	4,840,251	0.2	968,050	120,026	6,593	113,434	8.5
15	SP - Balzac to State Line	4,448,374	0.2	889,675	255,536	70,178	185,359	4.8
16	SP - South Park*		0.2	899,000				1.2

* South Park data taken directly from Topper et al., 2004.

Appendix D.2, Table 2
Calculation of Available Storage Capacity
Arkansas River Basin

Subregion Number	Subregion Name	Total Volume in Unsaturated Zone (excluding <10' unsaturated) (Acre-feet)	Aquifer Porosity	Available Storage Capacity (Acre-feet)	Total Area (acres)	Area of <10' Unsaturated Zone (acres)	Area for Acre ft/ac Calculation (acres)	Available Storage Capacity (Acre-feet/acre)
1	Ark - Pueblo to Apishapa	70,035	0.2	14,007	40,919	18,493	22,426	0.6
2	Ark - Crowley area	195,039	0.2	39,008	34,469	10,709	23,760	1.6
3	Ark - Apishapa to John Martin	148,675	0.2	29,735	90,178	38,586	51,593	0.6
4	Ark - John Martin to Lamar	179,830	0.2	35,966	52,341	21,400	30,941	1.2
5	Ark - Lamar to State Line	502,905	0.2	100,581	76,835	23,480	53,355	1.9
6	Upper Black Squirrel	2,549,851	0.2	509,970	68,037	6,519	61,518	8.3
7	Upper Big Sandy	55,552	0.2	11,110	25,453	16,508	8,946	1.2
8	Fountain Creek	222,823	0.2	44,565	7,860	1,185	6,675	6.7
9	Wet Mtn Valley	1,691,854	0.2	338,371	49,329	3,170	46,158	7.3
10	Ark - Buena Vista to Salida	10,370,583	0.2	2,074,117	86,912	3,875	83,037	25.0

Appendix D.2, Table 3
Calculation of Available Storage Capacity
Bedrock Aquifer Regions

Subregion Number	Subregion Name	Total Volume in Unsaturated Zone (excluding <10' unsaturated) (Acre-feet)	Storativity	Available Storage Capacity (Acre-feet)	Total Area (acres)	Area of <10' Unsaturated Zone (acres)	Area for Acre ft/ac Calculation (acres)	Available Storage Capacity (Acre-feet/acre)
1	Dawson Unconfined West	116,917,608	0.0100	1,169,176	460,533	31,575	428,958	2.73
2	Dawson Unconfined East	52,050,999	0.0100	520,510	400,091	124,046	276,045	1.89
3	Denver Confined West	289,181,255	0.0003	86,754	458,226	0	458,226	0.19
4	Denver Confined East	199,127,204	0.0003	59,738	401,481	132	401,349	0.15
5	Denver Unconfined West	38,728,041	0.0100	387,280	421,027	122,490	298,537	1.30
6	Denver Unconfined East	77,031,007	0.0100	770,310	807,054	168,981	638,073	1.21
7	Arapahoe Confined Northwest	510,515,080	0.0010	510,515	683,101	0	683,101	0.75
8	Arapahoe Confined Southwest	204,491,819	0.0010	204,492	195,716	233	195,483	1.05
9	Arapahoe Confined East	690,147,854	0.0010	690,148	1,209,707	2,295	1,207,412	0.57
10	Arapahoe Unconfined West	32,445,855	0.0100	324,459	224,594	34,249	190,345	1.70
11	Arapahoe Unconfined East	32,433,861	0.0100	324,339	663,478	385,085	278,393	1.17
12	LFH Confined West	899,760,677	0.0010	899,761	1,193,454	0	1,193,454	0.75
13	LFH Confined East	1,059,479,473	0.0010	1,059,479	2,484,803	123,988	2,360,815	0.45
14	LFH Unconfined West	12,232,847	0.0100	122,328	96,015	4,082	91,934	1.33
15	LFH Unconfined East	8,454,649	0.0100	84,546	551,951	403,119	148,832	0.57
16	Dakota-Cheyenne	5,237,907,866	0.0010	5,237,908	11,763,280	1,428,411	10,334,869	0.51
17	Ogallala - North	894,123,739	0.1000	89,412,374	8,600,531	1,183,549	7,416,982	12.06
18	Ogallala - South	311,778,236	0.1000	31,177,824	2,129,171	172,696	1,956,476	15.94

Appendix D.2, Table 1
Summary of Denver Basin Bedrock Aquifer Storage Coefficient Data (dimensionless) (CDM 2005)

Aquifer	Count	Minimum	Lower Quartile	Median	Upper Quartile	Maximum	Average
Upper Dawson	0	N/A	N/A	N/A	N/A	N/A	N/A
Lower Dawson	0	0.00	N/A	N/A	N/A	N/A	N/A
Denver	1	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Upper Arapahoe	0	N/A	N/A	N/A	N/A	N/A	N/A
Lower Arapahoe	14	0.00002	0.00015	0.0003	0.00044	0.008	0.00089
Laramie-Fox Hills	13	0.00002	0.0001	0.0003	0.00174	0.004	0.0011

Note: Storage Coefficient (S) is dimensionless

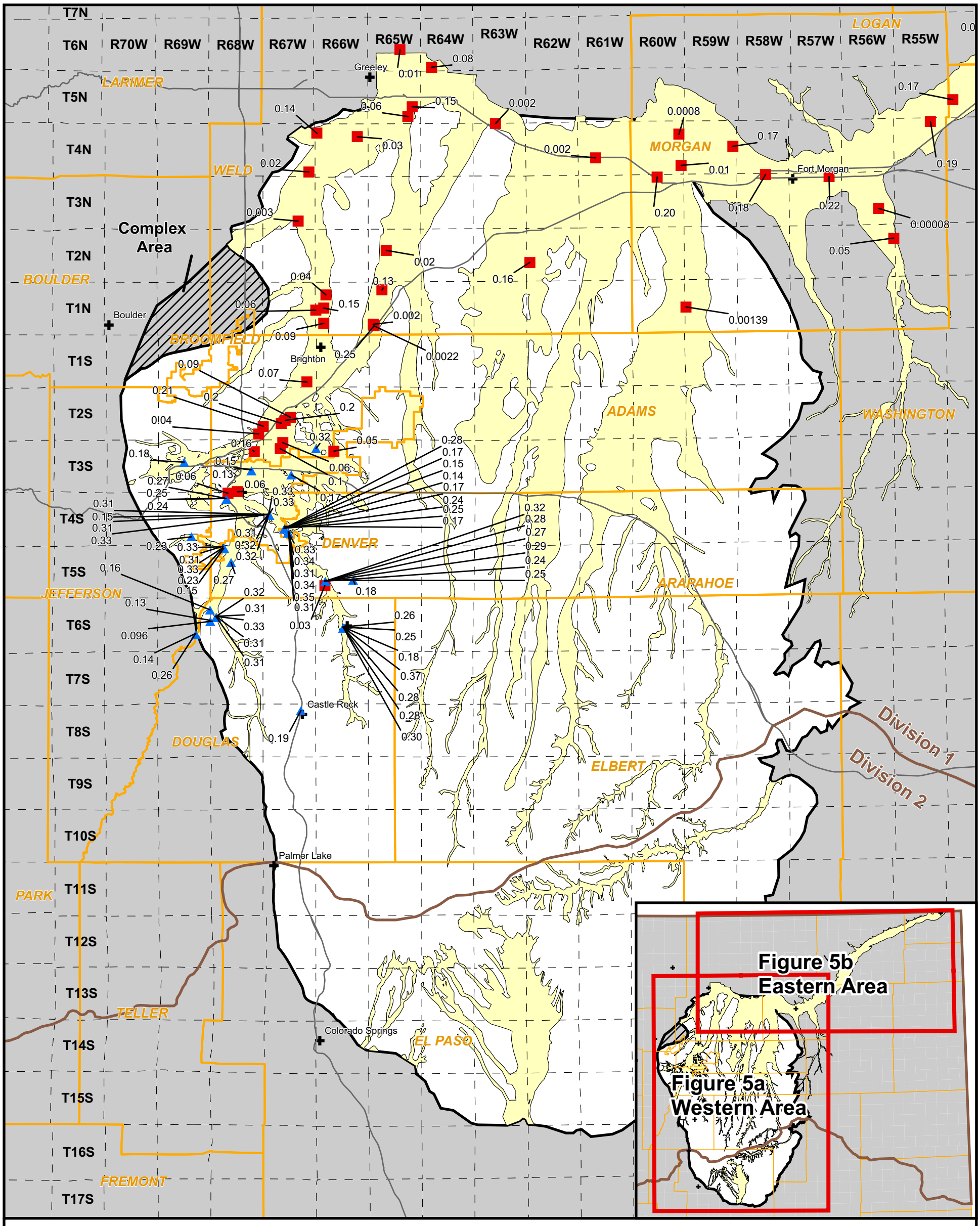
Appendix D.2, Table 2
Summary of South Platte Alluvial Aquifer Specific Yield Data (dimensionless) (CDM 2006a)

	Aquifer Test Values			
Data Type	**Count**	**Min**	**Max**	**Median**
Specific Yield	117	0.00008	0.34	0.18

SPDSS Phase 2 Task 43.3

SB06-193 Study
Figure D.2-1

Figure 5a: Storage Coeffecient (S) and Specific Yield (Sy) Distribution, Western Area



COLORADO DIVISION OF WATER RESOURCES
DEPARTMENT OF NATURAL RESOURCES

State of Colorado
Department of Natural Resources
Colorado Water Conservation Board
Division of Water Resources

Prepared by: CDM

SPDSS Phase 2 Task 43.3

SB06-193 Study
Figure D.2-2

Figure 5b: Storage Coeffecient (S) and Specific Yield (Sy) Distribution, Eastern Area

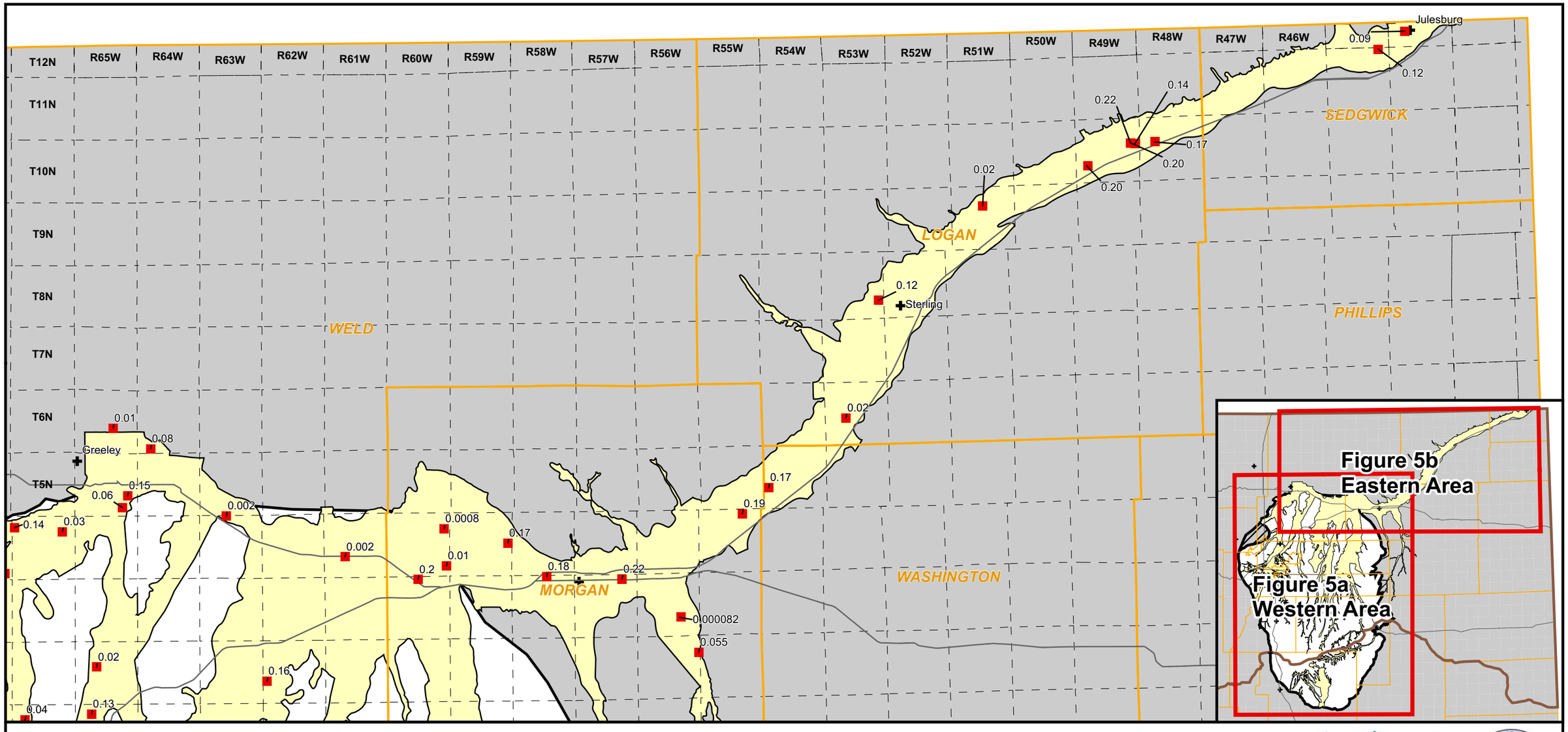


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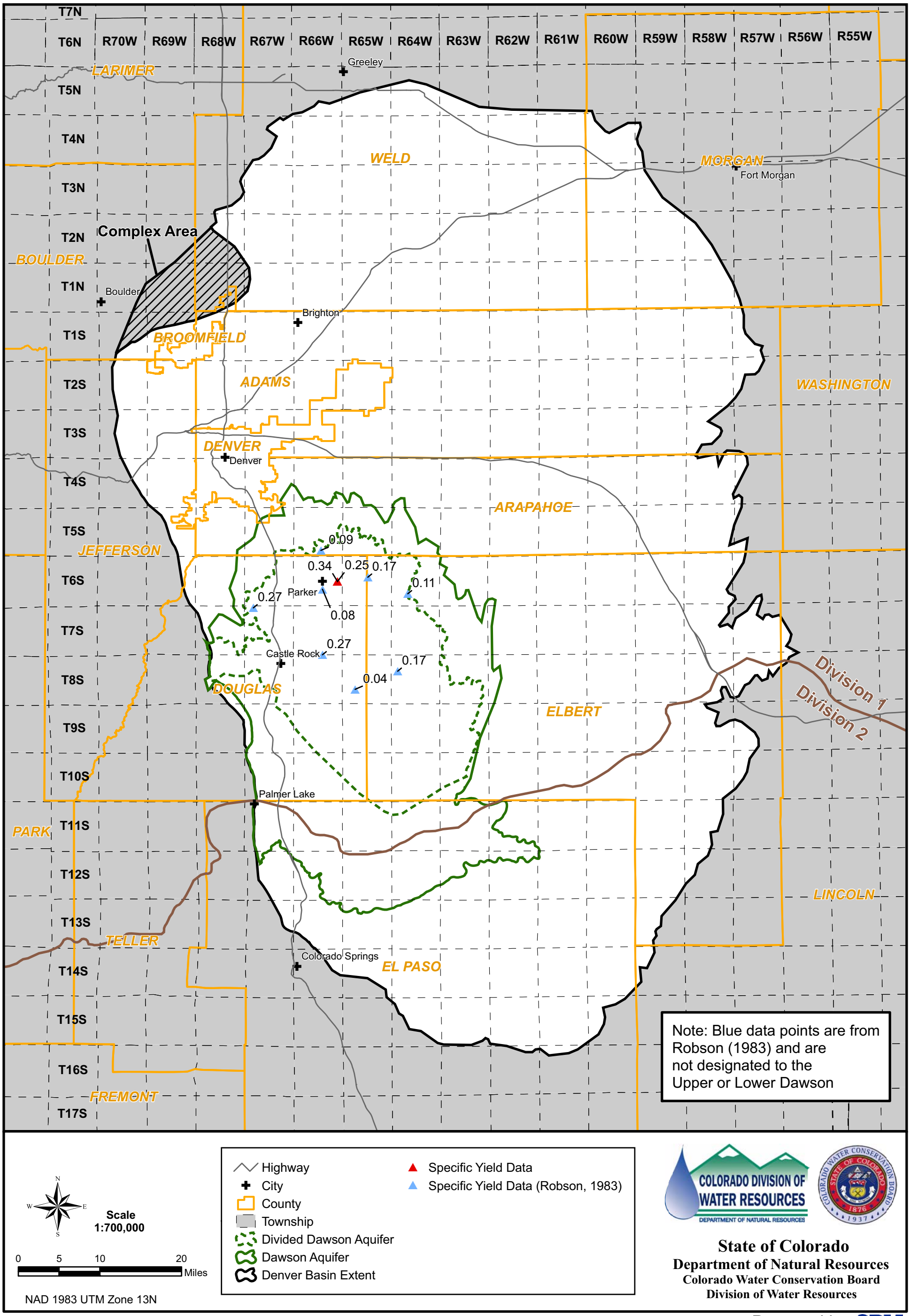
Figure 12: Upper Dawson Aquifer Specific Yield Data



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STATE OF COLORADO
1876
1937

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Figure 13: Lower and Undivided Dawson Aquifer Specific Yield Data

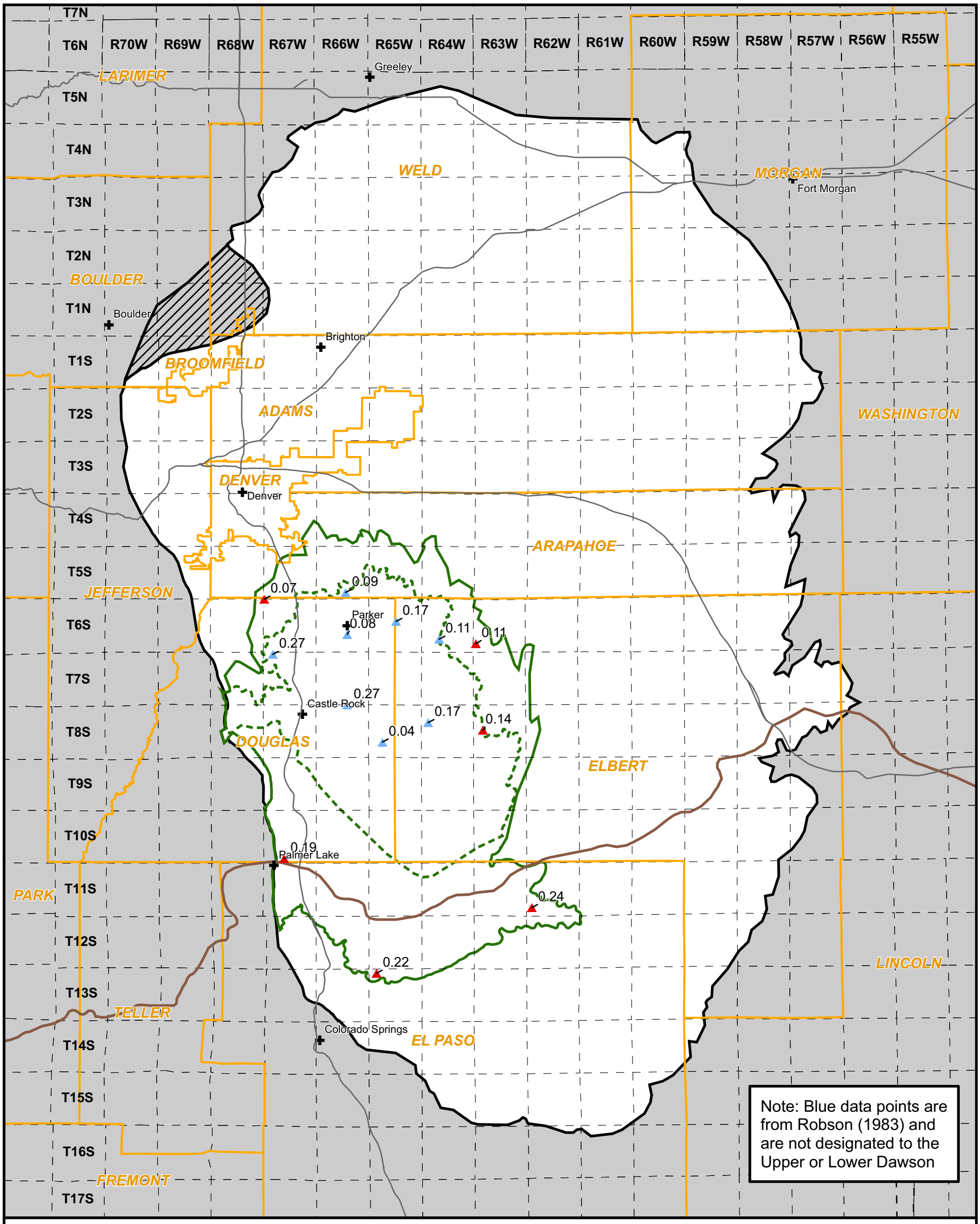

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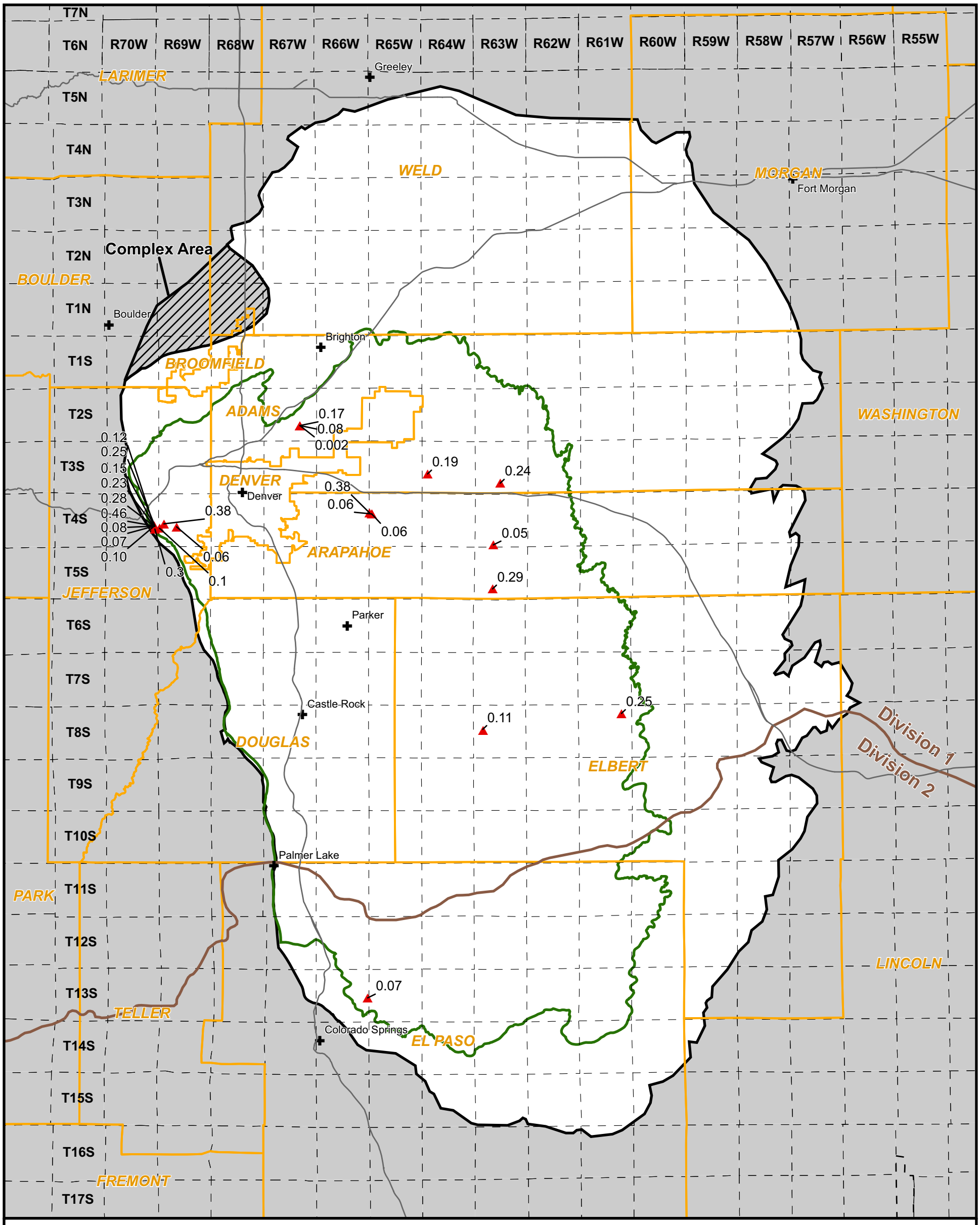
Figure 14: Denver Aquifer Specific Yield Data



Scale
1:700,000

0 5 10 20 Miles

NAD 1983 UTM Zone 13N

Highway
City
County
Township
Denver Aquifer
Denver Basin Extent
Specific Yield Data

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Figure 15: Upper Arapahoe Aquifer Specific Yield Data

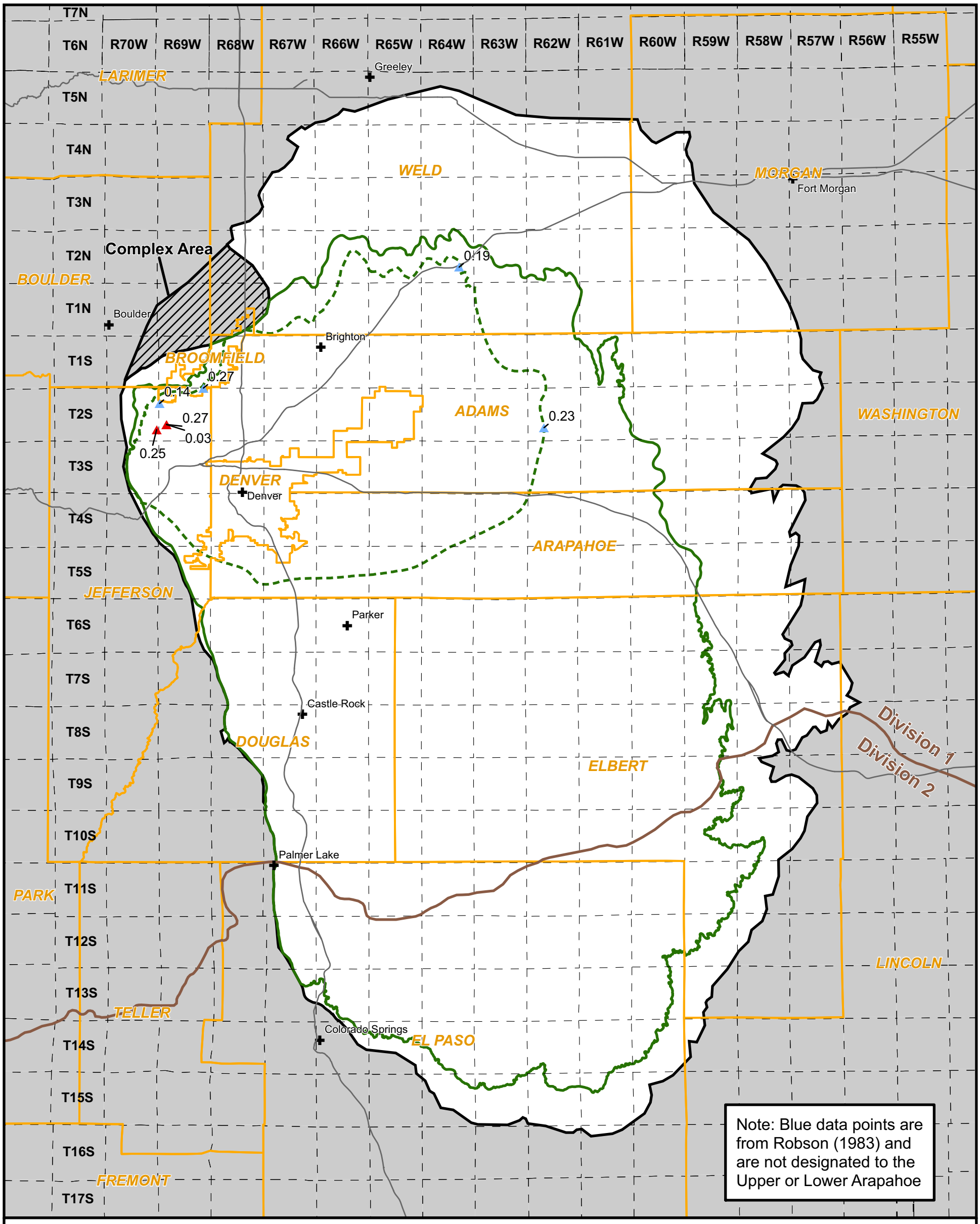

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Figure 16: Lower and Undivided Arapahoe Aquifer Specific Yield Data

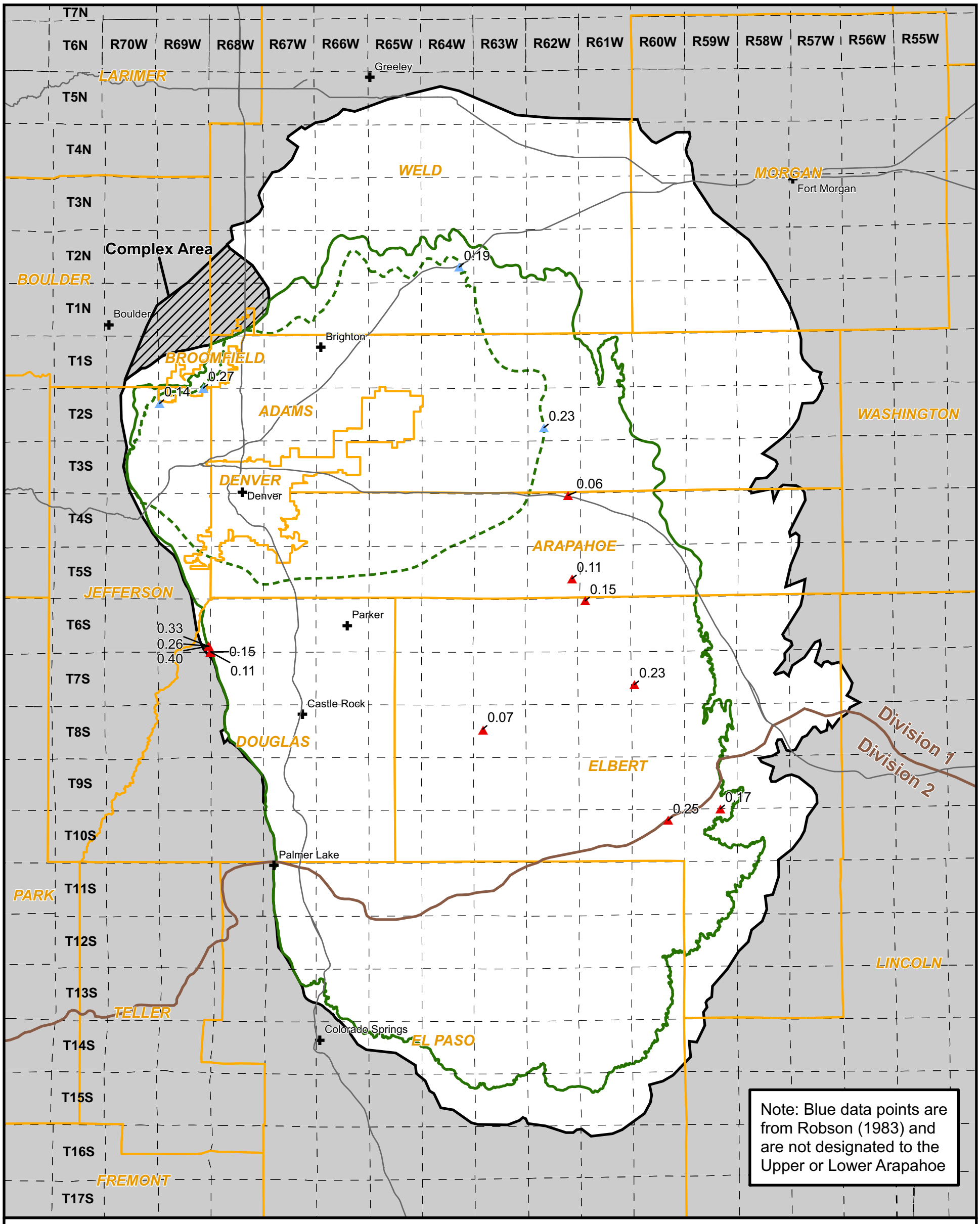

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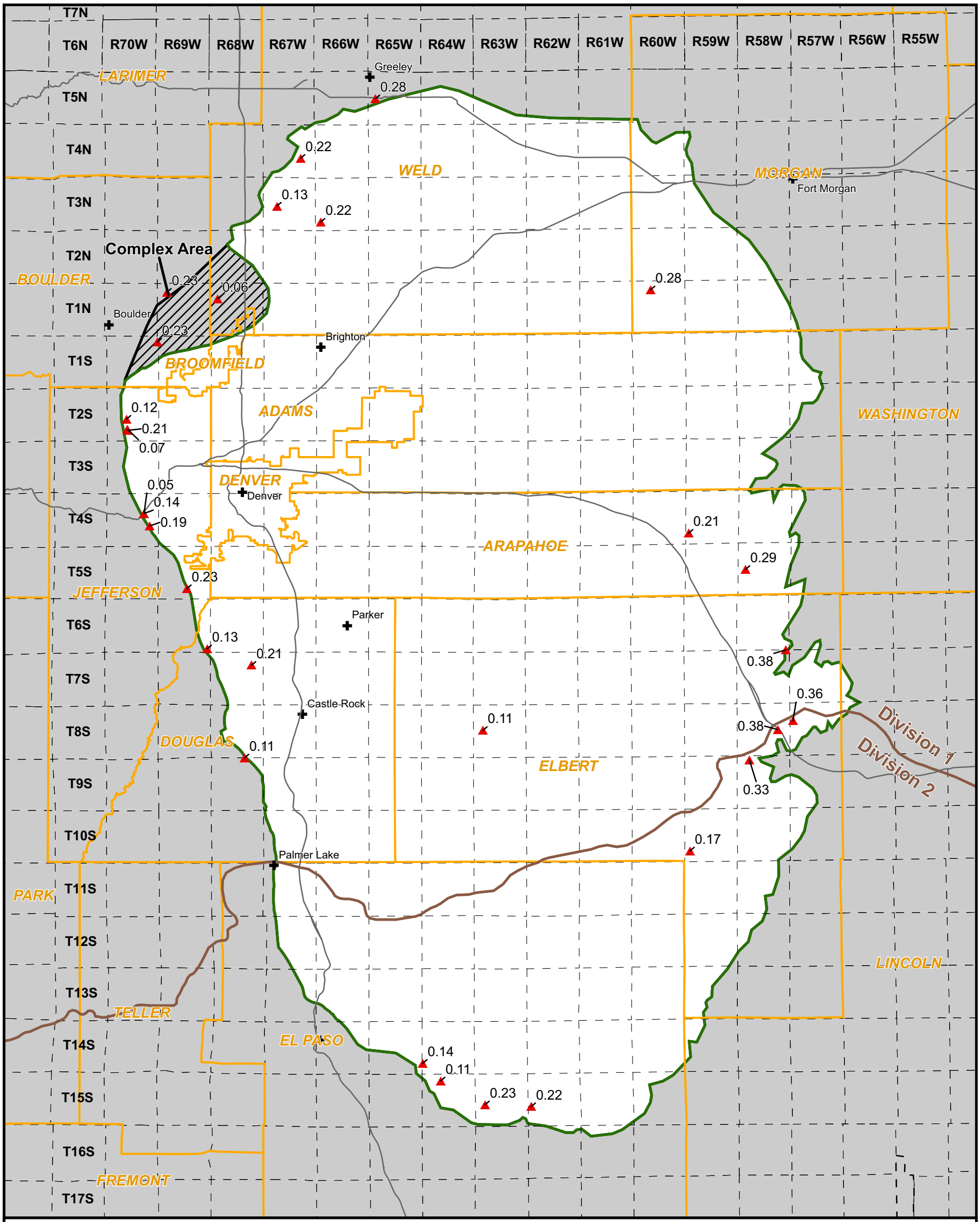
Figure 17: Laramie-Fox Hills Aquifer Specific Yield Data



Scale
1:700,000

0 5 10 20 Miles

NAD 1983 UTM Zone 13N

- Highway
- City
- County
- Township
- Laramie-Fox Hills Aquifer
- Denver Basin Extent
- Specific Yield Data

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Figure 18: Upper Dawson Aquifer Storage Coefficient Data

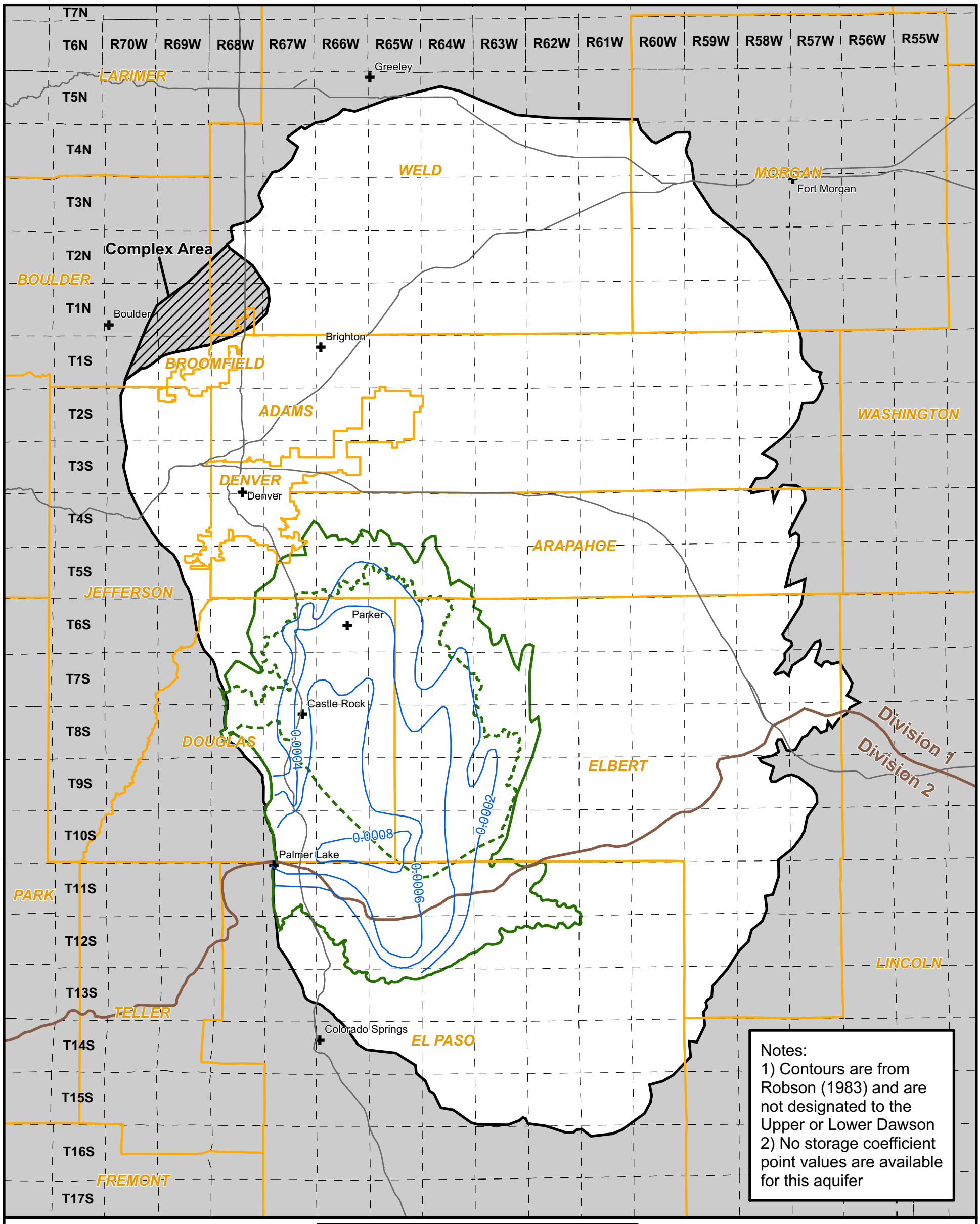

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Figure 19: Lower and Undivided Dawson Aquifer Storage Coefficient Data

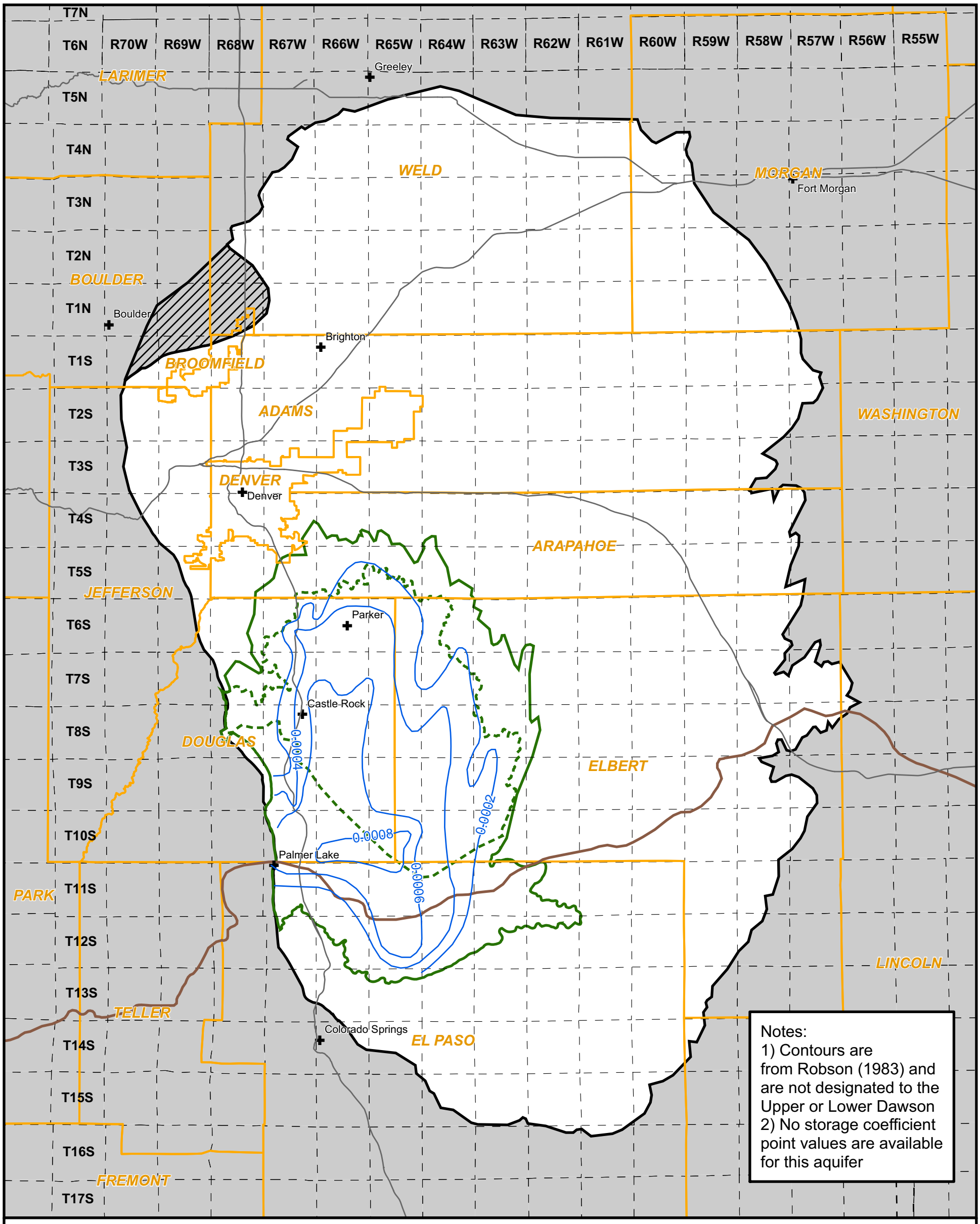

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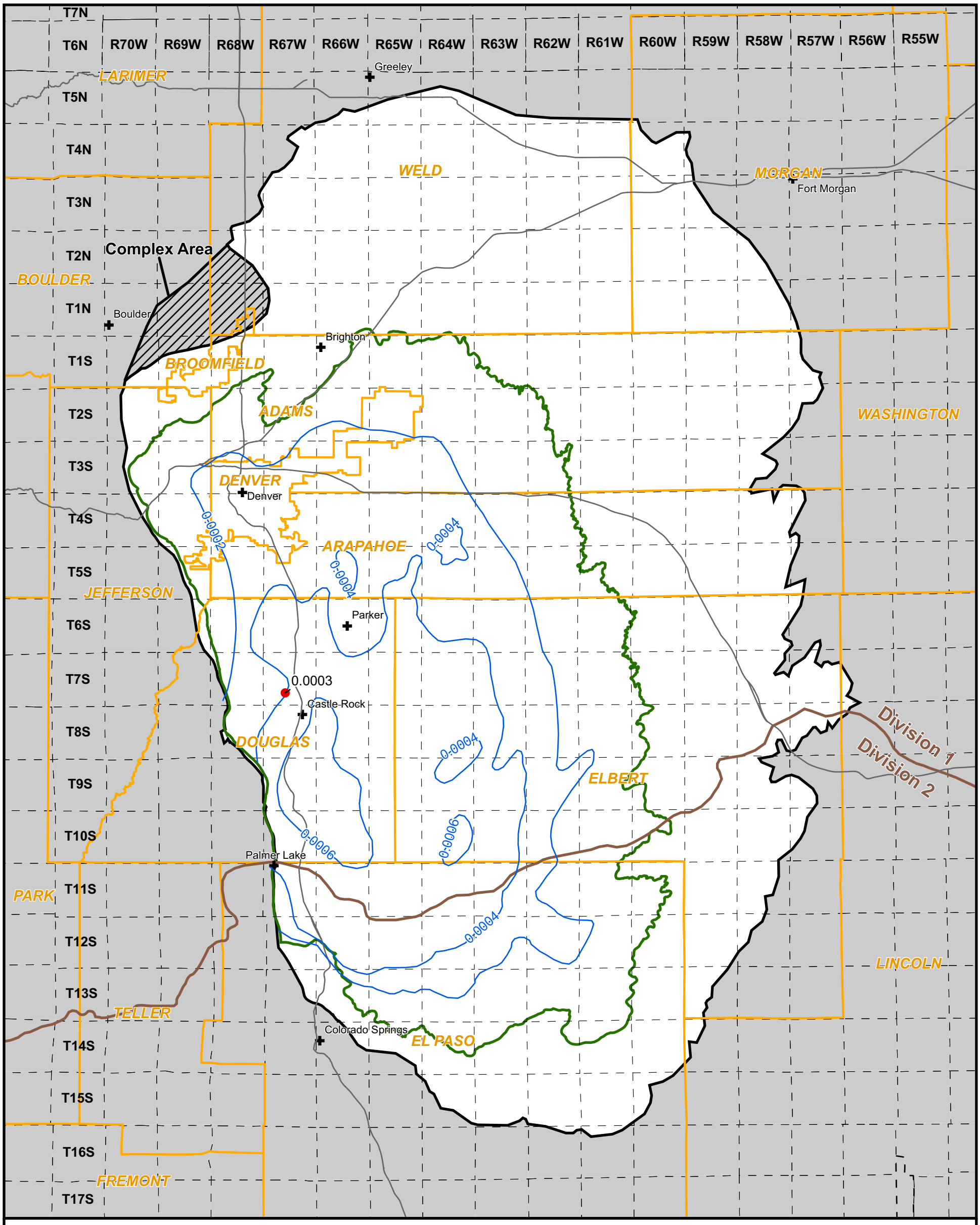
Figure 20: Denver Aquifer Storage Coefficient Data



N
W
E
S

Scale
1:700,000

0 5 10 20
Miles

NAD 1983 UTM Zone 13N

- Highway
- City
- County
- Township
- Denver Aquifer
- Denver Basin Extent
- Storage Coeffecient Data
- Storage Coeffecient Contour (Robson 1983)

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Figure 21: Upper Arapahoe Aquifer Storage Coefficient Data

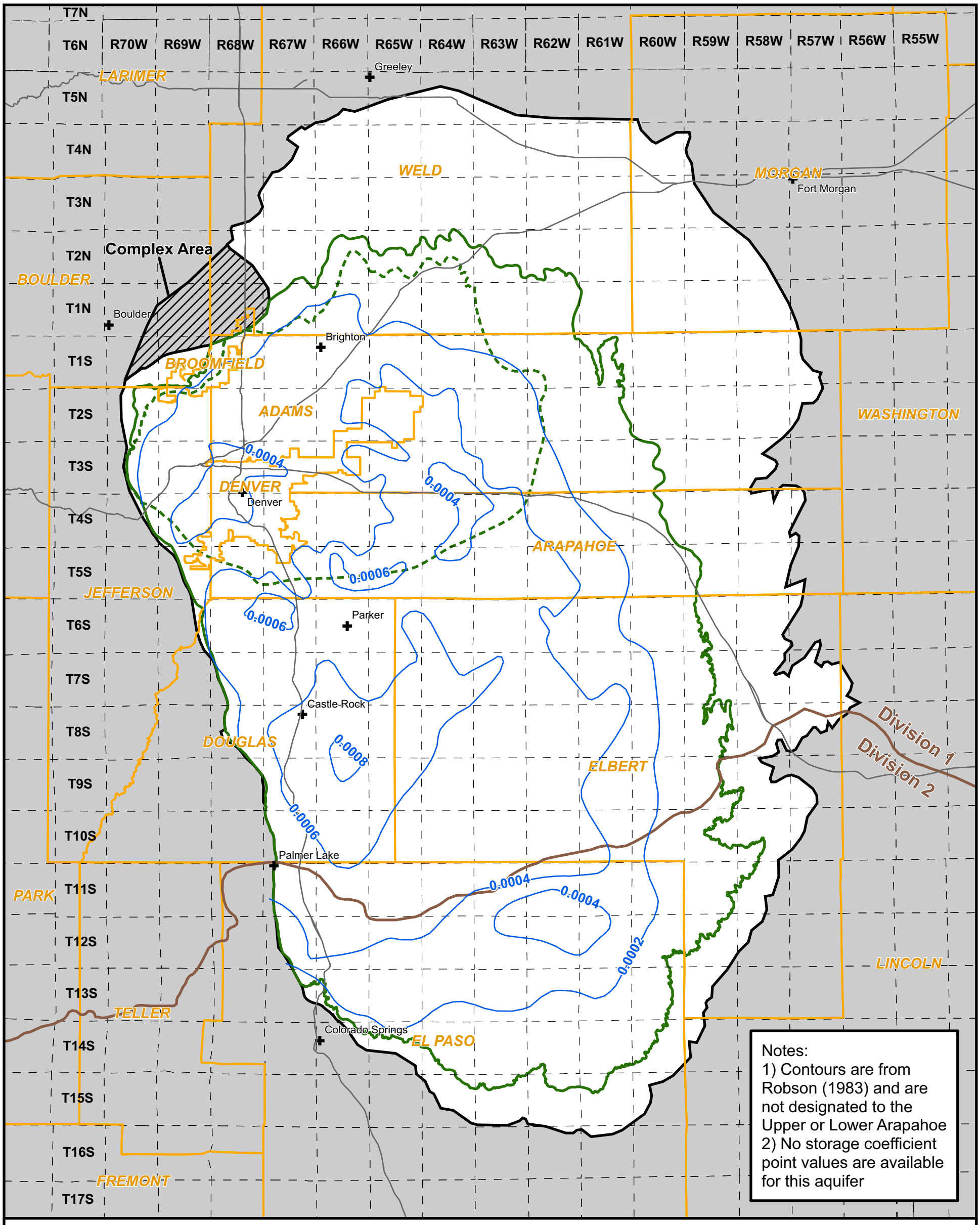

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Figure 22: Lower and Undivided Arapahoe Aquifer Storage Coefficient Data

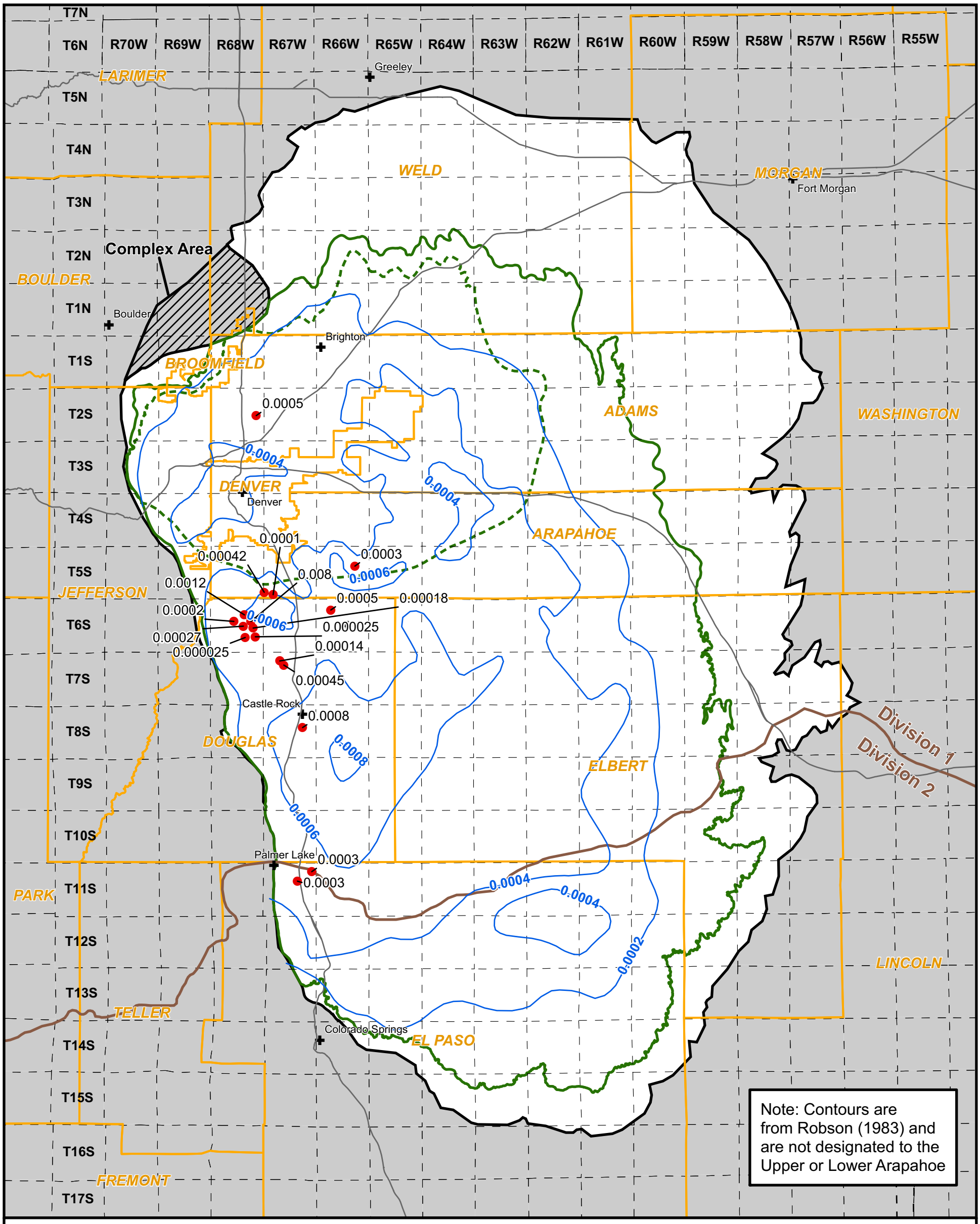

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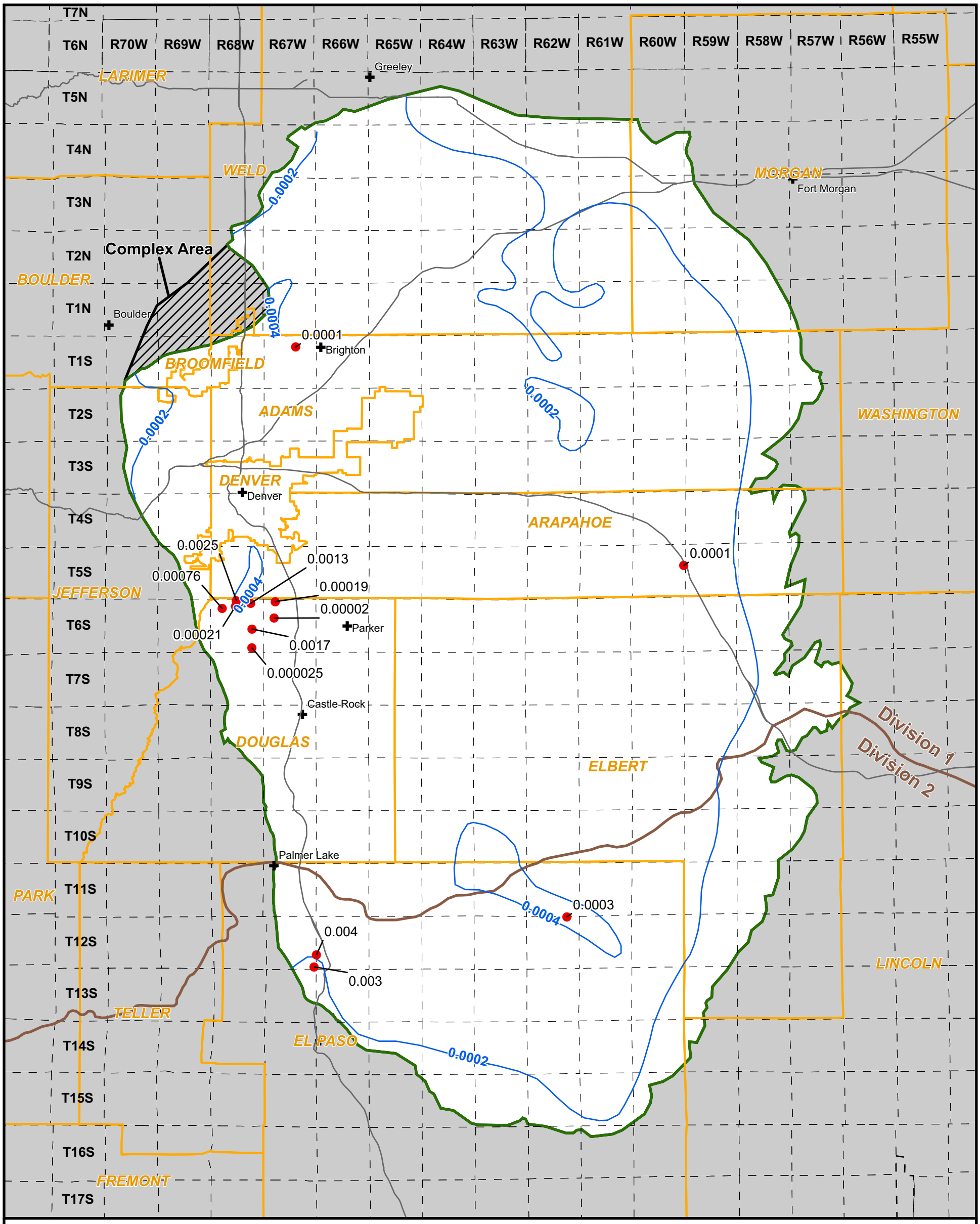
Figure 23: Laramie-Fox Hills Aquifer Storage Coefficient Data



Scale
1:700,000

0 5 10 20 Miles

NAD 1983 UTM Zone 13N

- Highway
- City
- County
- Township
- Laramie-Fox Hills Aquifer
- Denver Basin Extent
- Storage Coeffecient Data
- Storage Coefficient Contour (Robson, 1983)

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Appendix D.3

Aquifer Hydraulic Conductivity (K) and Transmissivity (T) Maps

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Appendix D.3 Aquifer Hydraulic Conductivity (K) and Transmissivity (T) Maps
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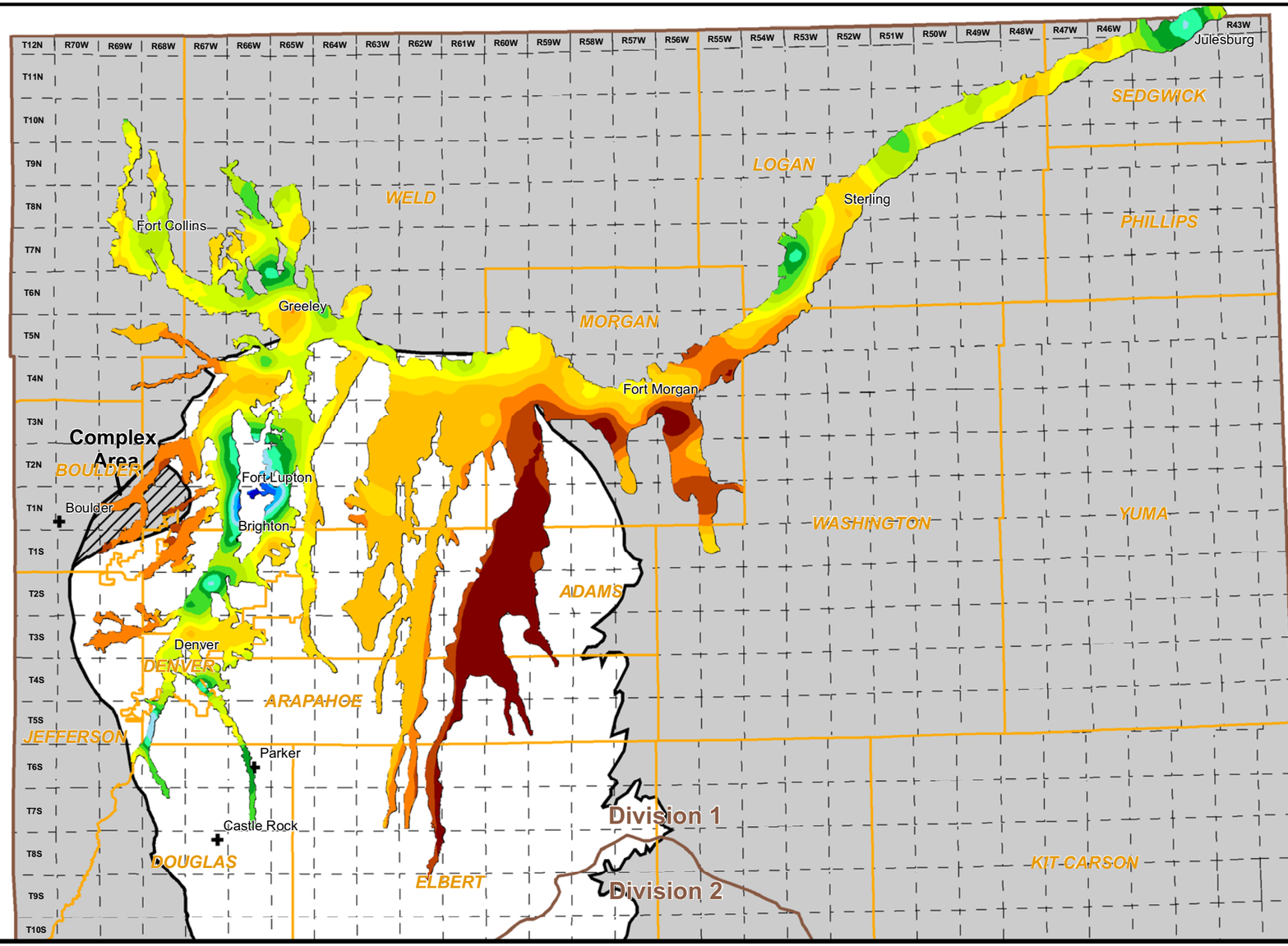
Figure 5a: Hydraulic Conductivity (K) Distribution, SPDSS Alluvial Groundwater Model Extent



Scale
1:1,100,000
0 10 20 40 Miles

NAD 1983 UTM Zone 13N

City
County
Township
Denver Basin Extent

Hydraulic Conductivity (ft/day)

< 150	500 - 550
150 - 200	550 - 600
200 - 250	600 - 650
250 - 300	650 - 700
300 - 350	700 - 750
350 - 400	750 - 800
400 - 450	> 800
450 - 500	

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Arkansas River Basin Alluvial Aquifer Hydraulic Conductivity

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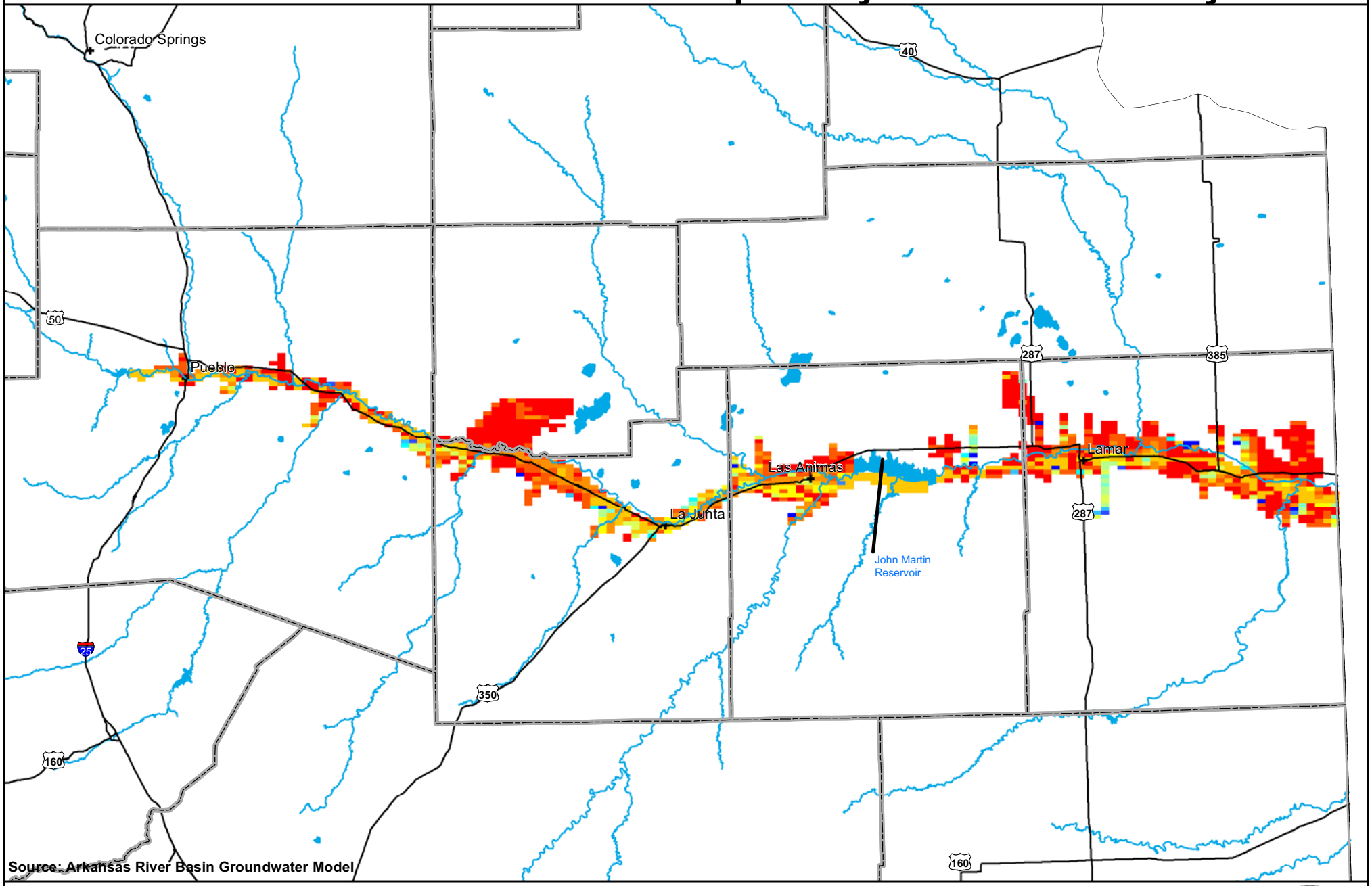

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Figure 6: Upper Dawson Aquifer Hydraulic Conductivity Data

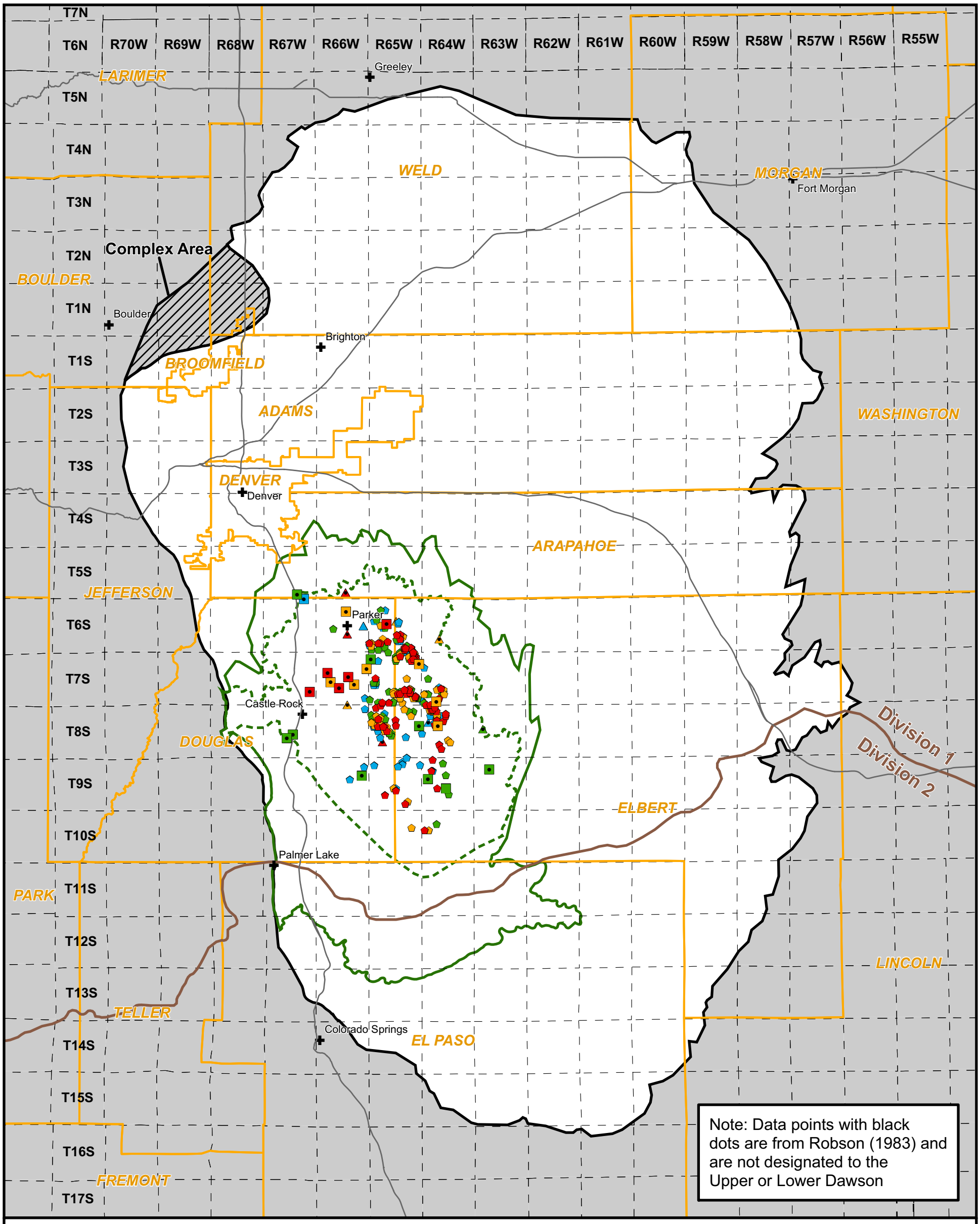

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Figure 7: Lower and Undivided Dawson Aquifer Hydraulic Conductivity Data

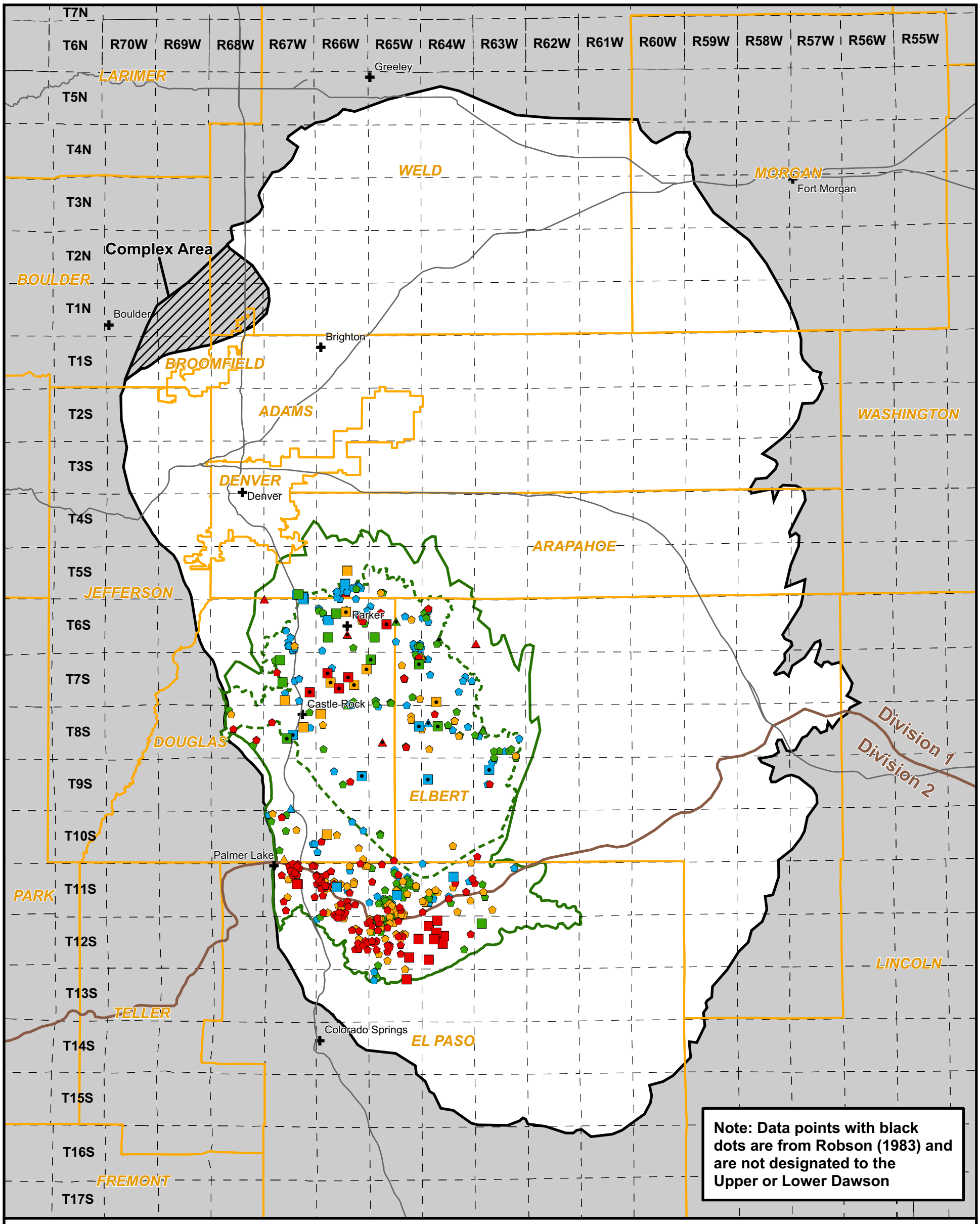

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Figure 8: Denver Aquifer Hydraulic Conductivity Data

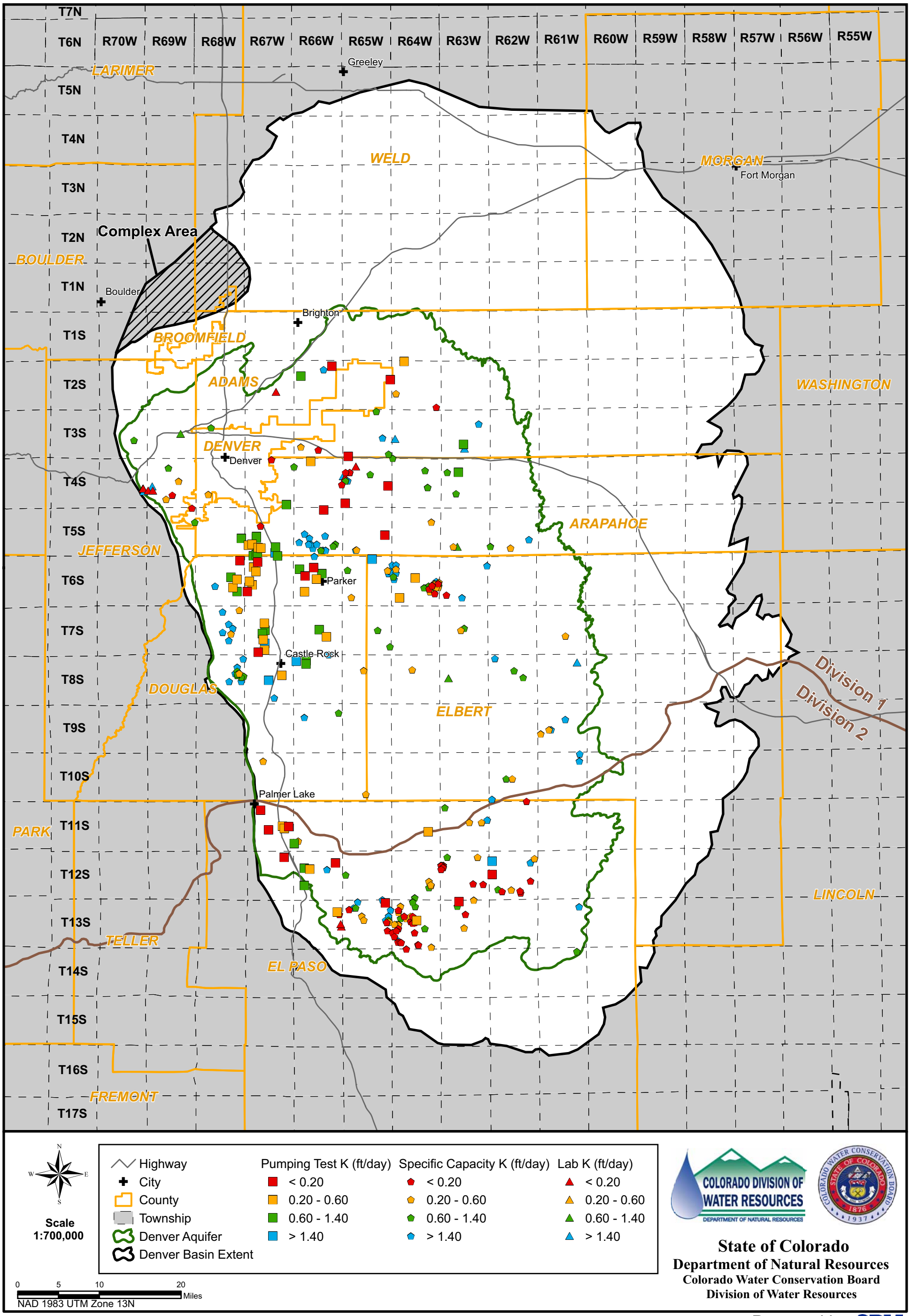

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Figure 9: Upper Arapahoe Aquifer Hydraulic Conductivity Data

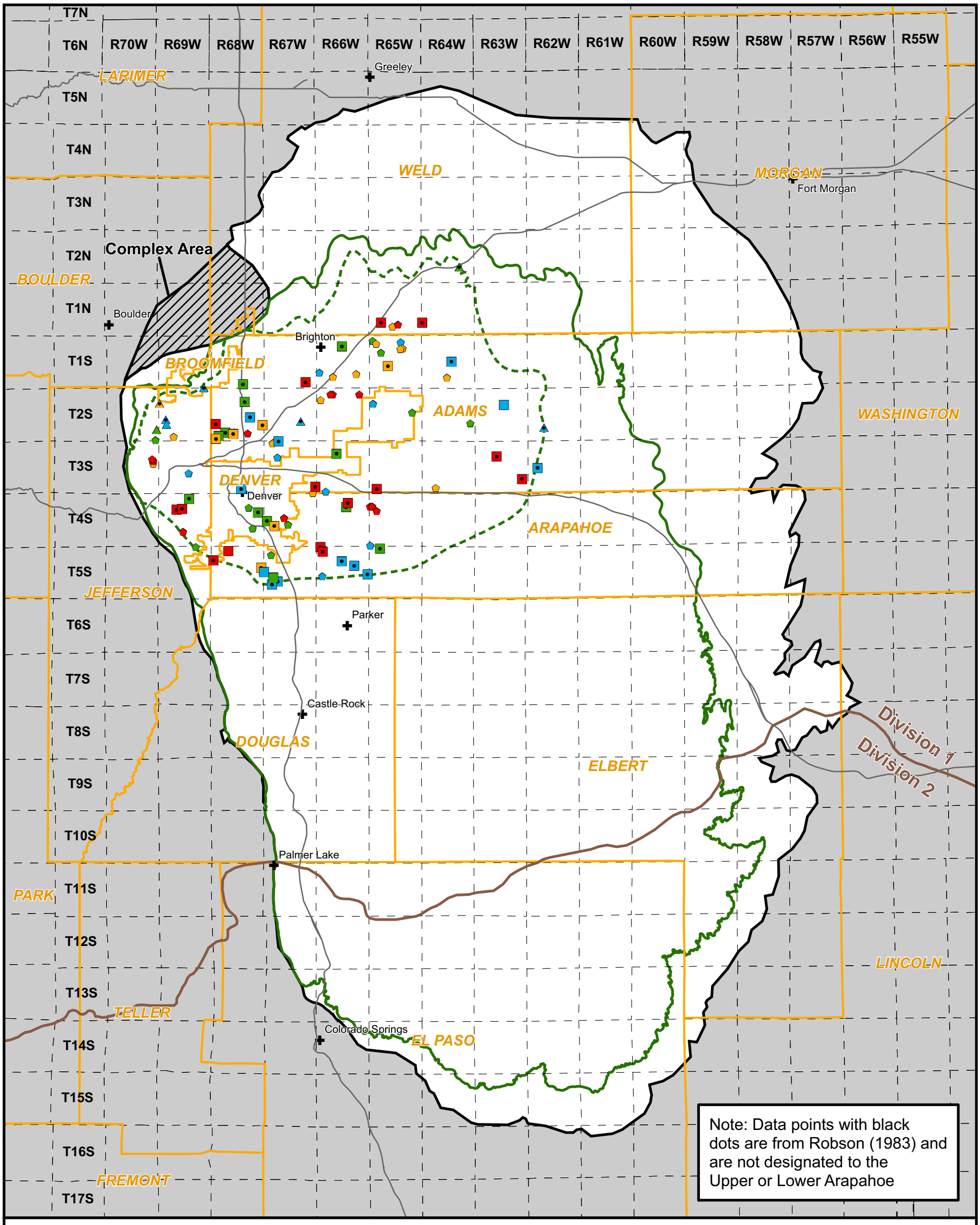

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Figure 10: Lower and Undivided Arapahoe Aquifer Hydraulic Conductivity Data

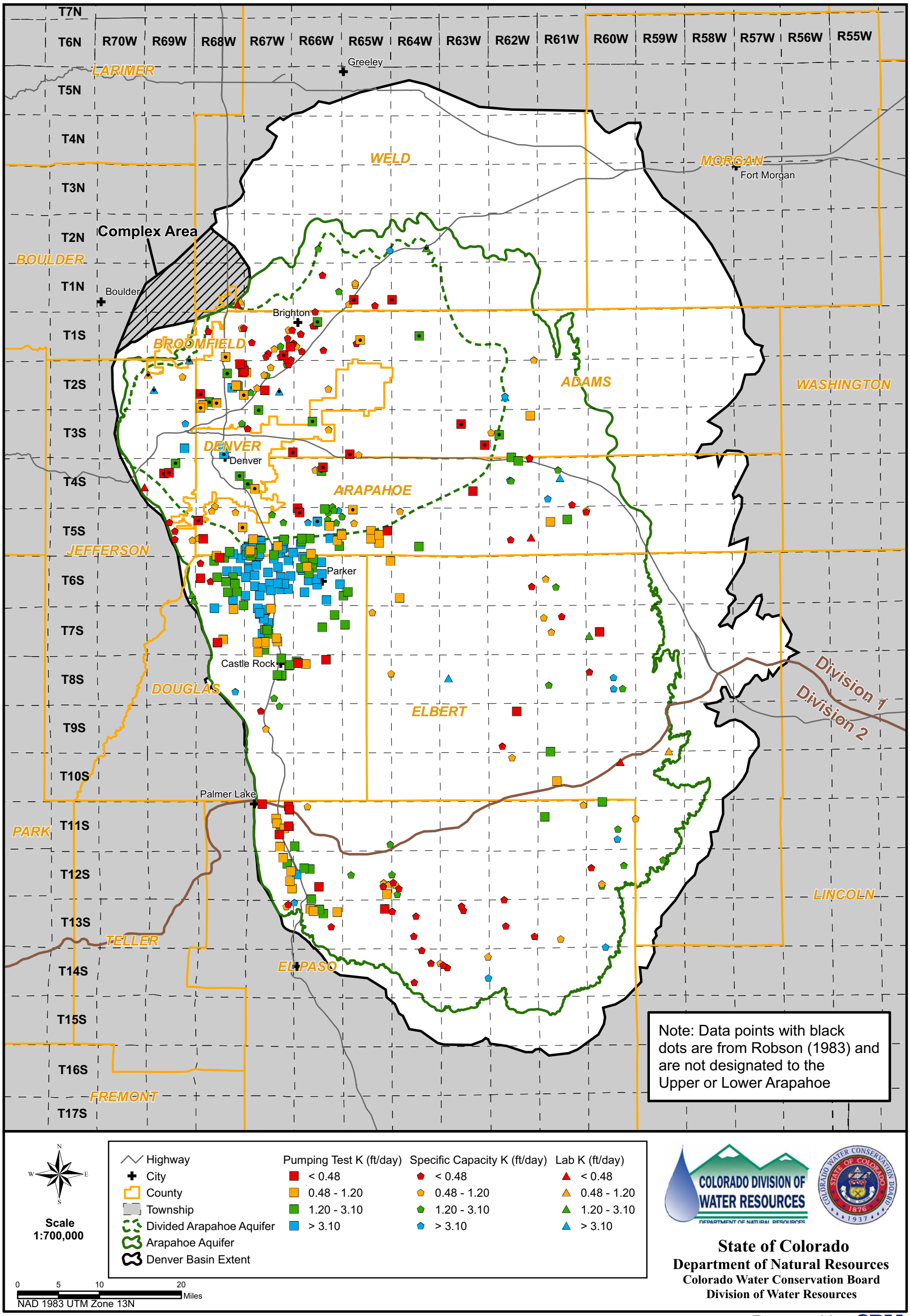

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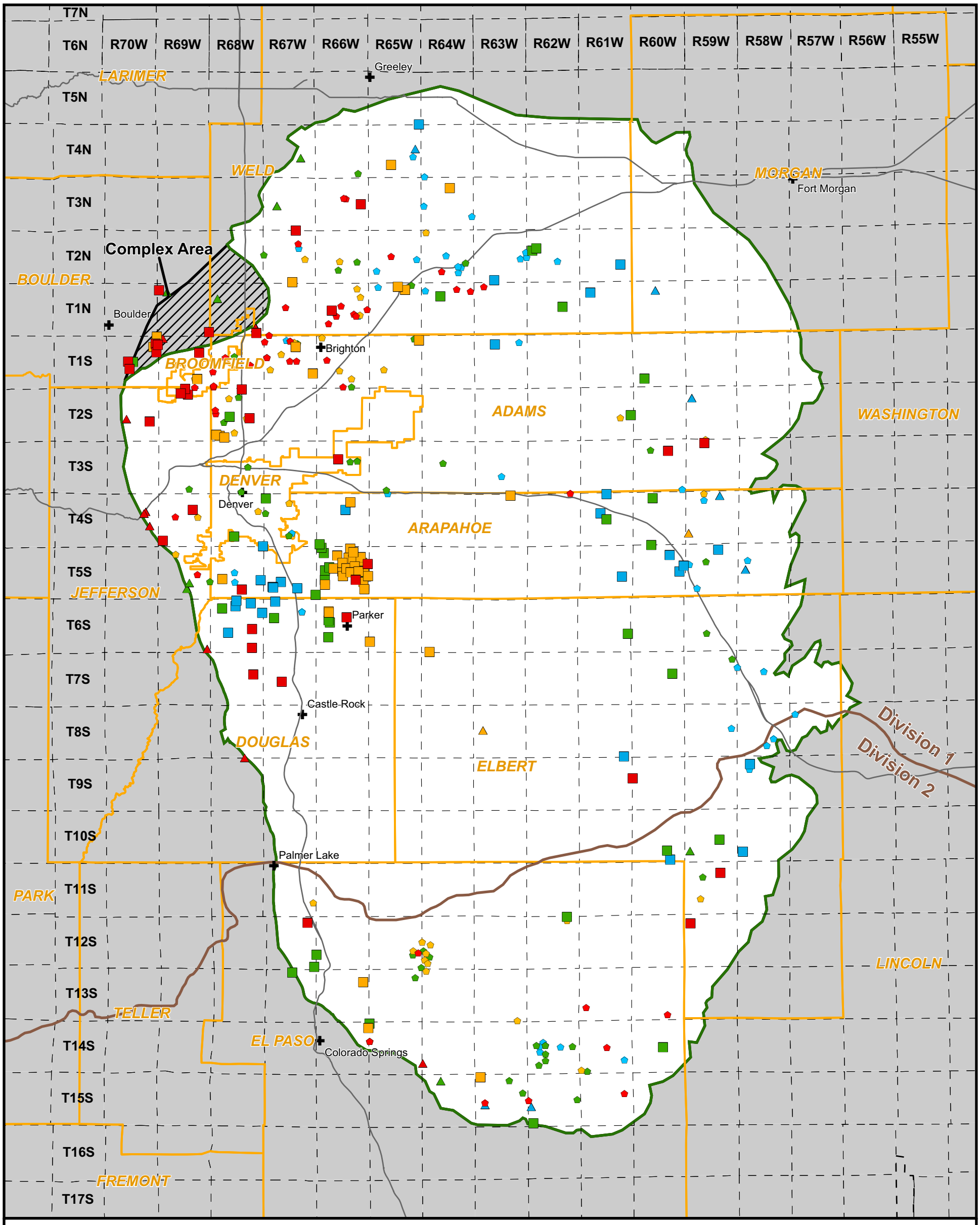
Figure 11: Laramie-Fox Hills Aquifer Hydraulic Conductivity Data



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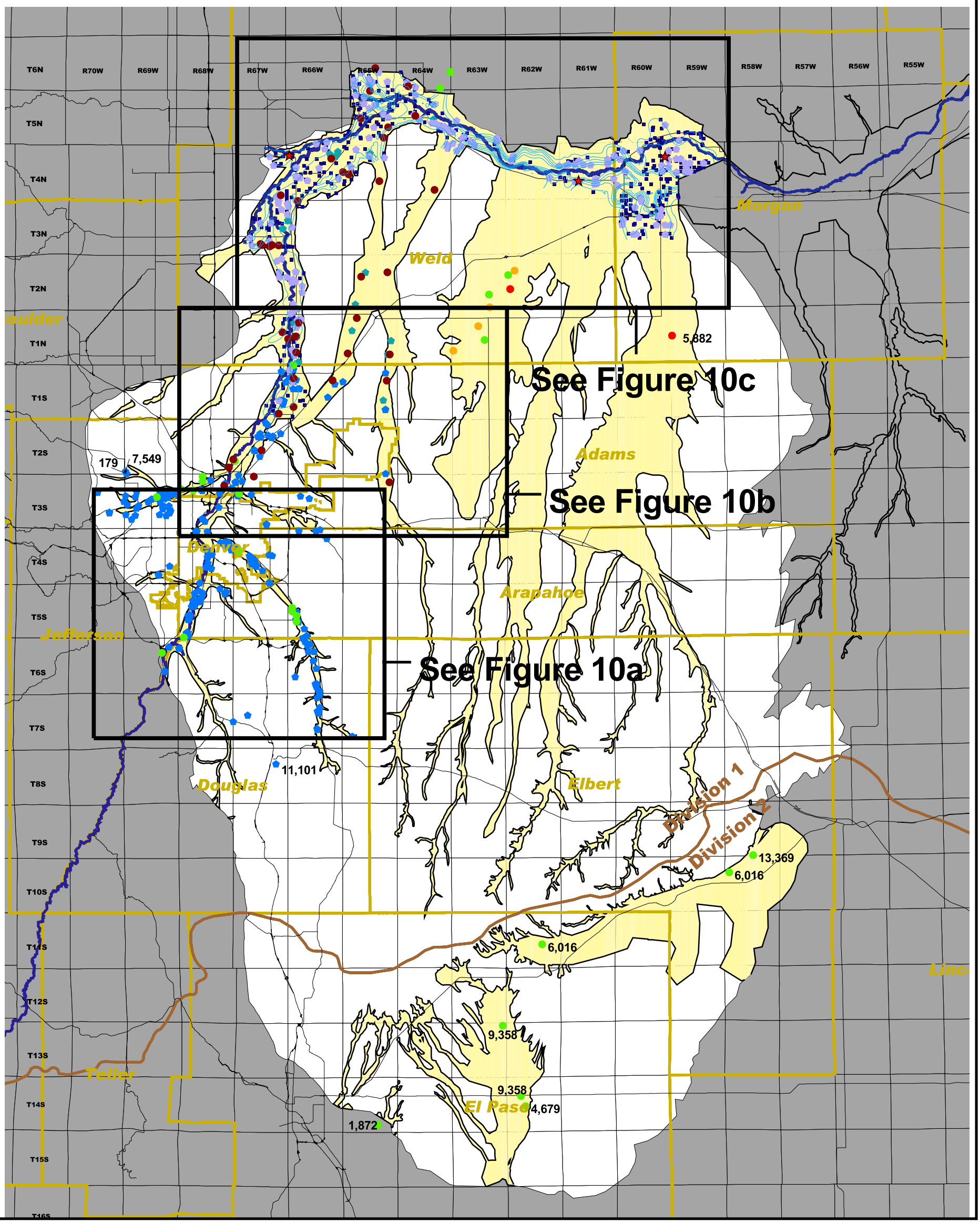
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin

Figure 10: Denver Basin Alluvial Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Alluvial Extent
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)
- Nelson et al. (1967) Pumping Test
- SEO Well Permit Database
- Schneider (1962) Specific Capacity Test
- McConaghy et al. (1964) Specific Capacity Test
- Smith et al. (1964)Pumping Test
- Wilson (1965) Pumping Test
- SPDSS Field Study Pumping Test
- Hurr and Schneider (1972) Data Point
- Hurr and Schneider (1972) Transmissivity Contour

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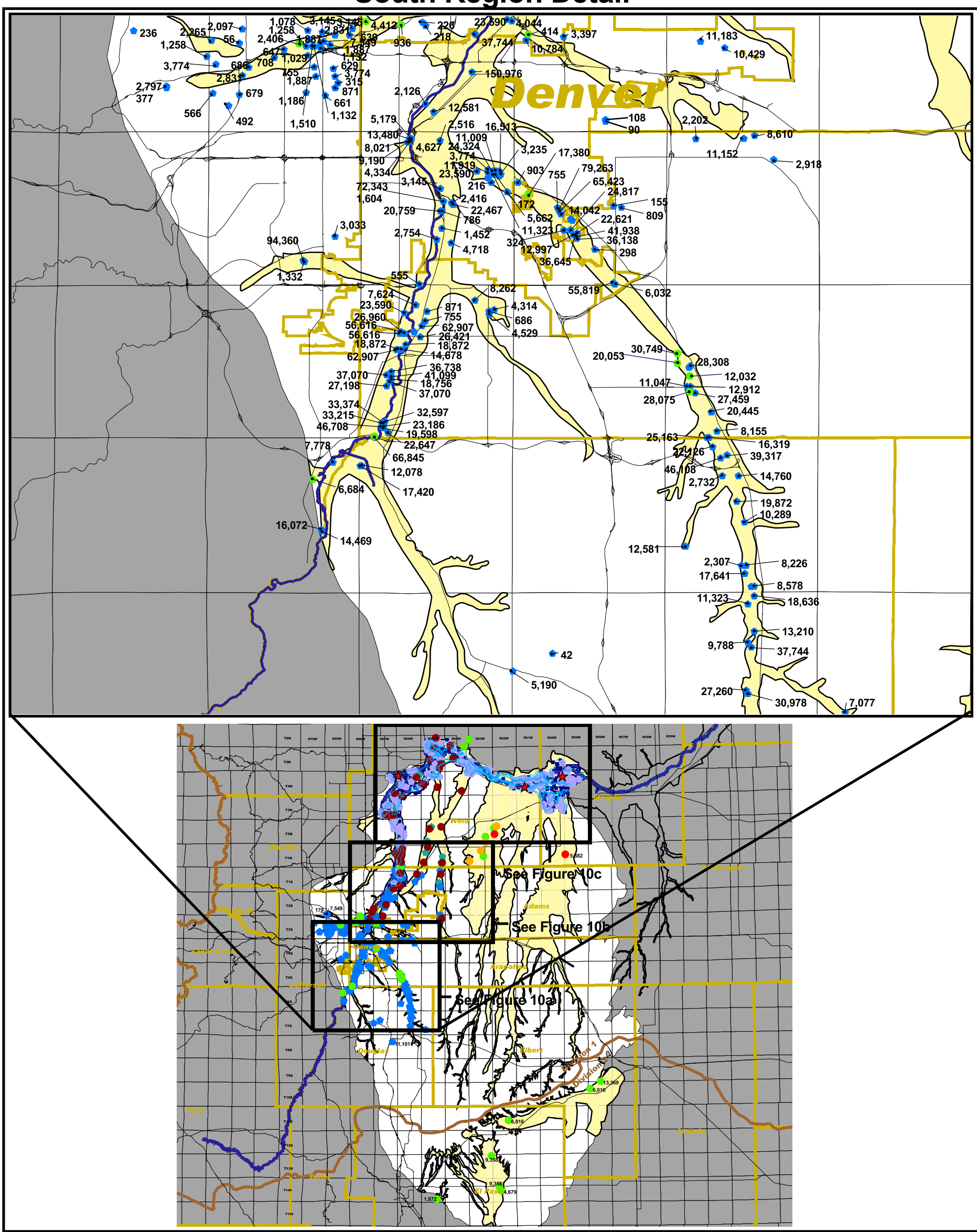
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin

Figure 10a: Denver Basin Alluvial Aquifer Transmissivity Data
South Region Detail



N
W E
S

1:250,000

1 0 1 2 Miles

NAD 1927 UTM Zone 13N

Alluvial Extent
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)
- SPDSS Field Study Pumping Test
- Nelson et al. (1967) Pumping Test
- SEO Well Permit Database
- Schneider (1962) Specific Capacity Test
- Smith et al. (1964)Pumping Test
- Wilson (1965) Pumping Test
- Hurr and Schneider (1972) Data Point
- Hurr and Schneider (1972) Transmissivity Contour

Countour Interval 10,000 ft^2/d

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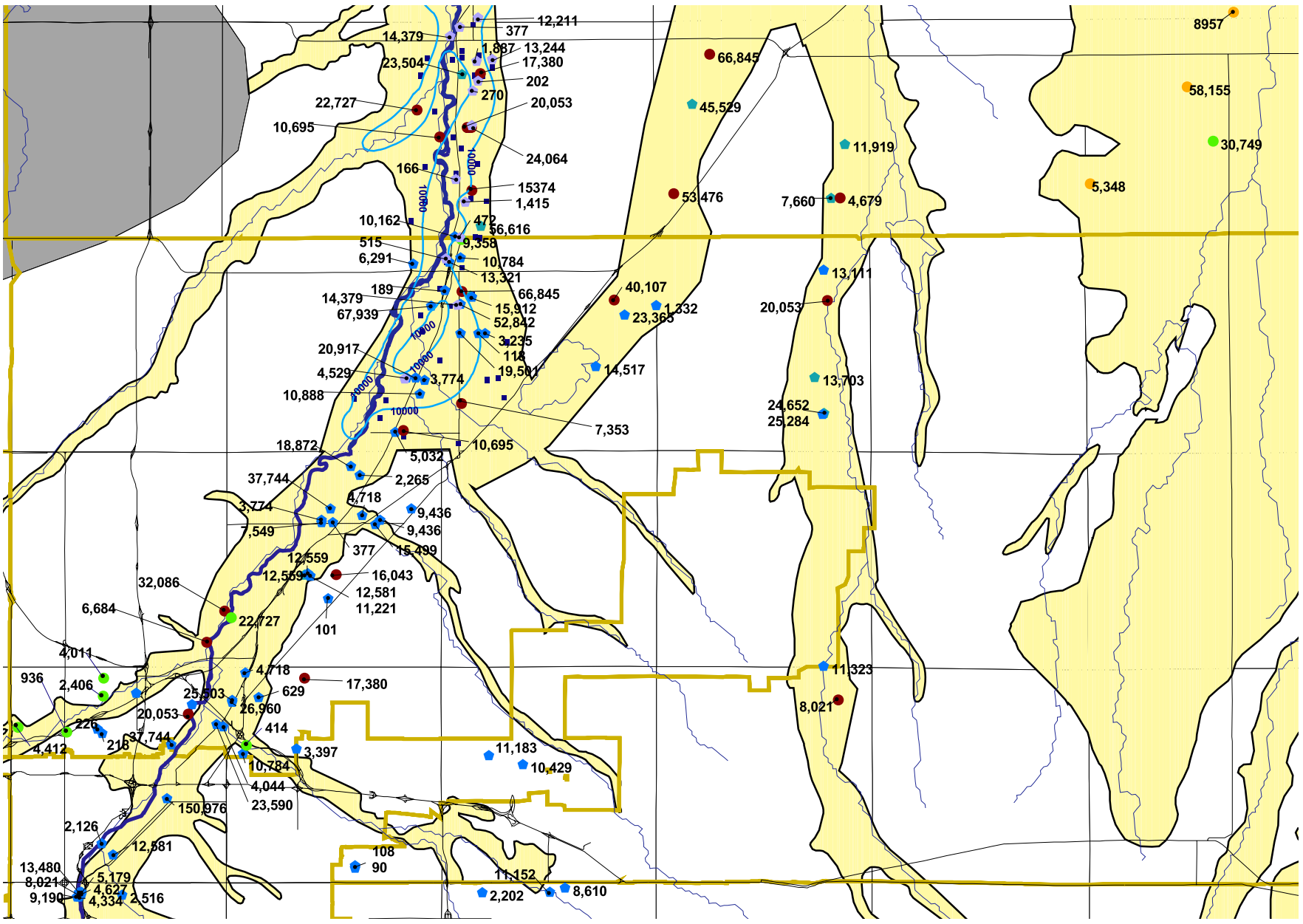
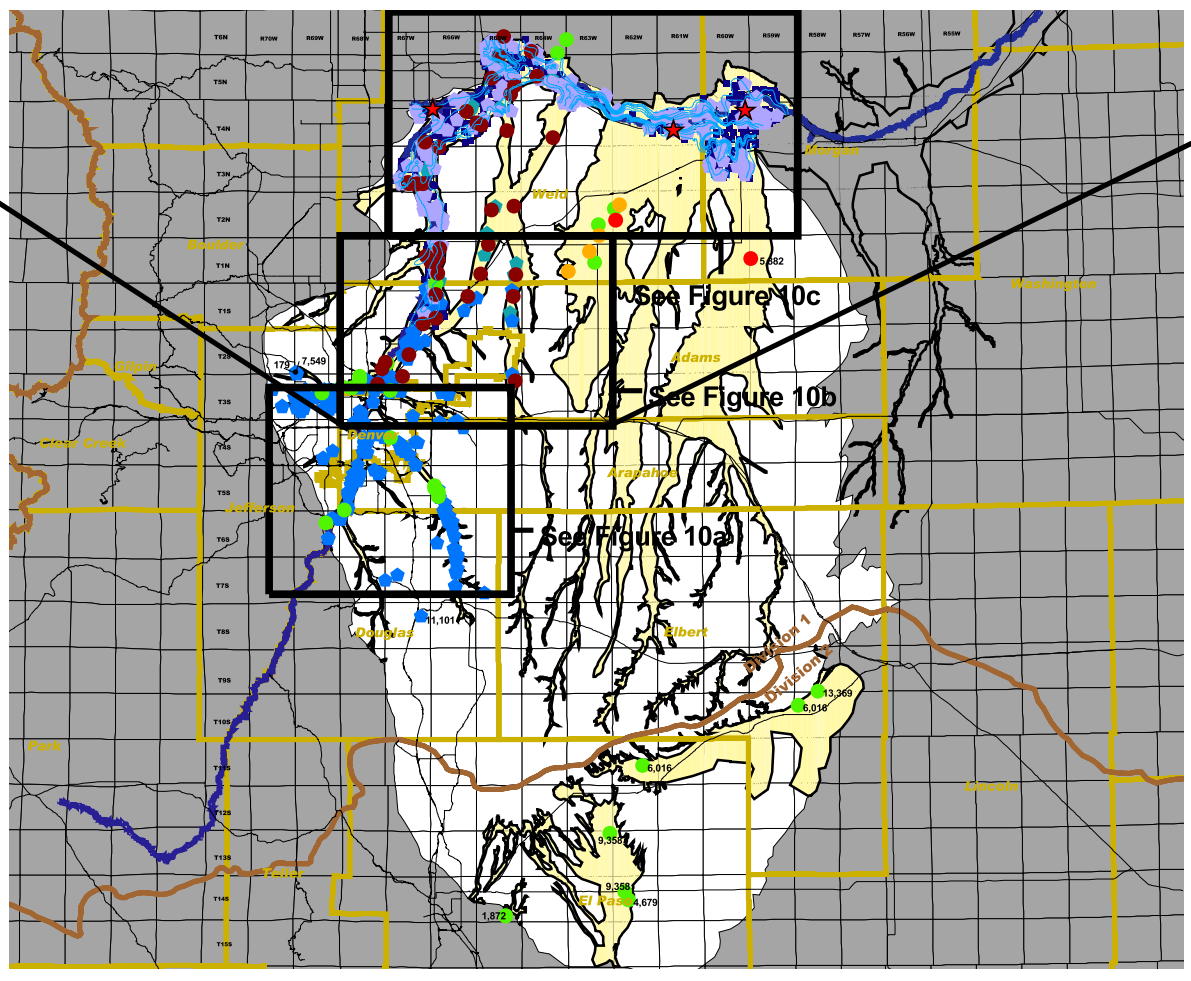
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin
Figure 10b: Denver Basin Alluvial Aquifer Transmissivity Data
Central Region Detail





N
W E
S

1:250,000

1 0 1 2 Miles

NAD 1927 UTM Zone 13N

- Alluvial Extent
- Counties
- Highways
- South Platte River

Transmissivity Data (ft^2/d)
- SPDSS Field Study Pumping Test
- Nelson et al. (1967) Pumping Test
- SEO Well Permit Database
- Schneider (1962) Specific Capacity Test
- Smith et al. (1964)Pumping Test
- Wilson (1965) Pumping Test
- Hurr and Schneider (1972) Data Point
- Hurr and Schneider (1972) Transmissivity Contour
  Countour Interval 10,000 ft^2/d

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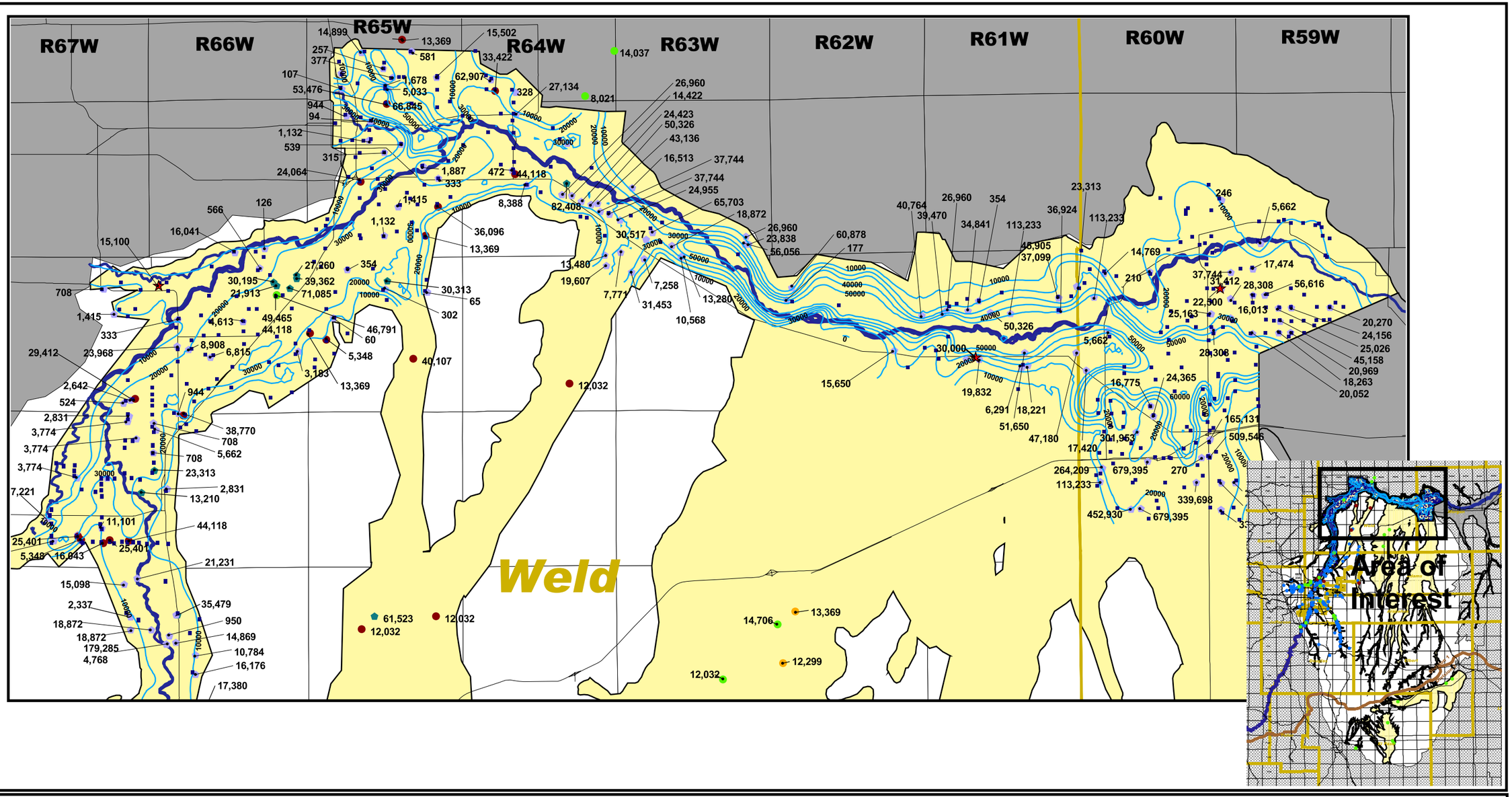
Figure 10c: Denver Basin Alluvial Aquifer Transmissivity Data: North Region Detail



N
W E
S

1:250,000

1 0 1 2 Miles

NAD 1927 UTM Zone 13N

Alluvial Extent
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)
- SPDSS Field Study Pumping Test
- Nelson et al. (1967) Pumping Test
- SEO Well Permit Database
- Schneider (1962) Specific Capacity Test
- Smith et al. (1964)Pumping Test
- Wilson (1965) Pumping Test
- Hurr and Schneider (1972) Data Point
- Hurr and Schneider (1972) Transmissivity Contour
  Countour Interval 10,000 ft^2/d

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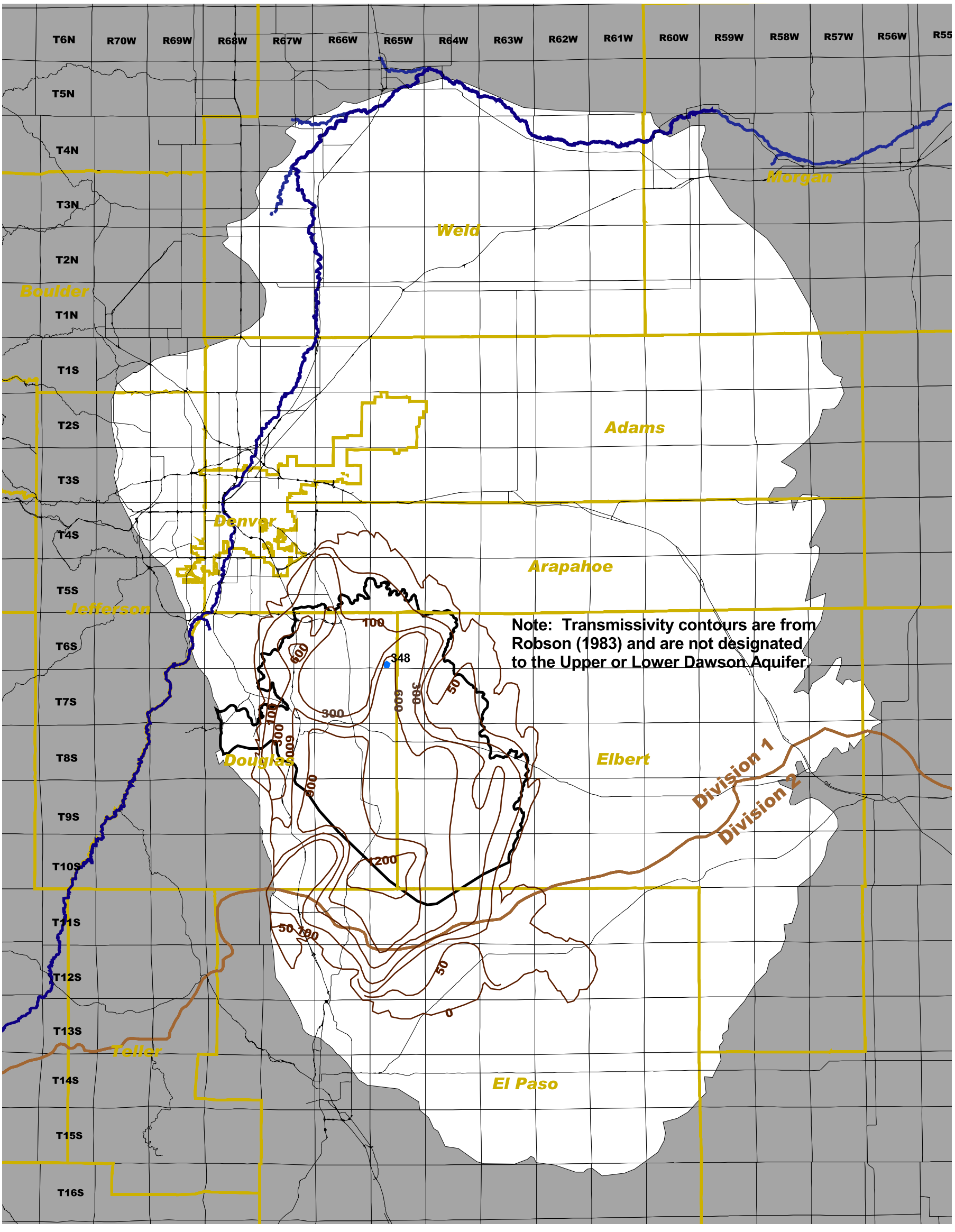
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin

Figure 11: Upper Dawson Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Upper Dawson Aquifer
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)

McConaghy et al. (1964) Specific Capacity Test
Robson (1983) Transmissivity Contour

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South Platte Decision Support System (SPDSS)
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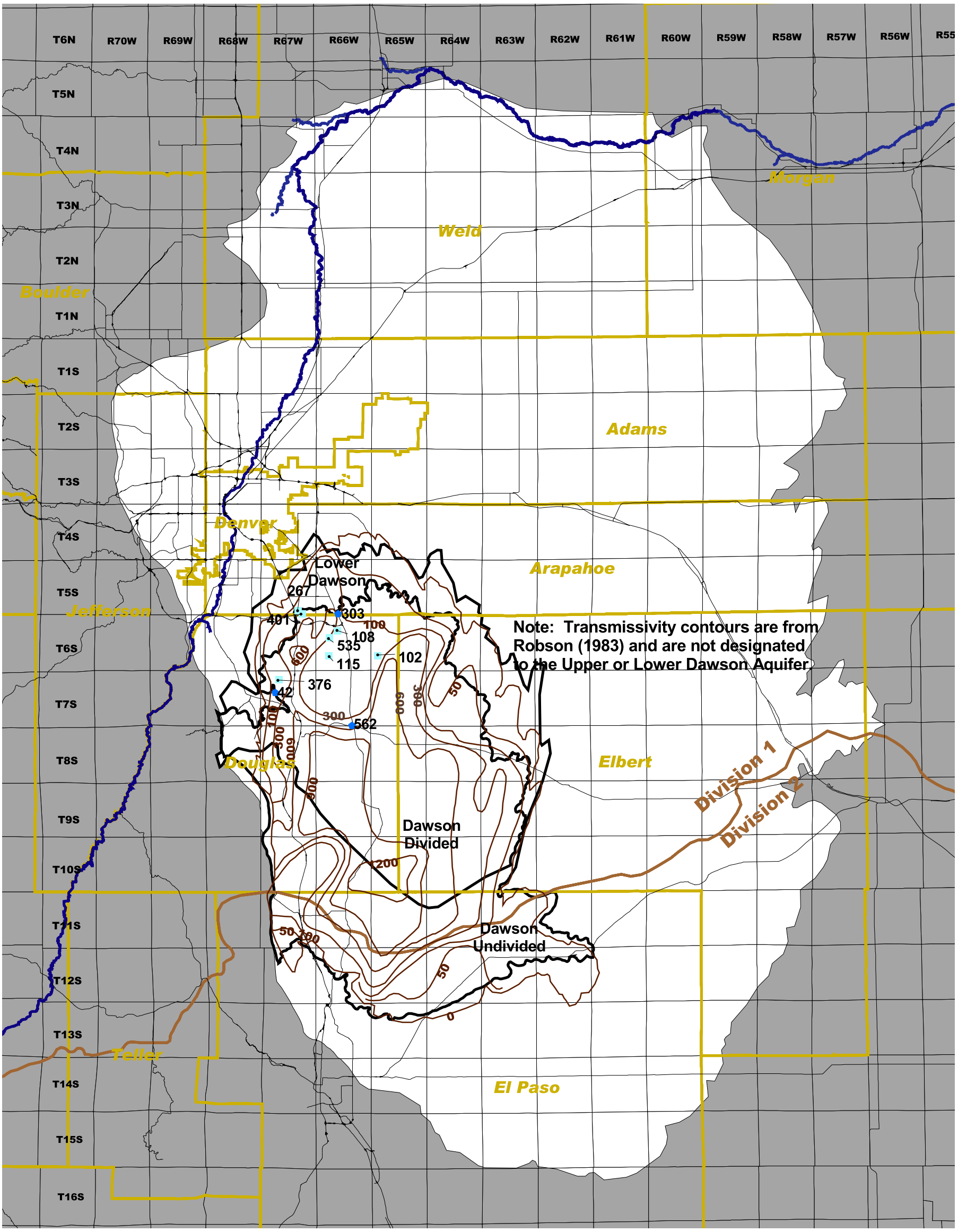
Figure 12: Lower Dawson Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Dawson Aquifer
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)
South Metro Study Pumping Test
McConaghy et al. (1964) Specific Capacity Test
Robson (1983) Transmissivity Contour

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South Platte Decision Support System (SPDSS)
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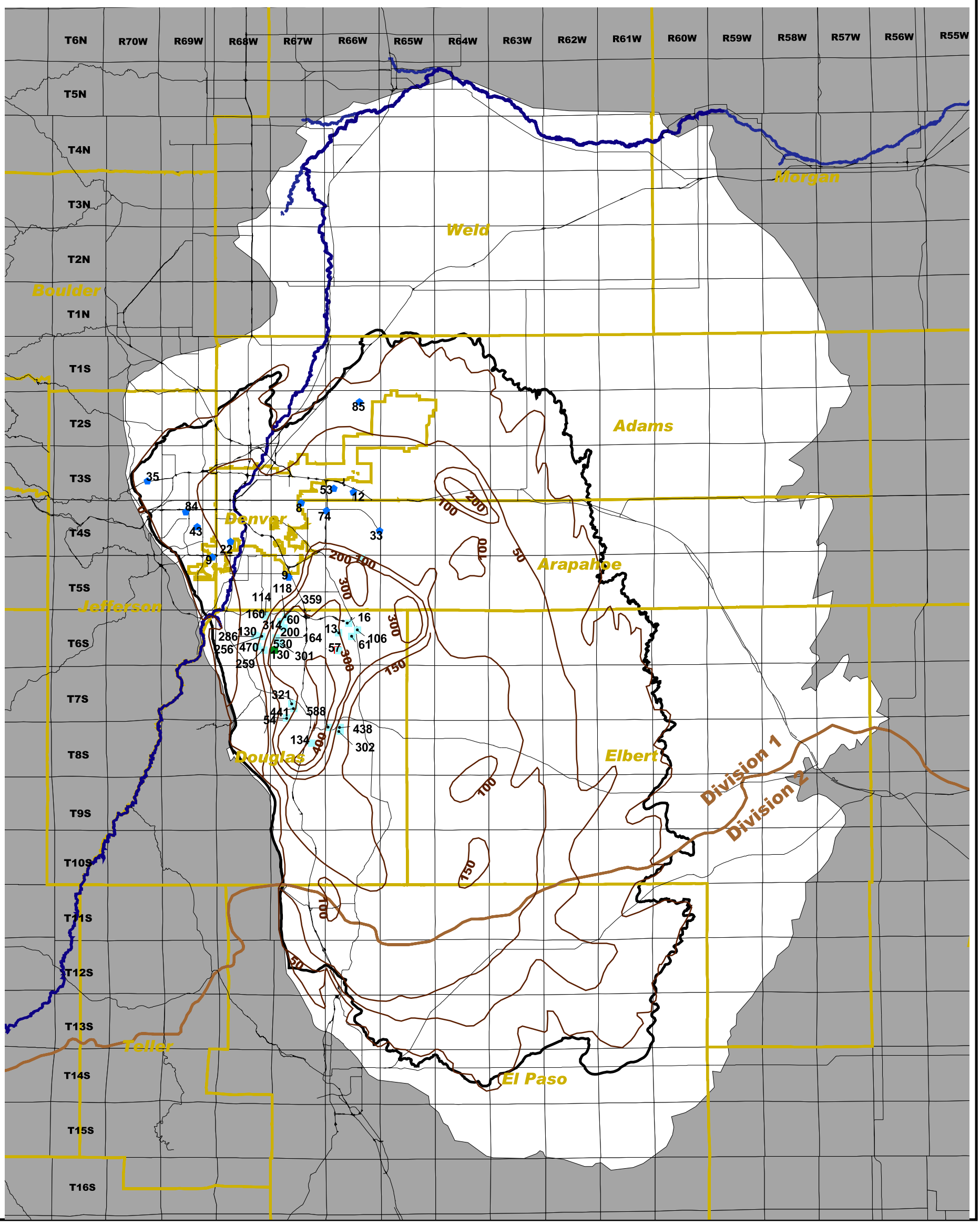
Figure 13: Denver Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

- Denver Aquifer
- Counties
- Highways
- South Platte River

Transmissivity Data (ft^2/d)

- South Metro Study Pumping Test
- Centennial WSD (Hill 1991) Pumping Test
- McConaghy et al. (1964) Specific Capacity Test
- Robson (1983) Transmissivity Contour

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South Platte Decision Support System (SPDSS)
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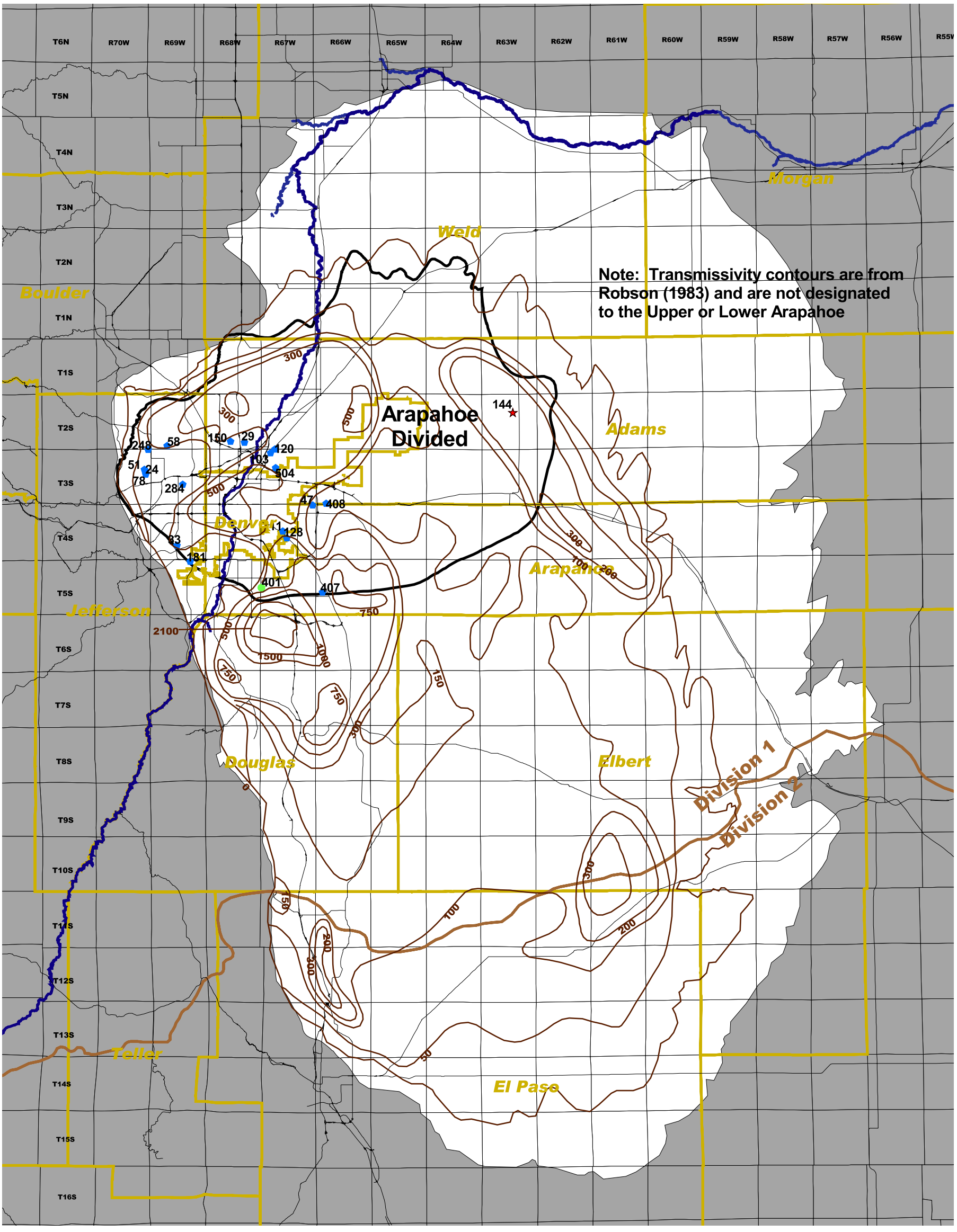
Figure 14: Upper Arapahoe Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Upper Arapahoe Aquifer
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)

McConaghy et al. (1964) Specific Capacity Test
Wilson (1965) Pumping Test
SPDSS Field Study Pumping Test
Robson (1983) Transmissivity Contour

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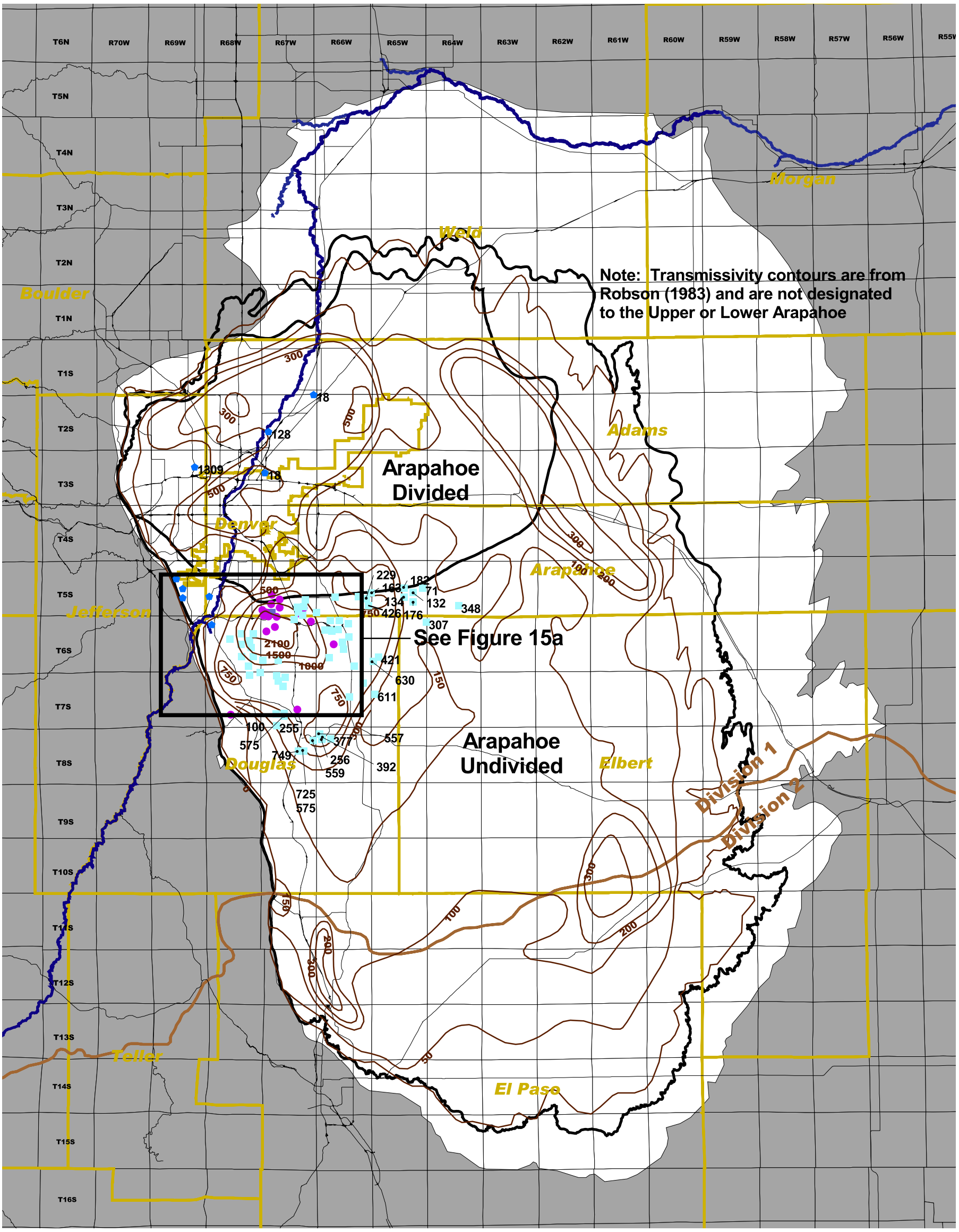
Prepared by: CDM

South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin

Figure 15: Lower Arapahoe Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

Arapahoe Aquifer
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)

South Metro Study Pumping Test
Willows WSD (Halepaska 1997) Pumping Test
McConaghy et al. (1964) Specific Capacity Test
Hillier et al. (1978) Pumping Test
Castle Pines (Robson & Banta 1990) Pumping Test
Robson (1983) Transmissivity Contour

NAD 1927 UTM Zone 13N

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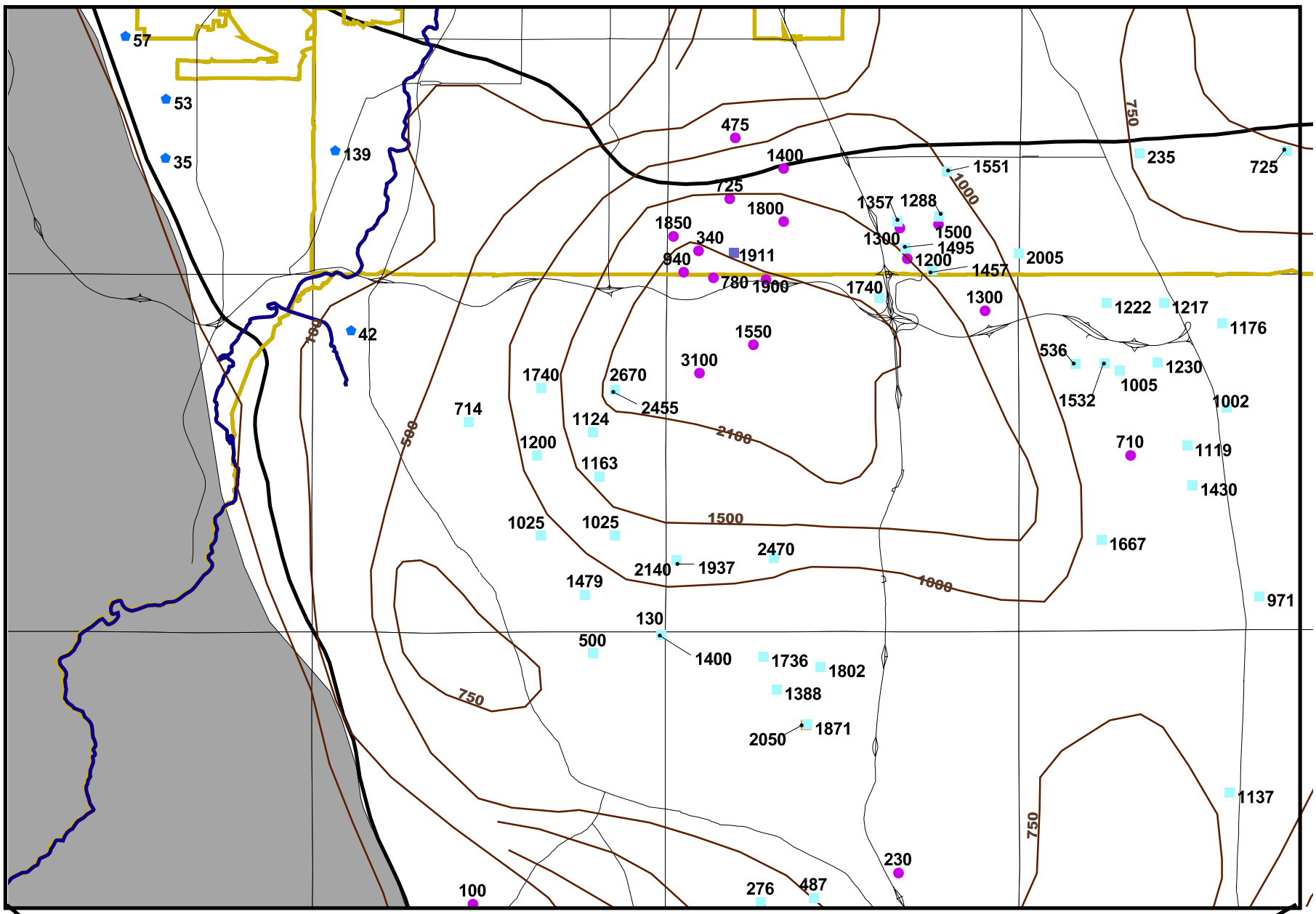
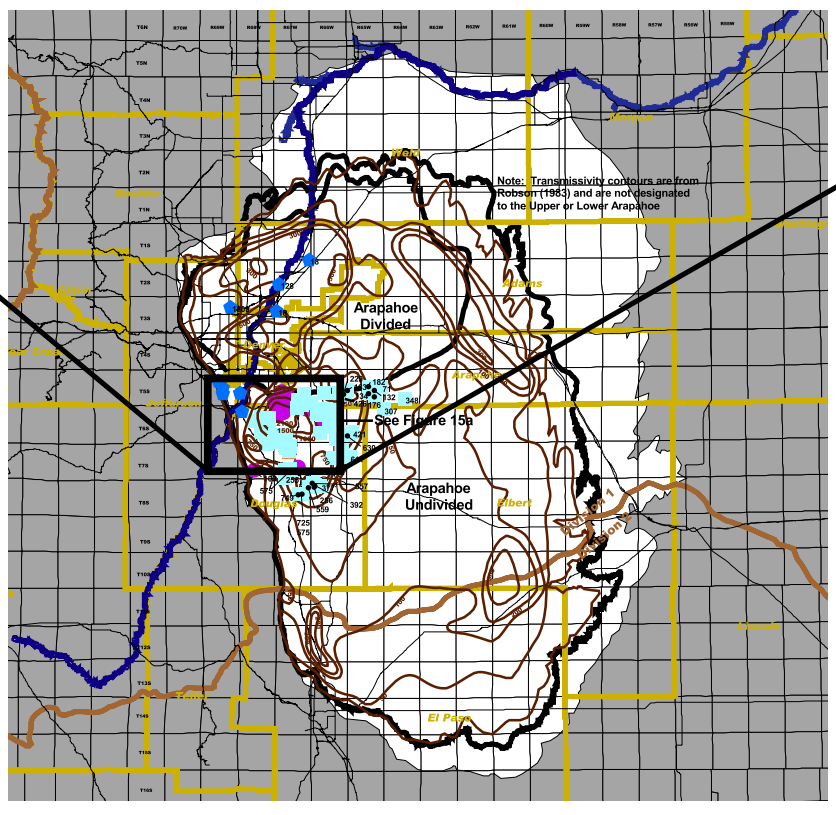
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin
Figure 15a: Lower Arapahoe Aquifer Transmissivity Data
South Metro Denver Area Detail





N
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1:150,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Transmissivity Data (ft^2/d)

- Arapahoe Aquifer
- Counties
- Highways
- South Platte River
- South Metro Study Pumping Test
- Willows WSD (Halepaska 1997) Pumping Test
- McConaghy et al. (1964) Specific Capacity Test
- Hillier et al. (1978) Pumping Test
- Castle Pines (Robson & Banta 1990) Pumping Test
- Robson (1983) Transmissivity Contour

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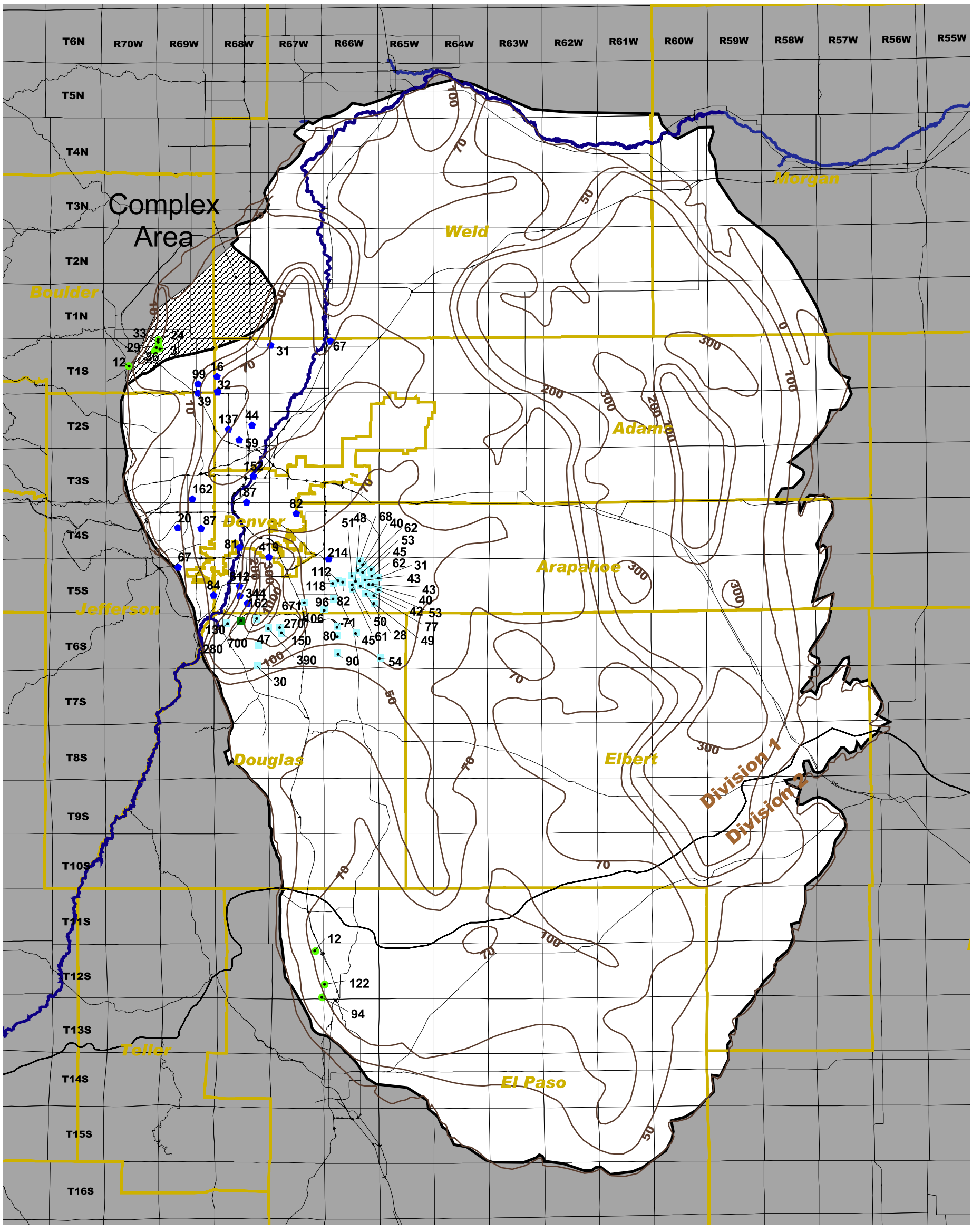
South Platte Decision Support System (SPDSS)
Division 1- South Platte River Basin

SB06-193 Study
Figure D.3-19

Figure 16: Laramie-Fox Hills Aquifer Transmissivity Data



N
W E
S

1:700,000

2 0 2 4 6 Miles

NAD 1927 UTM Zone 13N

Laramie-Fox Hills Aquifer
Counties
Highways
South Platte River

Transmissivity Data (ft^2/d)

South Metro Study Pumping Test
Wilson (1965) PumpingTest
Centennial WSD (Hill 1991) Pumping Test
McConaghy et al. (1964) Specific Capacity Test
Robson (1983) Transmissivity Contour

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Appendix D.4

Projected Unmet Demand Data

SB06-193 Study
Appendix D
March 1, 2007

Appendix D.4
Projected Year 2030 Unmet Demand Data

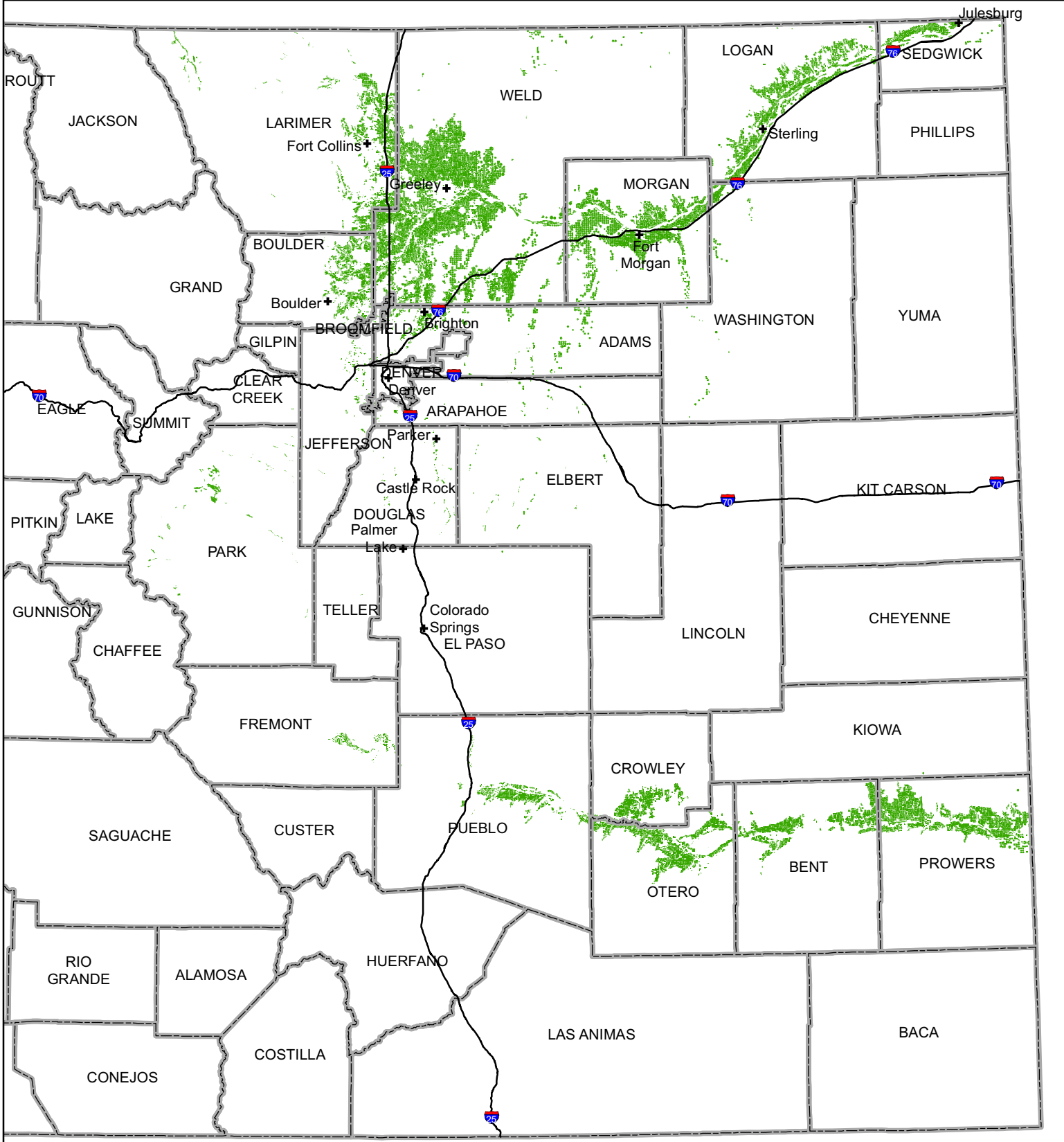
County	Projected Unmet Agricultural Demand	Projected Unmet Municipal and Industrial Demand	Total Projected Unmet Demand
ADAMS EAST	5,644	3,000	8,644
ADAMS WEST	4,624	7,000	11,624
ARAPAHOE EAST	712	500	1,212
ARAPAHOE WEST	284	0	284
BENT	14,487	100	14,587
BOULDER	15,096	2,550	17,646
BROOMFIELD	772	0	772
CHAFFEE	0	2,300	2,300
CLEAR CREEK	7	300	307
CROWLEY	8,839	100	8,939
CUSTER	0	350	350
DENVER	230	0	230
DOUGLAS	849	48,800	49,649
EL PASO EAST	66	1,600	1,666
EL PASO WEST	0	6,400	6,400
ELBERT	877	2,400	3,277
FREMONT	0	2,200	2,200
GILPIN	0	100	100
JEFFERSON	1,505	2,500	4,005
LAKE	0	1,100	1,100
LARIMER	28,888	1,200	30,088
LAS ANIMAS	0	500	500
LOGAN	34,952	0	34,952
MORGAN	48,305	8,000	56,305
OTERO	18,400	300	18,700
PARK	2,651	1,000	3,651
PROWERS	30,496	450	30,946
PUEBLO	7,025	0	7,025
SEDGWICK	9,072	0	9,072
TELLER	22	600	622
WASHINGTON	4,041	0	4,041
WELD EAST	51,365	4,650	56,015
WELD WEST	86,356	9,750	96,106

Notes:
"East"/"West" refers to portions of respective counties overlying Denver Basin Bedrock Aquifer subregions
Unmet agricultural demands calculated by allocating basin-wide unmet agricultural demands
according to irrigated acreage in each county.

SB06 - 193 Underground Water Storage Study

SB06-193 Study
Figure D.4-1

South Platte and Arkansas Basin Irrigated Lands



Sources: CDSS 2003; SPDSS 2001

N
W E
S

Scale: 1:2,100,000

10 5 0 10 Miles

- City
- Highway
- County
- Irrigated Lands

Colorado Water Conservation Board

Prepared by: CDM