CHAPTER 9
WATER QUALITY IMPACTS ON RELIABILITY

The Chino Basin Desalter Authority owns and operates groundwater collection wells, pipelines, pumps, reservoirs and advanced treatment facilities to extract, treat and distribute groundwater. The advanced treatment facilities of Chino Desalters 1 and 2 included air stripping for removal of volatile organic compounds, ion exchange and reverse osmosis for removal of other contaminates (primarily nitrates and total dissolved solids). These treatment processes are state-of-the-art in water treatment and remove most all of any contaminates in water. With these advanced water treatment processes, water quality impacts on reliability are minimized by the systems ability to remove contaminates.

The reader is referred to the CBWM's State of the Basin Report (Appendix F) for a general discussion of water quality impacts on reliability of Chino Basin groundwater.

9.1 GROUNDWATER QUALITY IN CHINO BASIN

The results of all OBMP planning efforts of IEUA and the Chino Basin Watermaster and its member agencies have emphasized the central importance of water quality. The primary challenges facing the agencies supplies, particularly *in the lower Chino Basin* are: (1) water quality problems, (2) future droughts, and (3) the potential for a catastrophic event that interrupts water service to the region. Mitigation efforts are needed in the projected long-term planning effort to meet the future water needs within the Basin, such as:

1. *Desalters*: Desalination is needed to cleanup existing problems within the lower Basin aquifer.

2. *Wellhead treatment:* In the mid and upper Basin, wellhead treatment of groundwater is needed where degradation has caused wells to be taken out of service due to decline in water quality.

3. *Industrial plumes:* Cleanup of all known existing industrial plumes is needed.

The aforementioned methods of water quality treatment constitute a waste of approximately 15 percent of the processed water and results in high concentrations of dissolved solids and other contaminates that require disposal.

Vigilance must be maintained regarding the water quality of imported water during drought/low yield water years to assure continued maintenance of the

Basin's aquifer for future use by the agencies in the Basin and for long-term storage of water for Southern California agencies outside the Basin boundaries.

The groundwater quality in the southern portion of the Basin becomes increasingly poor south of the 60 Freeway, with high total dissolved solids (TDS) and nitrate concentrations in the southern half of the basin. In addition, new contaminants such as perchlorate have been discovered in the region and other contaminants (particularly VOCs) threaten the future expanded use of the Chino Groundwater Basin.[1]

For the most part, the groundwater quality in the northern and central portions of the Chino Basin is good and most areas meet the California Department of Health Services' (CDHS) Safe Drinking Water Standards. Chino Basin groundwater quality is discussed in detail in the Chino Basin OBMP, State of the Basin Report – 2004, June 2005.[2] The discussion below is excerpted from the same reference and the reader is referred to this source for additional information.

In the State of the Basin Report 2004 (July 2005),[4] Figure 4-1 shows all wells that have groundwater quality monitoring results for the period ranging from 1999 to 2004. Figure 4-1 also shows the location of the proposed future desalter supply wells. This figure is reproduced here-in as Figure 9-1.

Numerous water quality standards are in place and governed by Federal and State agencies. Primary "maximum contaminant levels" (MCL) are enforceable criteria established to improve human health and environmental effects. Secondary standards are related to aesthetic qualities of the water such as taste and odor. In addition, for some chemicals there are "notification level" criteria set by the state. These notification levels have been established to meet health concerns but are not enforceable. Table 9-1 lists the constituents which exceed at least one water quality criteria for more than 10 wells in the Chino Basin groundwater for the period January 1999 through June 2004.

Figures 9-1 through 9-13 show the Chino Basin wells with one or more sets of water quality results included in the State of the Basin Report, 2005; additionally, Figure 9-14 shows the locations of plumes in the Basin aquifer with high volatile organic compounds (VOC's). In the figures that depict distributions of water quality in Chino Basin, the convention shown in Table 9-2 was typically followed in setting the class intervals in the legend (where WQS is the applicable water quality standard). Variations from this convention may be employed to highlight certain aspects of data.

[1] Chino Basin OBMP, State of the Basin Report – 2004, June 2005, Wildermuth Environmental, Inc. pp 4-10 to 4-12
[2] Chino Basin OBMP, State of the Basin Report – 2004, June 2005 Wildermuth Environmental, Inc.
[4] Chino Basin OBMP, State of the Basin Report – 2004, June 2005 Wildermuth Environmental, Inc. pp 4-34 to 4-60

Table 9-1 Constituents that Exceed MCL in Water Wells

Analyte Group /Constituent	Wells with Exceedances
Inorganic Constituents	
Total Dissolved Solids	479
Nitrate	606
Aluminum	57
Arsenic	12
Chloride	50
Fluoride	11
Iron	75
Manganese	40
Perchlorate	128
Sulfate	69
General Physical	
Color	13
Odor	14
Chlorinate VOC's	
1,1-dichloroethene	12
1,2,3-trichloropropane	55
cis-1,2-dichloroethene	10
tetrachloroethene (PCE)	30
trichloroethene (TCE)	101
Radiological	
gross alpha	153
total radon 222	21

Table 9-2 General Legend for Scheme for Figures 9-2 through 9-13

Symbol	Class Interval
	Not Detected
	<0.5.WQS, but detected
	0.5.WQS to WQS
	WQS to 2.WQS
	2.WQS to 4.WQS
	>4.WQS

Total Dissolved Solids (TDS)

In CDHS Title 22, TDS is regulated as a secondary contaminant. The recommended drinking water *maximum contaminant level* (MCL) for TDS is 500 mg/L; however, the upper limit is 1,000 mg/L.

TDS concentrations in the northeast part of Chino Basin range from about 170 to about 300 mg/L for the pre-1980 period with typical concentrations in the mid to low 200s. TDS concentrations in excess of 200 mg/L would indicate degradation from overlying land use. With a few exceptions, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated TDS concentrations. The exceptions are areas where point sources have contributed to TDS degradation; i.e., the former Kaiser Steel site in Fontana and the former wastewater disposal ponds near the IEUA *Regional Plant No. 1* (RP-1) south of the 60 Freeway and west of Archibald Avenue in the City of Ontario, CA.

Figure 9-2 illustrates the distribution of TDS concentrations in the Chino Groundwater Basin from 1999 to 2004. In some places, wells with low TDS concentrations are found to be proximate to wells with higher TDS concentrations, suggesting a vertical stratification of water quality.

Nitrate-Nitrogen (NO_3-N)

In CDHS Title 22, nitrate is regulated in drinking water with an MCL of 10 mg/L (as nitrogen). By convention, all nitrate values are reported in this document as *nitrate-nitrogen* (NO_3-N). Hence, the values of nitrate-nitrogen reported in this document should be compared with a NO_3-N MCL of 10 mg/L. Nitrate measurements in the surface water flows from the San Gabriel Mountains and in the ground water near the foot of these mountains are generally less than 0.5 mg/L. Nitrate concentrations in excess of 0.5 mg/L may indicate degradation from overlying land use.

Figure 9-3 shows the distribution of nitrate-nitrogen concentrations in Chino Basin for the period 1999 through 2004.

This sampling period primarily reflects data in the southern portion of Chino Basin. The results of comprehensive monitoring indicated that about eighty-three percent of the private wells had nitrate concentrations greater than the MCL and 60 percent are more than 2.5 times greater than the MCL. As with TDS, each consecutive sampling program saw a shift toward higher nitrate concentrations.

The following areas, south of the 60 Freeway, have somewhat elevated nitrate concentrations; east of the Puente and Chino Hills, south of the Jurupa Hills, along the Santa Ana River, the Temescal and Riverside Basins, and downgradient of the former RP-1 discharge point. Several wells in the southern portion of Chino Basin have nitrate concentrations greater than the MCL and 21 wells exceed 40 mg/L (4 times the MCL).

As explained earlier, areas with either significant irrigated land use or dairy waste disposal histories overlie groundwater with elevated nitrate concentrations. The primary areas of nitrate degradation are the areas formerly or currently overlain by dairy areas in the southern parts of the Chino-North Management Zone (MZ), the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ.

Over the same period, nitrate concentrations have increased significantly in the southern parts of the Chino-North MZ, the Chino-South MZ, the Chino-East MZ, and the Prado Basin MZ.[5]

Other Constituents of Concern

This section discusses the constituents whose water quality standards were exceeded in ten or more wells in Chino Basin (with the exception of nitrate and total dissolved solids). The details of these exceedances are displayed graphically in Figures 9-4 through 9-12. Chromium, hexavalent chromium and Methyl-tert-butyl ether (MTBE) are not discussed in the section that follows because standards were not exceeded in 10 or more wells. However, in the future, these constituents may be problematic, depending on the promulgation of future standards.

VOC's

The following five volatile organic compounds (VOCs) were detected at or above their MCL in more than 10 wells:

- Tetrachloroethene (PCE);
- Trichloroethene (TCE);
- 1,1-dichloroethene;
- *Cis*-1,2-dichloroethene; and
- 1,2,3-trichloropropane.

Tetrachloroethene and Trichloroethene

PCE and TCE were/are widely used industrial solvents. PCE is commonly used in the dry-cleaning industry. About 80 percent of all dry cleaners use PCE as their primary cleaning agent (Oak Ridge National Laboratory, 1989). TCE is commonly used for metal degreasing and as a food extractant. The distributions of PCE and TCE are shown in Figures 9-4 and 9-5 respectively. In general, PCE is below detection limits for wells in the Chino Basin. The wells with detectable levels tend to occur in clusters such as those seen around Milliken Landfill, south and west of the Ontario Airport, and along the margins of the Chino Hills. The spatial distribution of TCE resembles that of PCE. TCE was not detectable in most of the wells in the basin. Similar clustering of wells was also seen around Milliken Landfill, south and west of Ontario Airport, south of Chino Airport and in the Stringfellow plume.

[5] CBWM OBMP; Phase I Report. Prepared for the Chino Basin Watermaster, August 19, 1999; Wildermuth Environmental, Inc. 1999.

Dichloroethene and *cis*-1, 2-Dichloroethene

Dichloroethene (1, 1-DCE) and *cis*-1, 2-dichloroethene (*cis*-1,2-DCE) are degradation by-products of PCE and TCE (Dragun, 1988) formed by the reductive dehalogenation, and their aerial distribution as shown in Figures 9-6 and 9-7 respectively. In a majority of wells in the Chino Basin, dichloroethene and *cis*-1,2-dichloroethene is not detected. Dichloroethene is found near the Milliken Landfill, south and west of the Ontario Airport, south of Chino Airport and at the head of the Stringfellow plume. The compound *cis*-1,2-dichloroethene is found in the same general locations.

1,2,3-Trichloropropane

1,2,3-Trichloropropane (1,2,3-TCP) is a colorless liquid that is used primarily as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross linking agent in the synthesis of polysulfides. It has been used as a solvent, extractive agent, paint and varnish remover, cleaning and degreasing agent, and it has been formulated with dichloropropene in the manufacturing of soil fumigants, such as D-D.

The current California State Notification Level for 1,2,3-TCP is 0.005 micrograms per liter (µg/L). The adoption of the Unregulated Chemicals Monitoring Requirements (UCMR) regulations occurred before a method capable of achieving the required detection limit for reporting (DLR) was available. According to DHS, some utilities moved ahead with monitoring and the samples were analyzed using higher DLRs. Unfortunately, findings of non-detect with a DLR higher than 0.005 µg/L do not provide DHS with adequate information needed for possible standard setting. New methodologies to analyze for 1,2,3-TCP with a DLR of 0.005 µg/L have since been developed and the DHS is requesting that any utility with 1,2,3-TCP findings of nondetect with reporting levels of 0.01 µg/L or higher do follow-up sampling using a DLR of 0.005 µg/L. Private wells monitored in 1999 through 2001 were analyzed for 1,2,3-TCP at a DLR of 50 µg/L. Because 1,2,3-TCP may be a basin-wide water quality issue, all private wells are being retested at a lower detection limit - 0.005 µg/L.

Figure 9-8 shows the distribution of 1,2,3-trichloropropane (1,2,3-TCP) in Chino Basin, based on the data limitations discussed previously, using the legend convention typically employed throughout this report. Figure 9-8 shows that the very high values of 1,2,3-TCP are associated with the Chino Airport VOC plume. In addition, there is a cluster of wells that contain 1,2,3-TCP in concentrations greater than the Notification Level north of the Chino Airport along the western margins of the basin.

Aluminum, Arsenic, Fluoride, Iron and Manganese

The concentrations of aluminum, arsenic, iron, and manganese depend on mineral solubility, ion exchange reactions, surface complexations, and soluble ligands. These speciation and mineralization reactions, in turn, depend on pH, oxidation-reduction potential, and temperature.

Aluminum and Iron

In general, across the Chino Basin, aluminum and iron were non-detect (Figures 9-9 and 9-10, respectively). However, both constituents were high in the Stringfellow plume. Furthermore, iron was found at detectable levels (but still below one-half the MCL) in 2 clusters of wells on either side of Ontario Airport. Outside of the Stringfellow plume, there were 18 wells with concentrations greater than the MCL. Aluminum concentrations exceeded the primary California MCL in 5 wells outside of the Stringfellow plume. Exceedances may be an artifact of sampling methodology – relatively high concentrations of aluminum, iron, and trace metals are often the result of dissolution of aluminosilicate particulate matter and colloids caused by the acid preservative in unfiltered samples.

Arsenic

The current arsenic MCL is 50 µg/L. In January 2001, EPA mandated that compliance with the new federal arsenic MCL of 10 µg/L would be required by 2006. After adopting 10 µg/L as the new standard for arsenic in drinking water, the US 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 US EPA decided to move forward with implementing the 10 µg/L standard for arsenic in drinking water (US EPA, 2001). Figure 9-11 shows the distribution in Chino Basin. Fourteen wells in the Chino Basin had arsenic concentrations that exceed the 2006 MCL. Only 4 wells in the basin exceeded the current MCL of 50 µg/L. Three of these wells belong to the City of Chino Hills, the remaining well is at the northern tip of the Stringfellow plume. Higher concentrations of arsenic in the Chino Hills area are found at depths greater than about 350 feet below ground surface (Table 9-3).

Chino Hills 1A is a production well that is located about 30 feet from Chino Hills 1B, the well with the highest concentration of arsenic in the period from 1999 to 2004. During this period samples from Chino Hills 1A (perforated interval: 166-217 ft. bgs) were all non-detect.

Table 9-3 Arsenic Concentrations in Water Wells

Well	Arsenic Concentrations 1999-2004 (mg/L)			Perforated Intervals (ft bgs)
	Minimum	Maximum	Average	
Chino Hills 16	ND	67	39	430-940
Chino Hills 15B	13	72	51	360-440 480-900
Chino Hills 1B	58	80	66	440-470 49-610 720-900 940-1180

Fluoride

Fluoride occurs naturally in groundwater in concentrations ranging from less than 0.1 mg/L to 10-20 mg/L (Freeze and Cherry, 1979). Fluoride was detected in 954 wells within the basin, only 7 of which have concentrations that exceed the California primary MCL.

Manganese

Manganese is a naturally occurring element that is a component of over 100 minerals. Because of the natural release of manganese into the environment by the weathering of manganese-rich rocks and sediments, manganese occurs ubiquitously at low levels in soil, water, air, and food. Manganese compounds are used in a variety of products and applications including water and wastewater treatment, matches, dry-cell batteries, fireworks, fertilizer, varnish, livestock supplements, and as precursors for other manganese compounds. Manganese is often found near landfills especially when oxidation-reduction conditions promote its mobility in groundwater. Neither manganese nor any manganese compounds are regulated in drinking water. However, the US EPA has set a secondary standard MCL of 0.05 mg/L as has California. All these standards though are non-enforceable. Most of the wells sampled for manganese have resulted in non-detect. High concentrations of manganese in groundwater have been observed along the Santa Ana River in Reach 3, scattered throughout the southern portion of Chino Basin and near the Milliken Landfill (Figure 9-12).

Perchlorate

Perchlorate has recently been detected in several wells in the Chino Basin (Figure 9-13), in other basins in California, and in other states in the West. The probable reason that perchlorate was not detected in groundwater until recently is that analytical methodologies did not previously exist that could attain a low enough detection limit. Prior to 1996, the method detection limit for perchlorate was 400 µg/L. By March 1997, an ion chromatographic method was developed with a detection limit of 1 µg/L and a reporting limit of 4 µg/L.

Perchlorate (ClO_4) originates as a contaminant in the environment from the solid salts of ammonium perchlorate (NH_4ClO_4), potassium perchlorate ($KClO_4$), or sodium perchlorate ($NaClO_4$). The perchlorate salts are quite soluble in water. The perchlorate anion (ClO_4) is exceedingly mobile in soil and groundwater environs. Because of its resistance to react with other available constituents, it can persist for many decades under typical groundwater and surface water conditions.

Perchlorate has been detected in 152 wells in the Chino Basin. Historical values of perchlorate exceeding the State Action Level have occurred in areas of the Chino Basin. Areas where perchlorate is found that are of interest to the CDA are:

- Downgradient of the Stringfellow Superfund Site. Concentrations have exceeded 600,000 µg/L in on-site observation wells and the plume has likely reached Pedley Hills and may extend as far as Limonite Avenue.

- Wells in the City of Ontario water service area, south of the Ontario Airport (source(s) unknown).

- Scattered wells in the City of Chino water service area (source(s) unknown).

Several types of treatment systems designed to reduce perchlorate concentrations are operating in the United States, reducing perchlorate to below the 4 ppb quantization level. Biological treatment and ion (anion) exchange systems are among the technologies that are being used, with additional treatment technologies under development.

<u>Additional Constituents</u>

Radon is a radioactive gas found in nature. It has no color, odor, or taste and is chemically inert. Higher concentrations of radon and gross alpha in groundwater typically occur near granitic bedrock outcrops; one might expect to see higher occurrences of these constituents near the San Gabriel Mountains, Jurupa Hills, Puente Hills, and Chino Hills and along fault zones- Rialto-Colton Fault, San Jose Fault, and the Red Hill Fault. The aerial distributions of radon and gross alpha do not show the expected pattern however, there are no spatial patterns or outside evidence to suggest a source other than naturally-occurring. Based on water quality results from 1999 to the present, 58 wells in the basin are at or above the US EPA proposed MCL for Radon. Based on the same sampling record,165 wells are at or above the USEPA MCL for gross alpha.

Chloride and sulfate both exceeded secondary MCLs. As discussed previously, secondary MCLs apply to chemicals in drinking water that adversely affect its aesthetic qualities and are not based on direct health effects associated with the chemical. Chloride and sulfate are major anions associated with TDS. Most wells in the basin had detectable levels of sulfate but most were less than 125 mg/L (one-half the water quality standard). A total of 83 wells had concentrations at or above the sulfate MCL. In general, these wells were distributed in the southern portion of the basin, along the margins of the Chino Hills and in the Stringfellow plume. All wells had detectable levels of chloride but most concentrations were less than 125 mg/L (one-half the MCL). The secondary MCL for chloride is exceeded in 68 wells almost all of which are located in the southern portions of the basin.

Color, odor and turbidity were detected at greater than their secondary MCLs in more than 10 wells in the last 5 years. These parameters are monitored purely for aesthetic reasons and should not limit water quality in Chino Basin.

9.2 POINT SOURCES OF CONCERN

The previous water quality discussion broadly described water quality conditions across the entire basin. The discussion presented below describes the water quality anomalies associated with known point source discharges to groundwater. Figure 9-14 shows the location of various point sources and areas of water quality degradation associated with these sources.

<u>Chino Airport</u>

The Chino Airport is located approximately four miles east of the City of Chino and six miles south of Ontario International Airport, and occupies an area of about 895 acres. From the early 1940s until 1948, the airport was owned by the federal government and used for flight training and aircraft storage. The County of San Bernardino acquired the airport in 1948 and has operated and/or leased portions of the facility ever since. Since 1948, past and present businesses and activities at the airport include modification of military aircraft, crop dusting, aircraft-engine repair, aircraft painting, stripping and washing, dispensing of fir-retardant chemicals to fight forest fires, and general aircraft maintenance. The use of organic solvents for various manufacturing and industrial purposes has been widespread throughout the airport's history (RWQCB, 1990). From 1986 to 1988, a number of groundwater quality investigations were performed in the vicinity of Chino Airport. Analytical results from groundwater sampling revealed the presence of VOCs above MCLs in six wells down-gradient of Chino Airport. The most common VOC detected above its MCL was TCE. TCE concentrations in the contaminated wells ranged from 6.0 to 75.0 µg/L.

Figure 9-14 shows the approximate aerial extent of TCE in groundwater in the vicinity of Chino Airport at concentrations exceeding its MCL as of 2002. The plume is elongate in shape, up to 3,600 feet wide and extends approximately 14,200 feet from the airport's northern boundary in a south to southwestern direction. During the period from 1997 to 2002, the maximum TCE concentration in groundwater detected at an individual well within the Chino Airport plume was 570 µg/L.

In 2002, the County of San Bernardino submitted a work plan to the Regional Board for installing up to five monitoring wells at and around Chino Airport in the summer 2003. The concentrations of TCE observed by the five monitoring wells are entirely consistent with a conceptual mode of a plume that has migrated away form Chino Airport. These new data corroborate other data generated by the Watermaster and others.

California Institute for Men

The California Institute for Men (CIM) located in Chino is bounded on the north by Edison Avenue, on the east by Euclid Avenue, on the south by Kimball Avenue, and on the west by Central Avenue. CIM is a state correctional facility and has been in existence since 1939. It occupies approximately 2,600 acres – about 2,000 acres are used for dairy and agricultural uses and about 600 acres are used for housing inmates and related support activities (Geometric Consultants, 1996). In 1990, PCE was detected at a concentration of 26 µg/L in a sample of water collected for a CIM drinking water supply well. Analytical results from groundwater sampling indicated that the most common VOCs detected in groundwater underlying CIM were PCE and TCE. Other VOCs detected included carbon tetrachloride, chloroform, 1,2-DCE, bromodichloromethane, 1,1,1-trichloroethane (1,1,1-TCA), and toluene. The maximum PCE concentration in groundwater detected at an individual monitoring well (GWS-12) was 290 µg/L. The maximum TCE concentration in groundwater detected at an individual monitoring well (MW-6) was 160 µg/L (Geometric Consultants, 1996).

Figure 9-14 shows the approximate aerial extent of VOCs in groundwater at concentrations exceeding MCLs as of 2004. The plume is up to 2,900 feet wide and extends about 5, 800 feet from north to south. During the period from 1999 to 2004, the maximum PCE and TCE concentrations in groundwater detected at an individual well within the CIM plume were 1,990 µg/L and 141 µg/L respectively.

VOC Anomaly – South of the Ontario Airport

A VOC plume containing primarily TCE exists south of the Ontario Airport. The plume extends approximately from State Route 60 on the north and Haven Avenue on the east to Cloverdale Road on the south and South Grove Avenue on the west. Figure 9-14 shows the approximate aerial extent of the plume as of 2004. The plume is up to 17,700 feet wide and 20,450 feet long. During the period from 1999 to 2004, the maximum TCE concentrations in groundwater detected at an individual well within this plume was 83 μg/L.

9.3 CURRENT STATE OF GROUNDWATER QUALITY IN CHINO BASIN[6]

The baseline for the Initial State of the Basin is on or about July 1, 2000 – the point in time that represents the start of OBMP implementation. This initial state or baseline is one metric that can be used to measure progress from implementation of the OBMP.

The groundwater quality in Chino Basin is generally very good, with better groundwater quality found in the northern portion of Chino Basin where recharge occurs. Salinity (TDS) and nitrate concentrations increase in the southern portion of Chino Basin. Twenty-eight percent of the private wells south of the 60 Freeway (169 wells) had TDS concentrations below the secondary MCL. About 83 percent of the private wells south of the 60 Freeway had nitrate concentrations greater than the MCL.

The other constituents that have the potential to impact groundwater quality from a regulatory or Basin Plan standpoint are certain VOCs, arsenic, and perchlorate. As discussed above there are a number of point source releases of VOCs in Chino Basin. These are in various stages of investigation or cleanup. Likewise, there are known point source releases of perchlorate as well as what appears to be non-point source related perchlorate contamination from currently undetermined sources. Arsenic at levels above its water quality standards appears to be limited to the deeper aquifer zone near the City of Chino Hills. Total chromium and hexavalent chromium, while currently not a groundwater issue for Chino Basin, may become so, depending on the promulgation of future standards.

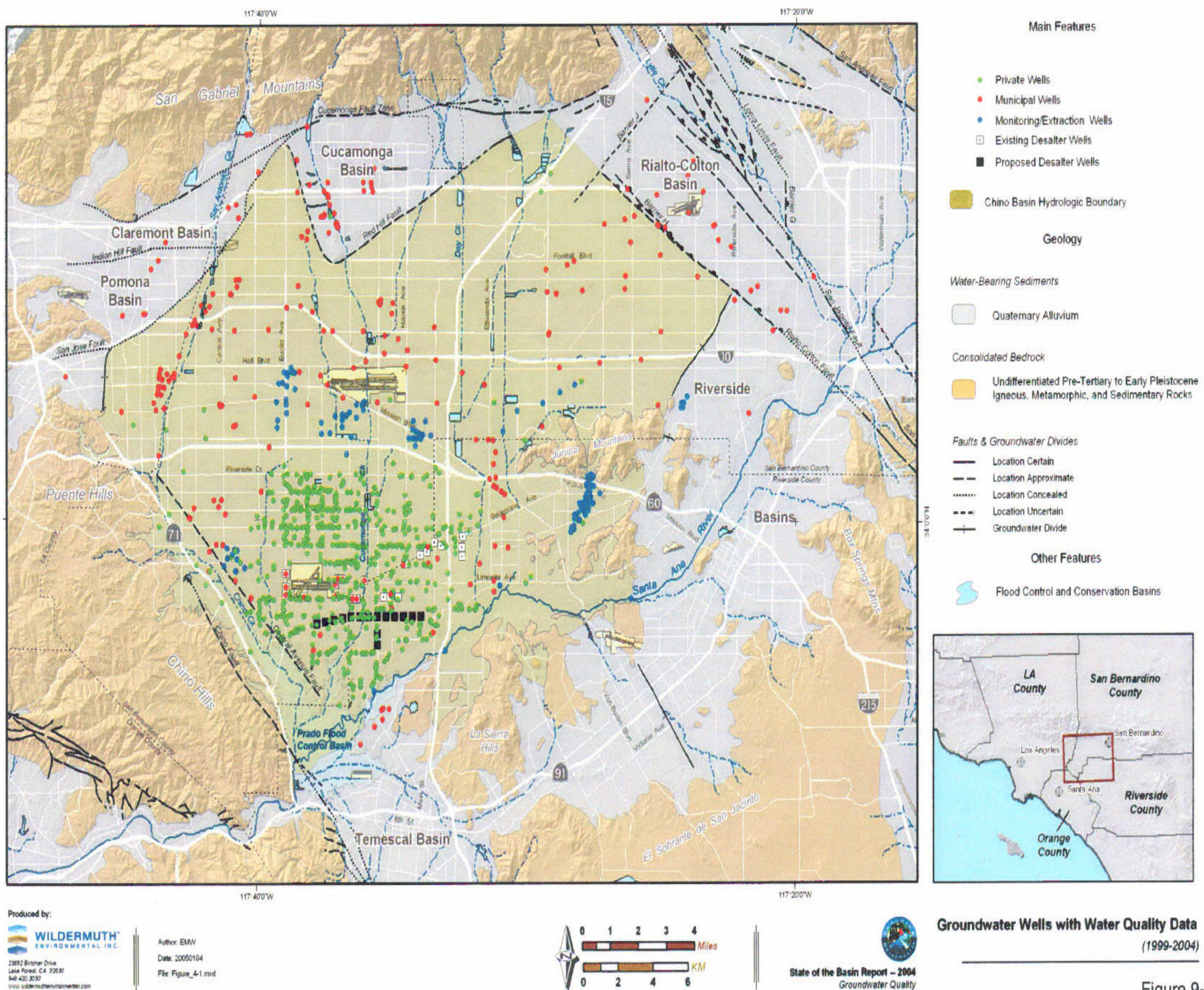
9.4 IMPACT OF WATER QUALITY ON RELIABILITY

The Chino Desalters are designed to recover contaminated groundwater and as such have a high degree of reliability. Reliability issues generally result from new unknown compounds that are discovered because of more sensitive detection limits or a plume that has migrated to an extraction well for the first time.

The Chino 1 Desalter had to shut down one of the initial raw water wells because of VOC contamination as the project was being initiated. The well has since come back on-line with the addition of air stripping and ion exchange at the Chino 1 Desalter. Any future water quality related issue is expected to be handled using a well head treatment technology such as air stripping, ion-exchange, reverse osmosis or a biological system. In addition, the Chino Basin

[6] CBWM OBMP, State of the Basin Report – 2004, Published January 2005.

Watermaster is actively working on remediation of known sources of pollution with the California Regional Water Quality Control Board.



Groundwater Wells with Water Quality Data

(1999-2004)

Figure 9-1

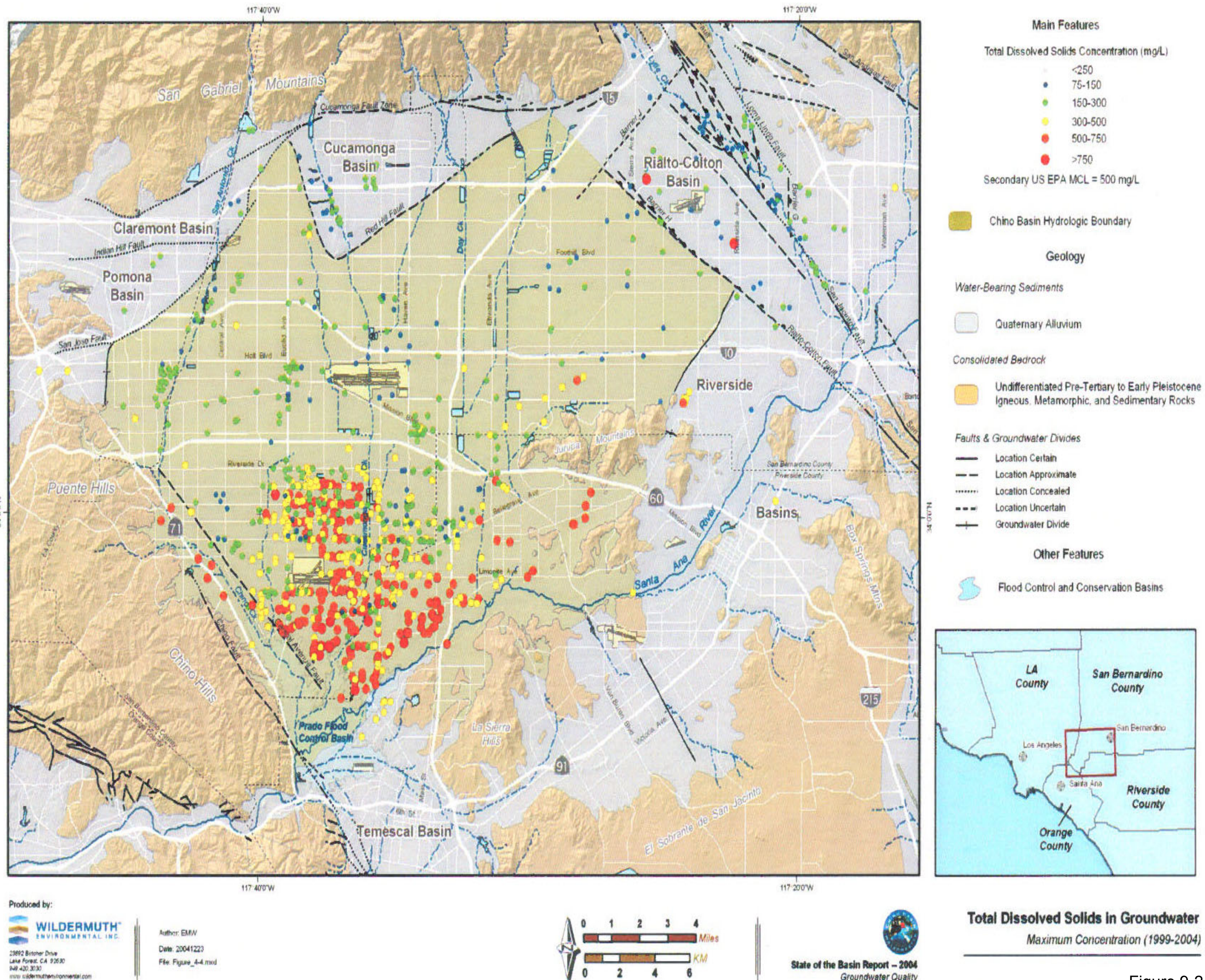
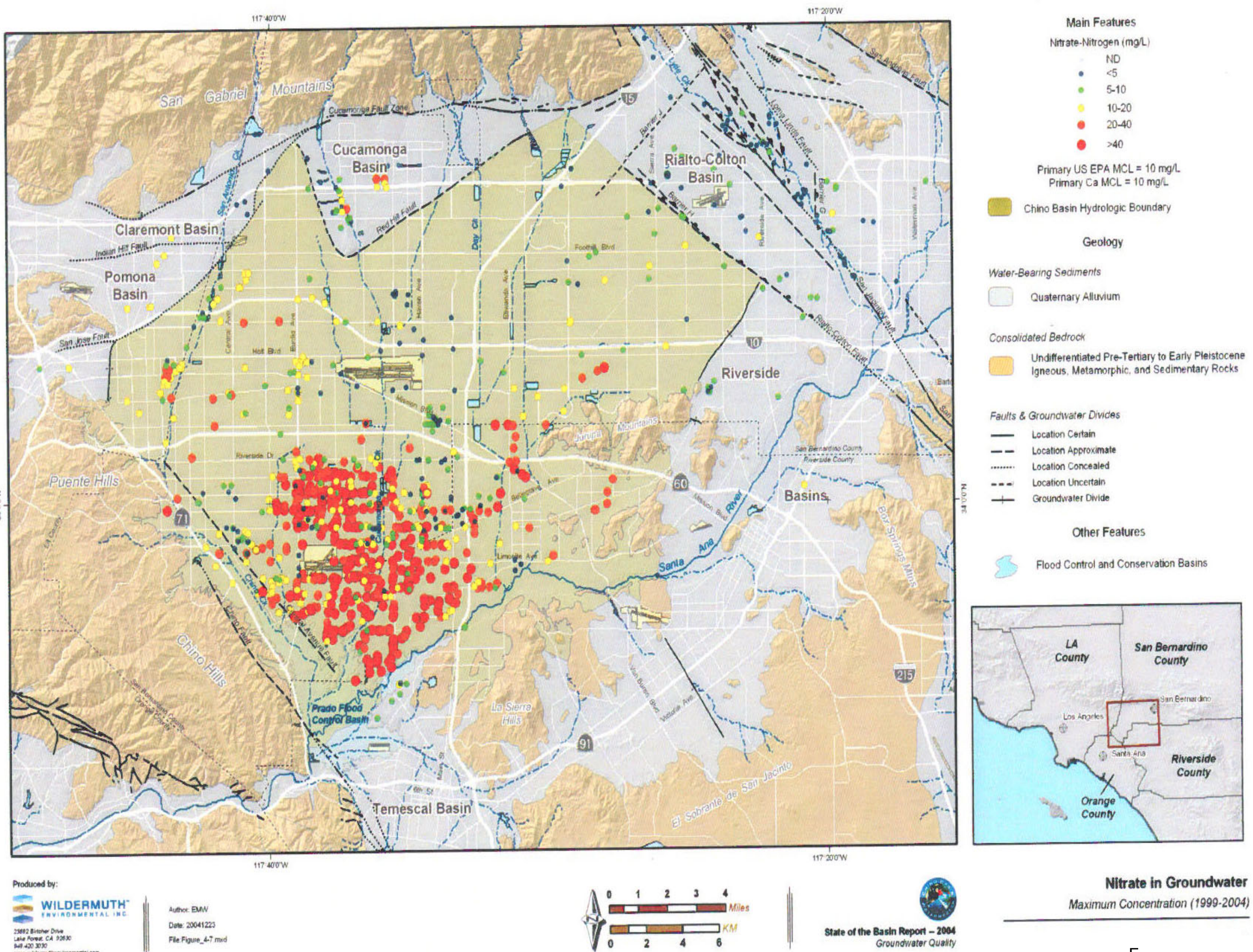
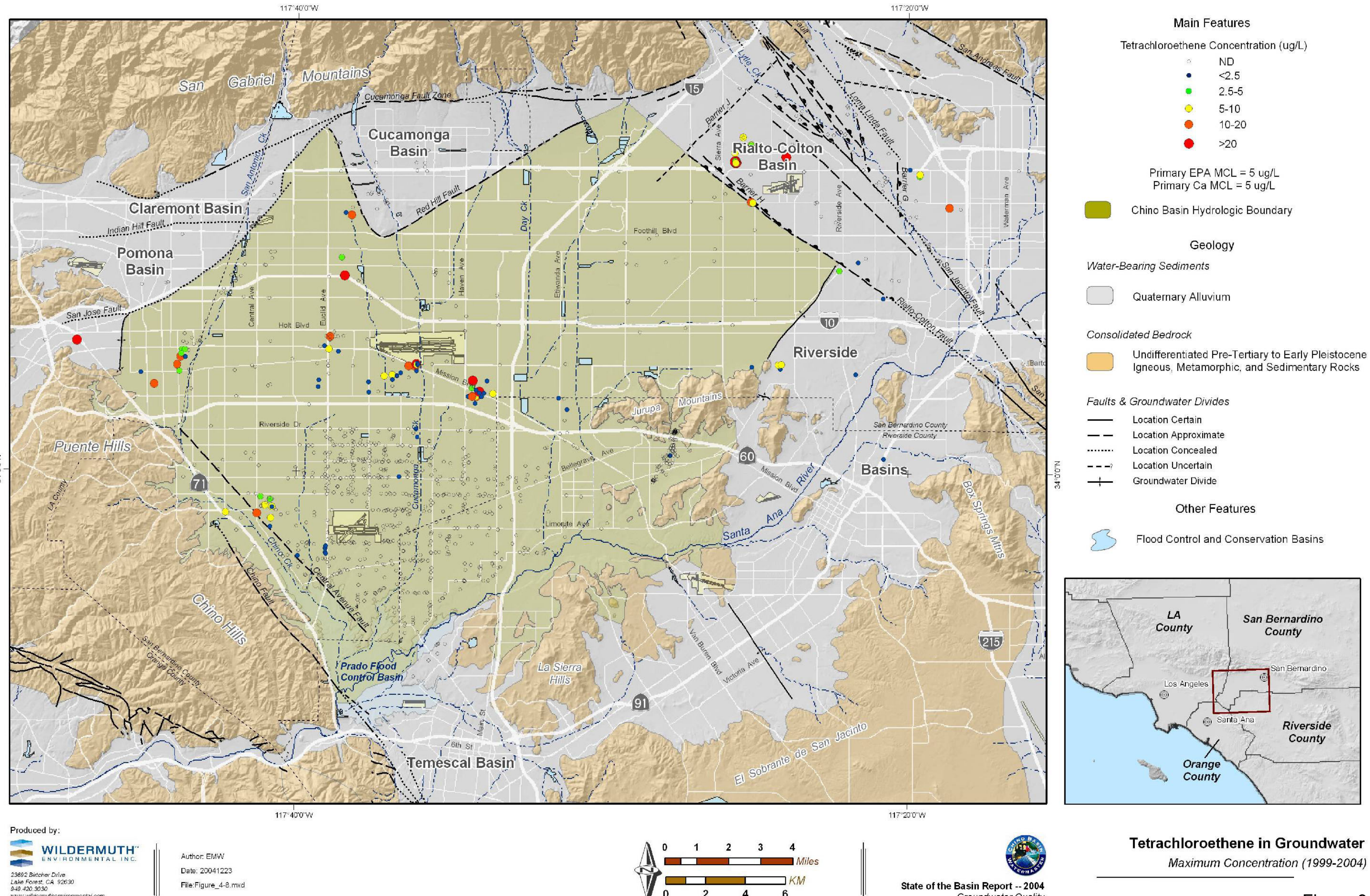

Main Features
Total Dissolved Solids Concentration (mg/L)
<250
75-150
150-300
300-500
500-750
>750
Secondary US EPA MCL = 500 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Riverside
Basins
Puente Hills
Chino Hills
Jurupa Mountains
Prado Flood Control Basin
Temescal Basin
La Sierra Hills
El Sobrante de San Jacinto
Box Springs Mtns
Santa Ana River
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
Produced by:
WILDERMUTH ENVIRONMENTAL, INC.
Author: EMW
Date: 20041223
File: Figure_4-4.mxd
Miles
KM
State of the Basin Report – 2004
Groundwater Quality
Total Dissolved Solids in Groundwater
Maximum Concentration (1999-2004)

Figure 9-2



Main Features
Nitrate-Nitrogen (mg/L)
ND
<5
5-10
10-20
20-40
>40
Primary US EPA MCL = 10 mg/L
Primary Ca MCL = 10 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
San Gabriel Mountains
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Puente Hills
Riverside
Basins
Chino Hills
Prado Flood Control Basin
La Sierra Hills
Temescal Basin
Santa Ana River
Box Springs Mtns
El Sobrante de San Jacinto
Jurupa Mountains
Indian Hill Fault
San Jose Fault
Red Hill Fault
Cucamonga Fault Zone
Rialto-Colton Fault
San Jacinto Fault
Loma Linda Fault
Riverside Dr
Holt Blvd
Foothill Blvd
117°40'0"W
117°20'0"W
34°0'0"N
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
Produced by:
WILDERMUTH ENVIRONMENTAL INC.
23692 Birtcher Drive
Lake Forest, CA 92630
949 420 3030
www.wildermuthenvironmental.com
Author: EMW
Date: 20041223
File: Figure_4-7.mxd
0 1 2 3 4 Miles
0 2 4 6 KM
State of the Basin Report – 2004
Groundwater Quality
Nitrate in Groundwater
Maximum Concentration (1999-2004)

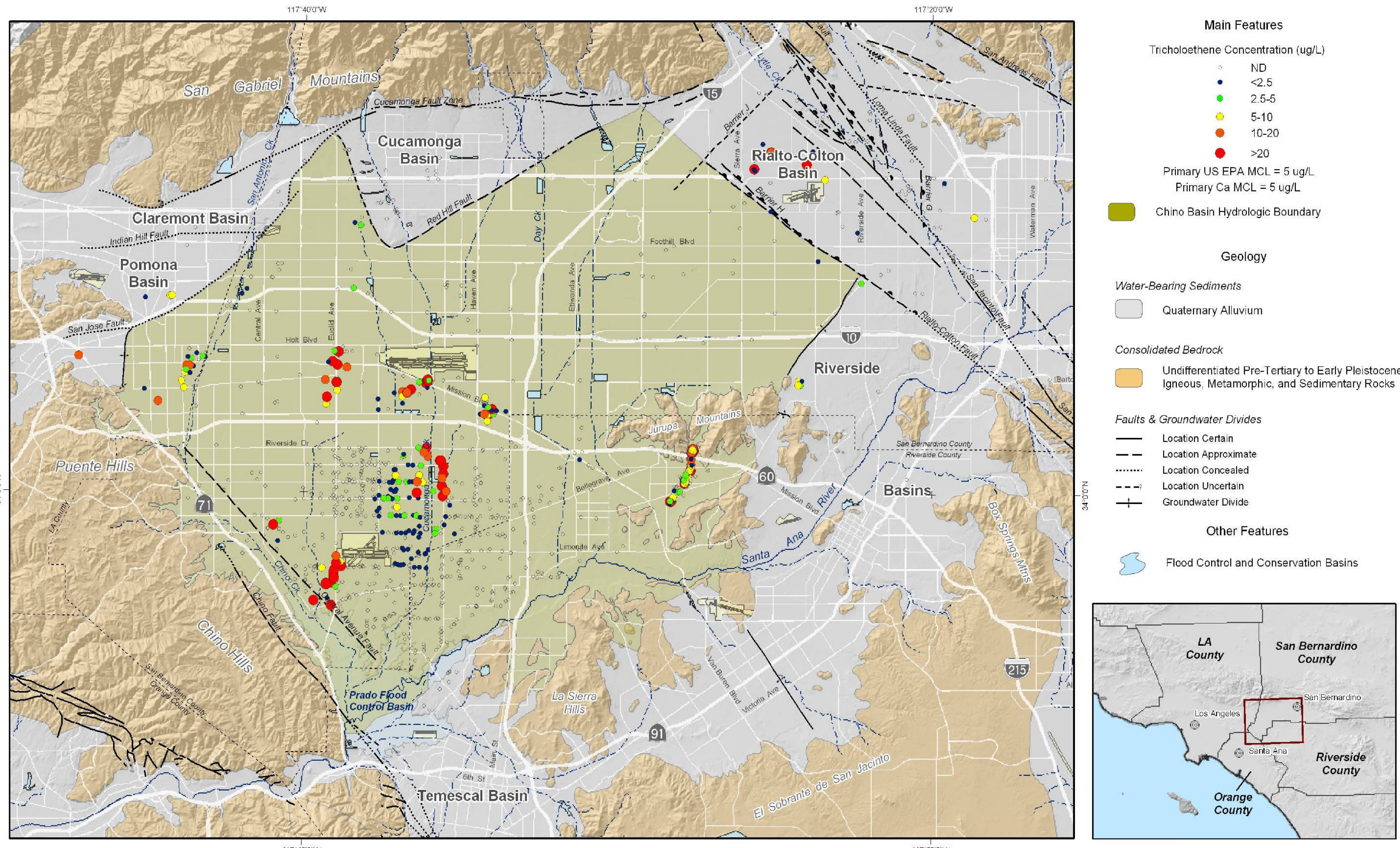
F Figure 9-3



Tetrachloroethene in Groundwater

Maximum Concentration (1999-2004)

Figure 9-4



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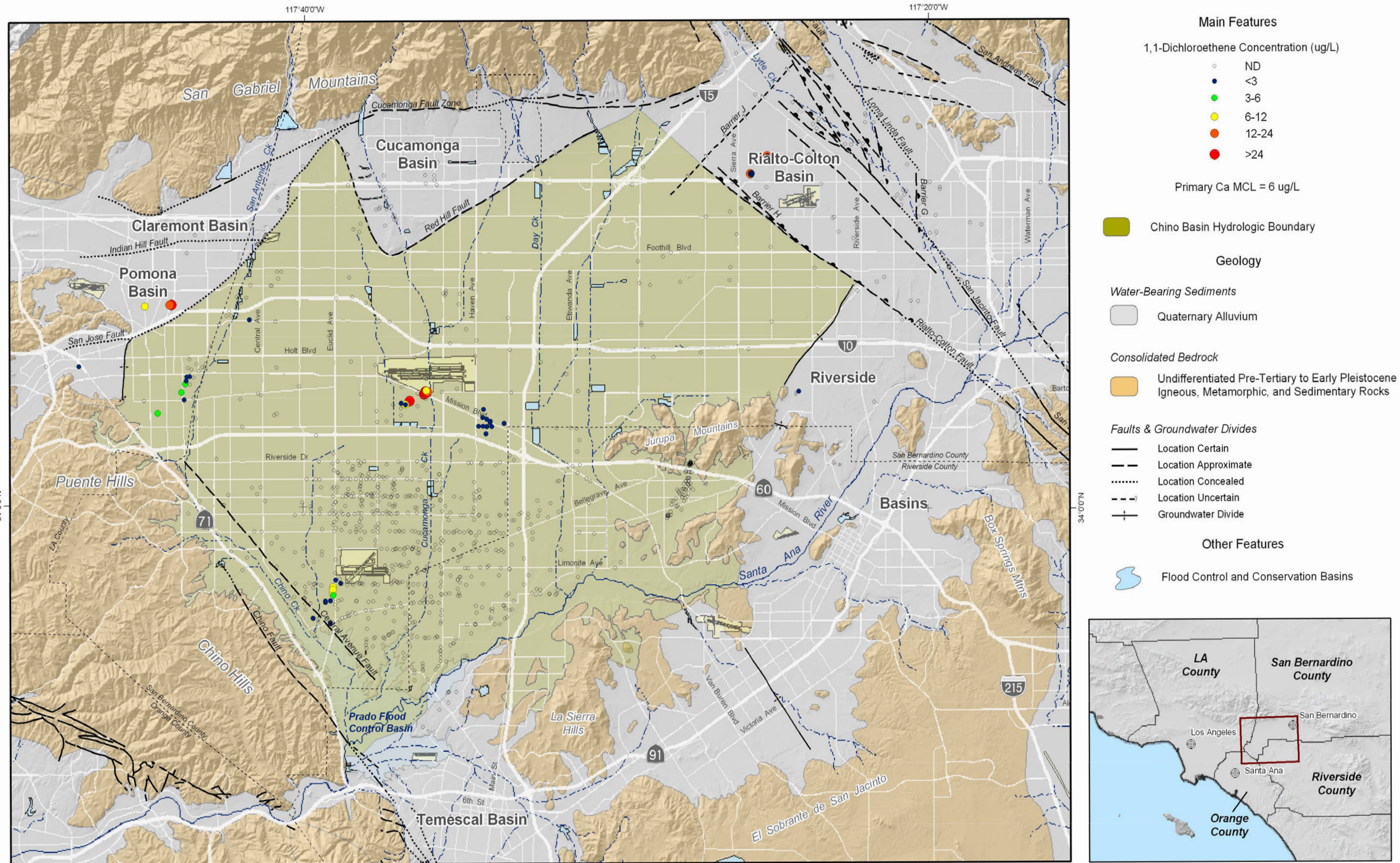
State of the Basin Report -- 2004
Groundwater Quality

Trichloroethene in Groundwater
Maximum Concentration (1999-2004)

Figure 9-5



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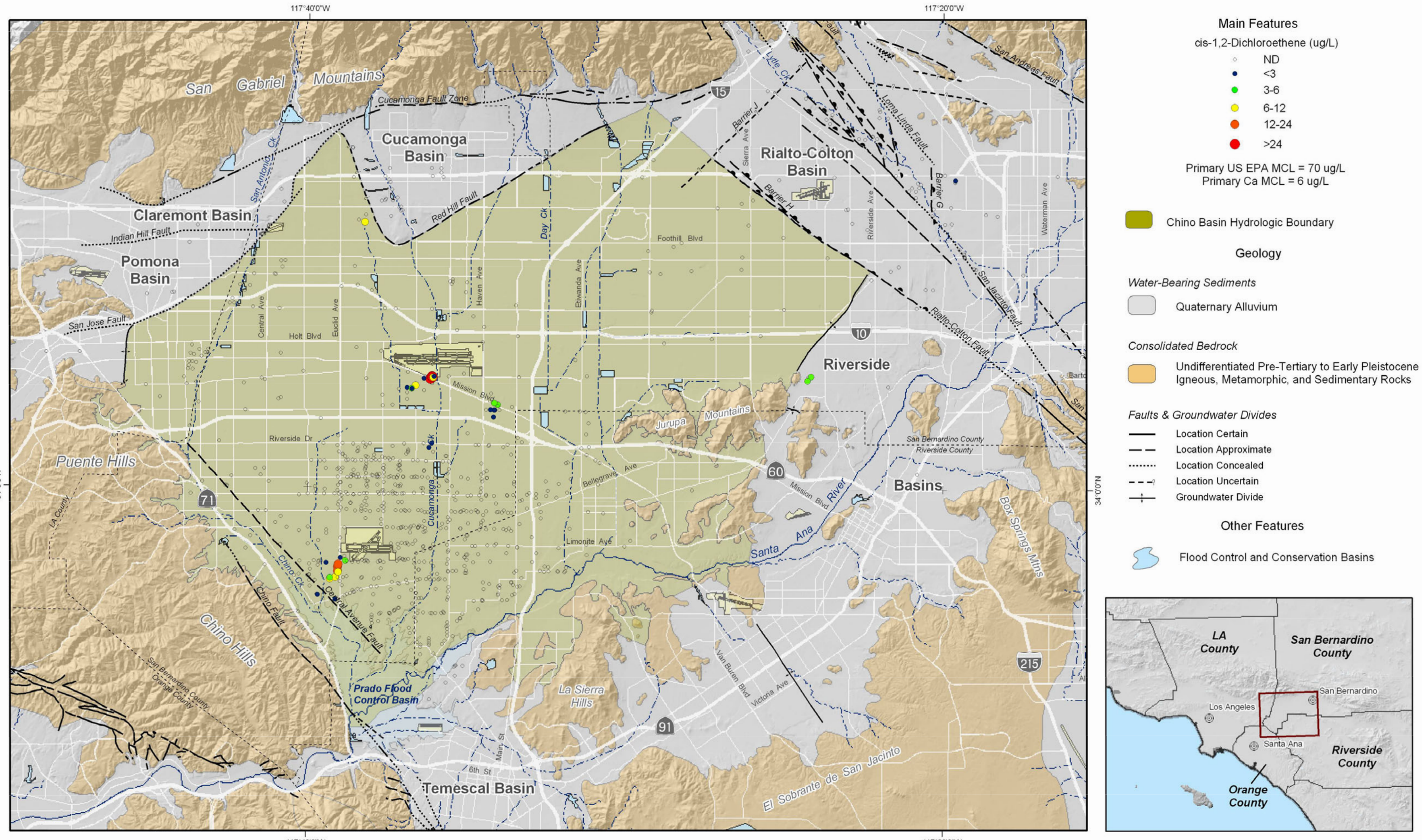
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report -- 2004
Groundwater Quality

1,1-Dichloroethene in Groundwater
Maximum Concentration (1999-2004)

Figure 9-6



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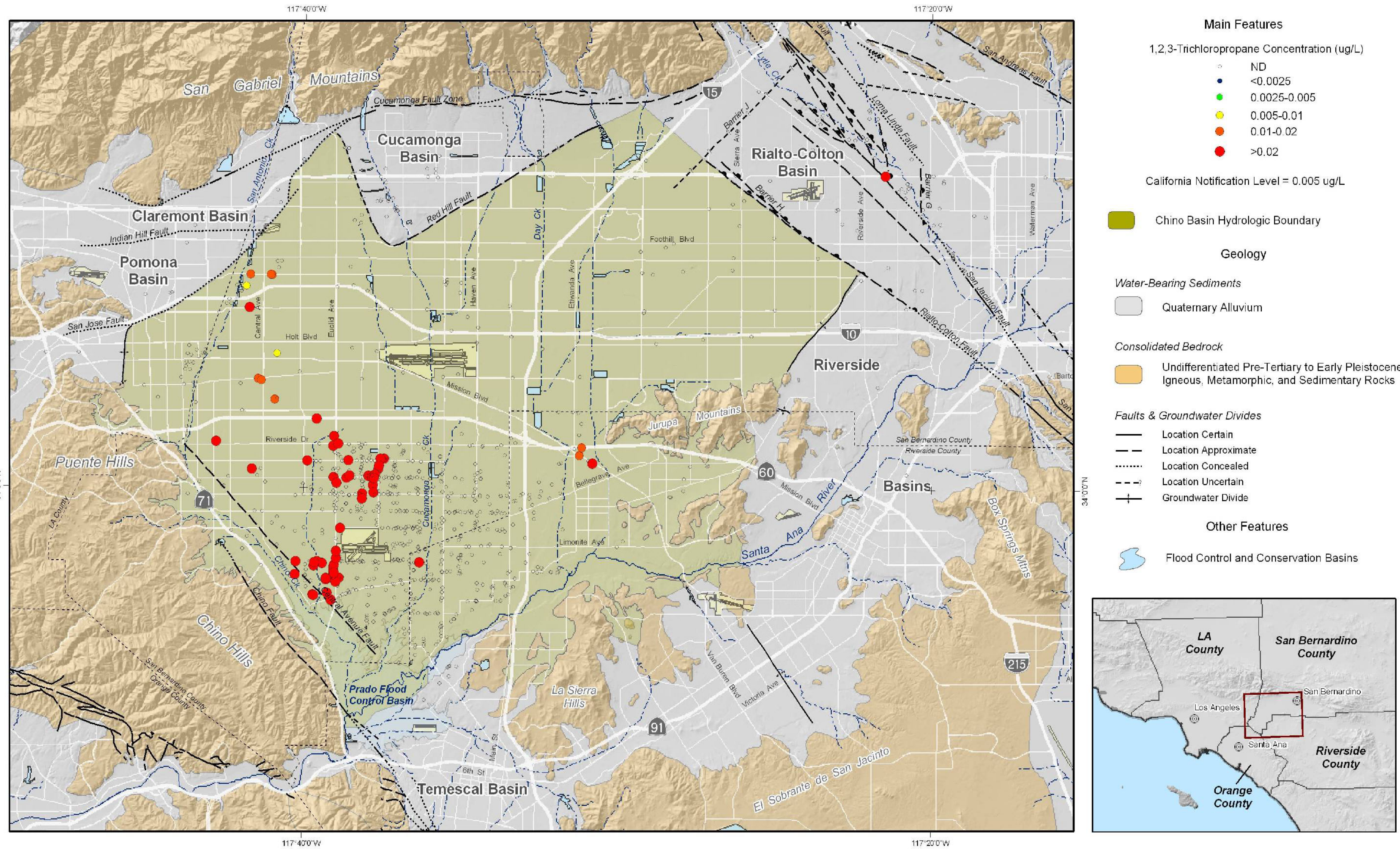
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report -- 2004
Groundwater Quality

cis-1,2-Dichloroethene in Groundwater
Maximum Concentration (1999-2004)

Figure 9-7



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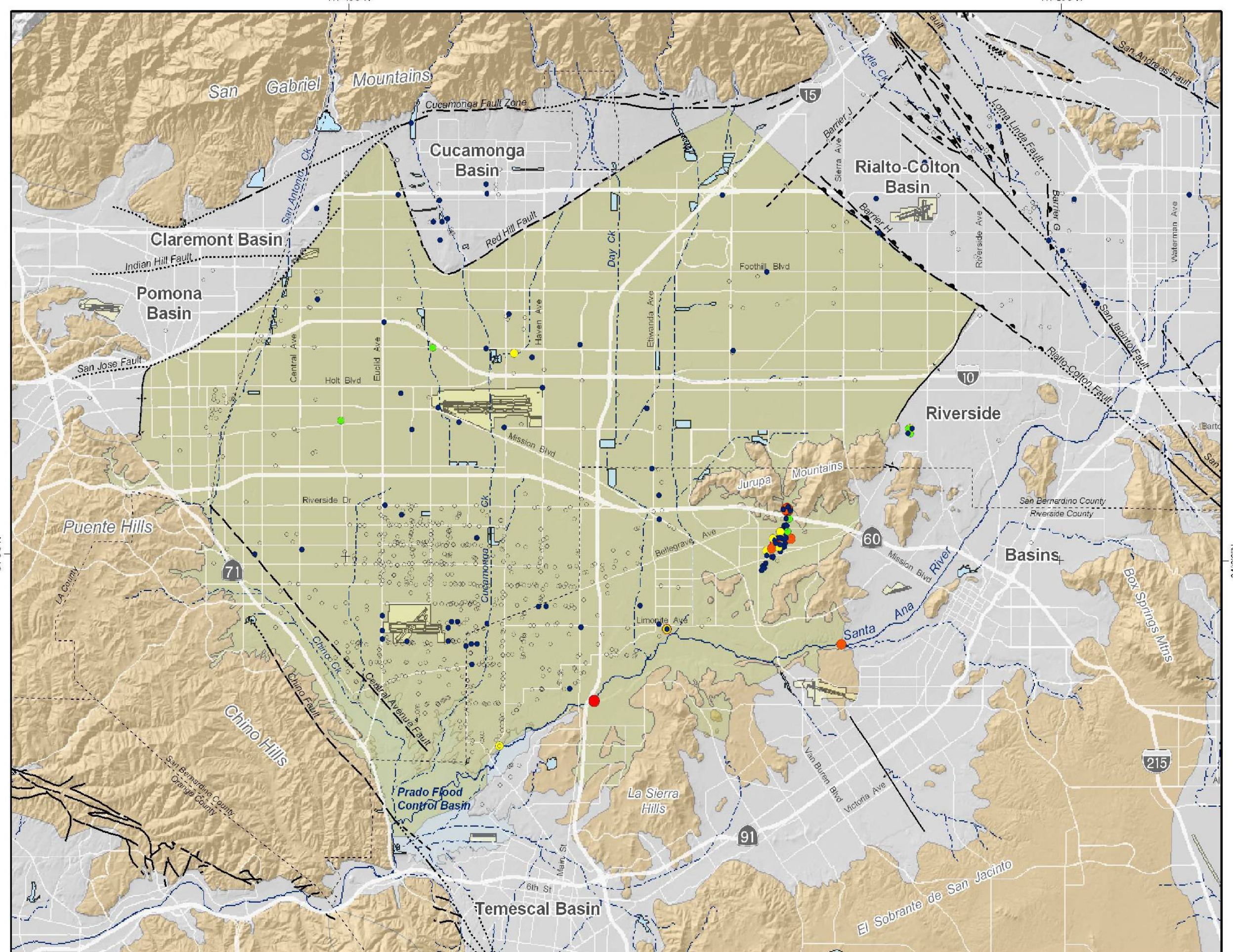
State of the Basin Report -- 2004
Groundwater Quality

1,2,3-Trichloropropane in Groundwater
Maximum Concentration (1999-2004)

Figure 9-8



Main Features

Aluminum Concentration (mg/L)

- ND
- <0.5
- 0.5-1
- 1-2
- 2-4
- >4

Primary Ca MCL = 1mg/L
Secondary US EPA MCL = 0.05 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

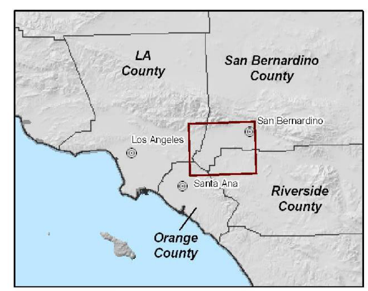
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins



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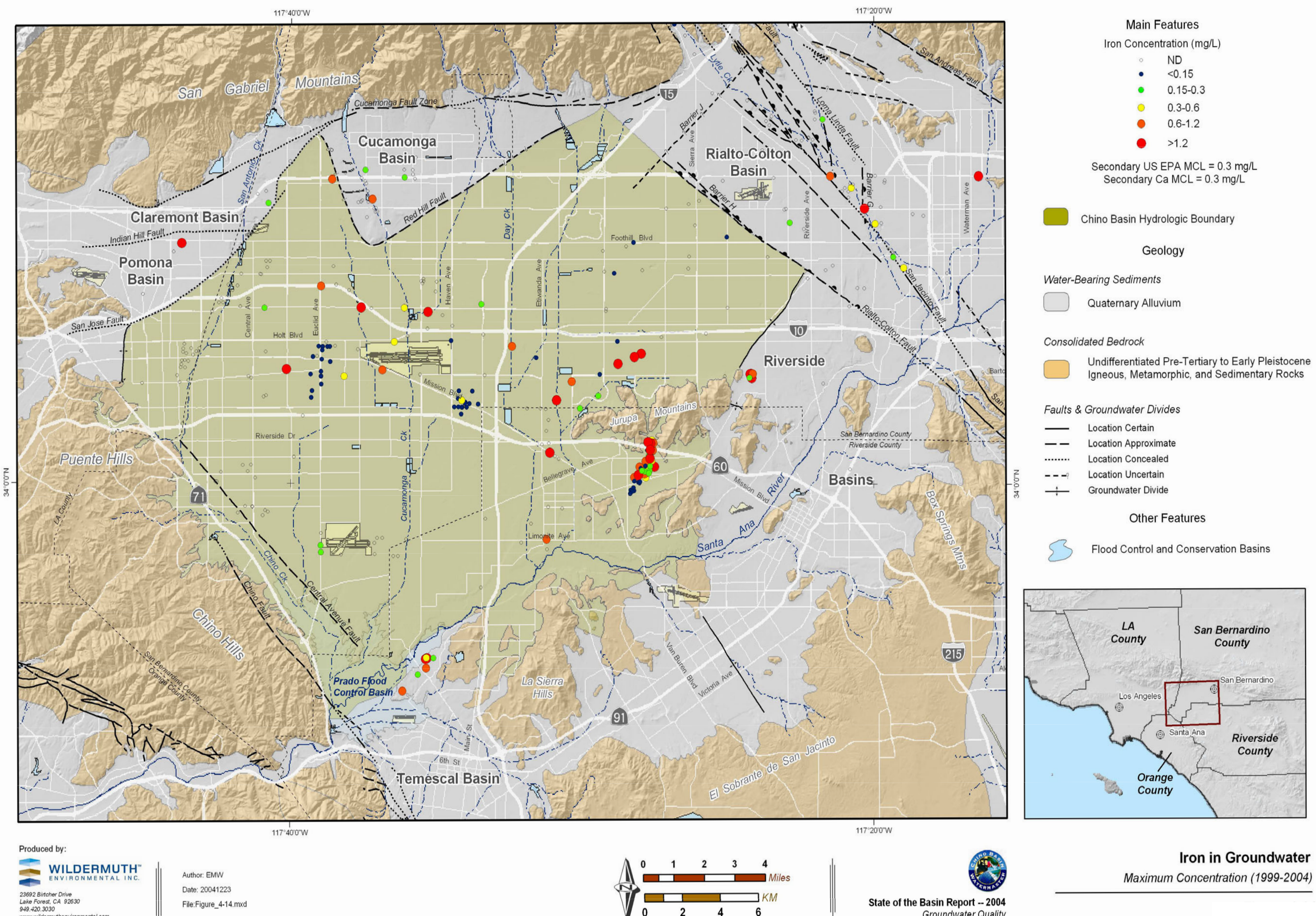
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report -- 2004
Groundwater Quality

Aluminum in Groundwater
Maximum Concentration (1999-2004)

Figure 9-9



117°40'0"W
117°20'0"W
34°0'0"N
San Gabriel Mountains
Cucamonga Fault Zone
Cucamonga Basin
Rialto-Colton Basin
Claremont Basin
Pomona Basin
Indian Hill Fault
San Jose Fault
Red Hill Fault
Lytle Ck
San Antonio Ck
Day Ck
Cucamonga Ck
Chino Ck
Barrier J
Barrier H
Barrier G
Loma Linda Fault
San Jacinto Fault
Rialto-Colton Fault
San Andreas Fault
Sierra Ave
Riverside Ave
Waterman Ave
Foothill Blvd
Central Ave
Euclid Ave
Haven Ave
Etiwanda Ave
Holt Blvd
Mission Blvd
Riverside Dr
Bellegrave Ave
Limonite Ave
Riverside
Basins
Jurupa Mountains
San Bernardino County
Riverside County
Santa Ana River
Box Springs Mtns
Puente Hills
LA County
Chino Hills
Chino Fault
Central Avenue Fault
San Bernardino County
Orange County
Prado Flood Control Basin
La Sierra Hills
Van Buren Blvd
Victoria Ave
Main St
6th St
Temescal Basin
El Sobrante de San Jacinto
15
10
60
71
91
215
Main Features
Iron Concentration (mg/L)
ND
<0.15
0.15-0.3
0.3-0.6
0.6-1.2
>1.2
Secondary US EPA MCL = 0.3 mg/L
Secondary Ca MCL = 0.3 mg/L
Chino Basin Hydrologic Boundary
Geology
Water-Bearing Sediments
Quaternary Alluvium
Consolidated Bedrock
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks
Faults & Groundwater Divides
Location Certain
Location Approximate
Location Concealed
Location Uncertain
Groundwater Divide
Other Features
Flood Control and Conservation Basins
LA County
San Bernardino County
Riverside County
Orange County
Los Angeles
San Bernardino
Santa Ana
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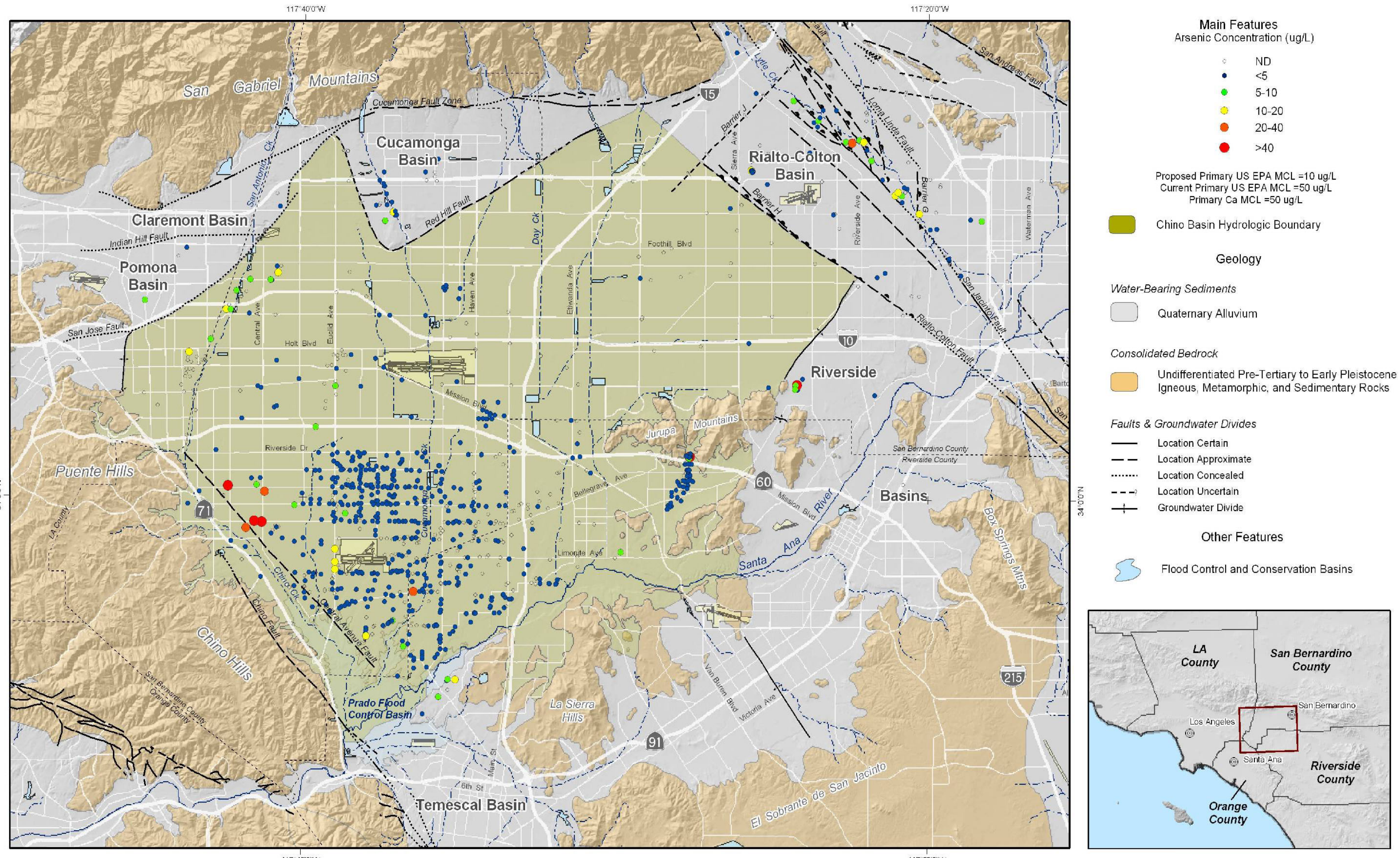
File:Figure_4-14.mxd
0 1 2 3 4 Miles
0 2 4 6 KM
State of the Basin Report -- 2004
Groundwater Quality
Iron in Groundwater
Maximum Concentration (1999-2004)

Figure 9-10



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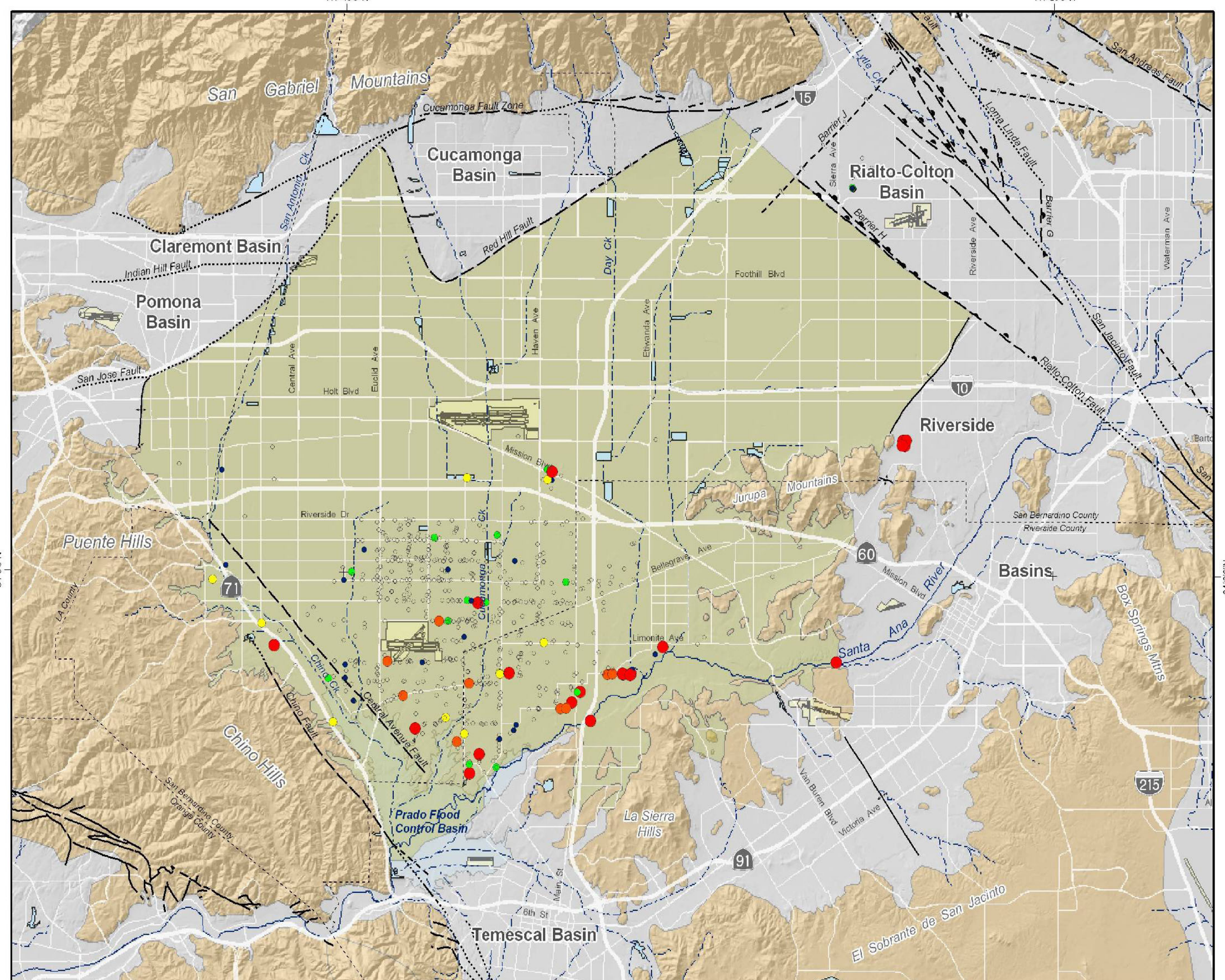
State of the Basin Report -- 2004
Groundwater Quality

Arsenic in Groundwater
Maximum Concentration (1999-2004)

Figure 9-11



Main Features

Manganese (mg/L)

- ND
- <0.025
- 0.025-0.05
- 0.05-0.1
- 0.1-0.2
- >0.2

Secondary US EPA MCL = 0.05 mg/L
Secondary US CA MCL = 0.05 mg/L
Ca Notification Level = 0.5 mg/L

Chino Basin Hydrologic Boundary

Geology

Water-Bearing Sediments

Quaternary Alluvium

Consolidated Bedrock

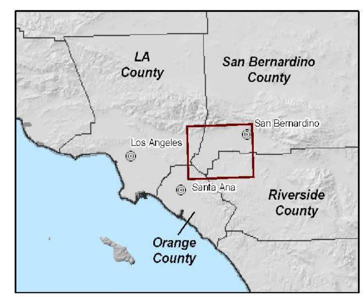
Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

Flood Control and Conservation Basins



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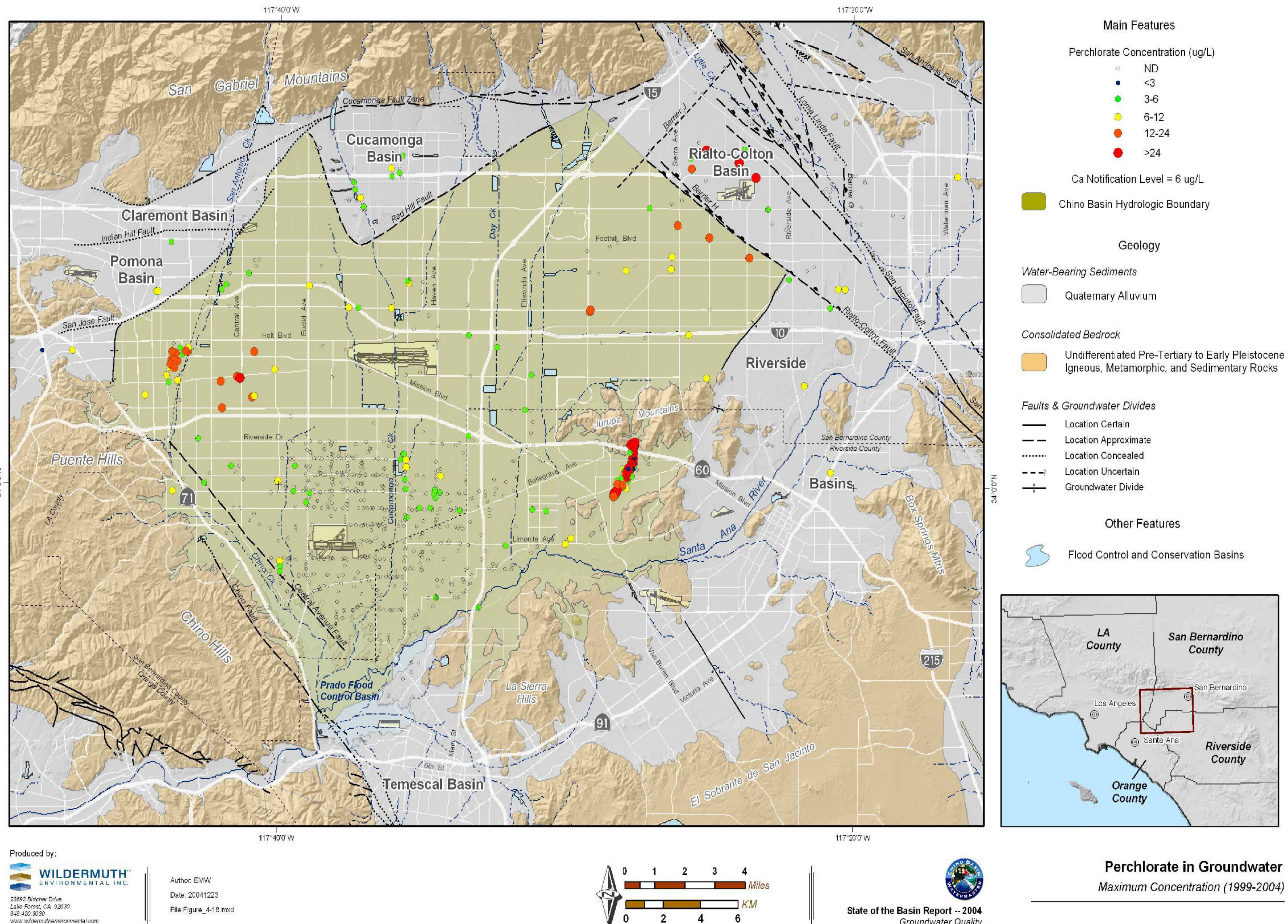
0 1 2 3 4 Miles
0 2 4 6 KM

State of the Basin Report -- 2004
Groundwater Quality

Manganese in Groundwater

Maximum Concentration (1999-2004)

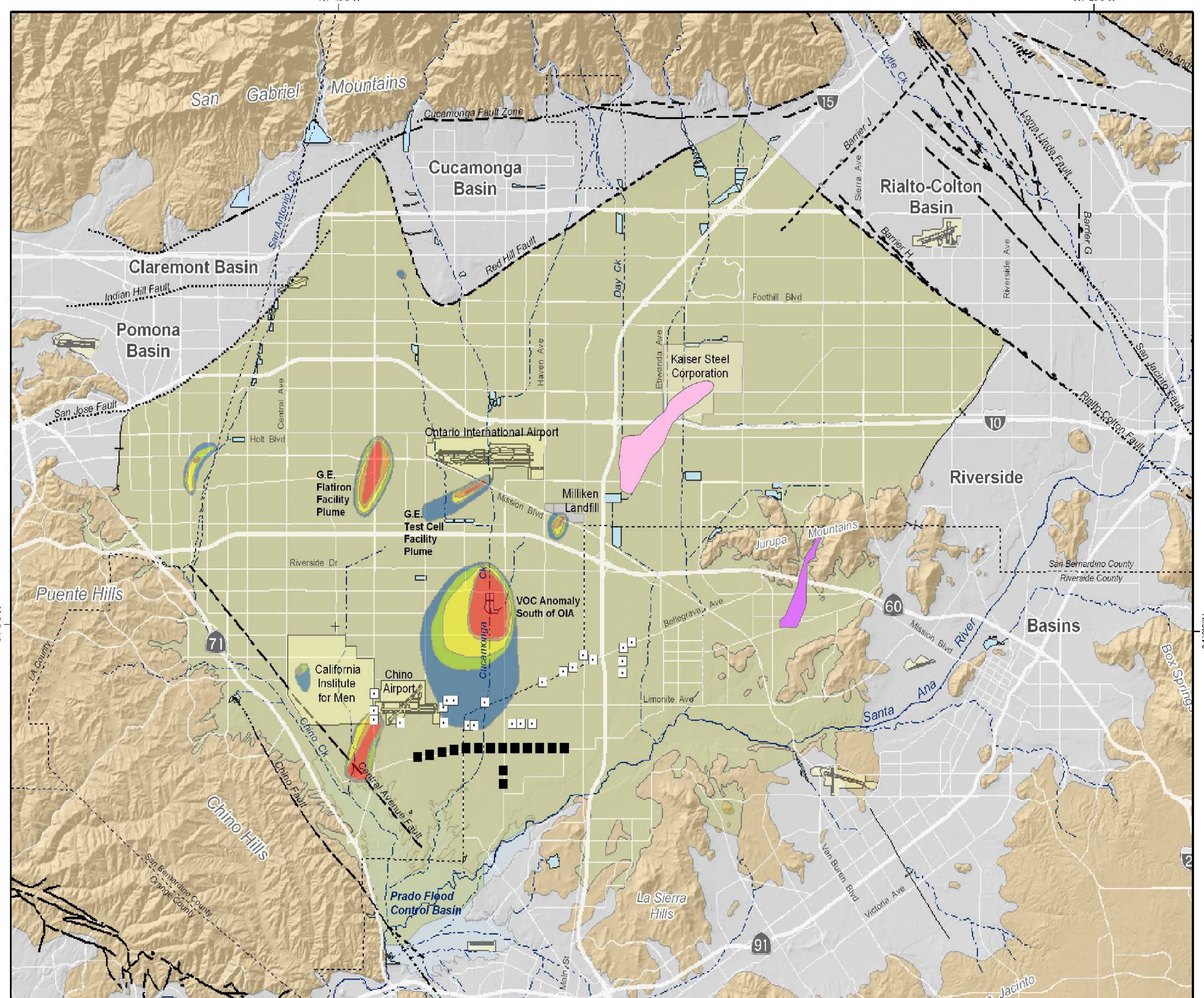
Figure 9-12



Perchlorate in Groundwater

Maximum Concentration (1999-2004)

Figure 9-13



Main Features

Tricholoethene Concentration (ug/L)

- Detectable levels but <2.5
- 2.5-5
- 5-10
- 10-20
- >20

- Approximate location of the Stringfellow plume
- Approximate location of the Kaiser plume
- Chino Basin Hydrologic Boundary
- Existing Desalter Wells
- Proposed Desalter Wells

Geology

Water-Bearing Sediments

- Quaternary Alluvium

Consolidated Bedrock

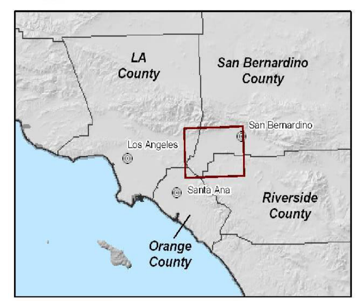
- Undifferentiated Pre-Tertiary to Early Pleistocene Igneous, Metamorphic, and Sedimentary Rocks

Faults & Groundwater Divides

- Location Certain
- Location Approximate
- Location Concealed
- Location Uncertain
- Groundwater Divide

Other Features

- Flood Control and Conservation Basins



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State of the Basin Report -- 2004
Groundwater Quality

VOC plumes in the Chino Basin
Represented by Maximum TCE Concentration (1999-2004)

Figure 9-14

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