BEAUMONT BASIN WATERMASTER

For

SAN TIMOTEO WATERSHED MANAGEMENT AUTHORITY

V.

CITY OF BANNING, ET AL
(CASE NO. RIC 389197)

FIRST BIENNIAL ENGINEERS REPORT
JULY 2003 THROUGH JUNE 2006

June 2007

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ACRONYM AND ABBREVIATIONS LIST	
acre-ft/yr	acre feet per year
BCVWD	Beaumont Cherry Valley Water District
CDFM	cumulated departure from the mean
MCL	maximum contaminant level
mg/L	milligrams per liter
RWQCB	Regional Water Quality Control Board, Santa Ana Region
SMWC	South Mesa Water Company
STWMA	San Timoteo Watershed Management Authority
SWRCB	State Water Resources Control Board
TDS	total dissolved solids
USGS	US Geological Survey
WEI	Wildermuth Environmental, Inc.
YVWD	Yucaipa Valley Water District

1. INTRODUCTION

Because of their common interest in the San Timoteo Watershed, the Beaumont Cherry Valley Water District (BCVWD), the City of Beaumont (Beaumont), the South Mesa Water Company (SMWC), and the Yucaipa Valley Water District (YVWD) formed the San Timoteo Watershed Management Authority (STWMA) in January 2001. Once formed, the STWMA began a watershed-wide, multi-phase effort to develop and implement a comprehensive San Timoteo Watershed Management Program (STWMP). Phase 1 included describing the area's water resources, establishing goals concerning the needs and issues identified for protecting and enhancing these resources, and affirming a management plan to accomplish these goals. This is documented in the San Timoteo Watershed Management Program, Phase 1 Report (Wildermuth Environmental, 2002) and its successor, the updated and re-titled Integrated Regional Water Management Program (IRWMP) for the San Timoteo Watershed (Wildermuth Environmental, 2005). The five goals include:

- Enhance basin water supplies.
- Protect and enhance water quality.
- Optimize management of the STWMA area groundwater basins.
- Protect riparian habitat in San Timoteo Creek and protect/enhance habitat in the STWMA area.
- Equitably distribute the benefits and costs of developing a San Timoteo Watershed Management Program (STWMP).

The process also identified the initiatives or program elements necessary to achieve these goals. Program Element 5 called for the STWMA members to establish a groundwater management entity for the Beaumont Basin. Two groups, representing appropriator and overlying interests, began negotiations in May 2002 to implement this program element.

A Stipulated Judgment was developed and submitted to the Court as a result of said negotiations. On February 4, 2004, the Honorable Judge Gary Tranbarger of the Superior Court of the State of California for the County of Riverside signed the Stipulated Judgment (Judgment) titled "*San Timoteo Watershed Management Authority, vs. City of Banning, et al*.," Case No. RIC 389197. Pursuant to the Judgment, the Court appointed a five-member Watermaster committee, consisting of representatives from the Cities of Banning and Beaumont, the BCVWD, the YVWD, and the SMWC. The effective date of the Judgment, for accounting purposes, is July 1, 2003. The Beaumont Basin encompasses approximately 26 square miles, has a safe yield of approximately 8,650 acre-feet/year, a total storage capacity of over a million acre-feet, and up to 200,000 acre-feet of storage capacity available for conjunctive use.

By approving the Judgment, the Court extended the responsibility of managing the Beaumont Basin to the Watermaster. Should there be any need in the future to resolve difficult questions, the Court retained continuing jurisdiction. The primary responsibilities of the Watermaster are listed below:

- Administer the Beaumont Basin Judgment.
- Approve producer activities.
- Develop contracts for beneficial programs and services.
- Maintain and improve the water supply.
- Maintain and improve water quality.
- Monitor and understand the basin.
- Provide cooperative leadership.

Part VI, Paragraph 5(A) of the Judgment calls for the establishment of Rules and Regulations for the conduct of Watermaster affairs. On June 8, 2004, Watermaster adopted the Rules and Regulations of the Beaumont Basin Watermaster. Section 2.13 of the Rules and Regulations calls for a basin condition report to be prepared at least once every two years. This report fulfills that requirement and is the first such report. The study period for this report is the fiscal years 2003-04 through 2005-06.

2. MONITORING PROGRAMS

2.1 Beaumont Basin Watermaster

2.1.1 Powers of the Beaumont Basin Watermaster

Part VI, Paragraph 5(G) of the Judgment gives the Beaumont Basin Watermaster (Watermaster) the power to conduct the monitoring of groundwater levels, ground levels, storage, and water quality. On a monthly basis, the appropriators report groundwater levels and production for the wells in their sphere of influence to the Watermaster. The appropriators in the Beaumont Basin include the City of Banning (Banning), the BCVWD, the SMWC, and the YVWD. As with groundwater level and groundwater production data, groundwater quality data are being managed by Watermaster in order to perform the requisite scientific and engineering analyses to ensure that the requirements of the Judgment are being met. Watermaster has a relational database that contains well location, construction, lithology, specific capacity, groundwater level, and water quality information.

In addition to the monitoring mentioned above, the Watermaster has initiated two studies to further understand the state of the Beaumont Basin and the impacts from the operation of the Basin: the subsidence monitoring and groundwater level monitoring programs.

2.1.2 Subsidence Monitoring Program

A subsidence monitoring program was initiated by the STWMA on behalf of the Watermaster during the 2005-06 fiscal year. The Watermaster adopted Resolution 2004-07 entitled "*A Resolution of the Beaumont Basin Watermaster in Support of AB303 Grant Applications That Further the Management of the Beaumont Basin*" on November 4, 2004. Program Element 1 of the IRWMP calls for the development and implementation of a comprehensive monitoring program for the STWMA area, including the Beaumont Basin. The Watermaster is concerned about the potential for future subsidence that could occur as a result of past and future groundwater pumping in the Basin. On behalf of the Watermaster, the STWMA developed a monitoring program specifically to assess the occurrence of subsidence from past groundwater pumping and future pumping. To implement this program, the STWMA applied for an AB303 Grant from the Department of Water Resources. The Watermaster agreed to match the funds if the application was successful. The application was successful, and as previously stated, the subsidence monitoring program was initiated during the 2005-06 fiscal year.

The preliminary results of the program indicated very little, if any, subsidence has occurred as a result of historic pumping and overdraft. Historical subsidence data (survey data and remote sensing data [InSAR]) for the period of 1928 to 2000 was compiled, analyzed, and used to finalize the locations of new survey lines that will be monitored for land subsidence, if any, that may accompany the future drawdown of water levels. The Beaumont Basin monuments were installed, and ground level surveys were completed in November 2006 and April 2007. Annual ground level surveys will be conducted to monitor for any possible land subsidence.

2.1.3 Groundwater Level Monitoring Program

In fiscal year 2006-07, the Watermaster initiated a groundwater level monitoring program to determine the location of subsurface groundwater barriers and to collect consistent long-term groundwater level information for its own use and for the use of pumpers in the Beaumont Basin. The implementation of this program consisted of the establishment of a groundwater level monitoring network and the installation of integrated pressure transducers and data loggers in ten wells. These instruments measure and record groundwater levels every fifteen minutes.

In addition to the data that the Watermaster collects from the ten pressure transducers mentioned above, the BCVWD and the SMWC report transducer data from their wells to the Watermaster. This information is also stored in a relational database.

2.2 Maximum Benefit Monitoring Program

In January 2004, the Santa Ana Regional Water Quality Control Board (RWQCB) amended the Water Quality Control Plan (Basin Plan) for the Santa Ana River Basin, incorporating an updated total dissolved solids (TDS) and nitrogen management plan (RWQCB, 2004). This amendment includes revised groundwater subbasin boundaries, revised TDS and nitrate-nitrogen quality objectives for groundwater, revised TDS and nitrogen wasteload allocations, revised reach designations, as well as TDS and nitrogen objectives and beneficial uses for specific surface waters.

The Basin Plan Amendment includes both “antidegradation” and “maximum benefit” objectives for TDS and nitrate-nitrogen for the Beaumont, San Timoteo, and Yucaipa Management Zones. The application of the “maximum benefit” objectives relies on the implementation of a specific program of projects and requirements—on behalf of the STWMA, the YVWD, and the City of Beaumont—that are an integral part of the IRWMP for the San Timoteo Watershed.

Table 5-9a and 5-10a in the Basin Plan Amendment identify the projects and requirements that must be implemented to demonstrate that water quality, consistent with maximum benefit to the people of the state, will be maintained. Two of the commitments in these tables are for surface water and groundwater monitoring programs. On April 15, 2005, the RWQCB adopted resolution R8-2005-0066—approving the Surface Water and Groundwater Monitoring Programs in support of the STWMA’s and the City of Beaumont’s maximum benefit commitments in the Beaumont and San Timoteo Management Zones—and resolution R8-2005-0065—approving the Surface Water and Groundwater Monitoring Programs in support of the YVWD’s maximum benefit commitments in the San Timoteo and Yucaipa Management Zones. The Groundwater Monitoring Programs for the Beaumont, San Timoteo, and Yucaipa Management Zones include the following key components: a well canvas, a groundwater level monitoring program, and a groundwater quality monitoring program.

2.2.1 Well Canvas

The first step of the groundwater monitoring program was to identify the universe of wells in the management zone of interest. A total of about 520 wells were identified in the Beaumont, San Timoteo, and Yucaipa Management Zones. Figure 2-1 shows the locations of the management zones and the wells identified. To obtain the necessary station information and to determine whether a water level measurement and water quality sample could be obtained, every well was canvassed via a site visitation. Station information is the static information of a well, including well name(s), well owner, location coordinates, well status, casing diameter, well depth, lithology, and screened intervals. This data was entered into a relational database. During the well canvas effort, many private wells could not be located and were presumed to be destroyed. New wells were found and added to the groundwater level and quality monitoring programs where appropriate.

2.2.2 Groundwater Level Monitoring Program

At the initiation of the Groundwater Level Monitoring Program, historical groundwater level data was acquired from the entities that have collected groundwater level data in the management zones of interest. Data is collected annually from agencies that have existing groundwater level monitoring programs. Additionally, monthly static groundwater level measurements are taken at all of the wells where water level measurements are obtainable, as identified during the well canvassing. All groundwater level data is entered into a relational database.

A key well program will be developed in fiscal 07/08. An assessment of the groundwater level data will be made to evaluate the minimum set of wells that need to be monitored to meet the management needs of the area. This minimum set of wells may include the construction of new monitoring wells.

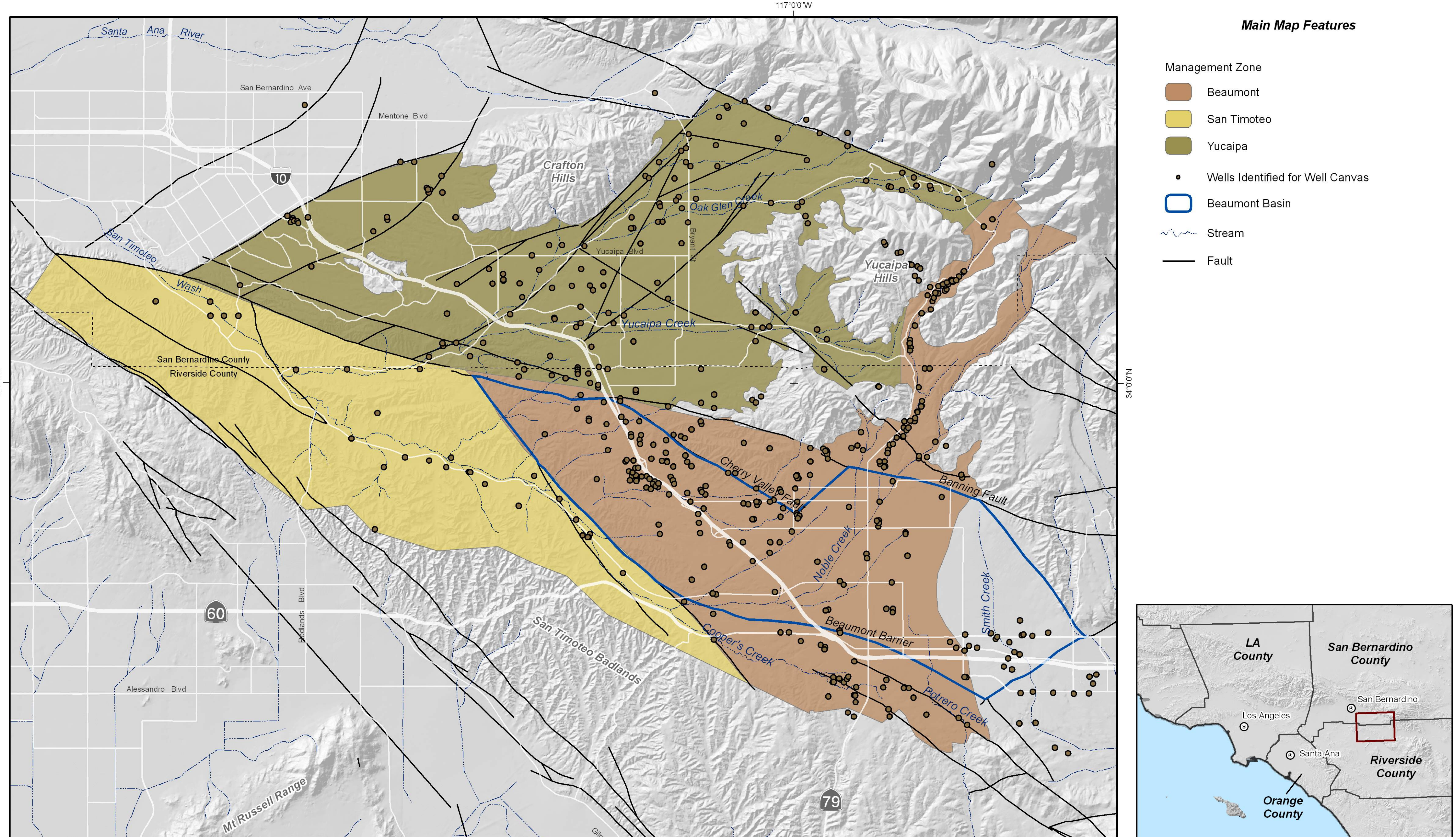
2.2.3 Groundwater Quality Monitoring Program

The Groundwater Quality Monitoring Program consists of collecting existing water quality data and sampling wells without existing data. All available groundwater quality data was acquired from entities that have existing and mandated water quality programs. Water quality samples from wells operated by appropriator producers and some overlying producers are collected as part of formalized monitoring programs. Constituents include those that are regulated for drinking water purposes in the California Code of Regulations, Title 22 or that are of special interest to the pumper. As with the Groundwater Level Monitoring Program, data is gathered annually from the agencies that collect groundwater quality data. A sampling program has been implemented for private and publicly owned wells that were identified for sampling in the well canvassing and are not part of an existing or mandated water quality monitoring program. These wells have been sampled once during the first two years of the monitoring program. All groundwater quality data is entered into a relational database.

A key well program will be developed in fiscal 07/08. The data collected will be rigorously reviewed, and based on this review, a long-term monitoring program will be developed and implemented. The long-term monitoring program will contain a minimum set of key wells that can be periodically monitored to assess water quality conditions in the area over time. As with groundwater level monitoring, this may require the construction of new monitoring wells.

2.3 Cooperative Monitoring Programs

The U.S. Geological Survey (USGS) monitors numerous wells throughout the Beaumont Basin. This monitoring consists of water level measurements in the spring and fall and periodic water quality sampling.



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Beaumont Basin Watermaster
Biennial Engineers Report 2006

Management Zones

Figure 2-1

3. GROUNDWATER PUMPING, ELEVATION, AND STORAGE

3.1 Groundwater Pumping

Table 3-1 shows appropriative and overlying groundwater pumping in the Beaumont Basin for the study period of this report, which is fiscal years 2003-04 through 2005-06. All parties to the Judgment are required to report monthly pumping to the Beaumont Basin Watermaster. In some cases, only annual pumping was reported or engineering estimates of pumping were made. Figure 3-1 shows the wells in the Beaumont Basin and shows which wells pump more than 10 acre-feet/year. In 2005, Sunny-Cal Egg and Poultry Company ceased pumping.

The largest pumpers in the Beaumont Basin, those that pump over 1,000 acre-feet/year, are Banning, the BCVWD, the YVWD, and the So Cal Professional Golfer's Association. The first three pumpers supply drinking water to the Cities of Banning, Beaumont, and Yucaipa, and unincorporated areas of Riverside County and the So Cal PGA pumps groundwater to irrigate golf courses. Of the four largest pumpers, the BCVWD pumps the greatest amount of groundwater from the Beaumont Basin. The BCVWD's service area and sphere of influence, which is shown in Figure 3-1, cover the over half of the Beaumont Basin.

Over the study period, the BCVWD's and the SMWC's groundwater pumping has increased; whereas, the City of Banning's groundwater pumping has decreased. The YVWD's groundwater pumping fluctuated over the study period. Even though Banning's pumping decreased during the study period, their overall water demand has grown. To meet its water demand, the city has utilized its groundwater supplies from other basins.

The population of San Timoteo Watershed region is growing and water demand is increasing. In the next couple of years, recycled water will be used for irrigation in lieu groundwater. Moreover, the two largest overlying pumpers in the Beaumont Basin, the California Oak Valley Golf and Resort and So Cal Professional Golfer's Association, will be using recycled water for irrigation in the near future. And, the groundwater pumping of other overlying pumpers is expected to decrease in the next few years as more development occurs and land uses shift from agricultural to residential and commercial.

Table 3-2 shows the projected groundwater pumping in the Beaumont Basin through the year 2020. The projections for the appropriators shown in this table are based on the most current planning numbers from the individual agencies. The projections for overlying pumpers reflect the transition of overlying water rights to appropriative water rights for the overliers that will transfer their water rights because of changing land uses and the use of recycled water in lieu of groundwater. The Groundwater pumping by the SMWC and overlying pumpers is projected to decrease through 2020, while pumping by Banning, the BCVWD, and the YVWD is projected to increase through 2020. Although the SMWC plans to decrease its pumping in the Beaumont Basin, its demand will increase, and this increase in demand will be met by imported water, recycled water, and other groundwater sources. Any groundwater that the City of Banning, the BCVWD, the YVWD pump from the Beaumont Basin beyond the safe yield will be offset by the use of the temporary surplus and the recharge of imported water, recycled water, stormwater, and urban runoff.

3.2 Groundwater Elevation

Section 2 describes the groundwater level monitoring programs in the Beaumont Basin. Groundwater level data is being collected by several agencies and includes data on private, monitoring, and production wells. Figure 3-2 shows all wells in the Beaumont Basin with groundwater level data for the period of 2003 through 2006. This data was used to generate groundwater elevation contour maps for fall 2003 and fall 2006.

Groundwater elevation time histories are provided in the Appendix for the wells in Figure 3-2 that have numerical IDs. In these time histories, groundwater elevation time histories are plotted against a cumulative departure from the mean (CDFM) curve. The CDFM curve is a representation of precipitation over time and, when plotted with a groundwater elevation time history, aids in understanding groundwater elevation fluctuations. The time histories can be used to distinguish between static and pumping groundwater levels. Pumping groundwater level measurements were discarded for the development of the groundwater elevation contour maps.

Figure 3-3 is a groundwater elevation contour map for fall 2003. It displays the general groundwater flow patterns (groundwater flows perpendicular to the contours). Groundwater flow typically follows the surface drainage patterns from higher elevations in the north to lower elevations in the southeast and west. Along these flow paths, groundwater encounters numerous faults, which act as barriers to flow with varying effectiveness. The major fault barriers in the Beaumont area are the Banning and Cherry Valley Fault Zones and the Beaumont Barrier. From the Banning Fault, at the mouth of Edgar Canyon, groundwater within the Beaumont Basin flows southward under a relatively minor gradient toward the City of Beaumont where the groundwater flow divides. Groundwater east of this divide flows southeastward, and some discharges as underflow into the Banning Basin. West of this divide, groundwater flows westward and discharges as underflow into the San Timoteo Basin or as rising groundwater at springs and seeps in the tributaries of San Timoteo Creek.

Figure 3-4 shows groundwater elevations for fall 2006. Because the Groundwater Level Monitoring Program began in 2005, more groundwater elevation data was available in 2006 than in 2003. Overall, the groundwater flow follows the same general pattern as in fall 2003.

Across the Beaumont Basin groundwater elevations have predominately declined over the period ranging from 2003 to 2006. The difference in groundwater elevations is shown in Figure 3-5. Groundwater elevations have declined by about 20 feet throughout the majority of the basin and increased by about 10 to 20 feet in the southeast near the border of the Beaumont and Banning Basins. This increase in groundwater elevations is most likely due to decreased pumping at the wells owned by Banning in this region.

Groundwater elevations were expected to decline over the study period as groundwater production has exceeded the safe yield of the Beaumont Basin. Specifically, during the study period, groundwater pumping exceeded the safe yield by about 21,300 acre-feet. The Judgment established a temporary surplus that allows up to 160,000 acre-ft of overdraft within the Beaumont Basin during the first ten years of operation. The purpose of the temporary surplus is to create room for the safe storage of supplemental water and to reduce losses from the basin to surrounding basins.

3.3 Groundwater Storage

Groundwater storage changes in response to how a groundwater basin is operated. This change can be calculated from the change in groundwater elevations over a known time period and the specific yield of the aquifer. The specific yield is the quantity of water that a unit volume of an aquifer, after being saturated, will yield by gravity. The specific yield of the Beaumont Basin was estimated using lithological data and pump test data from well completion reports. These estimates were further refined during the calibration of the BCVWD Beaumont Area Groundwater Flow Model (WEI, 2007). During the calibration process, the specific yield values were adjusted such that the model simulated water level changes over the 1927 to 2004 period closely corresponded to the actual measured water level data for that period. The resulting areal distribution of specific yield is shown in Figure 3-6.

On the far east side of the northwest edge of the basin, there is a small cluster of wells. With the exception of these few wells, there are no other known wells in this region and consequently no lithological or water level data was available. The specific yield and change in storage was not calculated for this region. However, based on the geology, the surface water flow patterns, and water level data from the cluster of wells previously mentioned, it appears that this region is hydrologically separated from the remainder of the Beaumont Basin.

For the study period, the change in storage of the Beaumont Basin was calculated using the change in groundwater elevation presented in Figure 3-5 and the specific yield shown in Figure 3-6. The Beaumont Basin was divided into 100 x 100 meter grid cells, and the change in storage was calculated for each cell. The resulting change in storage per cell was summed for all cells. The change in storage was approximately -14,450 acre-feet (AF). The areal distribution of the change in storage is shown in Figure 3-7. This decline in groundwater storage was expected because, as previously noted, annual groundwater production during the study period has exceeded the safe yield of the basin as defined by the Judgment, which is 8,650 acre-feet/year (AFY).

The developed yield of the basin is the yield developed over a period of time, which is based on how the basin is operated. The developed yield was calculated using the following equation:

$$\Delta Y = \frac{\sum P + \Delta S - \sum AR}{\Delta t}$$

where:

Y = yield
P = pumping
S = storage
AR = artificial recharge
t = time

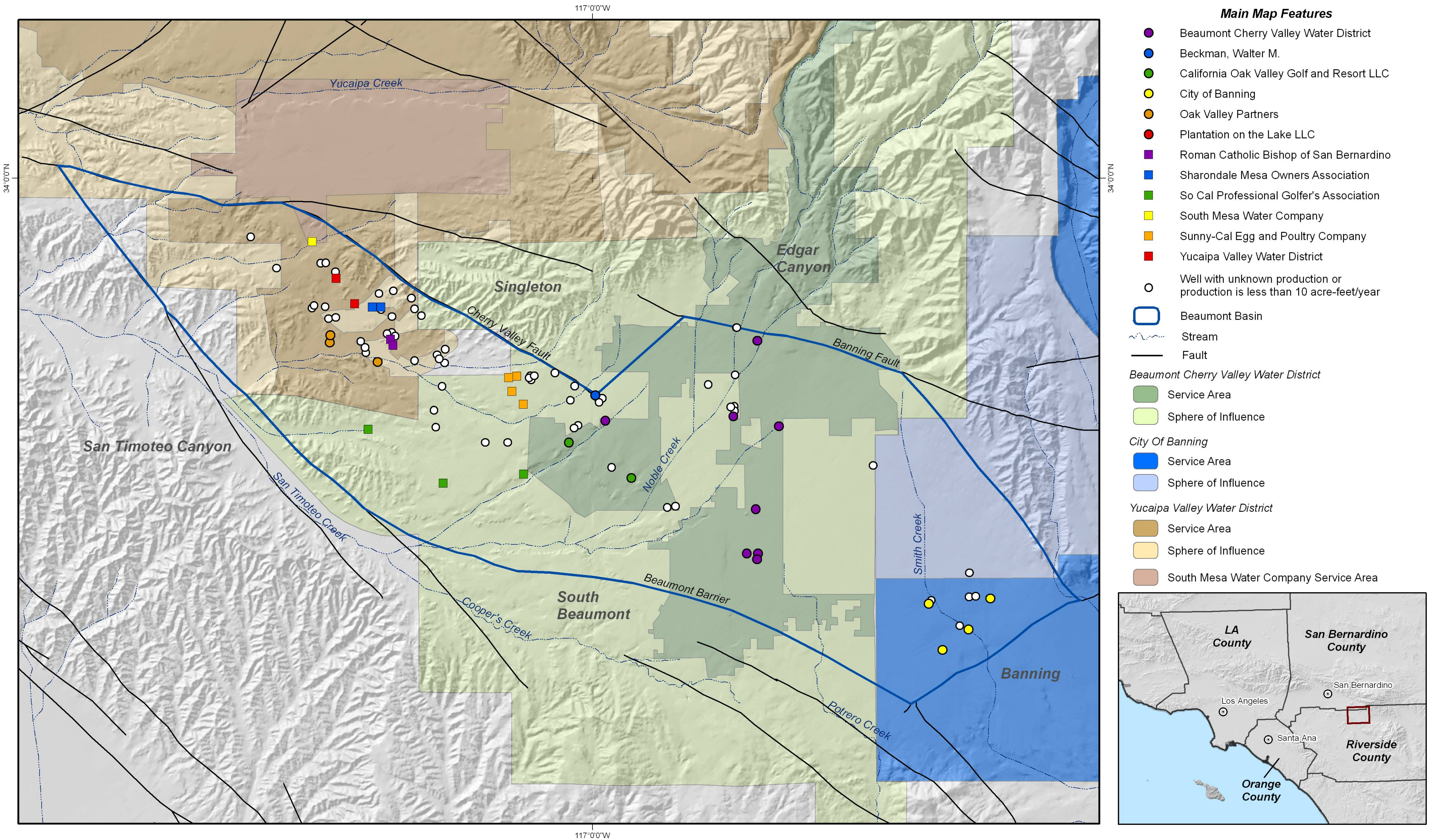
Over the study period, the developed yield of the basin was about 9,800 AFY. This exceeds the safe yield of the basin as set forth in the Judgment by about 1,150 AFY. This difference may indicate that the yield of the basin is greater than the safe yield defined by the Judgment. The yield of the basin is dependent on the outflow of groundwater from the basin to surrounding basins and surface water systems. These outflows are head dependent, and the decrease in groundwater elevations may have resulted in reduced losses from the Beaumont Basin and, thus, a greater developed yield.

Table 3-1
Groundwater Production in the Beaumont Basin (acre-feet)

Owner	Well Name	Station ID	Fiscal Year 2003-04	Fiscal Year 2004-05	Fiscal Year 2005-06
City of Banning					
	Well C2	1004340	1,018	312	0
	Well C3	1004377	1,000	791	325
	Well C4	1206706	827	918	318
	Well M3	1206700	696	75	698
	Well M9	1206834	63	0	0
	Production from BCVWD		347	324	427
	Total		3,951	2,420	1,768
Beaumont Cherry Valley Water District					
	Well 1	1004351	513	870	1,220
	Well 2	1004349	1,941	765	0
	Well 3	1004350	1,018	947	765
	Well 16	1002938	1,139	740	706
	Well 21	1201487	836	2,099	2,157
	Well 22	1002966	1,103	725	535
	Well 23	1207328	0	564	1,751
	Well 24	1208224	0	0	919
	Production for Banning		-347	-324	-427
	Total		6,204	6,386	7,625
South Mesa Water Company					
	3rd No. 4 Well	1003035	420	558	632
Yucaipa Valley Water District					
	Well 35	1003058	70	272	114
	Well 48	1003063	1,935	1,012	1,415
	Total		2,005	1,284	1,530
Beckman, Walter M.		1206852	27	27	83
California Oak Valley Golf and Resort LLC					
	Oak Valley #1	1007025			742
	OVGC Comfort Stn	1206848			97
Total			1,227	635	839
Merlin Properties			6	6	6
Oak Valley Partners					
	Haskell Ranch-Main[8]	1003078	49		
	Singleton Ranch #5	1003075	300	300	300
	Singleton Ranch #7	1003072	143	90	166
	Irrigation Stokes	1201567	10	10	10
	Total		503	400	476
Plantation on the Lake LLC		1206846	321	313	327
Rancho Calimesa Mobile Home Park			59	59	59
Roman Catholic Bishop of San Bernardino			78	72	72
Sharondale Mesa Owners Association					
	Well No.1	1206844	144	110	95
	Well No.2	1206845	25	53	91
	Total		169	163	186
So Cal Professional Golfer's Association					
	Well A	1206995	275	196	160
	Well C	1206997	32	62	0
	Well D	1206996	1,094	1,110	1,225
	Total		1,401	1,369	1,385
Stearns, Leonard M.			1	1	1
Sunny-Cal Egg and Poultry Company					
	Well No. 1	1206854			
	Well No. 2	1002950			
	Well No. 3	1201475			
	Well No. 4	1201480			
	Well No. 5	1206993			
	Well No. 6	1206994			
	Total		452	452	0
Total			**16,824**	**14,146**	**14,987**

Table 3-2
Projected Groundwater Pumping in the Beaumont Basin

Year	Beaumont Cherry Valley Water District	City of Banning	South Mesa Water Company	Yucaipa Valley Water District	Overlying Pumpers	Total
2005	7,054	1,780	636	1,274	4,251	14,995
2006	9,252	1,858	645	2,027	4,313	18,095
2007	9,950	2,929	600	2,300	4,074	19,853
2008	10,380	4,051	600	2,350	3,918	21,299
2009	12,240	1,924	600	2,400	3,918	21,082
2010	14,100	2,291	600	2,463	678	20,132
2011	15,140	2,835	600	2,463	678	21,716
2012	16,180	3,378	600	2,463	678	23,299
2013	17,220	3,921	600	2,463	678	24,882
2014	18,260	4,465	315	2,463	678	26,181
2015	19,300	5,008	315	2,463	678	27,764
2016	19,540	5,531	315	2,463	678	28,527
2017	19,780	6,055	315	2,463	678	29,291
2018	20,020	6,578	315	2,463	678	30,054
2019	20,260	7,102	315	2,463	678	30,818
2020	20,500	7,625	315	2,463	678	31,581



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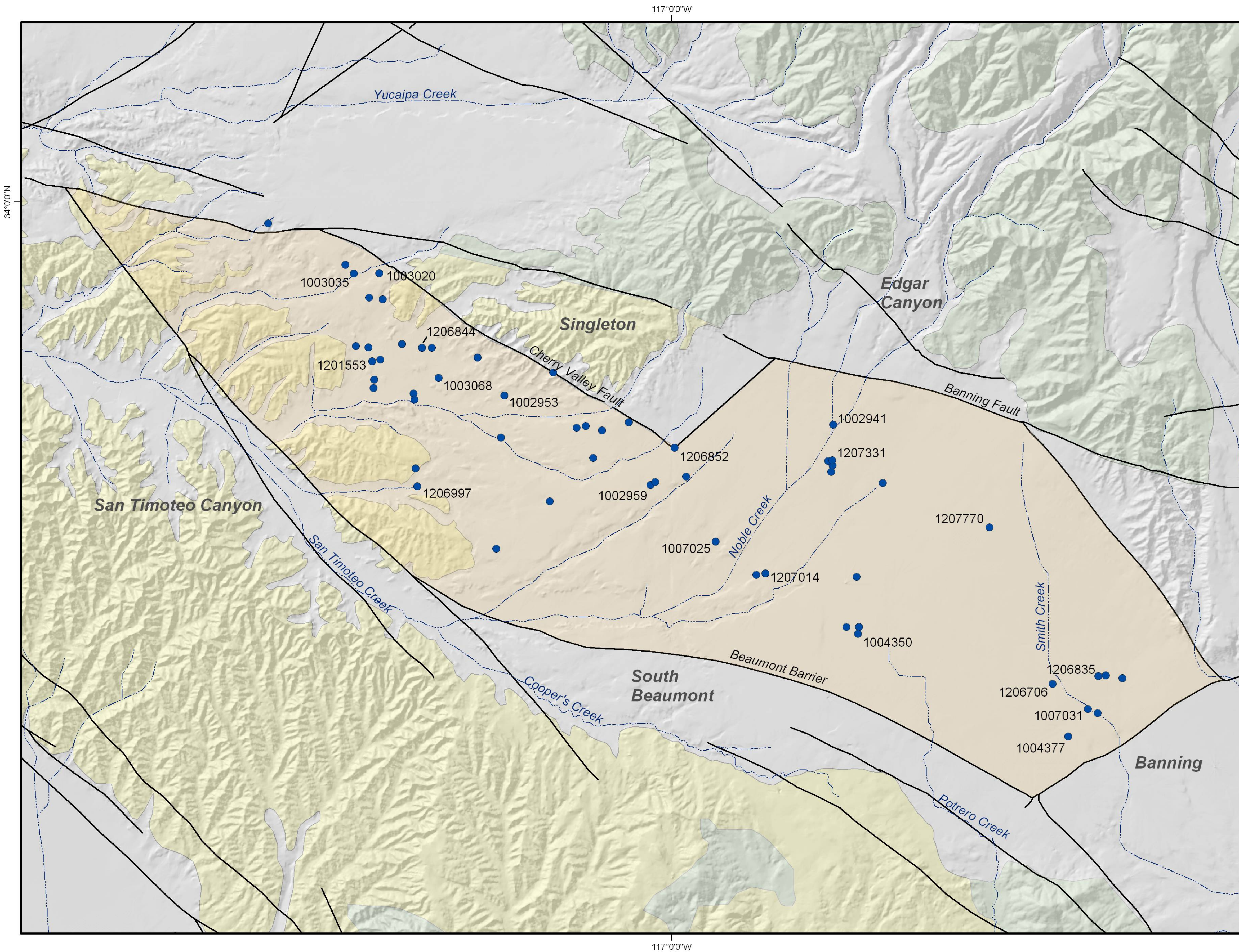
Wells in the Beaumont Basin and Major Groundwater Producers

Figure 3-1



Main Map Features

- Well with Water Level Data
- Beaumont Basin
- Stream
- Fault

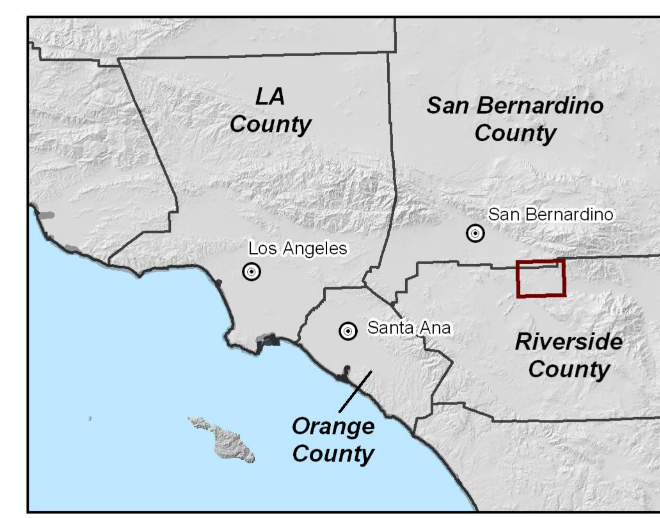
Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks



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0 1 2 Miles
0 1 2 3 KM

Beaumont Basin Watermaster

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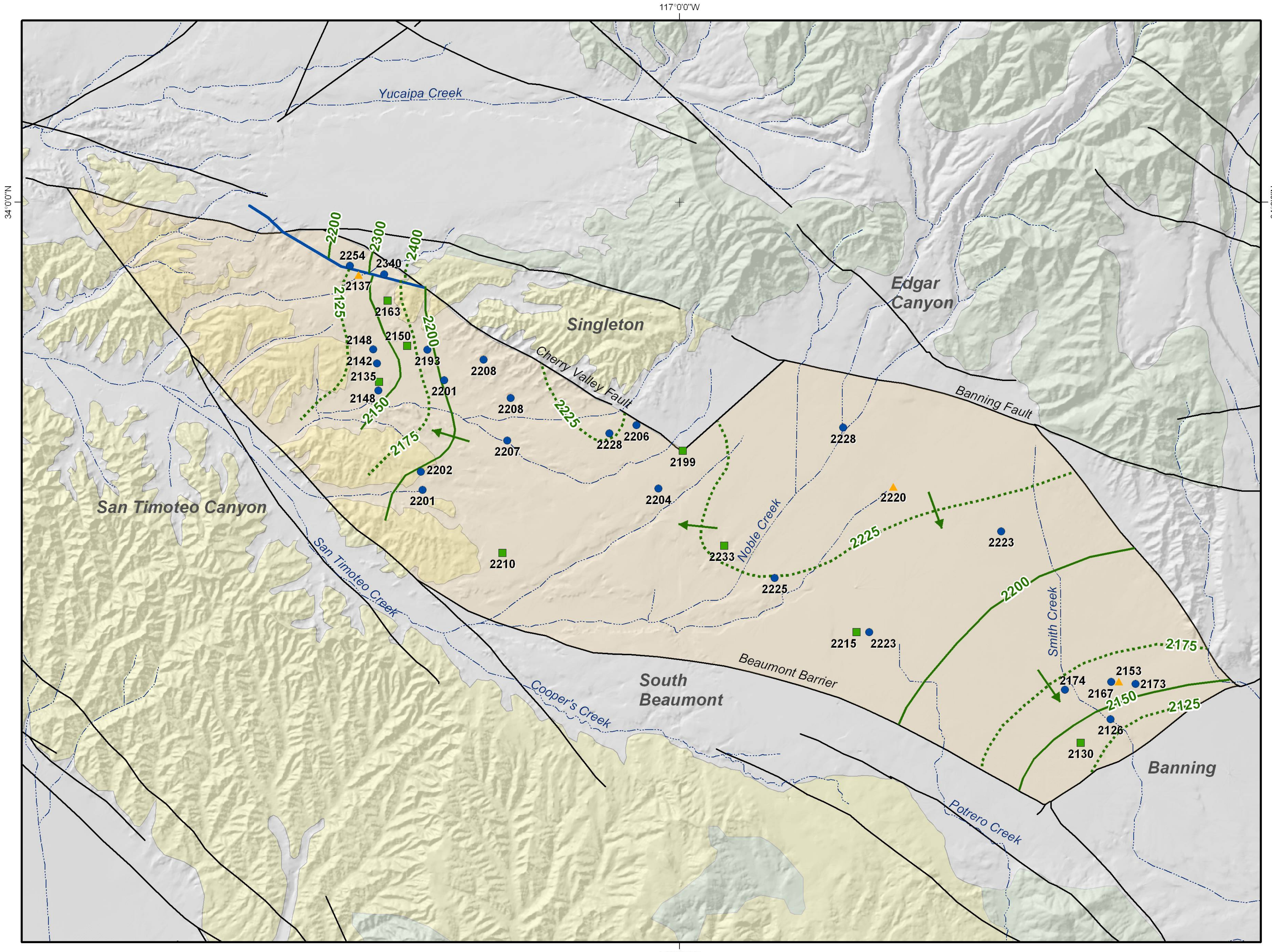
Wells with Water Level Data from 2003 to 2006

Figure 3-2



Main Map Features

2100
2125
Contours of Equal Groundwater Elevation (feet above mean sea level)

General Direction of Groundwater Flow

Well Activity of Groundwater Elevation Measurement

- Recovering
- Estimated Static
- Static

Inferred Barrier to Groundwater Flow (based on significant differences in groundwater elevation at neighboring wells)

Beaumont Basin

Stream

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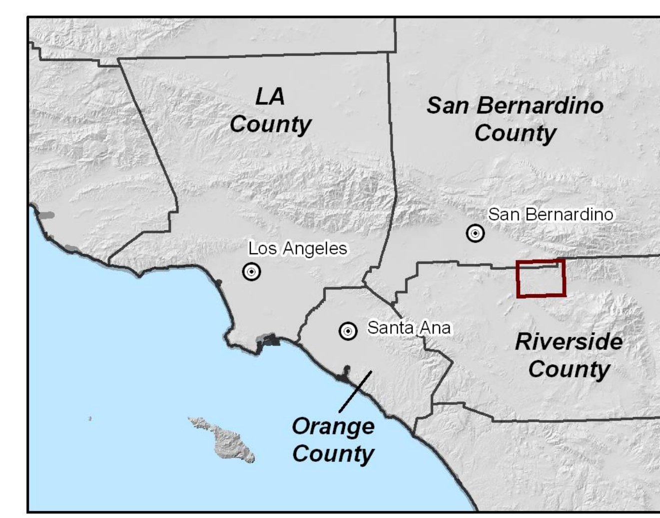

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0 1 2 *Miles*

0 1 2 3 *KM*

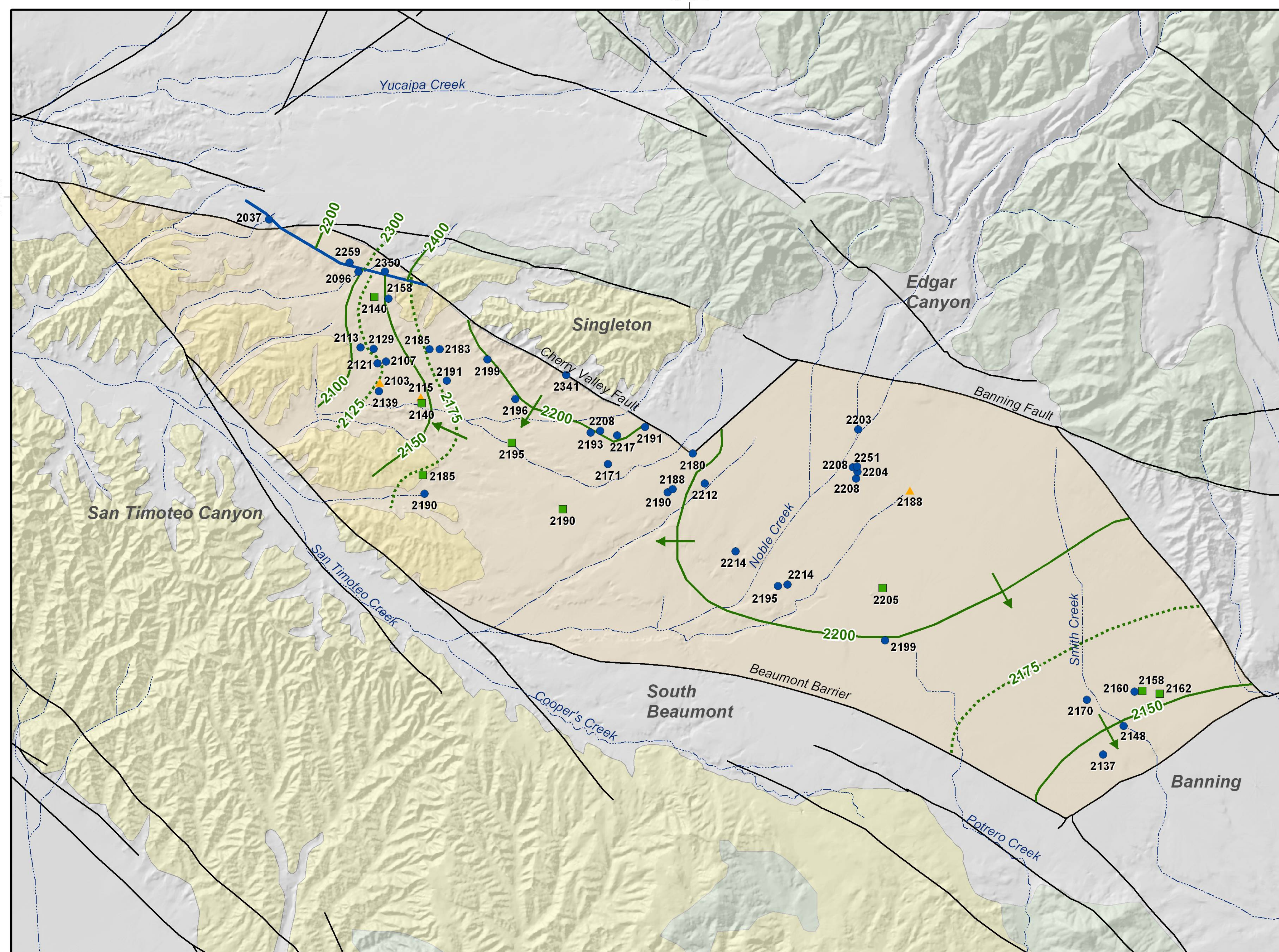
Beaumont Basin Watermaster

Biennial Engineers Report 2006

Groundwater Elevation for Fall 2003

Beaumont Basin

Figure 3-3



Main Map Features

2100 2125 Contours of Equal Groundwater Elevation (feet above mean sea level)

General Direction of Groundwater Flow

Well Activity of Groundwater Elevation Measurement

- Recovering
- Estimated Static
- Static

Inferred Barrier to Groundwater Flow (based on significant differences in groundwater elevation at neighboring wells)

Beaumont Basin

Stream

Fault

Geology

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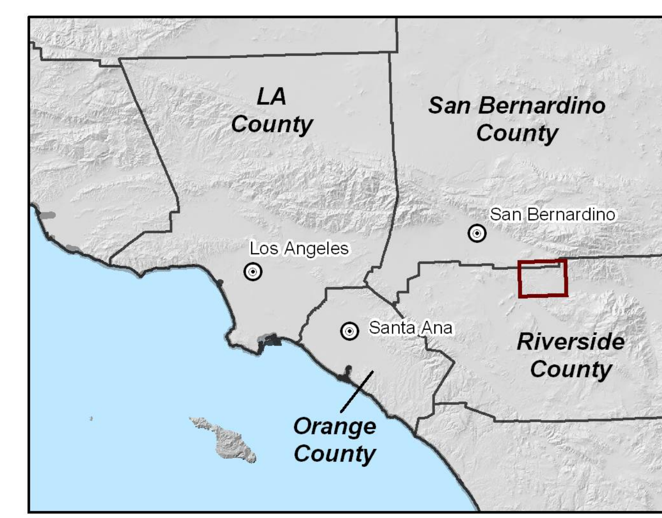
Consolidated Bedrock

Plio-Pleistocene Sedimentary Rocks

Pre-Tertiary Igneous and Metamorphic Rocks



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0 1 2 Miles
0 1 2 3 KM

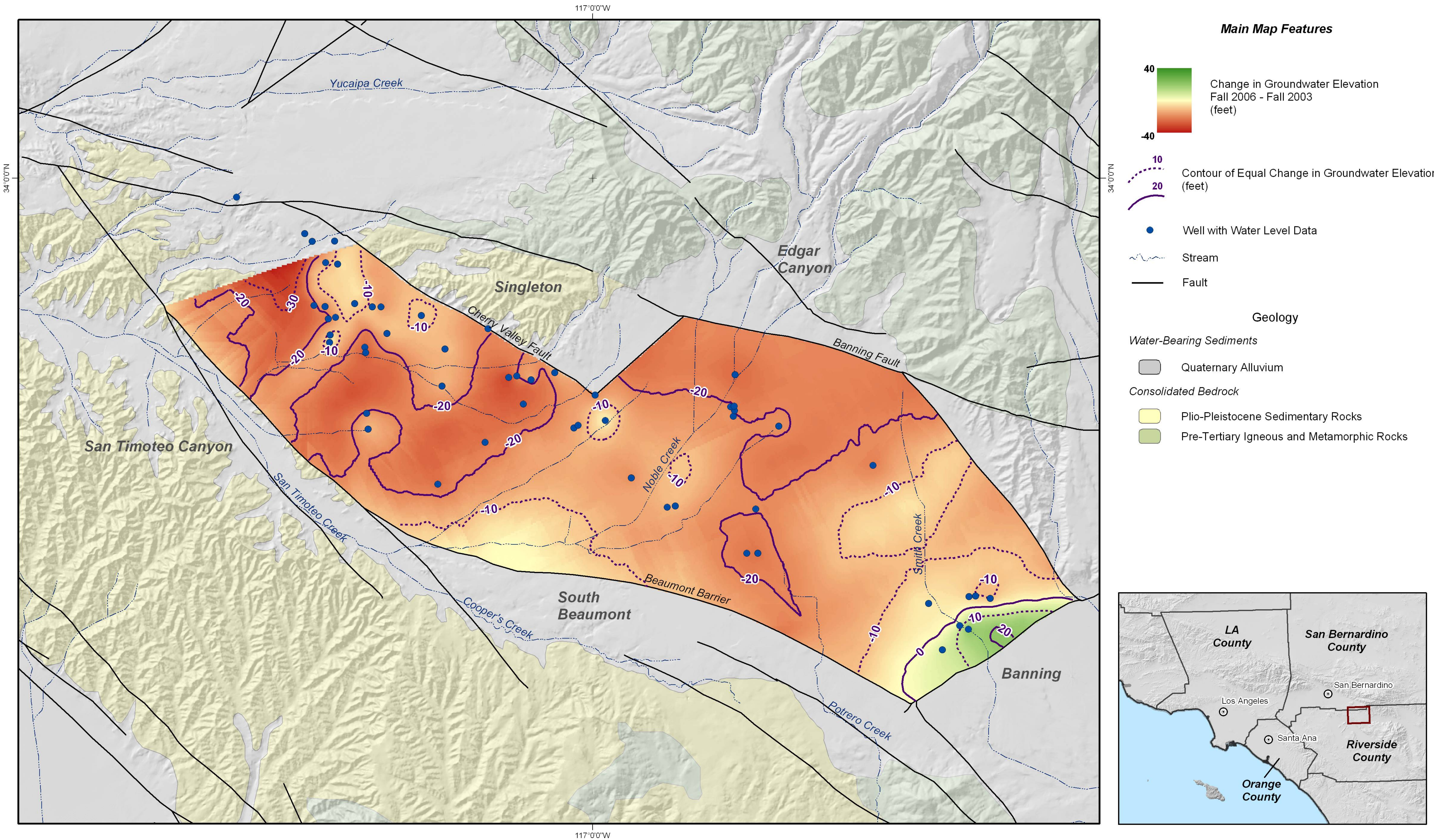
Beaumont Basin Watermaster

Biennial Engineers Report 2006

Groundwater Elevation for Fall 2006

Beaumont Basin

Figure 3-4



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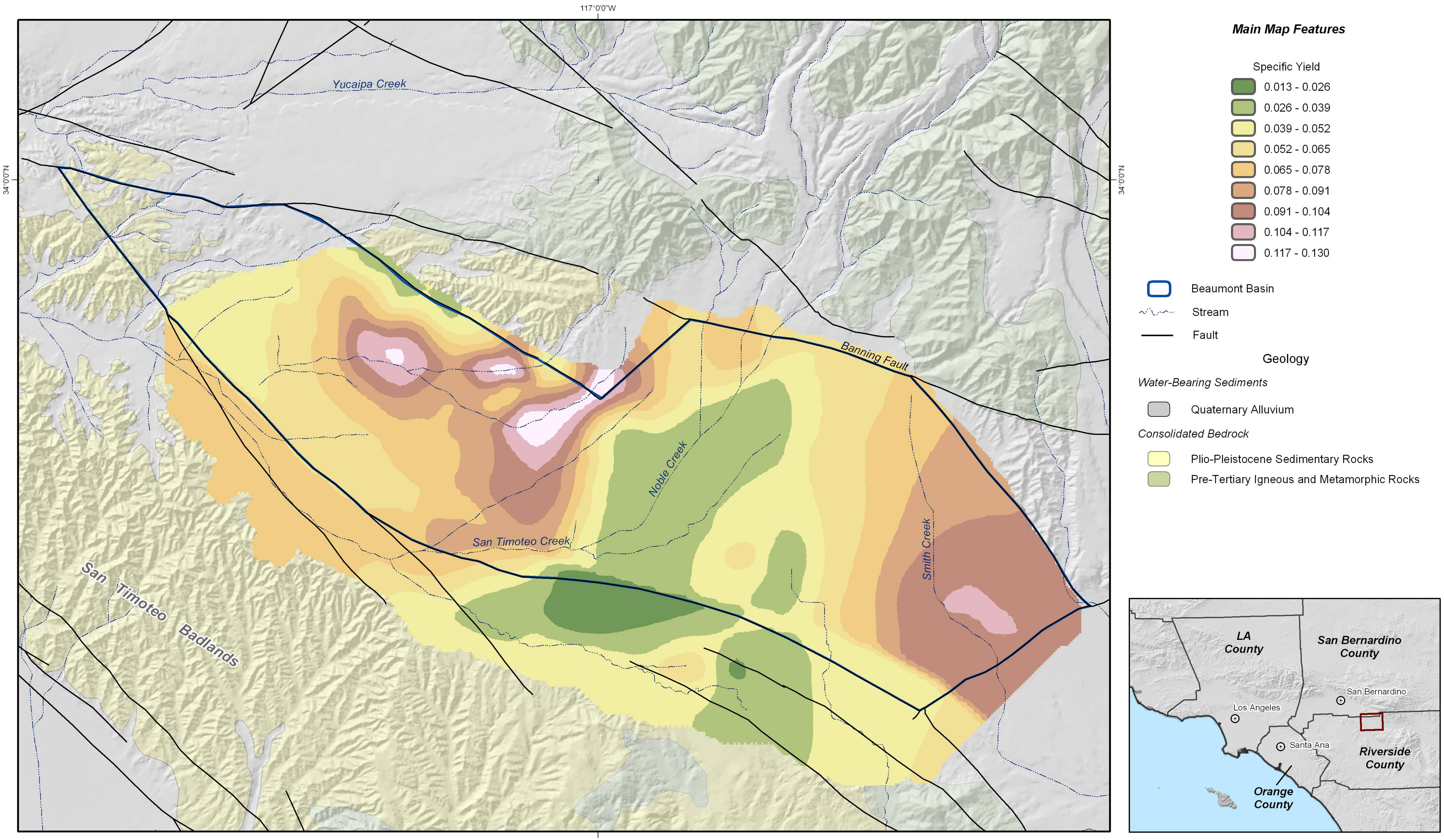
Change in Groundwater Elevation
Fall 2003 - Fall 2006

Figure 3-5



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0 1 2 Miles
0 1 2 3 KM

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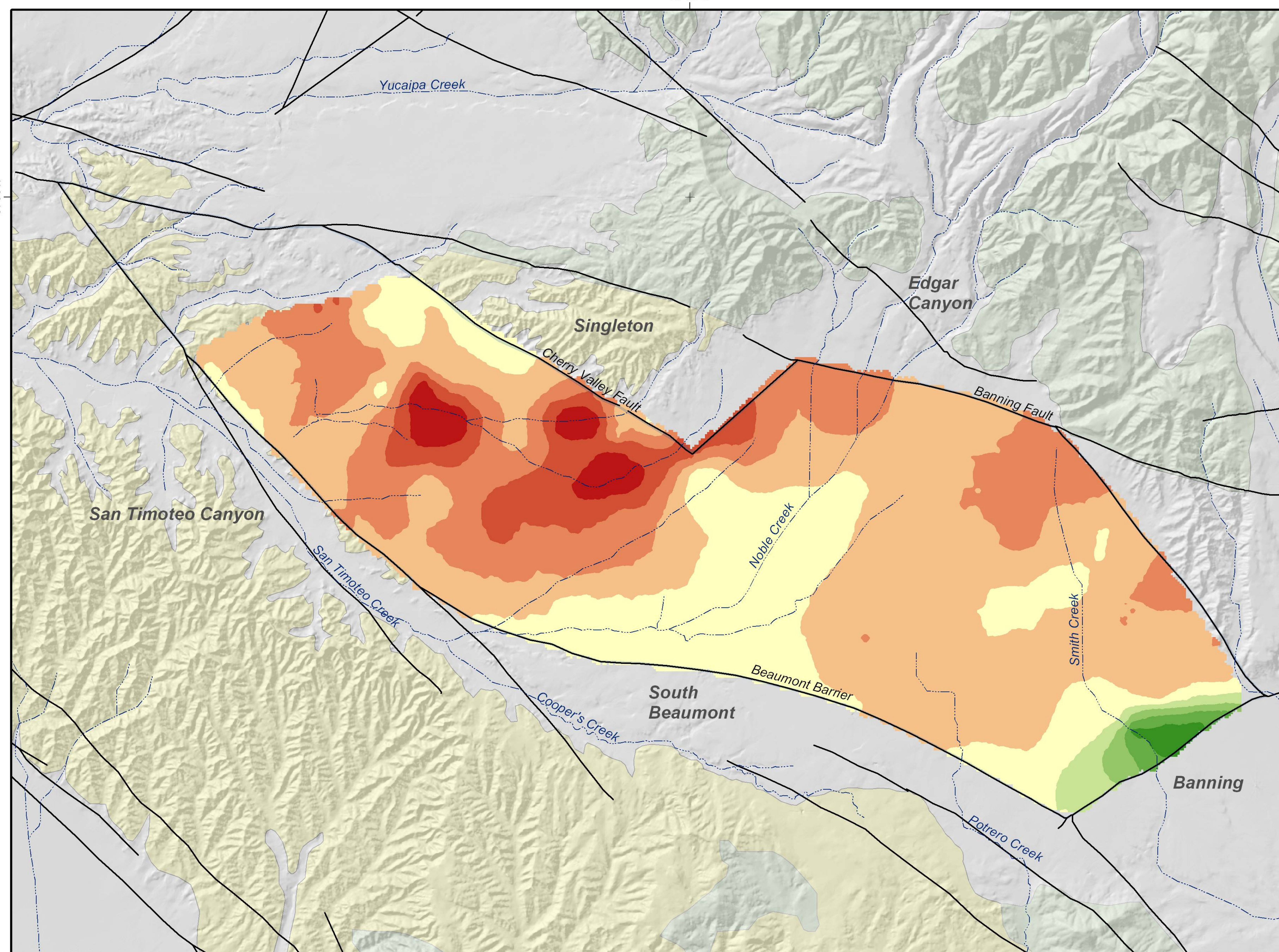
Specific Yield of the Beaumont Basin

Figure 3-6



Main Map Features

Change in Storage (acre-feet)

- -7.7 - -6.0
- -6.0 - -4.5
- -4.5- -3.0
- -3.0 - -1.5
- -1.5 - 0
- 0 - 1.5
- 1.5 - 3.0
- 3.0 - 4.5
- 4.5 - 5.3

- Beaumont Basin
- Stream
- Fault

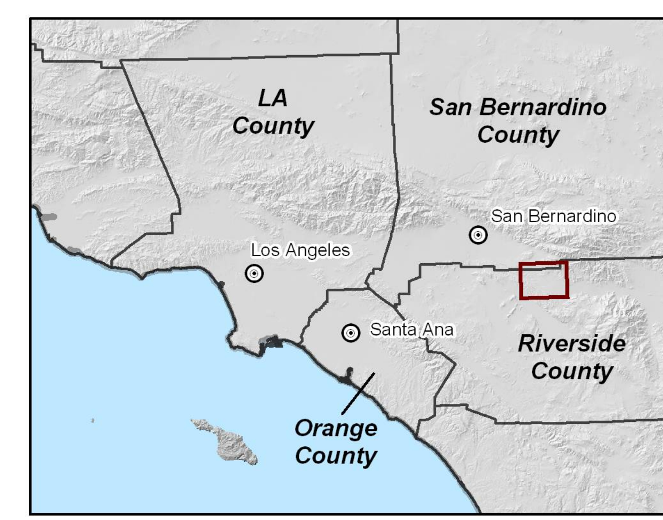
Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks



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0 1 2 Miles
0 1 2 3 KM

Beaumont Basin Watermaster

Biennial Engineers Report 2006

Change in Storage in the Beaumont Basin

Fall 2003 - Fall 2006

Figure 3-7

4. WATER QUALITY CONDITIONS

4.1 Background

In the past, various entities have collected groundwater quality samples from wells in the Beaumont Basin. Moreover, municipal supply entities have collected groundwater quality samples to comply with the Department of Health Services' requirements in the California Code of Regulations, Title 22 or for programs that involve irregular study-oriented measurements or long-term periodic measurements. As described in Section 2, the Watermaster collects water quality data from appropriator and overlying pumpers in the Beaumont Basin. The Watermaster has combined previously digitized groundwater quality data from all known sources into a comprehensive database.

4.2 Beaumont Basin Groundwater Quality

Figure 4-1 shows all of the wells that have groundwater quality monitoring results for the period ranging from 2002 to 2006. Although the study period for this report is the fiscal years 2003-04 through 2005-06, additional water quality data has been included because of the limited data available for the study period. Two important groundwater quality constituents in the Beaumont Basin are total dissolved solids (TDS) and nitrate-nitrogen. Groundwater basin objectives have been established by the RWQCB for TDS and nitrate-nitrogen in the Beaumont Management Zone, which encompasses the majority of the Beaumont Basin (see Figure 2-1).

There are numerous federal and state drinking water quality standards. Primary maximum contaminant levels are (MCL) are enforceable criteria that have been set for health reasons. Secondary standards are related to the aesthetic qualities of water, such as taste and odor. In addition, for some chemicals, there are "notification level" criteria that are set by the state. These notification levels have been set because of health concerns, but are not enforceable. A secondary MCL has been established for TDS, and a primary MCL has been established for nitrate-nitrogen. Another water quality parameter discussed in this report is the water character index, which can provide a semi-quantitative estimate of the mixing of different source waters in a groundwater basin and constituents that exceeded a federal or state drinking water standard.

4.2.1 Total Dissolved Solids

Figures 4-2 and 4-3 show average and maximum TDS concentrations, respectively, across the Beaumont Basin for the period of 2002-2006. During this period, TDS concentrations ranged from 160 to 360 milligrams per liter (mg/L), which is below the secondary maximum contaminant level (MCL) of 500 mg/L. Figures 4-2 and 4-3 show TDS concentrations displayed in intervals that correspond to regulatory objectives for groundwater quality in the Beaumont Management Zone. The historical ambient TDS concentration, representative of the 1954-1973 period, is 230 mg/L. This is also the anti-degradation objective. The current ambient TDS concentration is 260 mg/L, representative of the 1984-2003 period, and 330 mg/L is the maximum benefit objective for the Beaumont Management Zone.

About one-half of the wells with TDS measurements taken during the period of 2002-2006 had an average concentration that was below the historical ambient TDS concentration, and twelve wells had a maximum TDS concentration that was below the historical ambient concentration. Three wells had average and maximum TDS concentrations that were above the maximum benefit TDS objective.

A representative time history of TDS concentrations at several wells, shown in Figure 4-4, was prepared to show the temporal changes in water quality in the Beaumont Basin since the early 1960s. The locations of these wells are shown in Figure 4-5. While some of the wells included have also been included in the water level charts, there was not sufficient data to construct water quality time histories for all of the same wells.

As shown in Figure 4-4, TDS concentrations in the Beaumont Basin have remained stable with concentrations typically below 350 mg/L. YVWD Well 35 is the one exception; that is, the TDS concentration of this well has increased by about 150 -200 mg/L over the past forty years.

4.2.2 Nitrate-Nitrogen

Figures 4-6 and 4-7 show the average and maximum nitrate-nitrogen concentrations, respectively, across the Beaumont Basin for the period of 2002-2006. By convention, all nitrate values are reported in this document as nitrate-nitrogen (NO_3-N): therefore, they should be compared with an MCL of 10 mg/L. The average nitrate-nitrogen concentrations range from 0.26 to 7.9 mg/L, and the maximum concentrations range from 0.26 to 9.03 mg/L. In the 2002-2006 period, about seventy percent of the wells that were sampled for nitrate-nitrogen had an average concentration of less than 2.5 mg/L, and about sixty-one percent had maximum nitrate-nitrogen concentrations below 2.5 mg/L. Two wells had an average and four wells had a maximum nitrate-nitrogen concentration above 7.5 mg/L. None of the wells had a nitrate-nitrogen concentration that exceeded the drinking water MCL of 10 mg/L.

Figure 4-8 shows the nitrate-nitrogen time histories of selected wells in the Beaumont Basin. Nitrate-nitrogen concentrations have remained stable in some wells and increased in others. As seen with TDS concentrations, nitrate-nitrogen concentrations have increased at YVWD Well 35, rising from about 1.5 to 8 mg/L over the past thirty years. Increasing concentrations have also been observed at BCVWD Wells 16 and 21. These wells are known to be impacted by septic effluent from on-site waste disposal systems. Over the past few years, nitrate-nitrogen levels at YVWD Well 35 and BCVWD Well 16 have approached the MCL of 10 mg/L. Other wells shown in Figure 4-8 have nitrate-nitrogen concentrations that range from about 1 to 3 mg/L.

4.2.3 Water Character Index

The water character index (WCI) is a unitless parameter that provides a numerical estimation of water character. The WCI can be used to assess the ionic distribution of constituents in a water sample. This is analogous to a trilinear or Piper diagram, which is a graphical means of displaying the ratios of the principal ionic constituents in water (Piper, 1944; Watson and Burnett, 1995). Water character is defined by the following equation:

$$WCI = 100 \cdot \left(\left\{ \frac{Ca + Mg}{Na + K} \right\} + \left\{ \frac{CO_3 + HCO_3}{Cl + SO_4} \right\} \right)$$

Where Ca, Mg, *et cetera*, are expressed in terms of milliequivalents per liter (meq/L) rather than milligrams per liter (mg/L). The first term on the right hand side of the equation is the ratio of divalent to monovalent cations and the second term on the right hand side of the equation is the ratio of carbonate character to chloride/sulfate character. The utility of the WCI method, compared to a Stiff or Piper/trilinear diagram, is that many data points can be plotted as time histories for a given well or surface water station. The points can also be plotted to show areal and spatial distributions of water character.

What is more, the WCI method can be used to provide a semi-quantitative estimate of the mixing of source waters with differing WCIs, as long as the WCIs of the source waters are consistent.

Figure 4-9 shows the average WCI for each well. The lower the WCI value, the more the water character reflects a sodium-chloride-sulfate character (blue and green well symbols). The higher WCI values represent water character that has more of a calcium-magnesium-bicarbonate character (red and orange well symbols). Groundwater that is directly influenced by drainage from the San Bernardino Mountains is typically calcium-magnesium-bicarbonate in character (high WCIs). Higher WCI values are seen in wells that are influenced by Smith Creek, Noble Creek, and Little San Gorgonio Creek. Wells that are not directly influenced by these large drainages exhibit a lower WCI, representing water that has more of a sodium-chloride-sulfate character. This may be due to the influence of on-site waste disposal systems, agricultural practices, and/or return flows from irrigation. Mendez *et al*. (2001) postulated that the sodium-chloride-sulfate character in this area may represent mineralization from nearby fault zones. The majority of wells in the Beaumont Basin show relatively high WCIs, suggesting that they may be influenced by surface water.

4.2.4 Other Constituents of Potential Concern

Table 4-2 lists the wells in the Beaumont Basin wherein a measured constituent exceeded at least one water quality criteria during the period of 2002 through 2006. In total, three wells exceeded a primary MCL and seventeen wells exceeded a secondary MCL. The locations of these wells are shown in Figure 4-10. A description of potential constituents of concern follows.

4.2.4.1 Aluminum

The aluminum concentration exceeded the secondary MCL at two wells; however, no health based standards were exceeded. Above the secondary MCL, aluminum can add color to water.

4.2.4.2 Arsenic

In January 2001, the EPA revised the drinking water standard for arsenic from 50 μg/L to 10 μg/L by 2006. After adopting 10 μg/L as the new standard for arsenic in drinking water, the EPA decided to review the decision to ensure that the final standard was based on sound science and accurate estimates of costs and benefits. In October 2001, the EPA decided to move forward with implementing the 10 μg/L standard (EPA, 2001). One well exceeded the new federal standard for arsenic, but not the state primary MCL. The erosion of natural deposits can contribute arsenic to groundwater.

4.2.4.3 Chromium

Two wells exceeded the state primary MCL for chromium, but not the federal MCL. The erosion of natural deposits can contribute chromium to groundwater.

4.2.4.4 Iron

Six wells exceeded the federal and state secondary MCLs for iron. At a concentration above the secondary MCL, iron can effect the color, odor, and taste of water. Iron can turn water a rusty color and produces a metallic taste. It can also cause reddish and orange staining of household fixtures, scaling, and sedimentation.

4.2.4.5 Manganese

Three monitoring wells exceeded the federal and state secondary MCLs for manganese. At a concentration above the secondary MCL, manganese can effect the color, odor, and taste of water. Manganese can turn water a black to brown color and produce a bitter metallic taste. It can also cause a blackish staining of household fixtures.

4.2.4.6 pH

Three wells exceeded the federal secondary MCL for pH. Water with a pH above 8.5 can result in a soda taste, a slippery feel, and the formation of deposits.

4.2.4.7 Turbidity

One well exceed the state secondary MCL for turbidity. The drinking water standard for turbidity is based on aesthetics.

Table 4-1
Constituents Analyzed

1,1,1,2-Tetrachloroethane	Amoxicillin	Dacthal Acid Metabolites
1,1,1-Trichloroethane	Anion	Dalapon
1,1,2,2-Tetrachloroethane	Anthracene	DCAA
1,1,2-Trichloro-1,2,2-Trifluoroethane	Antimony	Decachlorobiphenyl
1,1,2-Trichloroethane	Arsenic	di(2-Ethylhexyl)Adipate
1,1-Dichloroethane	Asbestos	di(2-Ethylhexyl)Phthalate
1,1-Dichloroethene	Atrazine	Diazinon
1,1-Dichloroethylene	Barium	Dibromoacetic Acid
1,1-Dichloropropene	Bentazon	Dibromochloromethane (THM)
1,2,3-Drichlorobenzene	Benzene	Dibromochloropropane (DBCP)
1,2,3-Trichloropropane	Benzo (a) Pyrene	Dibromomethane
1,2,4-Drimethylbenzene	Beryllium	Dicamba
1,2,4-Trichlorobenzene	Bicarbonate Alkalinity (as CaCO3)	Dichloroacetic Acid
1,2-Dibromo-3-Chloropropane	Bicarbonate Alkalinity AS HCO3	Dichlorobromomethane
1,2-Dichlorobenzene	bis(2-Chloroethyl) Ether	Dichlorodifluoromethane
1,2-Dichloroethane	Boron	Dichloromethane
1,2-Dichloropropane	Bromacil	Dieldrin
1,3,5-Trimethylbenzene	Bromide	Di-isopropyl Ether
1,3-Dichlorobenzene	Bromobenzene	Dimethoate
1,3-Dichloropropane	Bromochloromethane	Dinoseb
1,3-Dimethyl 2-Nitrobenzene	Bromodichloromethane (THM)	Diquat
1,4-Dichlorobenzene	Bromofluorobenzene	Diuron
1,4-Dioxane	Bromoform (THM)	DO(field)
1-Phenylpropane	Bromomethane	DOC
2- Butanone	Butachlor	E. Coli Bacteria
2- Chloroethylvinyl Ether	Cadmium	Endothall
2,2-Dichloropropane	Caffeine	Endrin
2,3,7,8-TCDD	Calcium	EPTC
2,4,5-TP (silvex)	Carbaryl	Estradiol
2,4-D	Carbofuran	Ethylbenzene
2,4-Dinitrotoluene	Carbon Tetrachloride	Ethylene Dibromide
2,6-Dinitrotoluene	Carbonate Alkalinity as CaCO3	Fluoranthene
2-Chlorotoluene	Cations	Fluoride
3-Hydroxycarbofuran	Chlordane	Fluoxetine
4,4-DDD	Chloride	Foaming Agents
4,4-DDE	Chloroethane	Gemfibrozil
4-Chlorotoluene	Chloroform (THM)	Glyphosate
4-Methyl-2-pentanone	Chloromethane	Gross Alpha
4-Nitrophenol	Chlorothalonil	Gross Alpha Counting Error
Acetaminophen	Chlorpyrifos	Heptachlor
Acetochlor	Chromium	Heptachlor Epoxide
Agressiveness Index	Chromium IV	Heterotrophic, Plate Count
Alachlor	Chromium VI (Hexavalent)	Hexachlorobenzene
Aldicarb	cis-1,2-Dichloroethene	Hexachlorobutadiene
Aldicarb Sulfone	cis-1,2-Dichloroethylene	Hexachlorocyclopentadiene
Aldicarb Sulfoxide	cis-1,3-Dichloropropene	Hydroxide Alkalinity
Aldrin	Coliform Bacteria (Total)	Ibuprofen
Alkalinity (as CaCO3)	Color	Iopromide
Aluminum	Copper	Iron
Ammonia-Nitrogen	Cyanide	Isophorone
Isopropylbenzene	Polychlorinated Biphenyls	Turbidity
Kjeldal Nitrogen	Potassium	Uranium
Langelier Index @ 60 C	Progesterone	Uranium Counting Error
Langelier Index @ Source Temp.	Prometryn	Vanadium

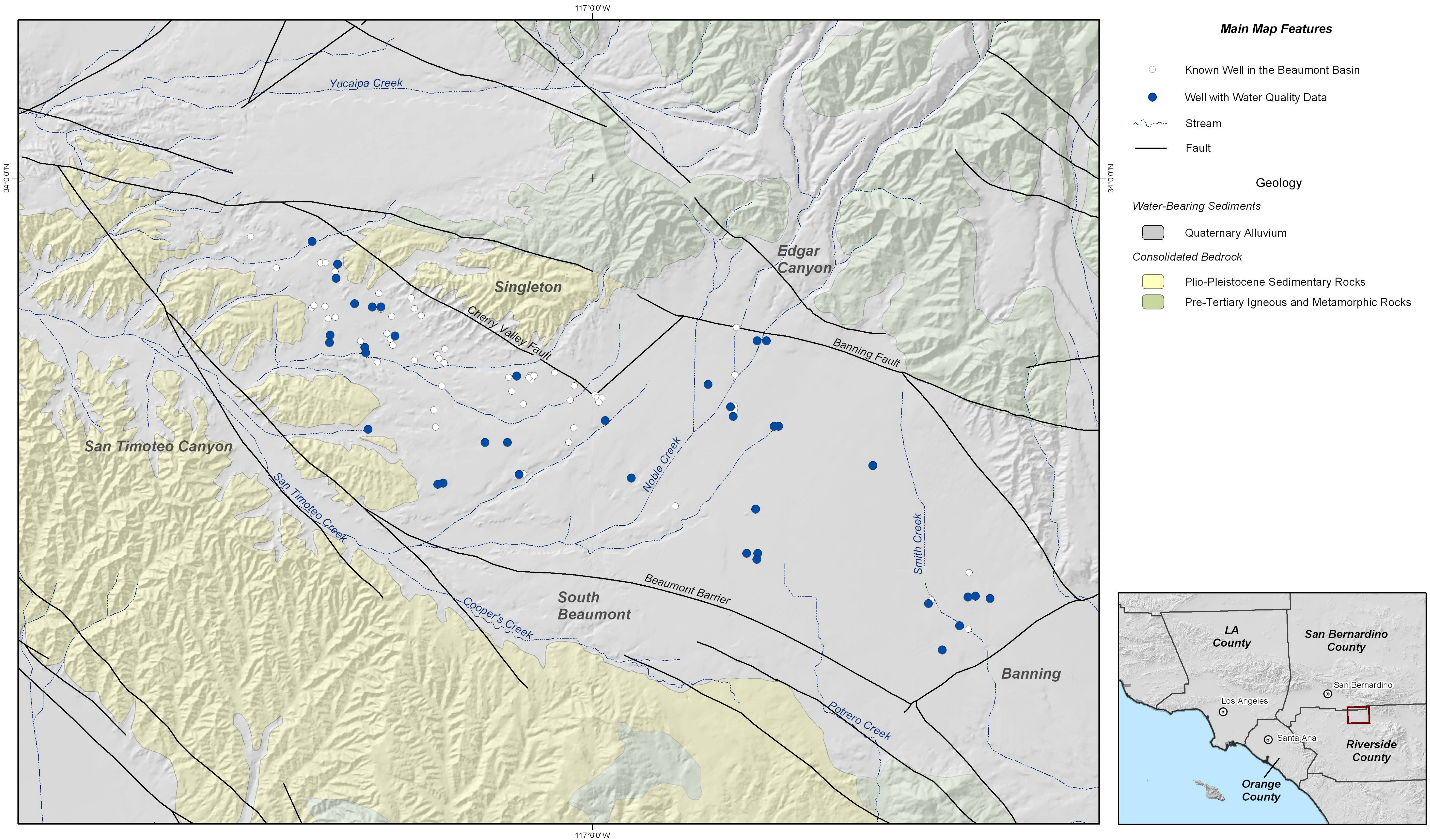
Table 4-1
Constituents Analyzed

Lead	Propachlor	Vinyl Chloride
Lindane	Propoxur	Xylene (m,p)
Magnesium	Radium 222	Xylene (o)
Manganese	Radium 222 Counting Error	Xylene (p+m)
Mercury	Radium 226	Xylenes
Methiocarb	Radium 226 Counting Error	Zinc
Methomyl	Radium 228	
Methoxychlor	Radium 228 Counting Error	
Methyl Ethyl Ketone	sec-Butylbenzene	
Methyl Isobutyl Ketone	Selenium	
Methyl-tert-butyl-ether	Silica	
Metolachlor	Silver	
Metribuzin	Simazine	
Molinate	Sodium	
Monobromoacetic Acid	Source Temperature	
Monochloroacetic Acid	Specific Conductance (Field)	
Monochlorobenzene	Specific Conductance (Laboratory)	
Naphthalene	Strontium	
n-Butylbenzene	Styrene	
NH3+NH4-N	Sulfamethoxazole	
Nickel	Sulfate	
Nitrate	Terbacil	
Nitrate + Nitrite - Nitrogen	tert-Amyl Methyl Ether	
Nitrate-Nitrogen	Tert-butyl Alcohol	
Nitrite	Tert-butyl Benzene	
Nitrite-Nitrogen	Tert-butyl Ethyl Ether	
Nitrobenzene	Testosterone	
Odor Threshold @ 60 C	Tetrachloroethylene	
Oil-grse	Thallium	
Orthopo4	Thiobencarb	
Oxamyl	Toluene	
Paraquat	Total 1,3-Dichloropropene	
PCB-1016	Total Coliform	
PCB-1221	Total Dissolved Solids	
PCB-1232	Total Hardness (as Caco3)	
PCB-1242	Total Nitrite + Nitrogen As N	
PCB-1248	Total Organic Carbon	
PCB-1254	Total Trihalomethanes	
PCB-1260	Toxaphene	
PCB-209	trans-1,2-Dichloroethene	
Pentachlorophenol	trans-1,2-Dichloroethylene	
Perchlorate	trans-1,3-Dichloropropene	
pH (Field)	Trichloroacetic Acid	
pH (Laboratory)	Trichloroethylene	
Phosphate	Trichlorofluoromethane	
Phosphorus	Triclosan	
Picloram	Trimethoprim	
p-Isopropyltoluene	Tritium	

Table 4-2
Water Quality Exceedance Report

Chemical	Well Owner	Well Name	Date	Chemical Concentration	Primary EPA MCL	Secondary EPA MCL	Primary CA MCL	Secondary CA MCL
Aluminum (µg/L)								
	City of Banning	Well M-3	5/31/2005	270		200	1000	200
	So. Calif. Professional Golf Association	Well A	1/5/2006	320		200	1000	200
Arsenic (µg/L)								
	Oak Valley Partners	Singleton Ranch 5	9/21/2006	24	10		50	
Chromium (µg/L)								
	So. Calif. Professional Golf Association	Well A	1/16/2003	86	100		50	
	South Mesa Water Company	Well 4	3/31/2004	86	100		50	
Iron (µg/L)								
	City of Banning	Well M-3	5/31/2005	330		300		300
	Beaumont-cherry Valley Water District	Well 24	9/23/2005	990		300		300
	So. Calif. Professional Golf Association	Well A	1/5/2006	930		300		300
	City of Banning	Well C-2A	1/10/2006	490		300		300
	Oak Valley Partners	Singleton Ranch 7	9/21/2006	1300		300		300
	Sunny-Cal Egg & Poultry Company	Well 1	9/22/2006	1100		300		300
Manganese (µg/L)								
	United States Geological Survey	335714116565002	8/28/2002	61		50		50
	United States Geological Survey	335714116565001	8/29/2002	55		50		50
	United States Geological Survey	335714116565003	8/29/2002	96		50		50
	United States Geological Survey	335714116565003	6/11/2003	58		50		50
pH								
	So. Calif. Professional Golf Association	Well A	1/16/2003	8.8		8.5		
	South Mesa Water Company	Well 4	9/10/2003	9.0		8.5		
	South Mesa Water Company	Well 4	3/31/2004	8.6		8.5		
	Oak Valley Partners	Singleton Ranch 5	9/21/2006	9.6		8.5		
Turbidity (NTU)								
	So. Calif. Professional Golf Association	Well A	1/5/2006	8.5				5

Primary EPA MCL	Primary EPA MCLs are federally enforceable limits for chemicals in drinking water and are set as close as feasible to the corresponding EPA MCLG.
Secondary EPA MCL	Secondary EPA MCLs apply to chemicals in drinking water that adversely affect its odor, taste, or appearance. Secondary EPA MCLs are not based on direct health effects associated with the chemical. Secondary MCLs are considered desirable goals and are not federally enforceable.
Primary CA MCL	Primary CA MCLs are analogous to Primary EPA MCLs and are enforceable at the state level. If the California DHS has adopted a more stringent primary MCL than the EPA MCL, the primary CA MCL would be enforceable.
Secondary CA MCL	Secondary CA MCLs are analogous to Secondary EPA MCLs and are applicable at the state level. If the California DHS has adopted a more stringent secondary MCL than the EPA MCL, the secondary CA MCL would be applied.



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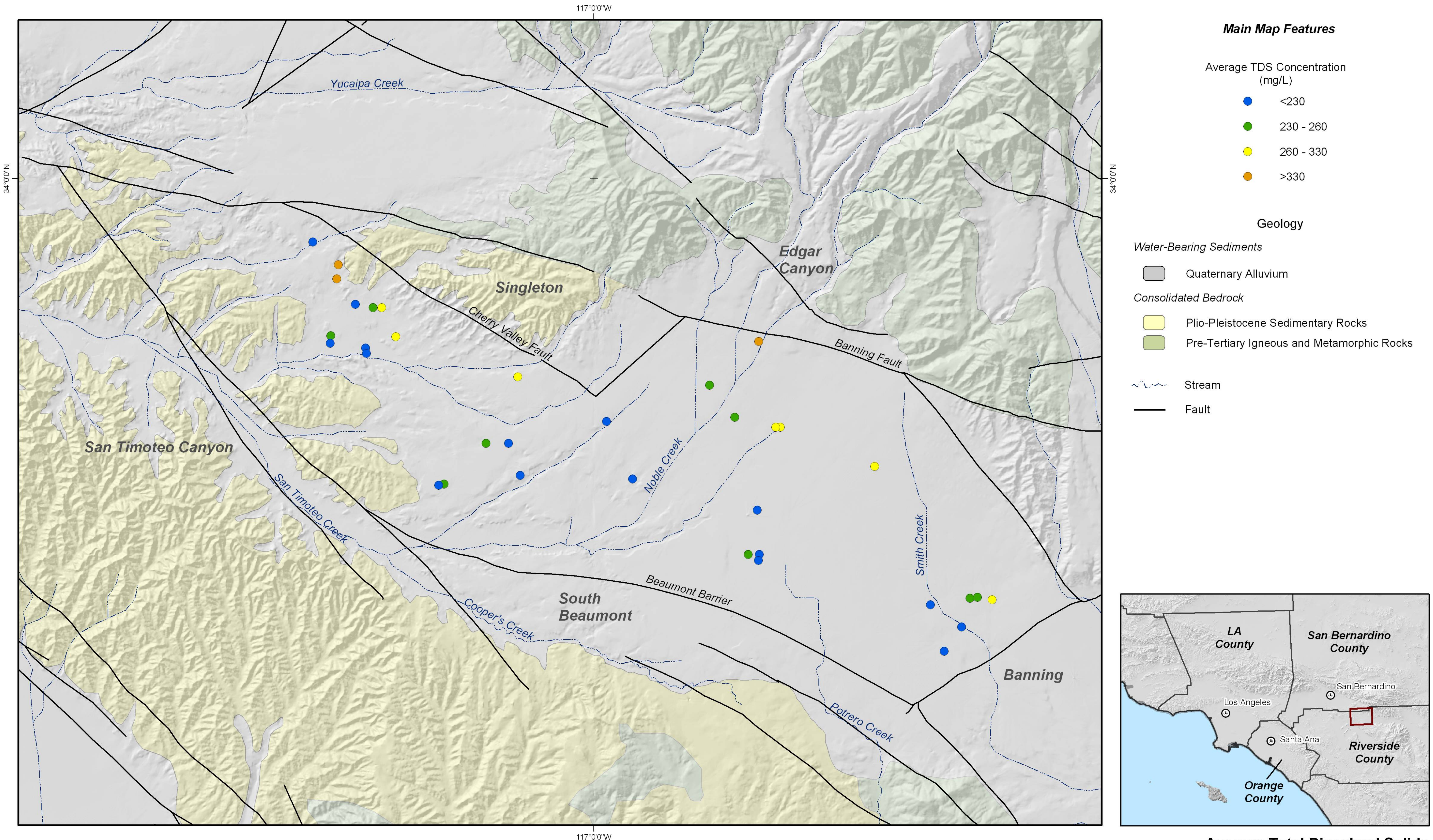
Wells with Water Quality Data
2002 - 2006

Figure 4-1



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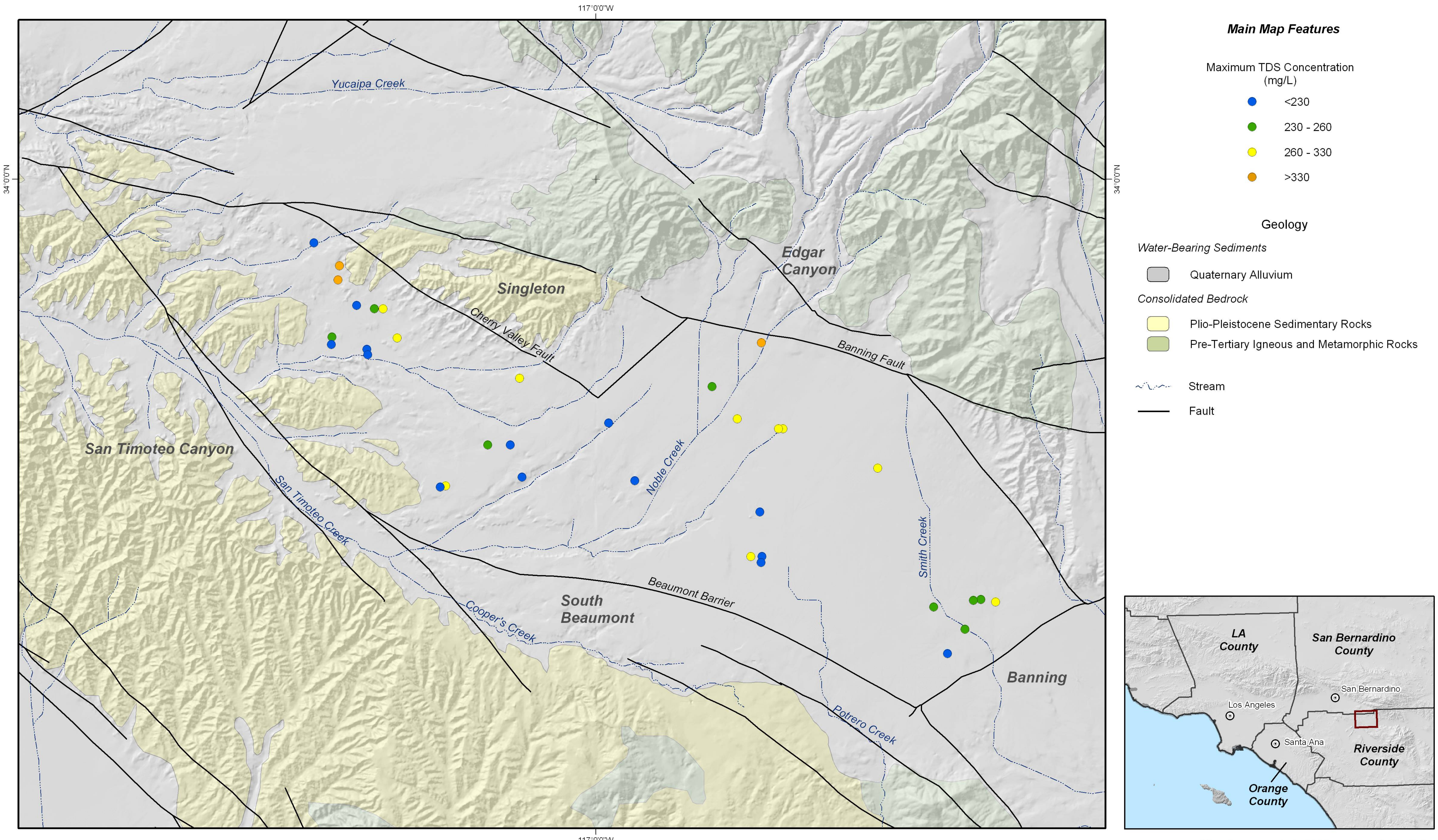
Average Total Dissolved Solids Concentration

2002 - 2006

Figure 4-2



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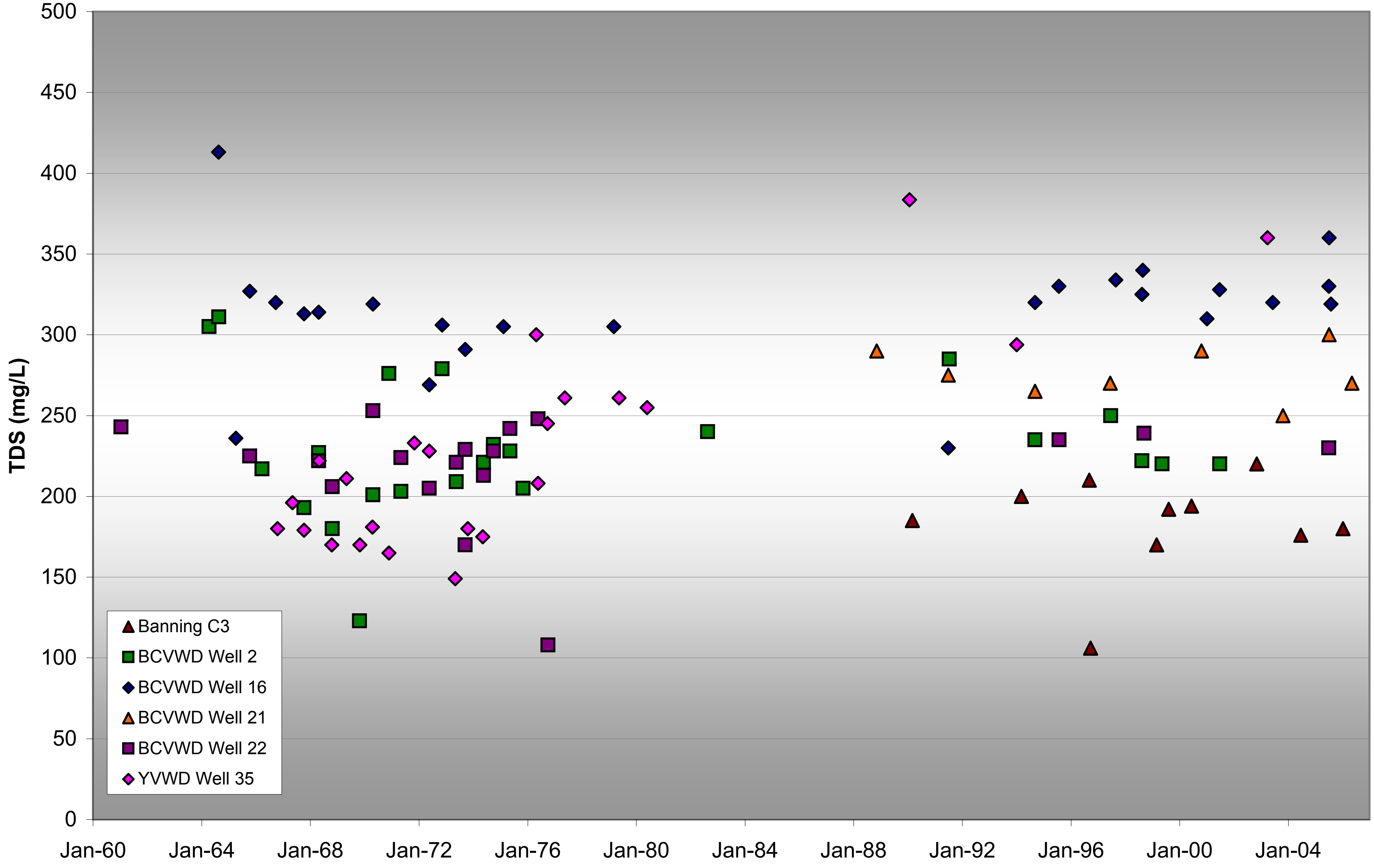
Maximum Total Dissolved Solids Concentration
2002 - 2006

Figure 4-3

Figure 4-4
Total Dissolved Solids Time History in the Beaumont Basin



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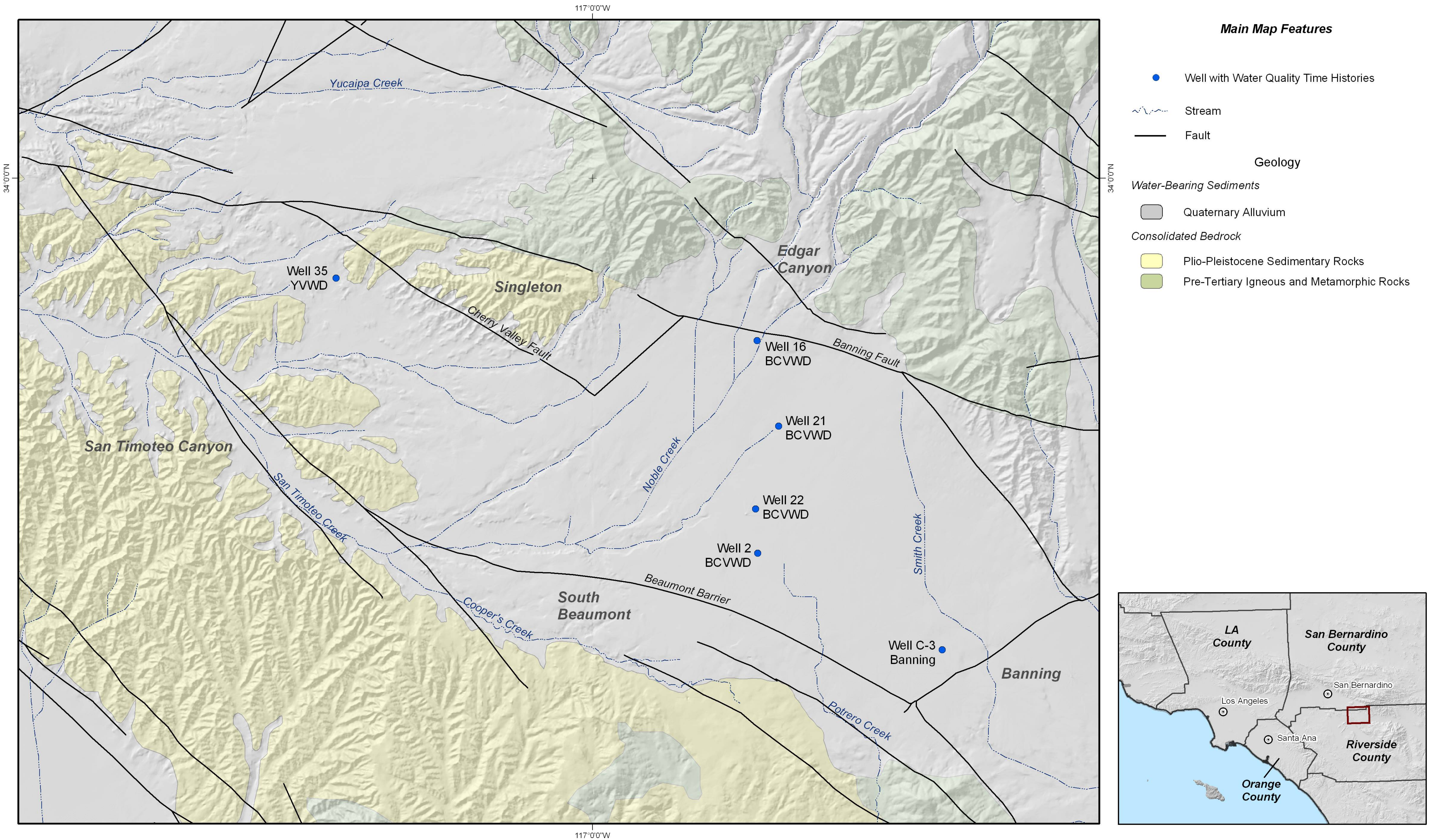

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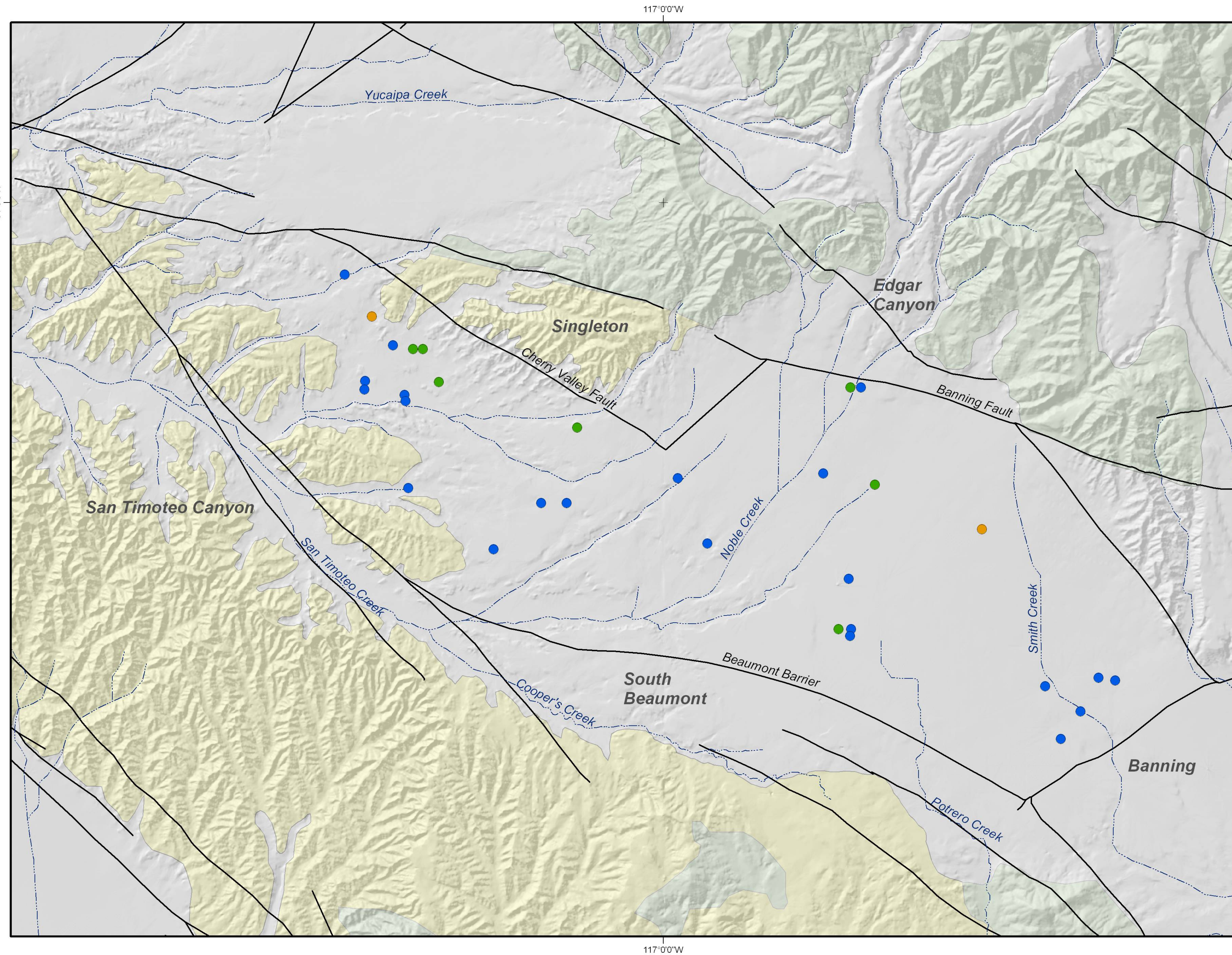
Wells with Water Quality Time Histories

Figure 4-5



Main Map Features

Average NO3-N Concentration (mg/L)

- <2.5
- 2.5 - 5
- 5 - 7.5
- 7.5 - 10

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

- Stream
- Fault

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0 1 2 Miles
0 1 2 3 KM

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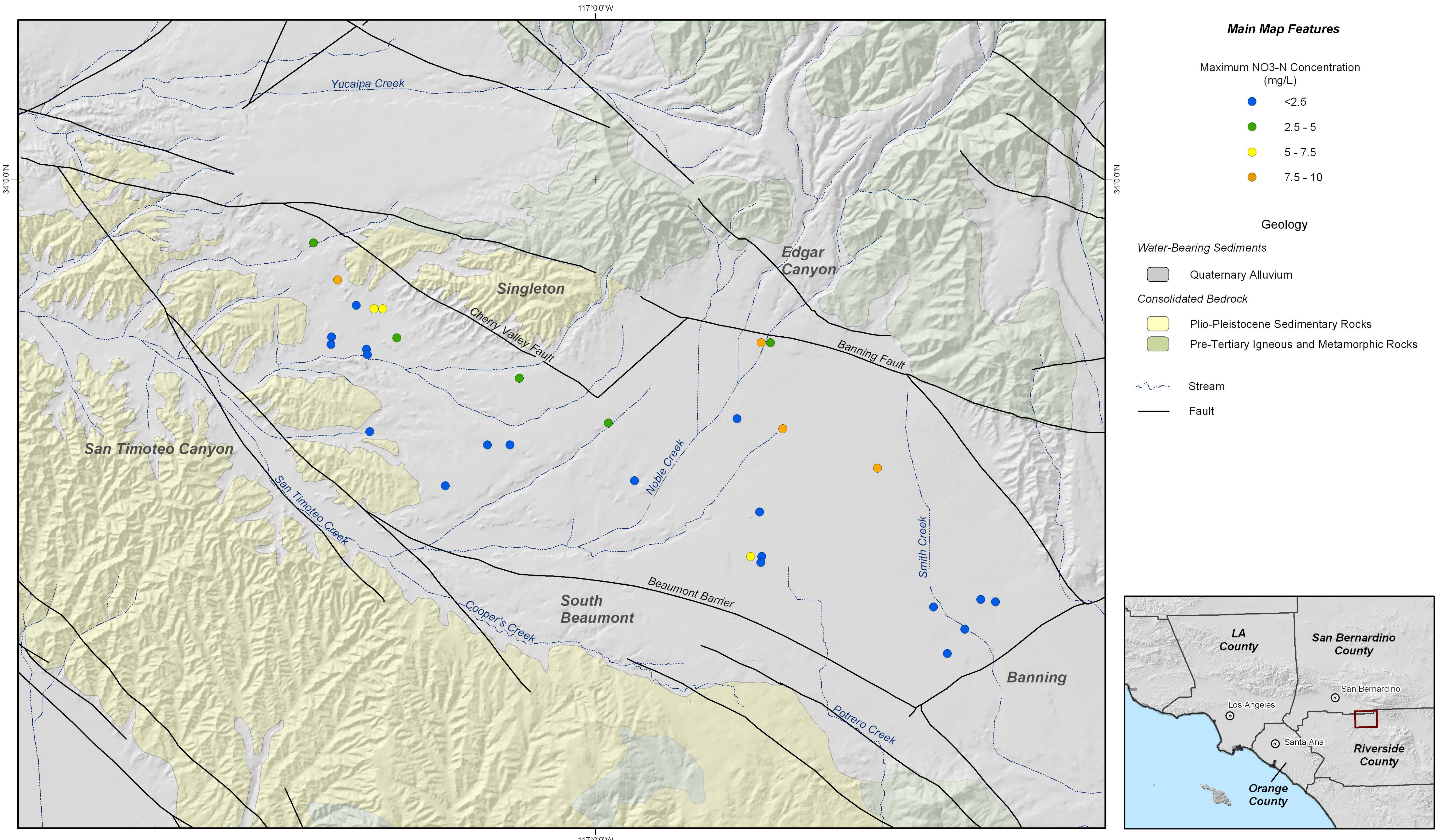
Biennial Engineers Report 2006

Average Nitrate-Nitrogen Concentration
2002 - 2006

Figure 4-6



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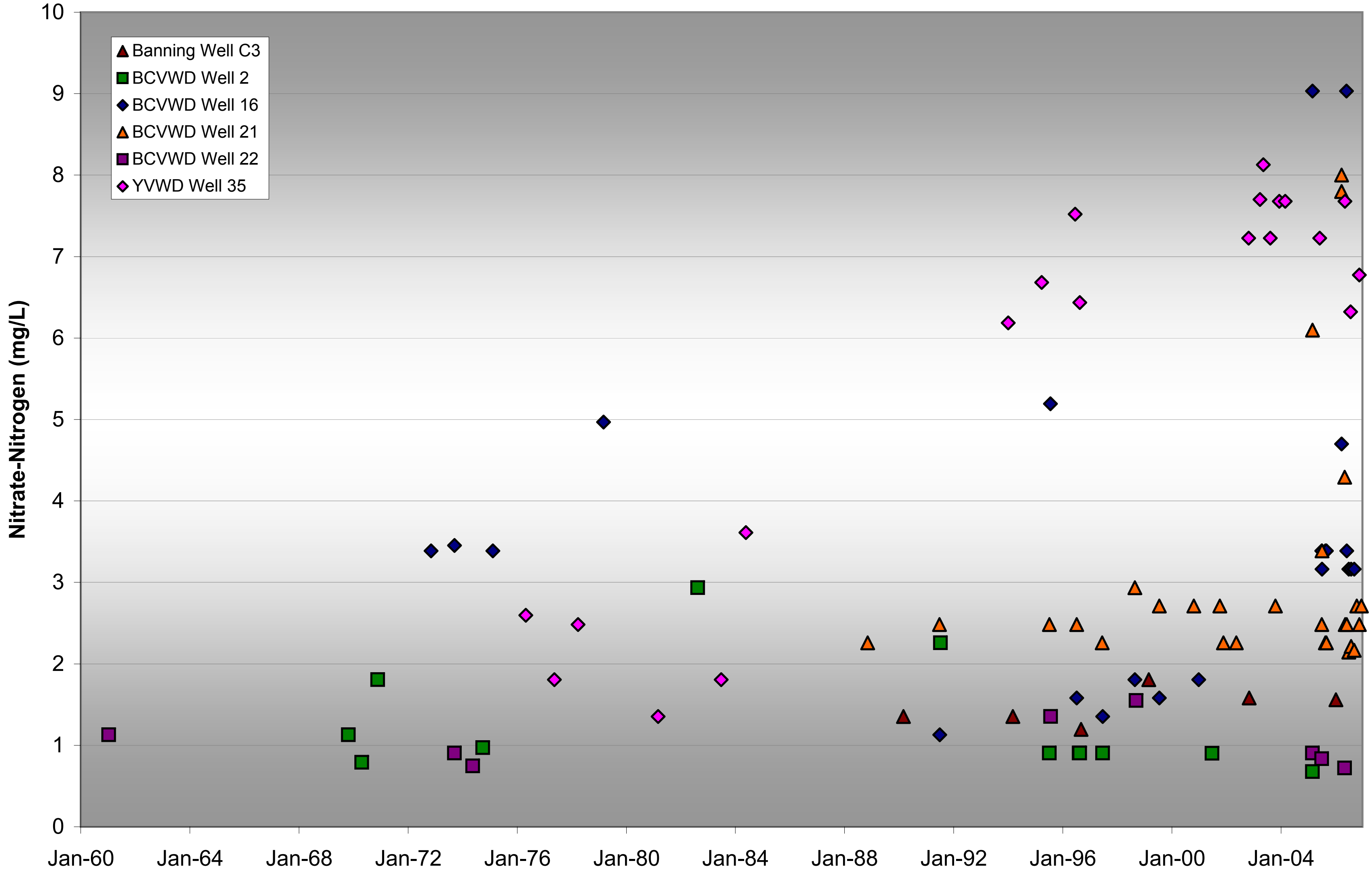
Biennial Engineers Report 2006

Maximum Nitrate-Nitrogen Concentration
2002 - 2006

Figure 4-7

Figure 4-8
Nitrate-Nitrogen Time History in the Beaumont Basin



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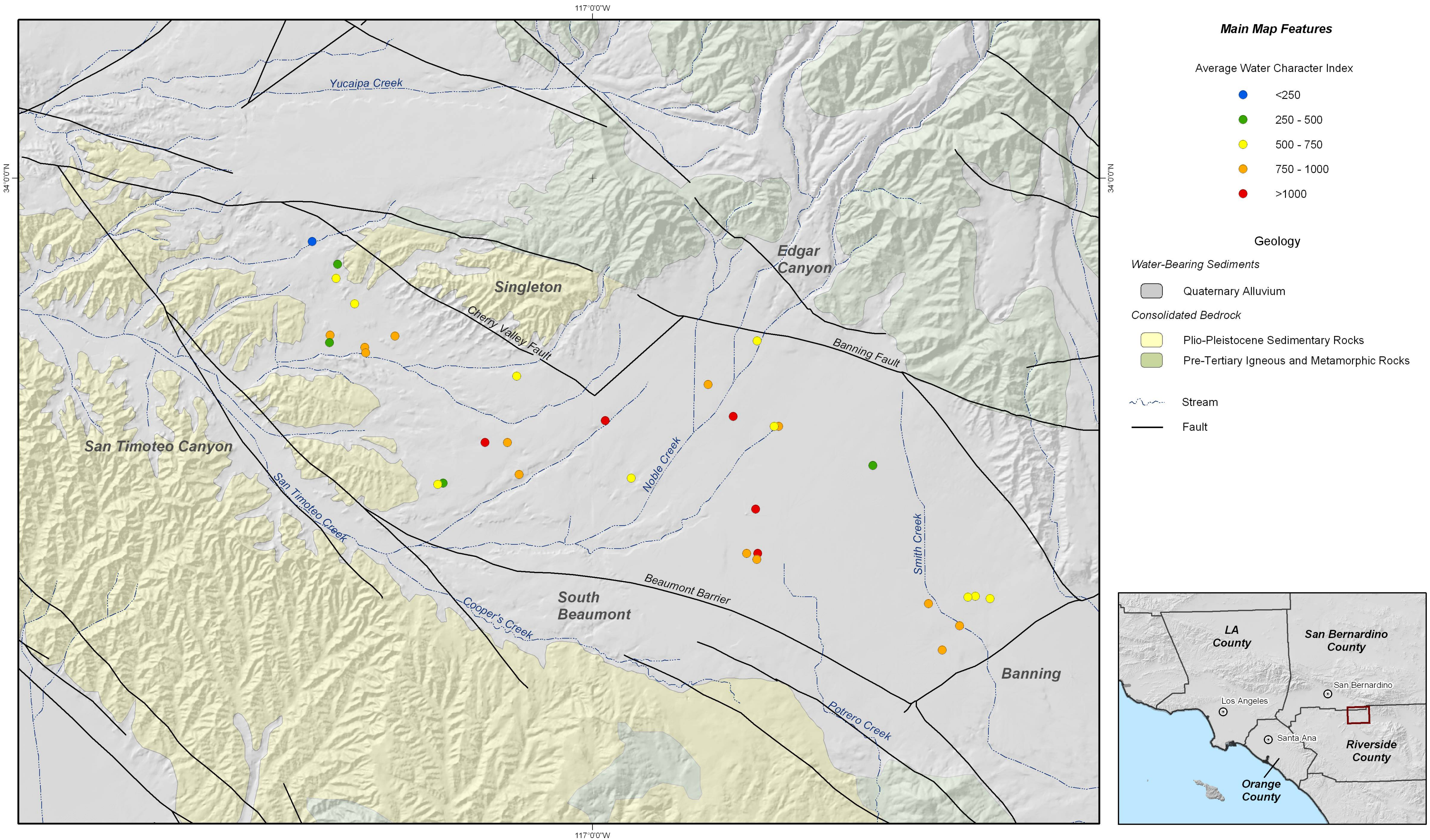

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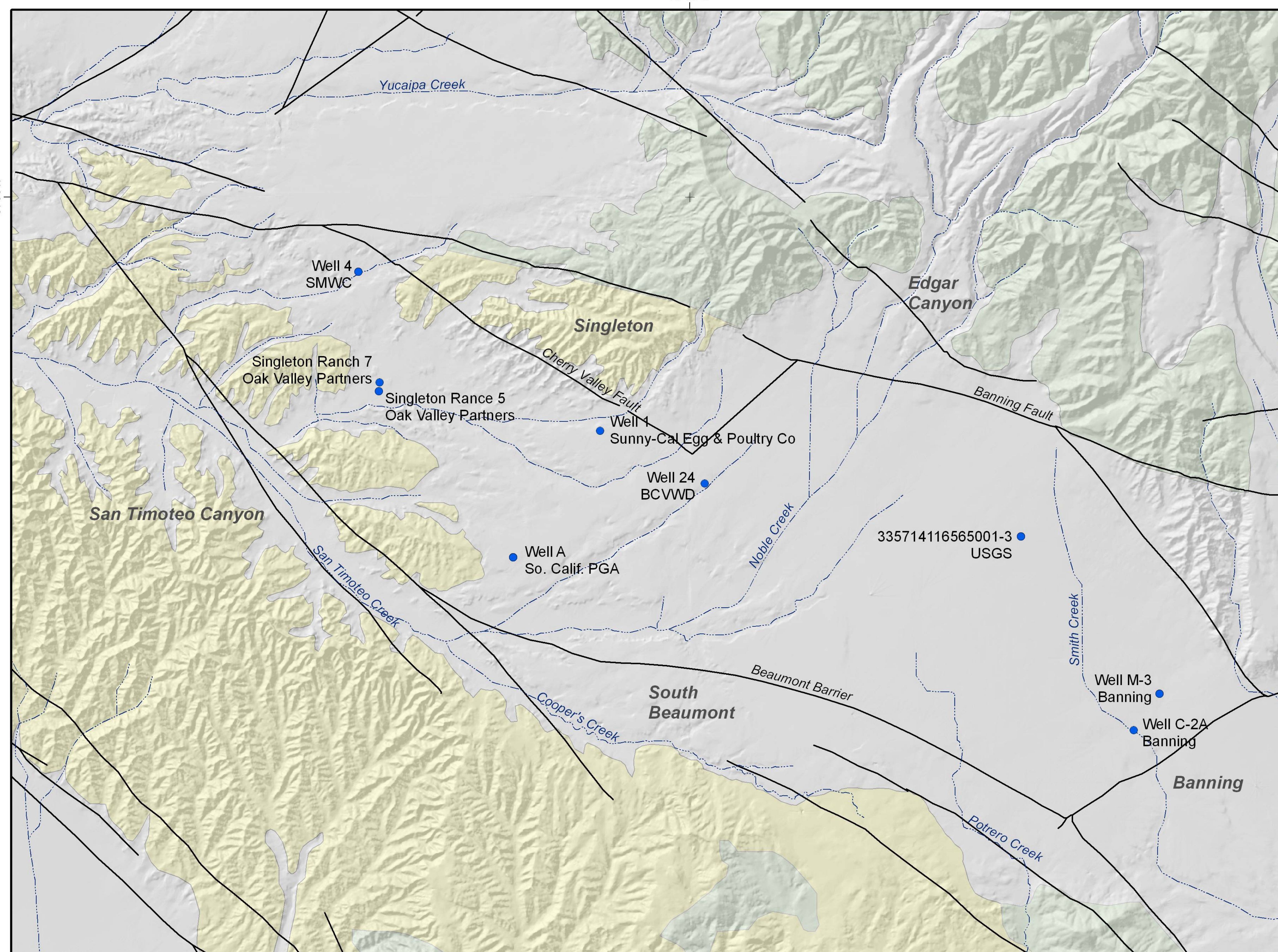
Author: KD
Date: 20070522
File: Figure_4-9.mxd

Beaumont Basin Watermaster
Biennial Engineers Report 2006

Average Water Character Index
2002 - 2006

Figure 4-9



Main Map Features

- Well with Drinking Water MCL Exceedance
- Stream
- Fault

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

- Plio-Pleistocene Sedimentary Rocks
- Pre-Tertiary Igneous and Metamorphic Rocks

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Author: KD
Date: 20070522
File: Figure_4-10.mxd

0 1 2 Miles
0 1 2 3 KM

Beaumont Basin Watermaster
Biennial Engineers Report 2006

Wells with Water Quality Maximum Contaminant Level Exceedances

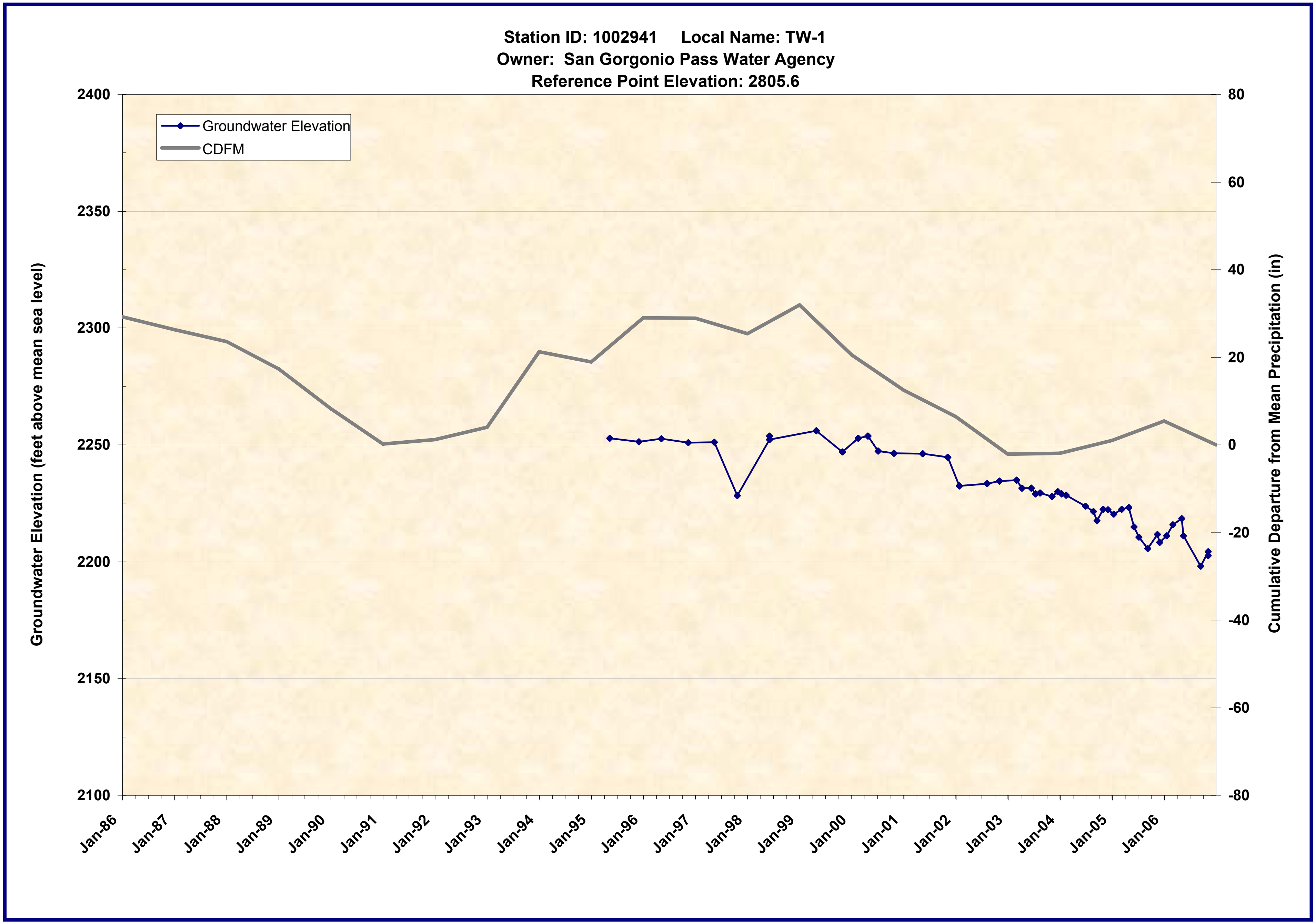
Figure 4-10

5. REFERENCES

RWQCB. 2004. R8-2004-001. Resolution Amending the Water Quality Control Plan for the Santa Ana River Basin to Incorporate an Updated Total Dissolved Solids (TDS) and Nitrogen Management Plan for the Santa Ana Region Including Revised Groundwater Subbasin Boundaries, Revised TDS and Nitrate-Nitrogen Quality Objectives for Groundwater, Revised TDS and Nitrogen Wasteload Allocations, and Revised Reach Designations, TDS and Nitrogen Objectives and Beneficial Uses for Specific Surface Waters

APPENDIX

GROUNDWATER LEVEL TIME HISTORIES



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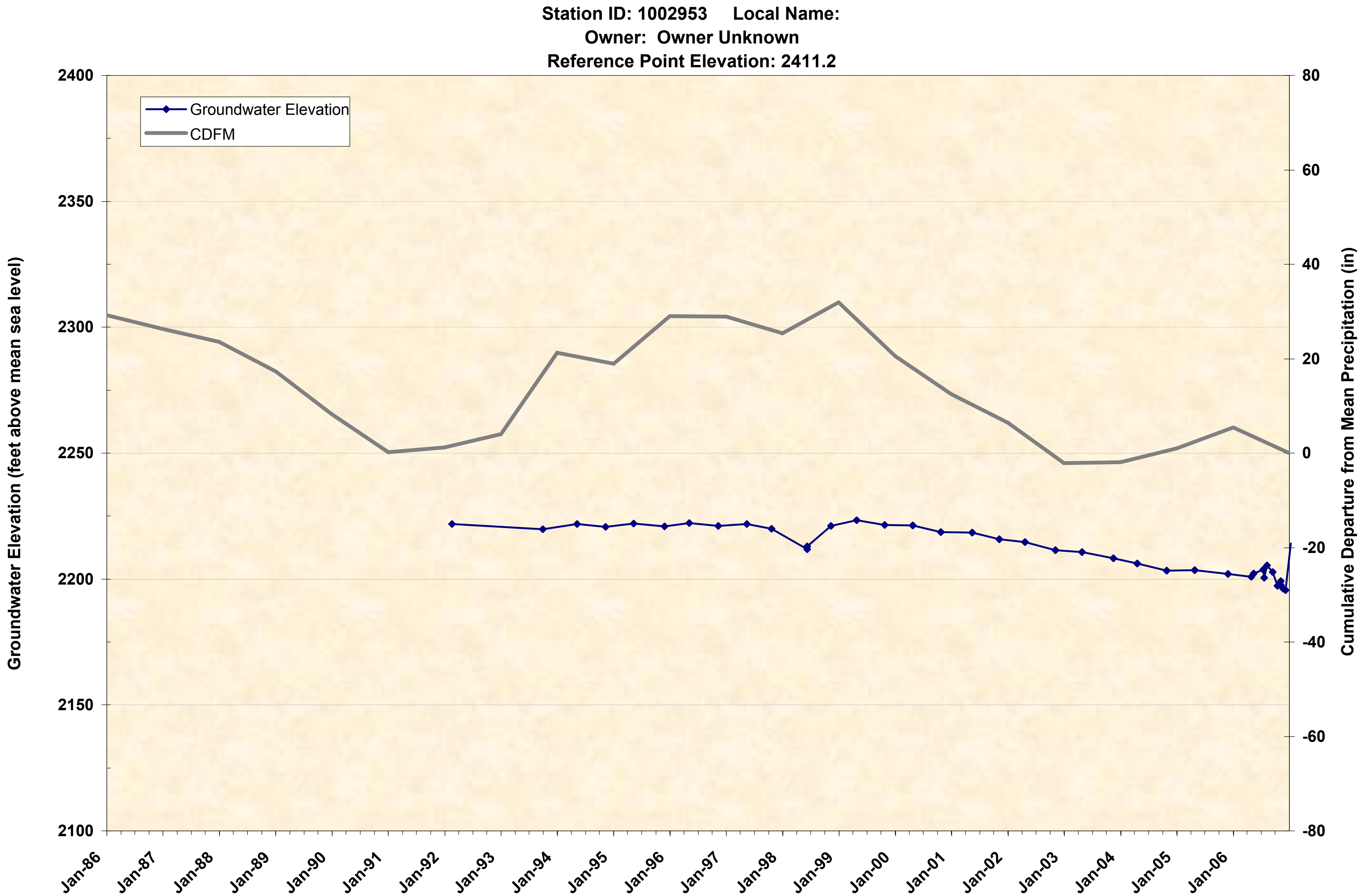

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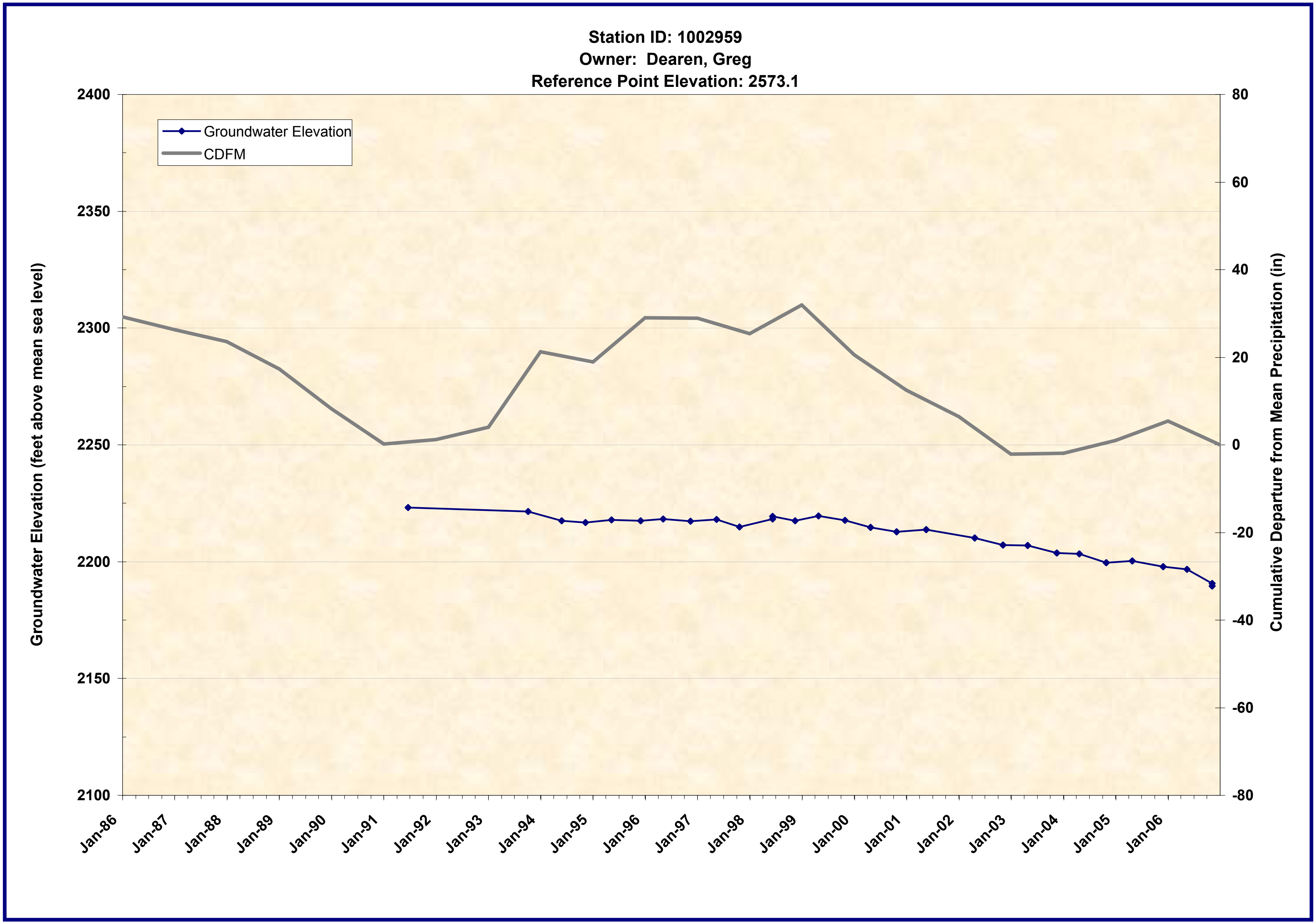

Station ID: 1002959
Owner: Dearen, Greg
Reference Point Elevation: 2573.1
Groundwater Elevation
CDFM
Groundwater Elevation (feet above mean sea level)
Cumulative Departure from Mean Precipitation (in)
2400
2350
2300
2250
2200
2150
2100
80
60
40
20
0
-20
-40
-60
-80
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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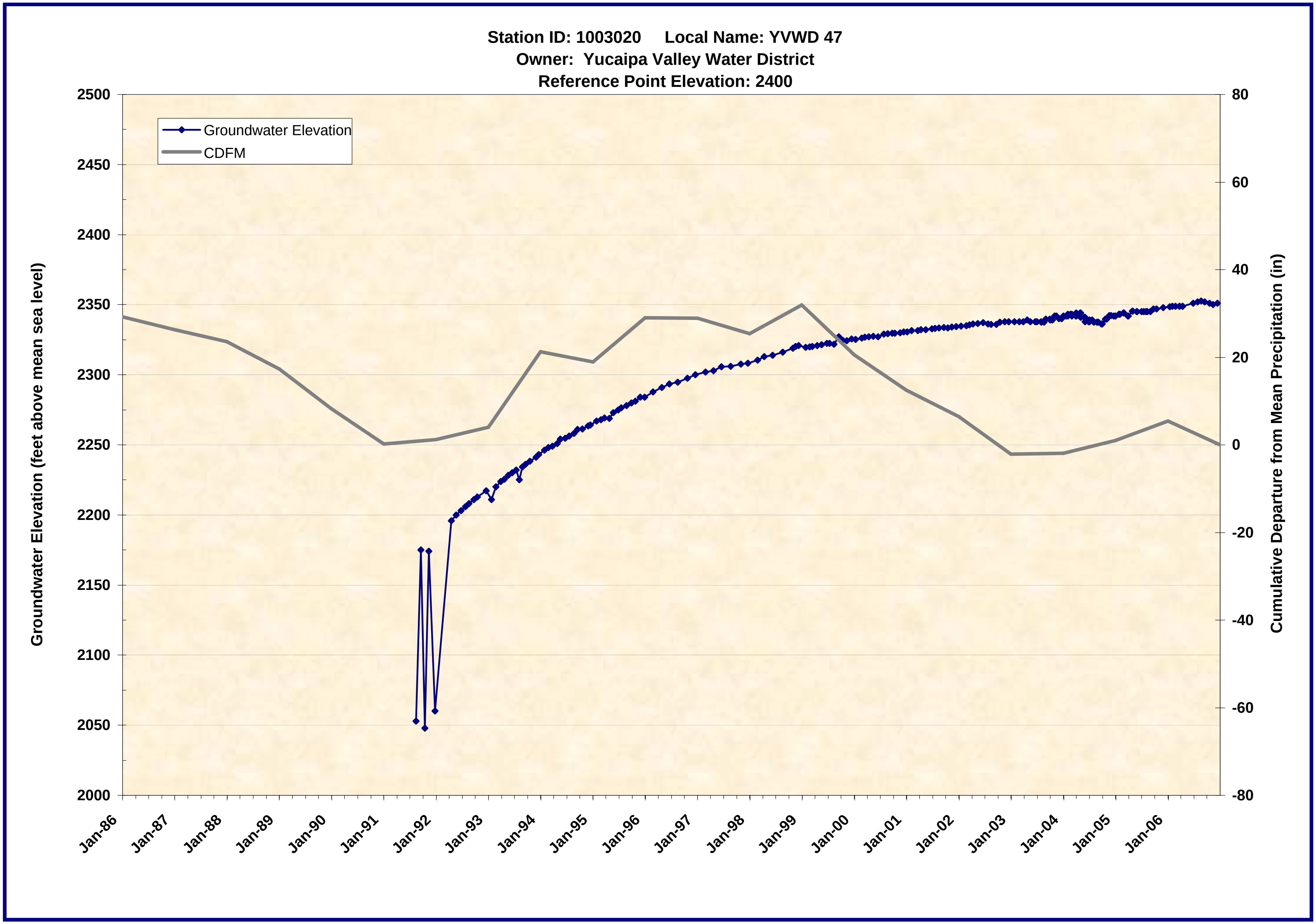
Jan-04
Jan-05
Jan-06



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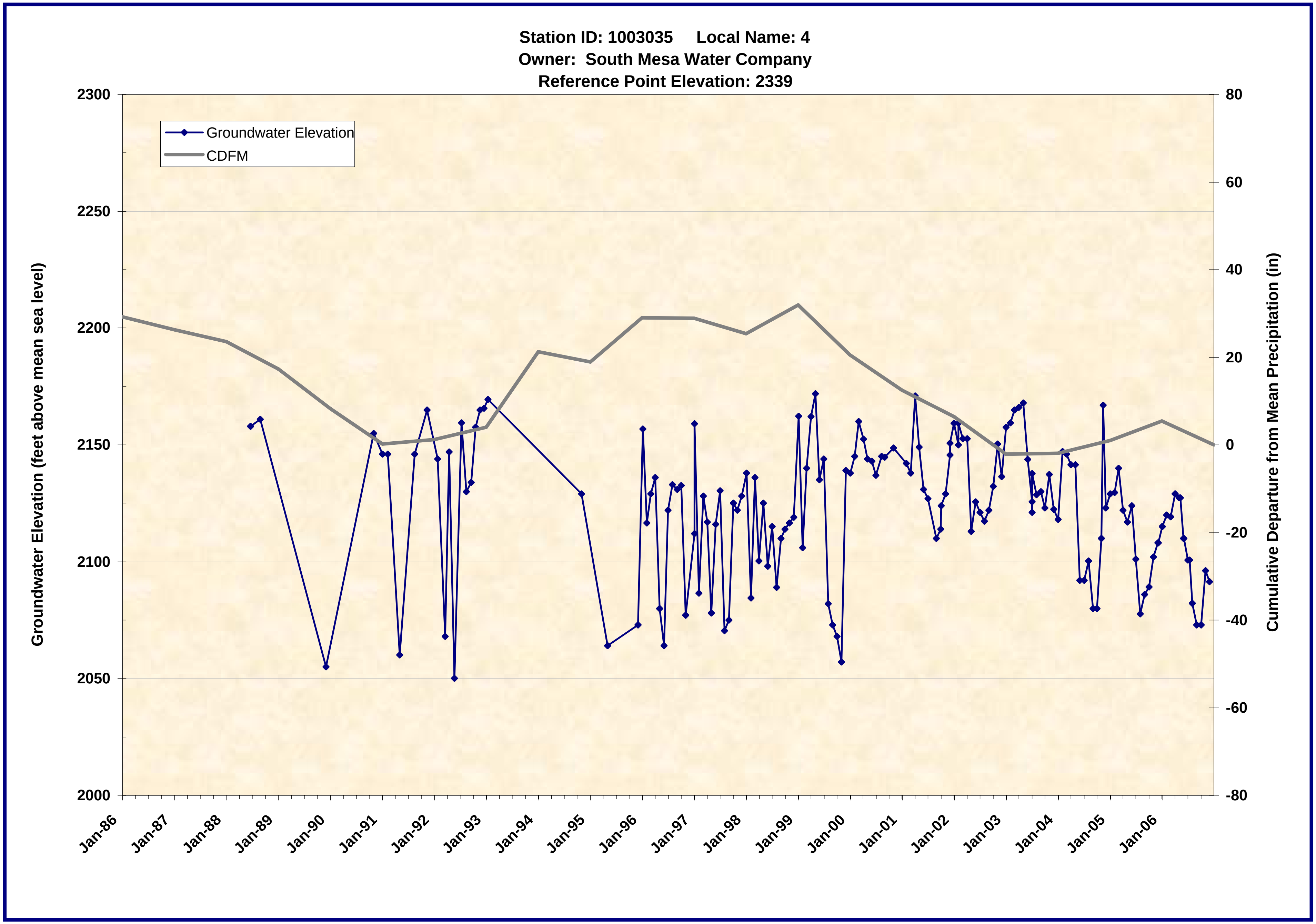

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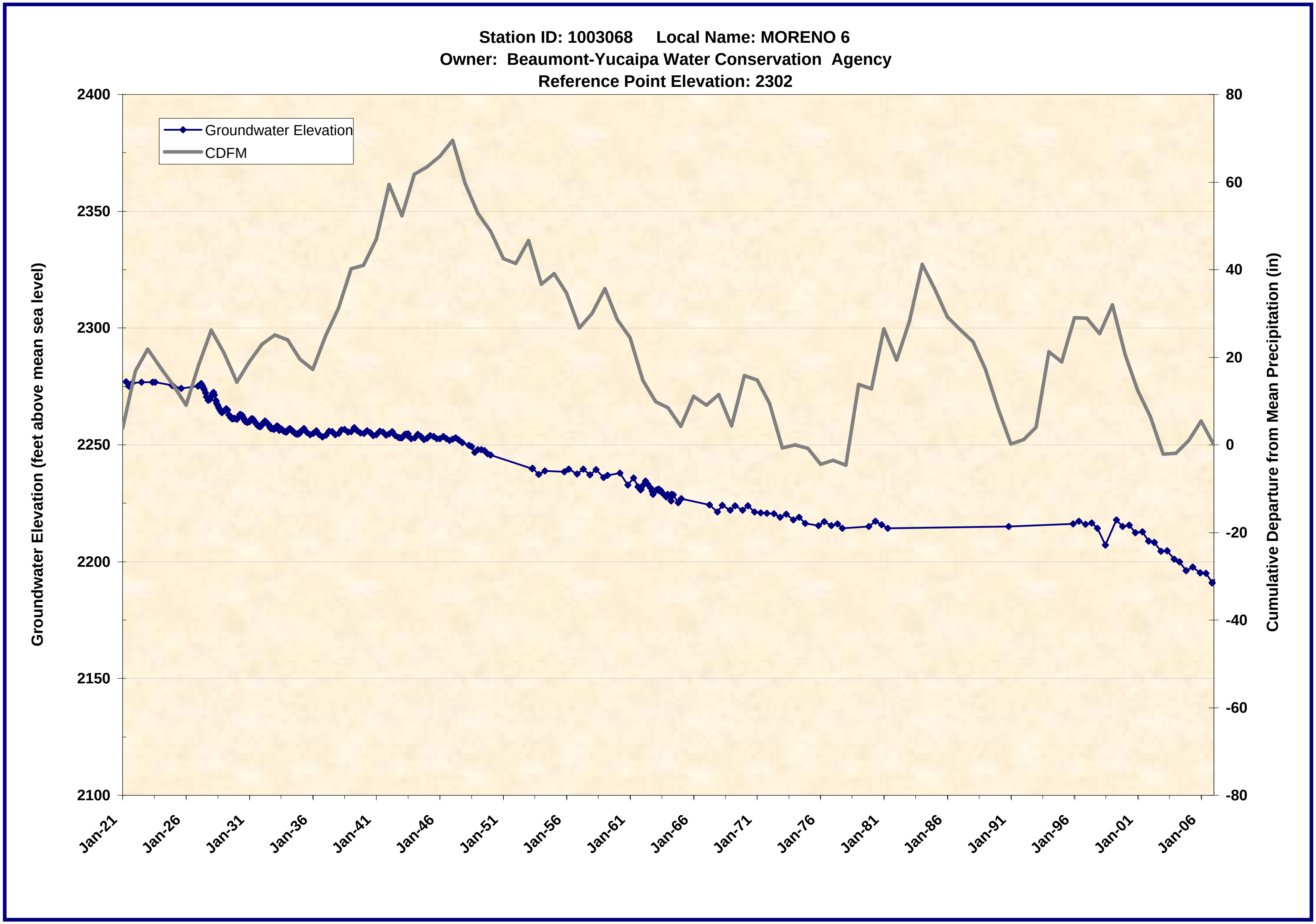

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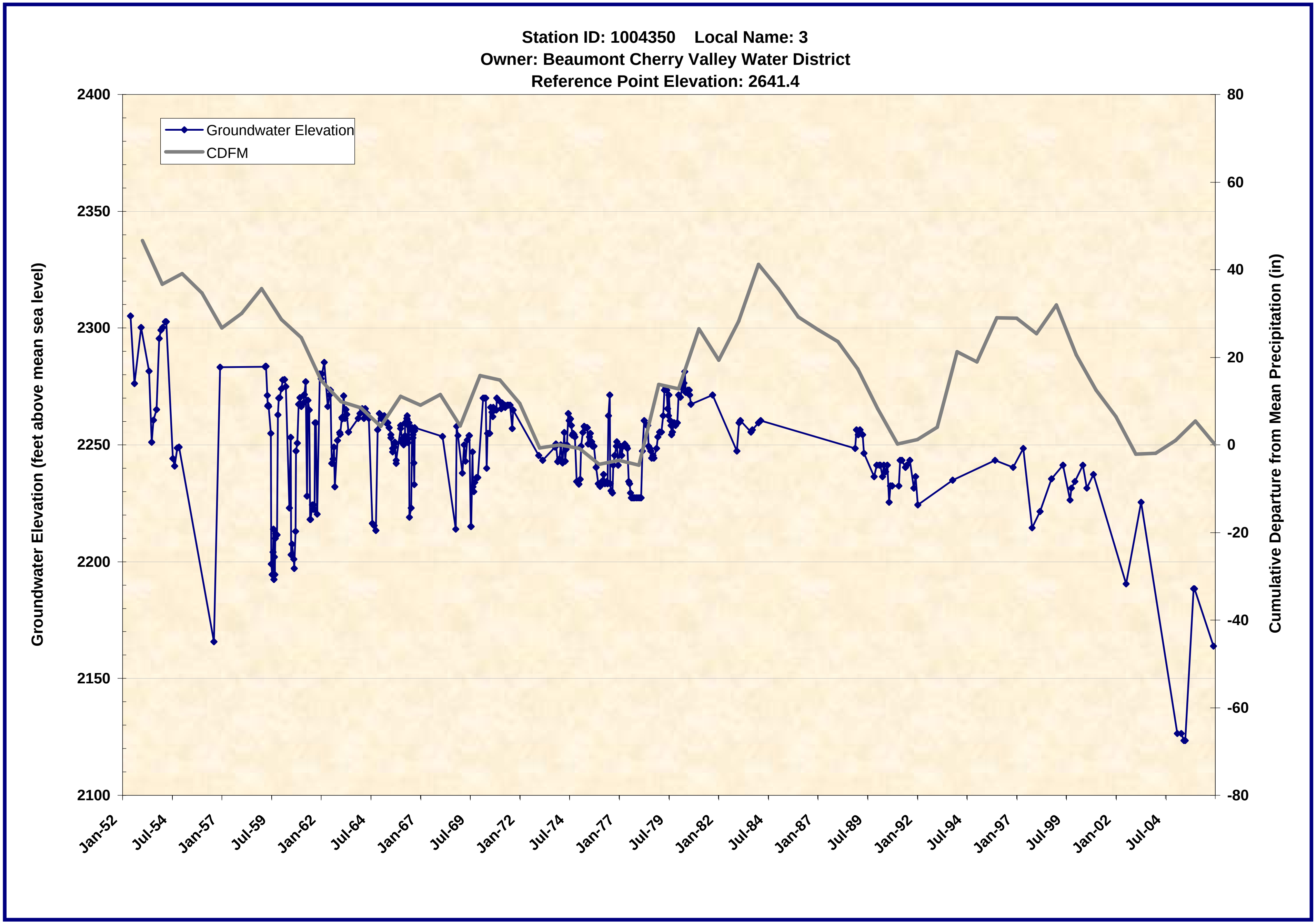

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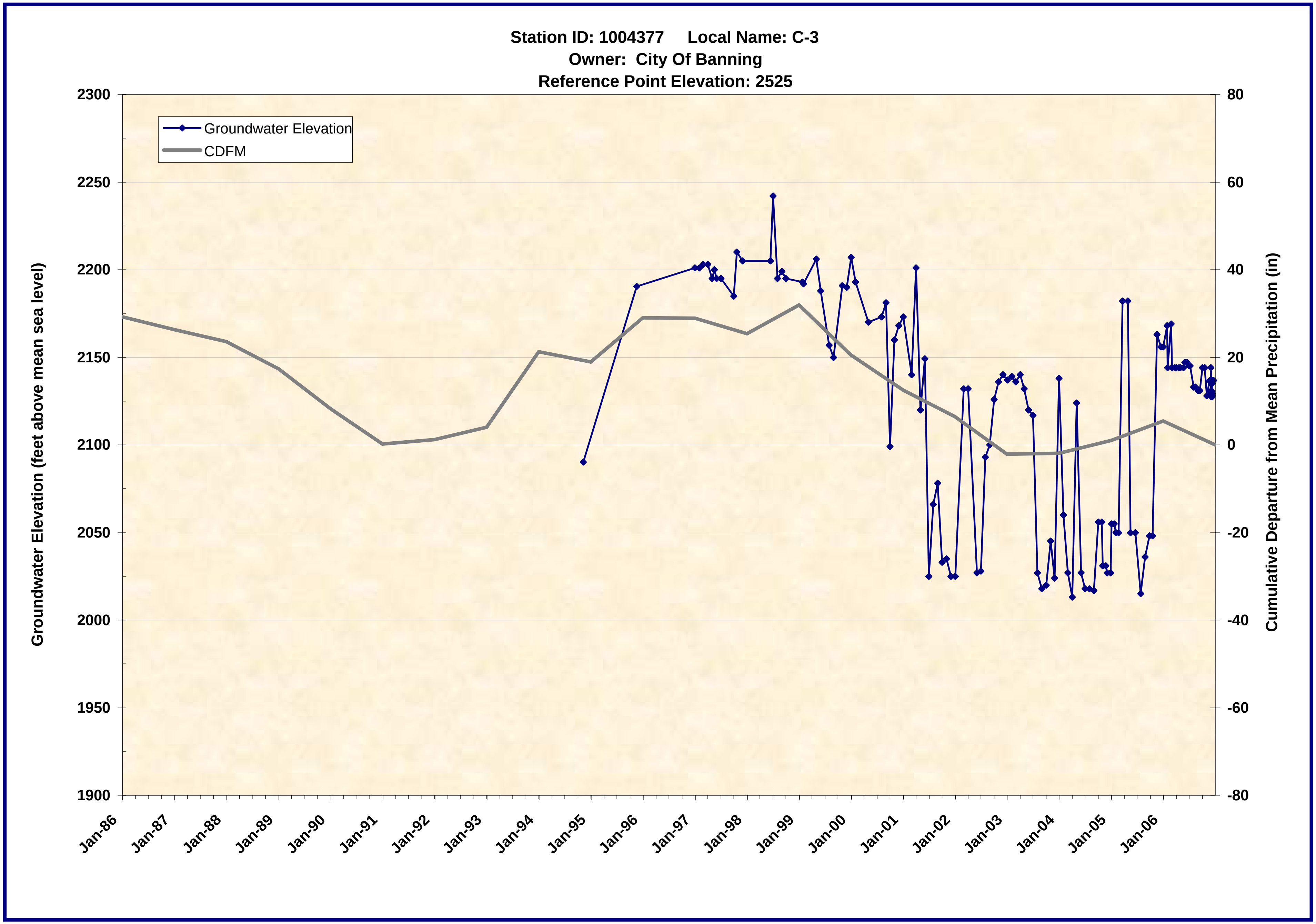

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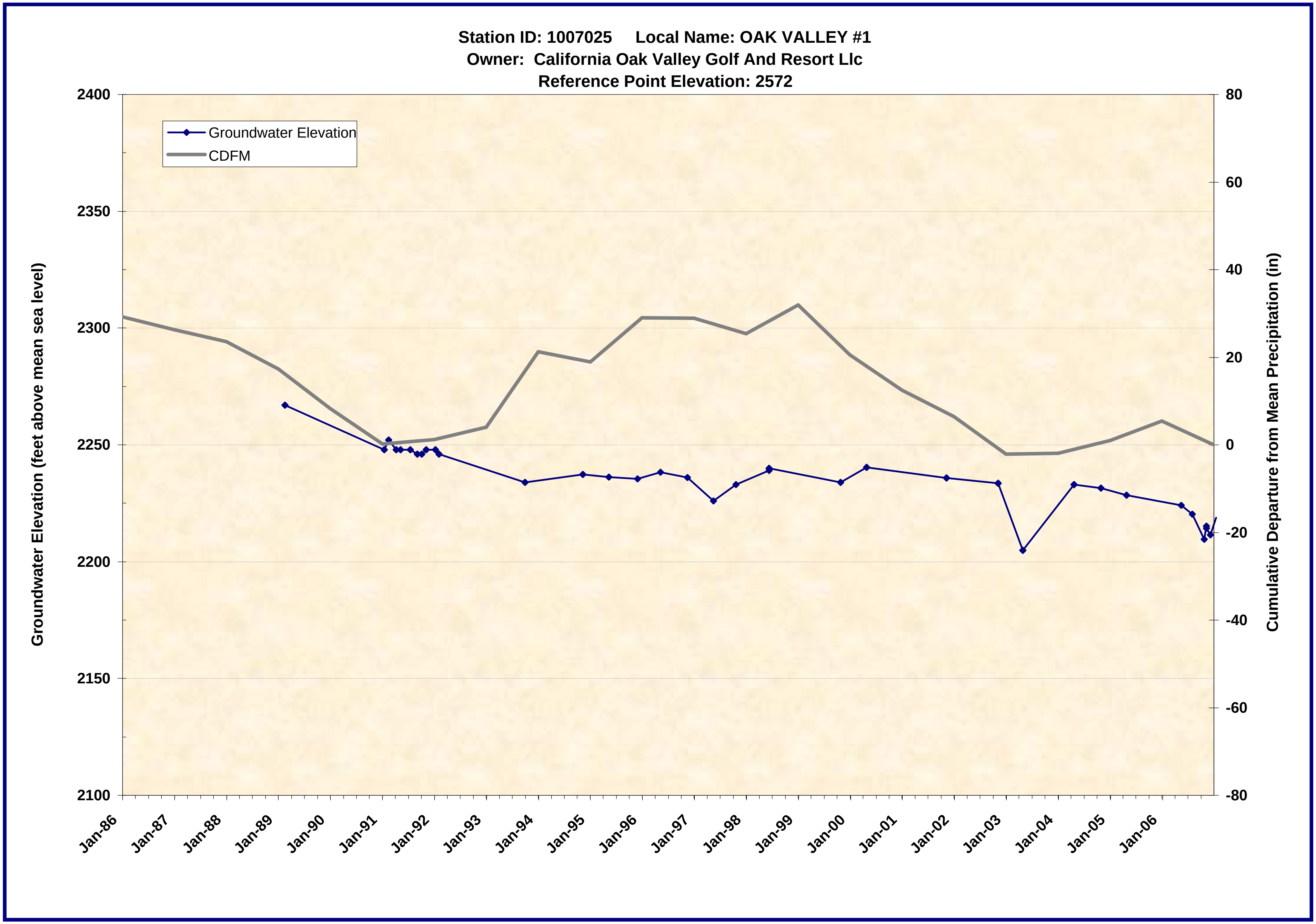

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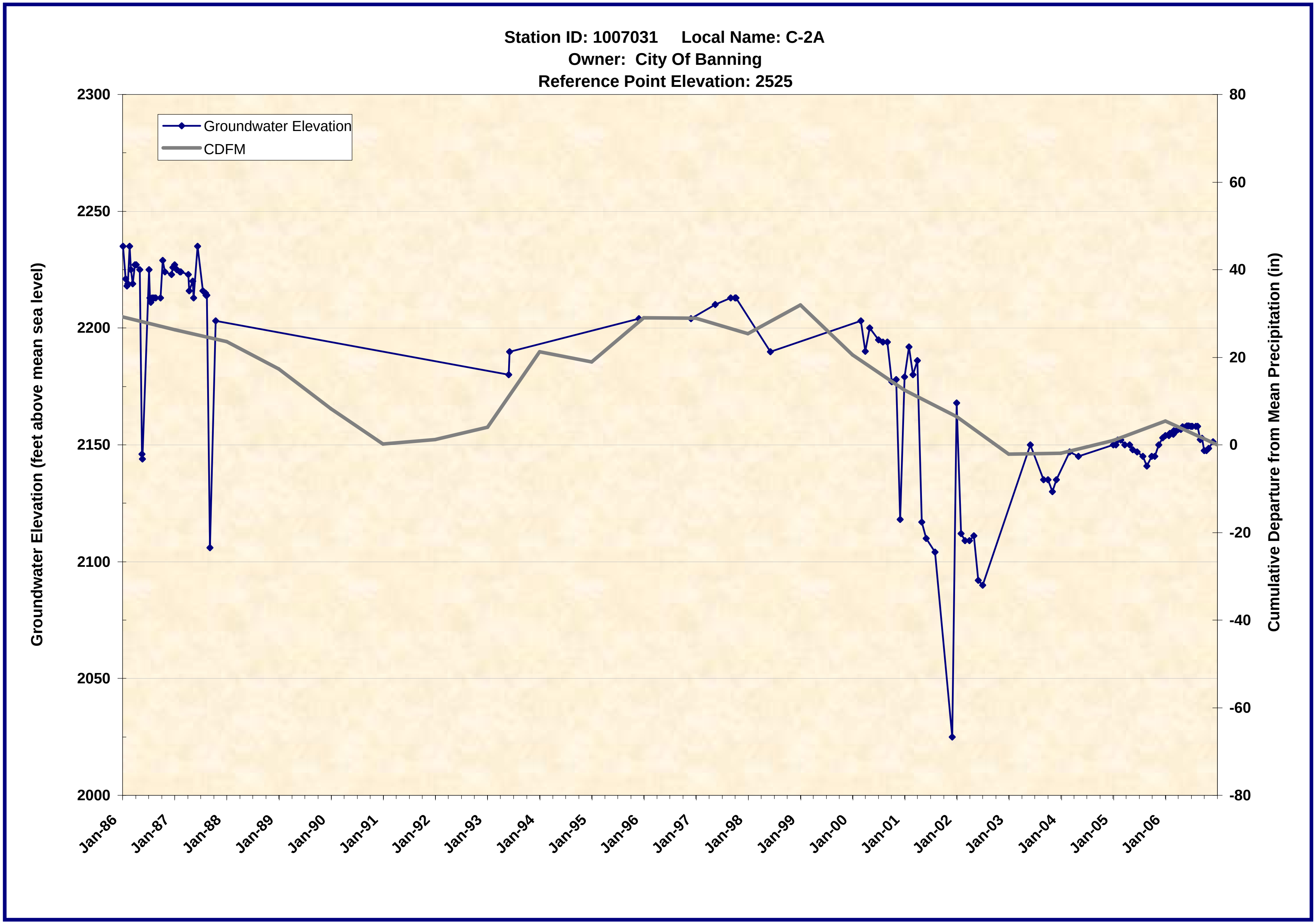

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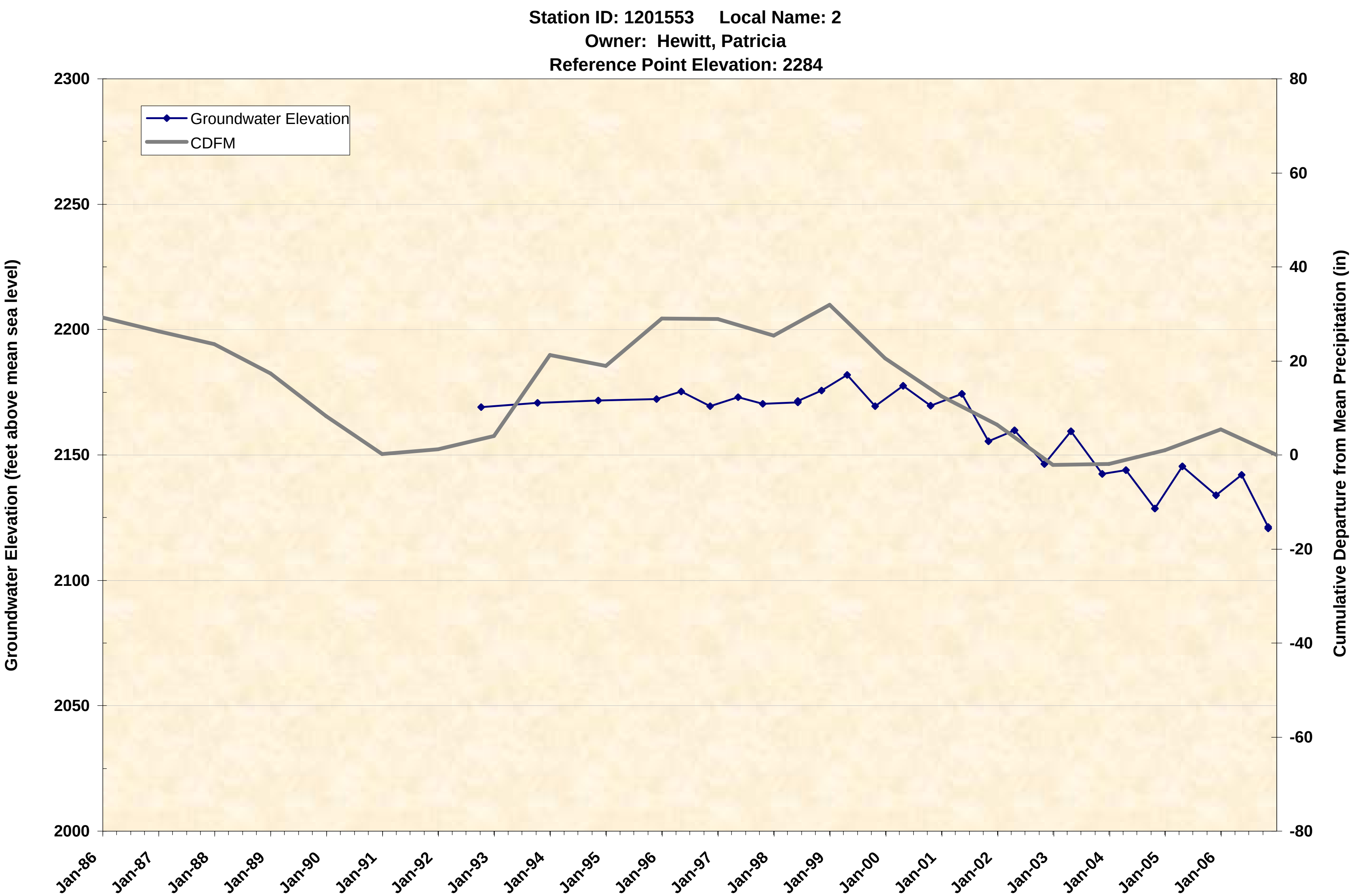

Station ID: 1201553 Local Name: 2
Owner: Hewitt, Patricia
Reference Point Elevation: 2284
Groundwater Elevation
CDFM
Groundwater Elevation (feet above mean sea level)
Cumulative Departure from Mean Precipitation (in)
2300
2250
2200
2150
2100
2050
2000
80
60
40
20
0
-20
-40
-60
-80
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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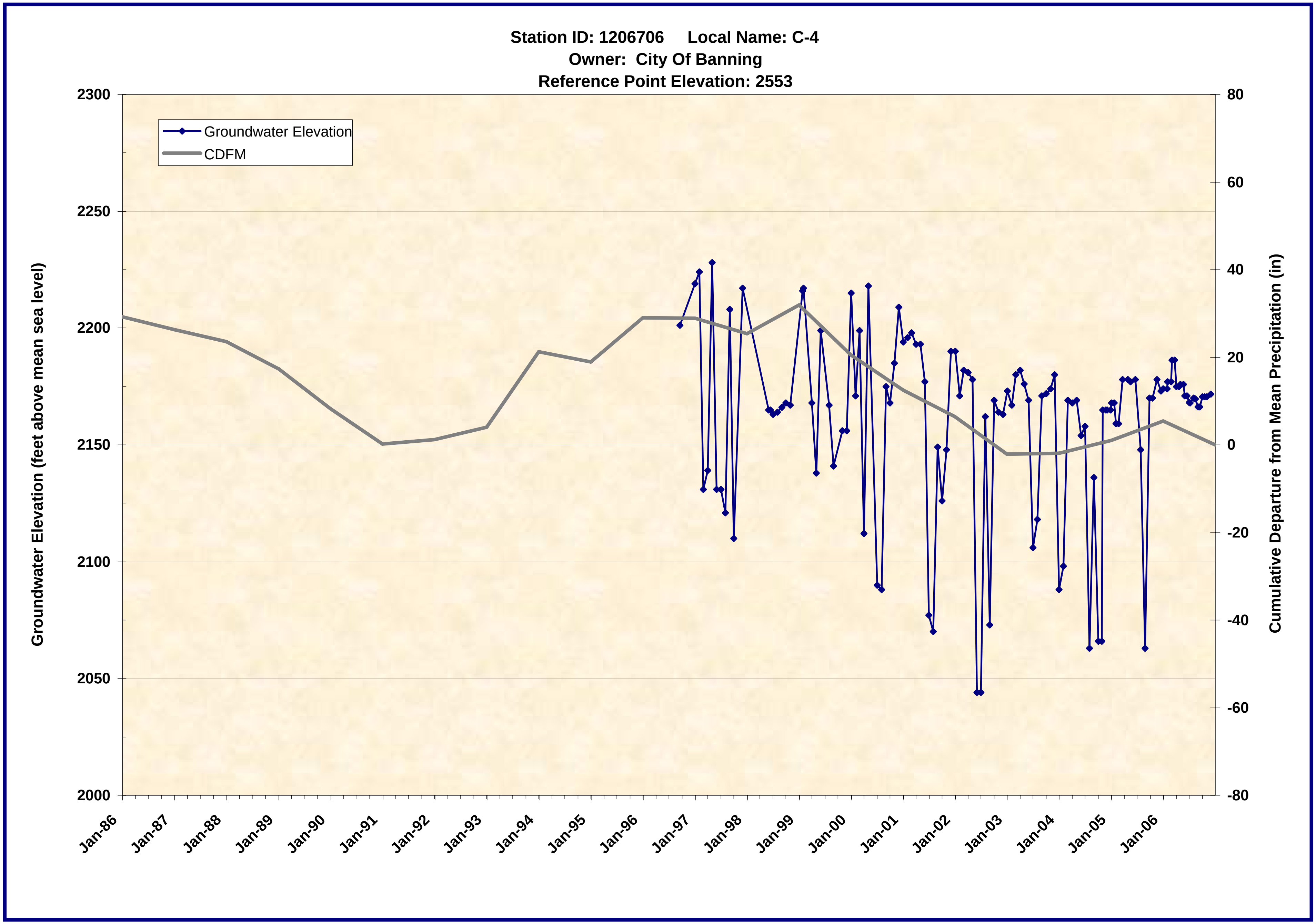
Jan-03
Jan-04
Jan-05
Jan-06



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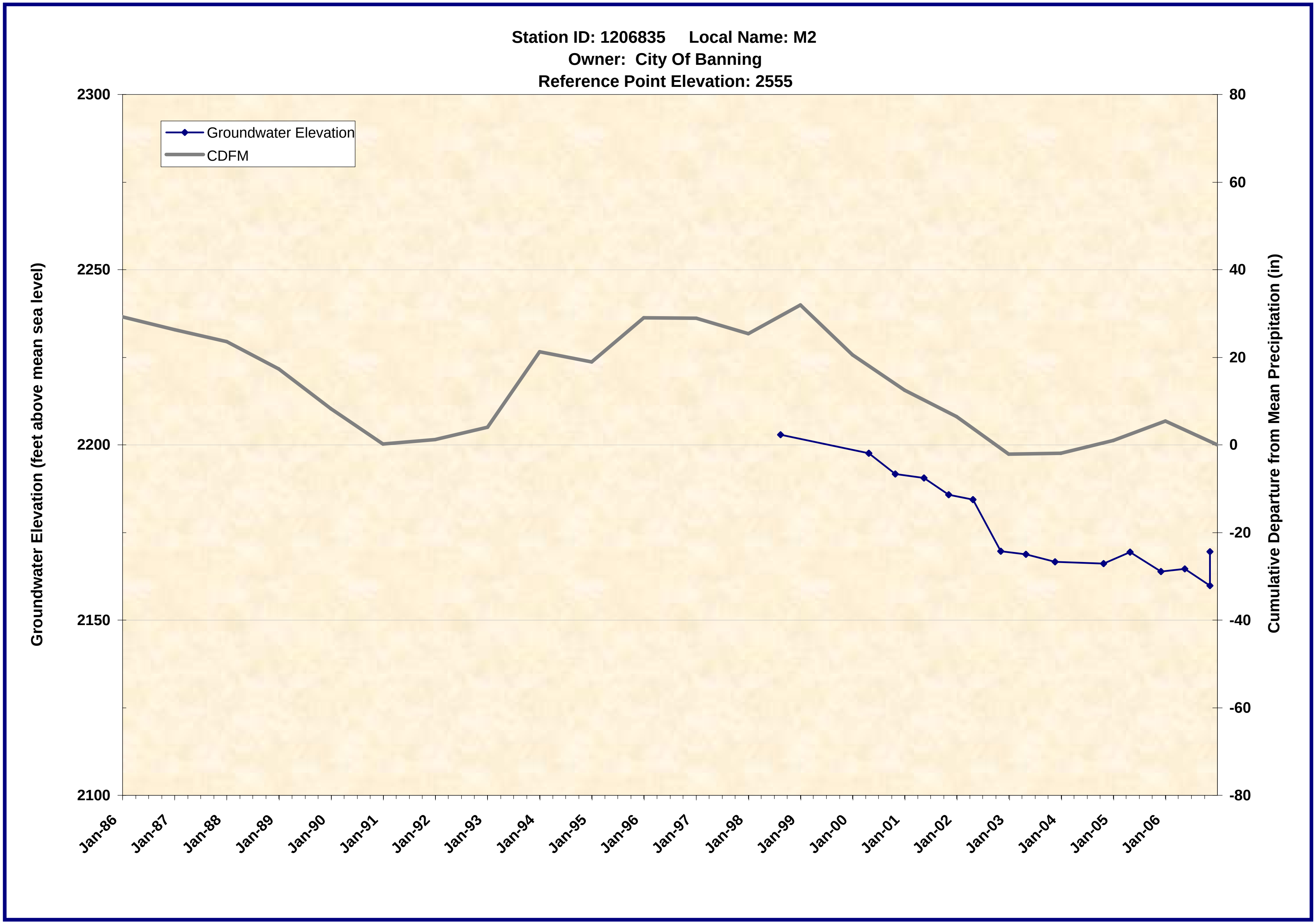

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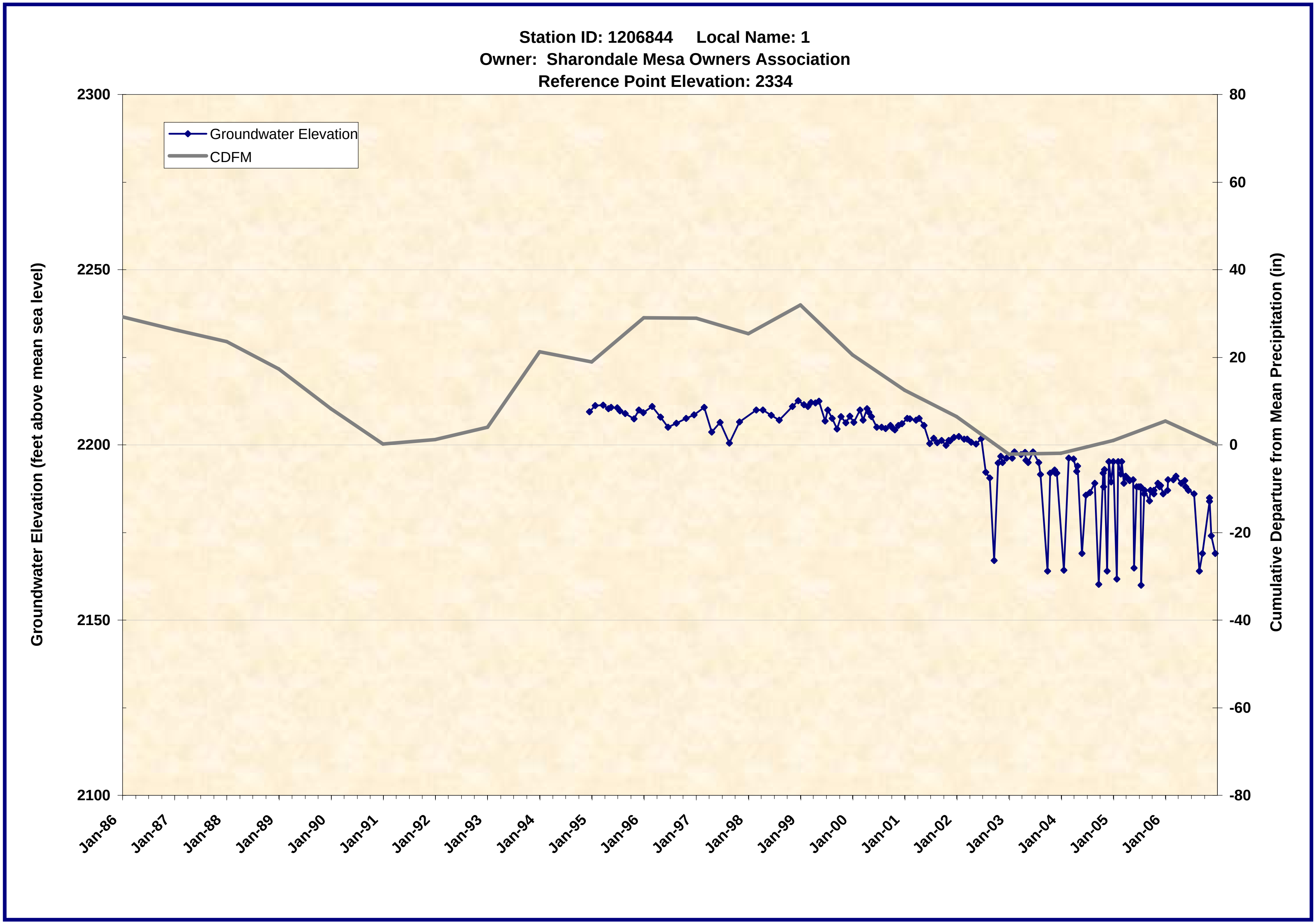

Station ID: 1206844 Local Name: 1
Owner: Sharondale Mesa Owners Association
Reference Point Elevation: 2334
Groundwater Elevation
CDFM
Groundwater Elevation (feet above mean sea level)
Cumulative Departure from Mean Precipitation (in)
2300
2250
2200
2150
2100
80
60
40
20
0
-20
-40
-60
-80
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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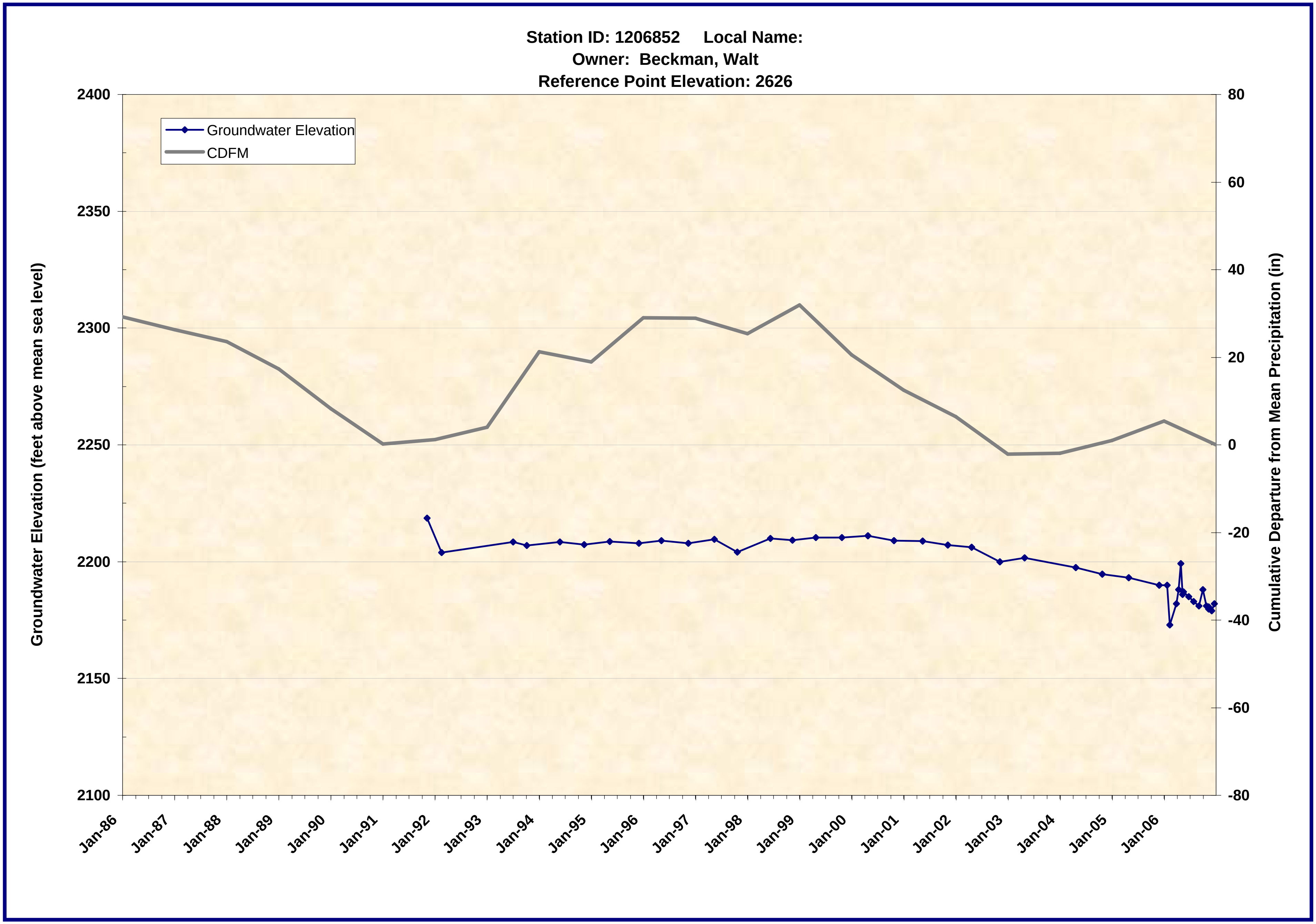
Jan-04
Jan-05
Jan-06



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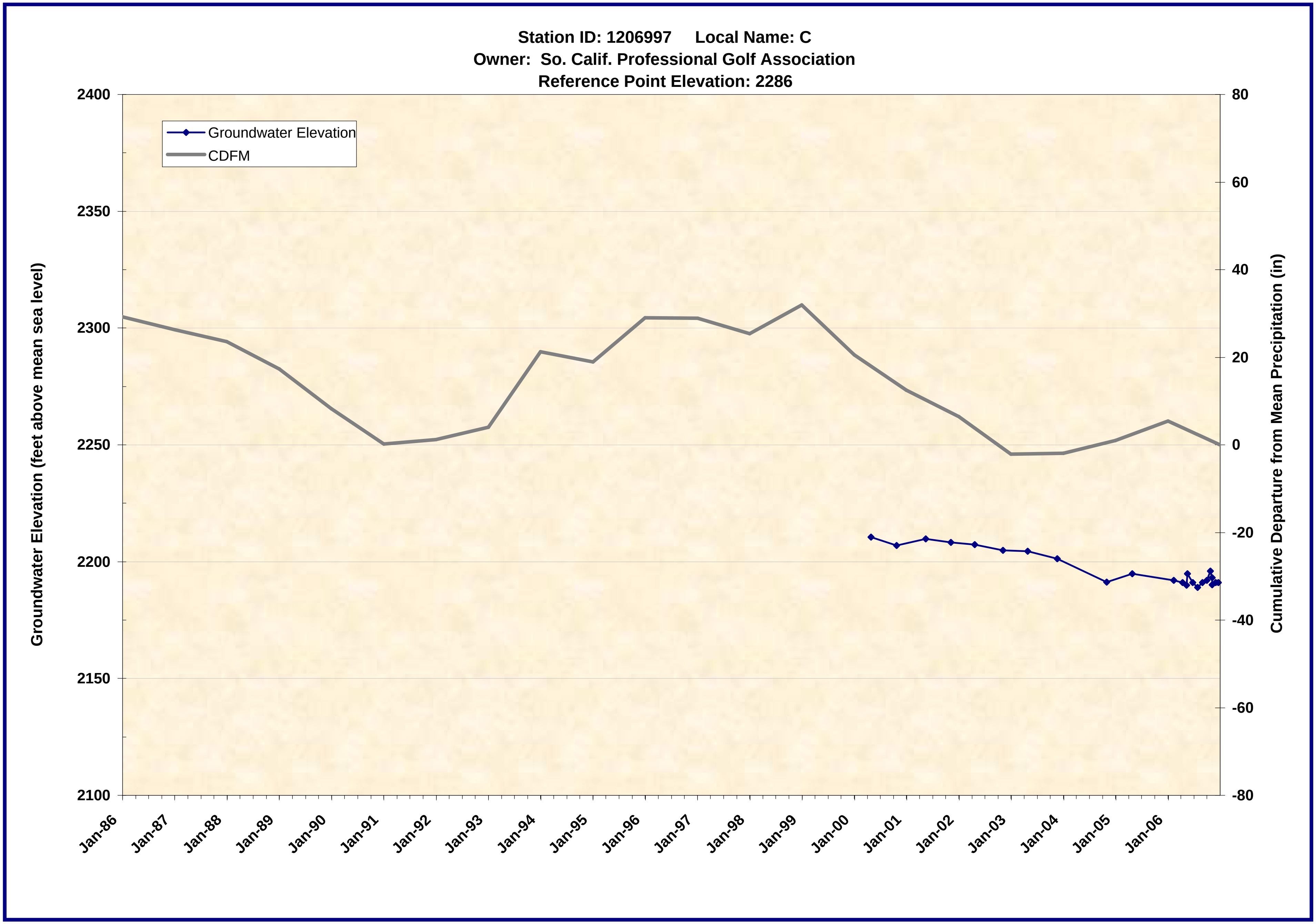

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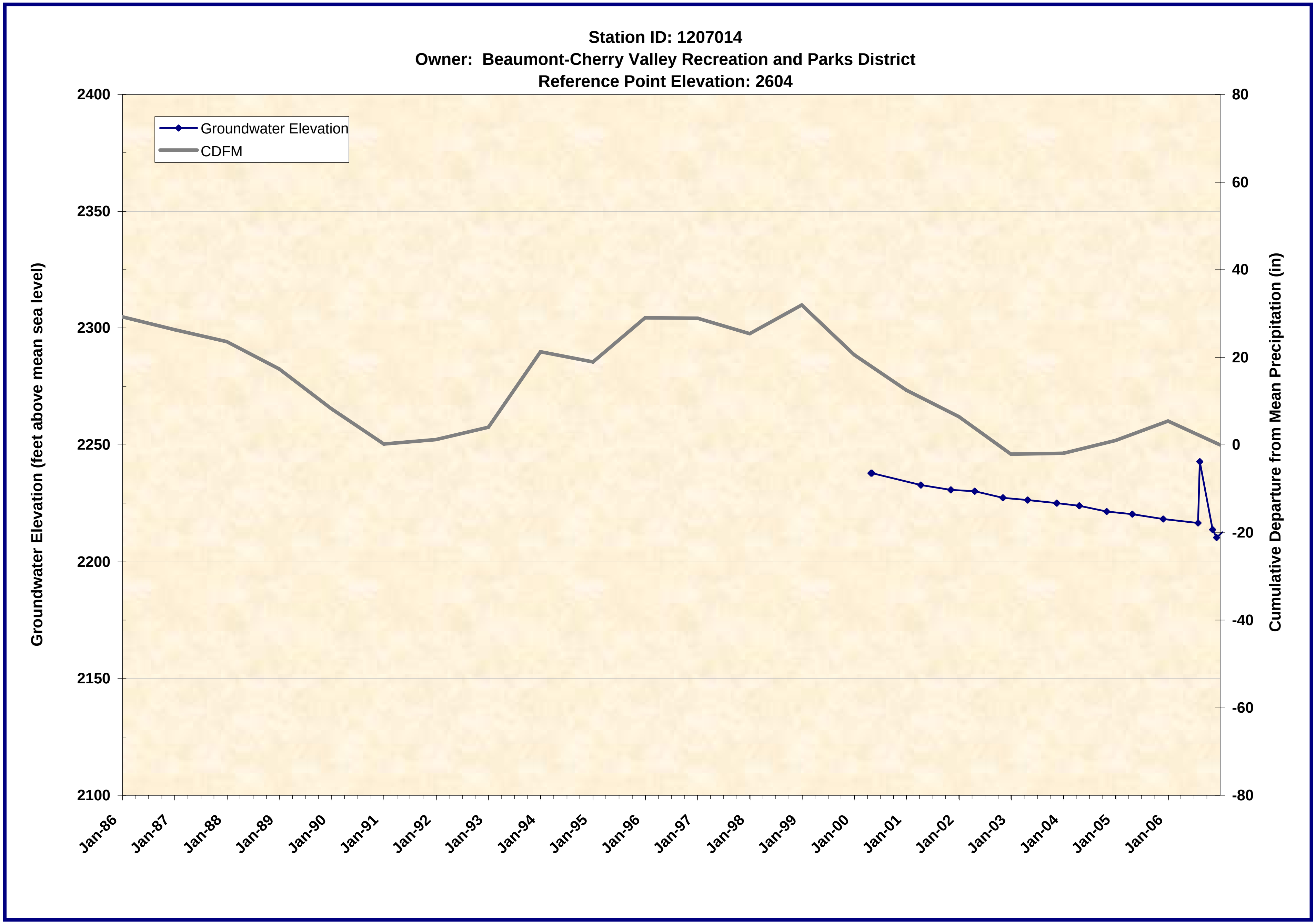

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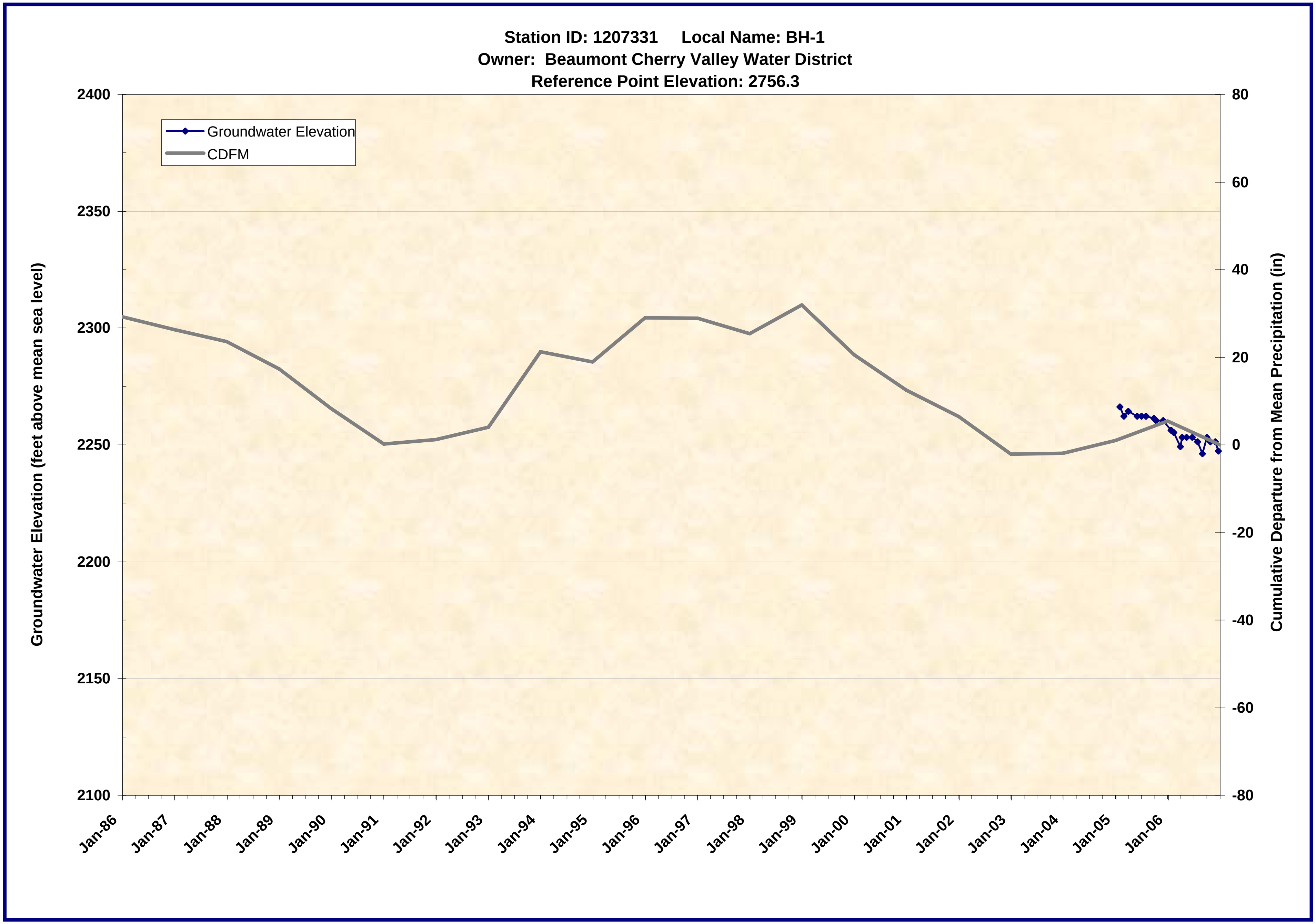

Station ID: 1207331 Local Name: BH-1
Owner: Beaumont Cherry Valley Water District
Reference Point Elevation: 2756.3
Groundwater Elevation
CDFM
Groundwater Elevation (feet above mean sea level)
Cumulative Departure from Mean Precipitation (in)
2400
2350
2300
2250
2200
2150
2100
80
60
40
20
0
-20
-40
-60
-80
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
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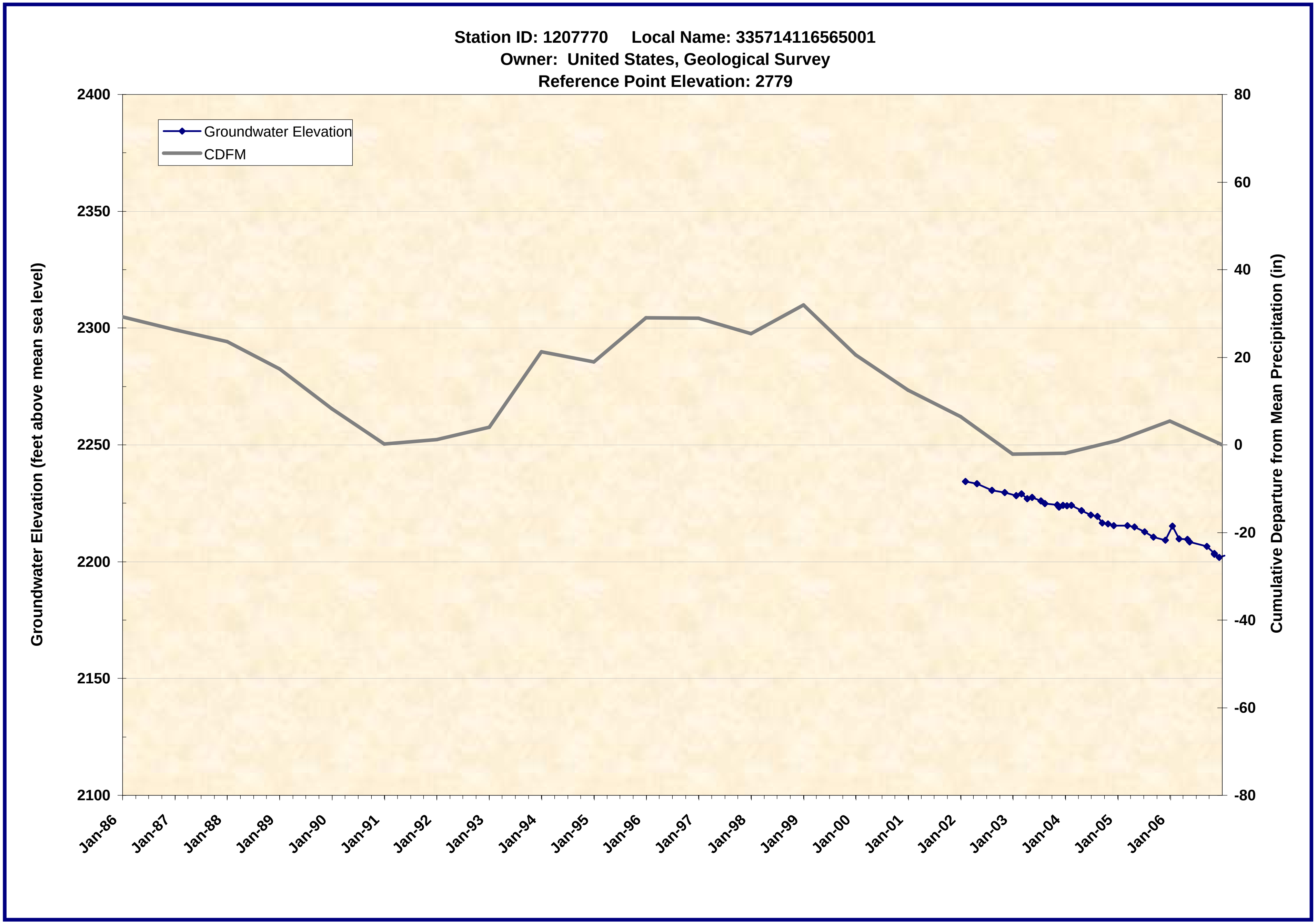
Jan-04
Jan-05
Jan-06



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