SECTION 6

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GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

FIGURES

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GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

FIGURES
(continued)

6.0 MIDDLE CHINLE AQUIFER MONITORING

6.1 MIDDLE CHINLE WELL COMPLETION AND LOCATION

Tables 5.1-1 through 5.1-4 (previous section) present the Middle Chinle well data along with other Chinle aquifer wells. Figure 6.1-1 shows the locations of the Middle Chinle wells and areas where the Middle Chinle aquifer exists at the Grants Project. The area where the alluvium is saturated and has direct contact with the Middle Chinle sandstone is very important with respect to transfer of water between these two aquifers and is shown with the red horizontal cross hatch pattern. The area where the Middle Chinle subcrops against alluvium that is not saturated is shown by the red plus (+) pattern.

The Middle Chinle aquifer also exists east of the extension of the East Fault (shown as a red pattern area on Figure 6.1-1) with an alluvium-Middle Chinle subcrop zone on the south side of this area. A limited area of Middle Chinle aquifer exists west of the West Fault. All three of these areas in the Middle Chinle aquifer act as separate ground water systems, except that there is some contact between two of the three areas of the Middle Chinle near the south end of the East Fault in the southwest corner of Section 35.

Middle Chinle wells CW1 and CW2 were used in 2004 as a source of water for the tailings flushing effort, while well CW28 was used as source of fresh water injection in 2004. Wells CW14, CW30 and CW46 were used for fresh-water injection in 2004. Wells 498, CW44 and CW45 were used as irrigation supply wells.

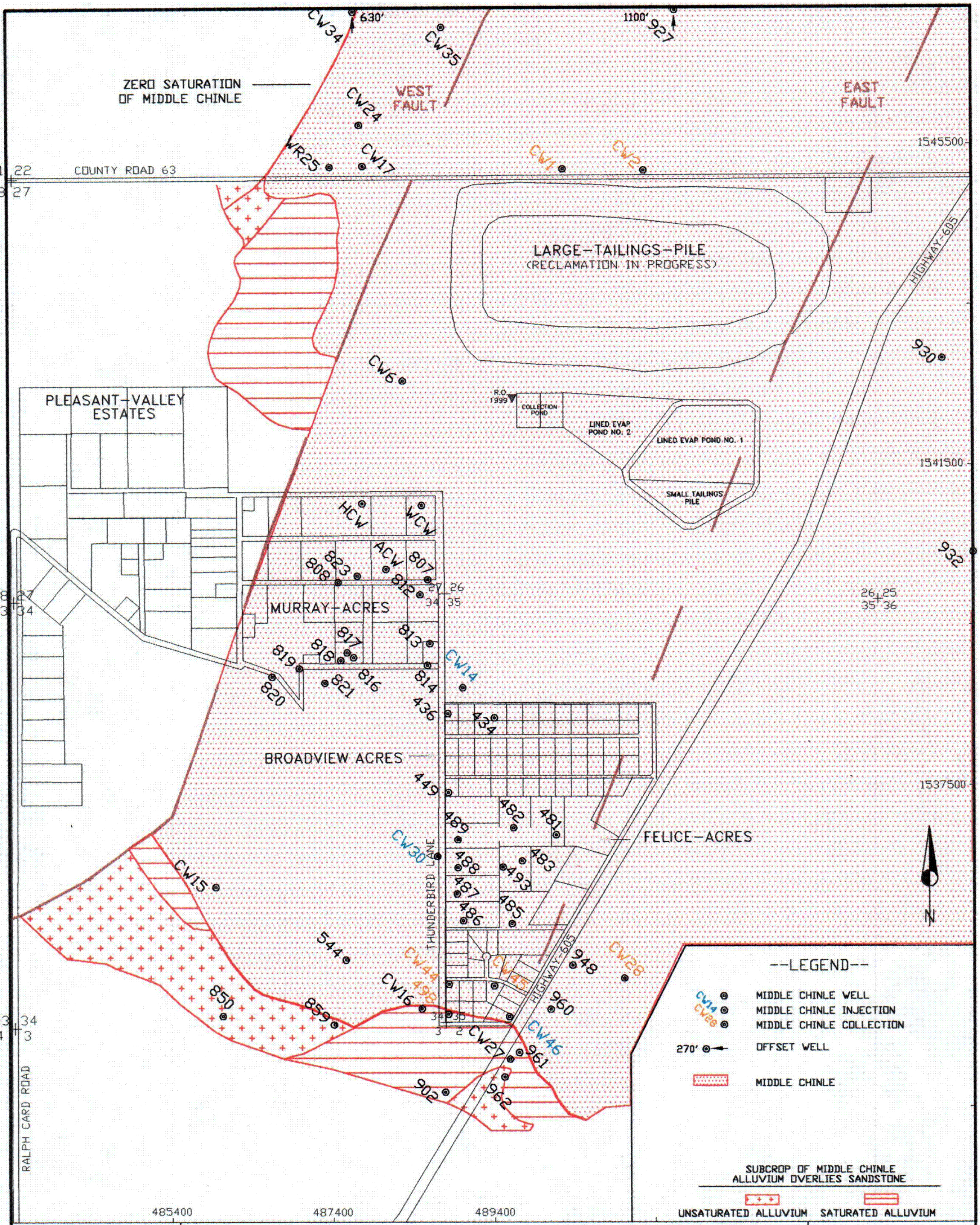

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FIGURE 6.1-1. LIMITS OF MIDDLE CHINLE AQUIFER AND WELL LOCATIONS

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6.2 MIDDLE CHINLE WATER LEVELS

Water levels in Homestake's Upper, Middle and Lower Chinle wells are presented in Appendix A. Fall, 2004 water-level elevation contours for the Middle Chinle aquifer are presented on Figure 6.2-1. The hydraulic gradient in the Middle Chinle aquifer is steeper in its alluvial subcrop area in the southern portion of Felice Acres near wells 498, CW45 and CW46. This increase in gradient is due to an influx of water to the Middle Chinle aquifer from the alluvial aquifer. The red arrows on Figure 6.2-1 show the direction of ground water flow in the Middle Chinle aquifer. Flow on the east side of the East Fault is mainly toward well CW28 near the East Fault.

Ground water flow west of the West Fault in the Middle Chinle aquifer is to the southwest, and it discharges into the alluvial aquifer. This prevents the alluvial aquifer from affecting the water quality of the Middle Chinle aquifer on the west side of the West Fault. This Middle Chinle water flows from up-gradient of the site into the area west of the Large Tailings Pile. The remainder of the Middle Chinle aquifer is recharged by the alluvial aquifer south of Felice Acres.

The injection of fresh water into wells CW14 (north of Broadview Acres) and CW30 (west of Felice Acres) has created ground water mounds in their respective areas. These mounds cause the ground water to flow both north and south from these two wells. Collection of ground water from wells CW1 and CW2 intercepts the water flowing from the south in the Middle Chinle aquifer between the two faults. Pumping from these wells also draws water flow from the north. The head in the Middle Chinle aquifer on each side of the two faults is significantly different than the head between the two faults, which demonstrates that the ground water is not readily connected on each side of these faults.

Figure 6.2-2 shows the locations of the Middle Chinle wells that are used to present the water-level changes with time. The colors and symbols used on this figure are the same as those used on the water-level elevation time plots. Figure 6.2-3 presents the water-level elevation changes versus time in Middle Chinle wells 493, 859, CW15, CW27, CW28, CW45 and CW46. The non-pumping water levels are higher in Middle Chinle well CW45 than they are farther north in well 493 except during pumping well CW45 for irrigation water in 2004. The pumping of irrigation wells 498, CW44 and CW45 has caused the water levels in wells 493, 859 and CW15 to decline. Some of this decline could also be attributable collection of water from wells CW1 and CW2. Variations in the pumping rate of well CW28 contribute to the observed variable water levels. Injection into Upper Chinle well CW46 has caused a rise in water level in this well.

The water-level plots for the Middle Chinle wells located west of the West Fault and wells CW1, CW2 and WCW are presented on Figure 6.2-4. Water levels have generally been gradually increasing in the Middle Chinle aquifer west of the West Fault. Water levels were variable in pumping wells CW1 and CW2 in 2004 due to their variable pumping rates. Water levels have decreased in well WCW as a result of the pumping of wells CW1 and CW2 since 2001. As expected, water levels west of the West Fault have not responded to the pumping of water from wells CW1 and CW2 situated east of the West Fault.

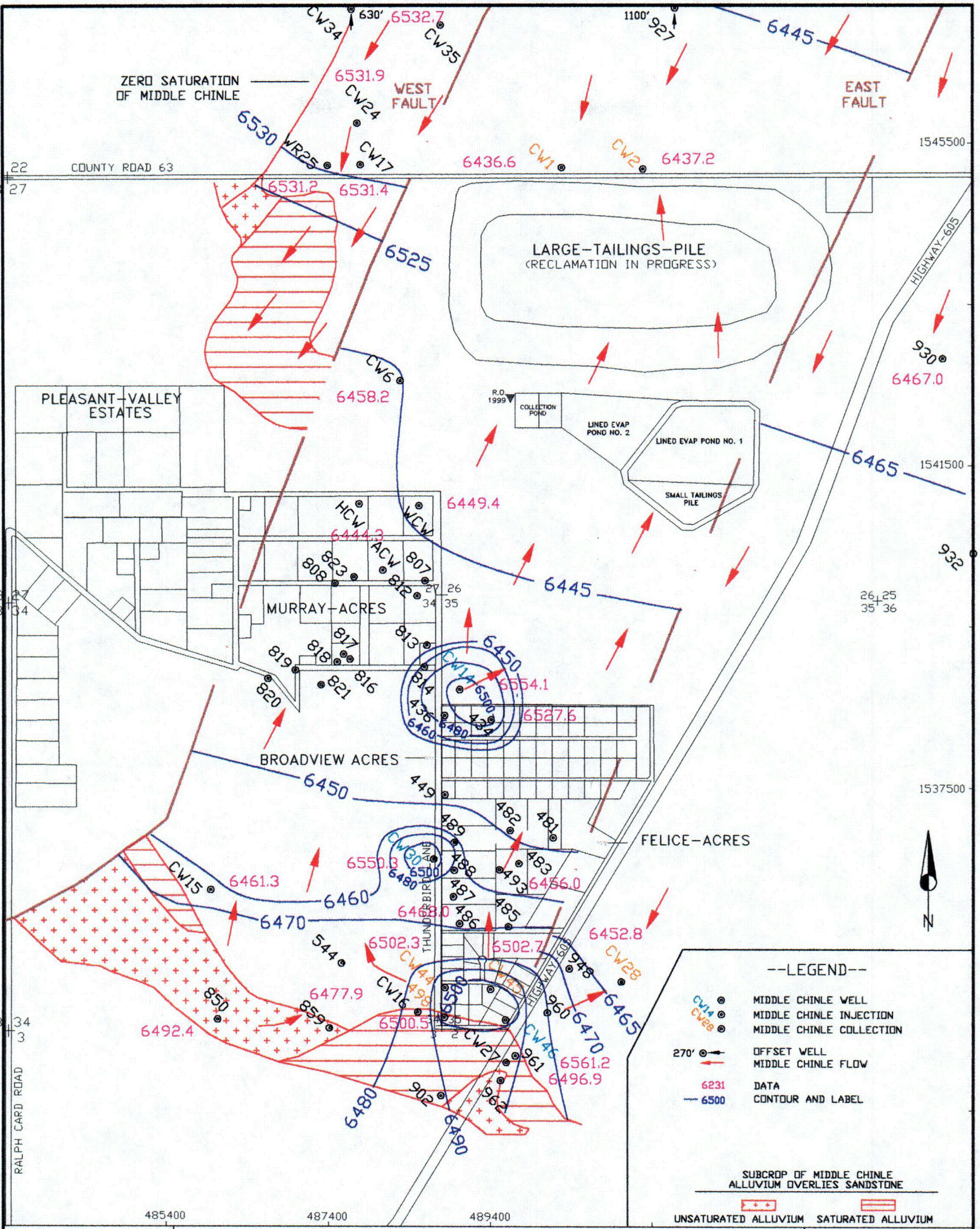

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FIGURE 6.2-1. WATER-LEVEL ELEVATIONS OF THE MIDDLE CHINLE AQUIFER, FALL 2004, FT-MSL

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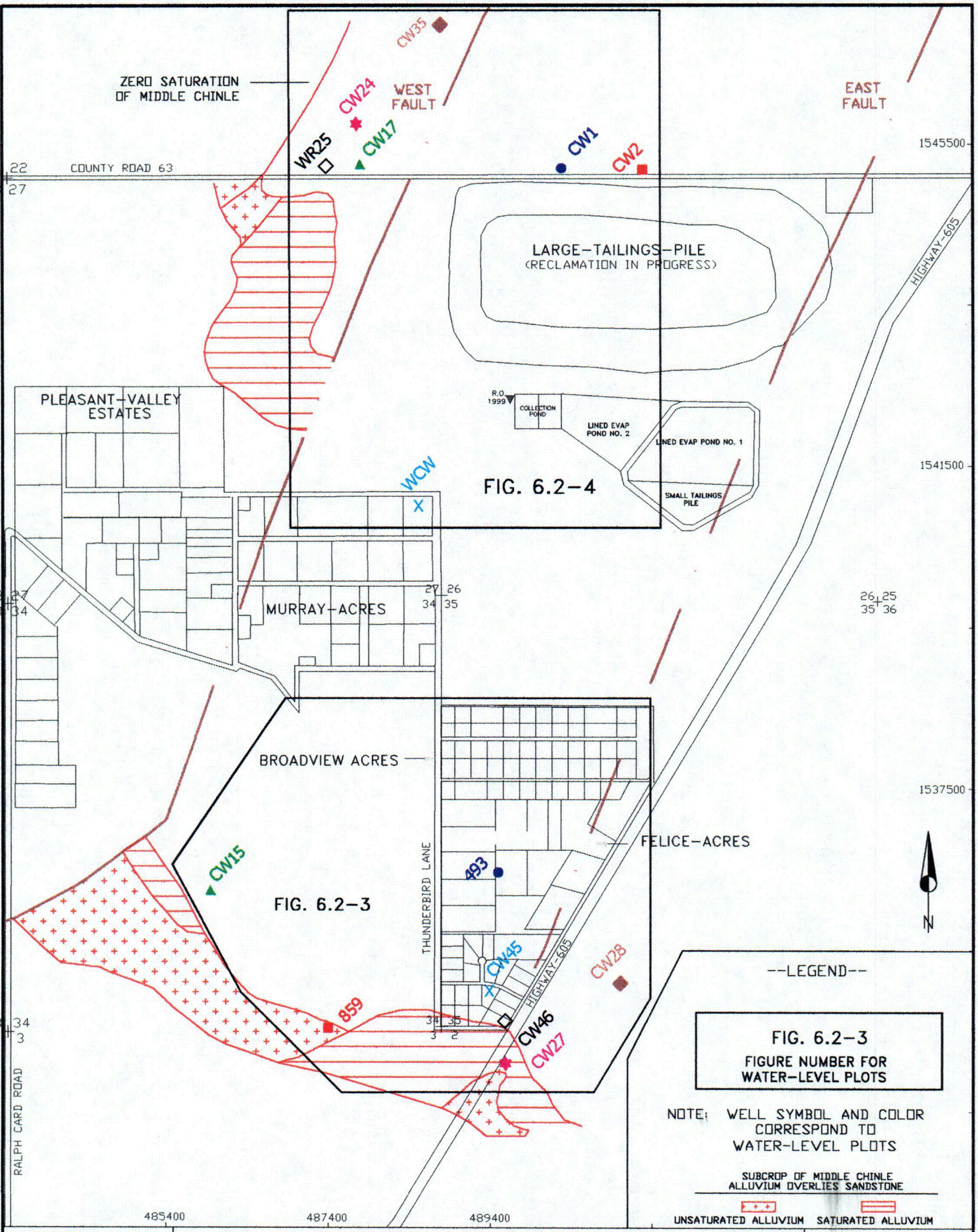

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FIGURE 6.2-2. LOCATION OF MIDDLE CHINLE WELLS WITH WATER-LEVEL PLOTS

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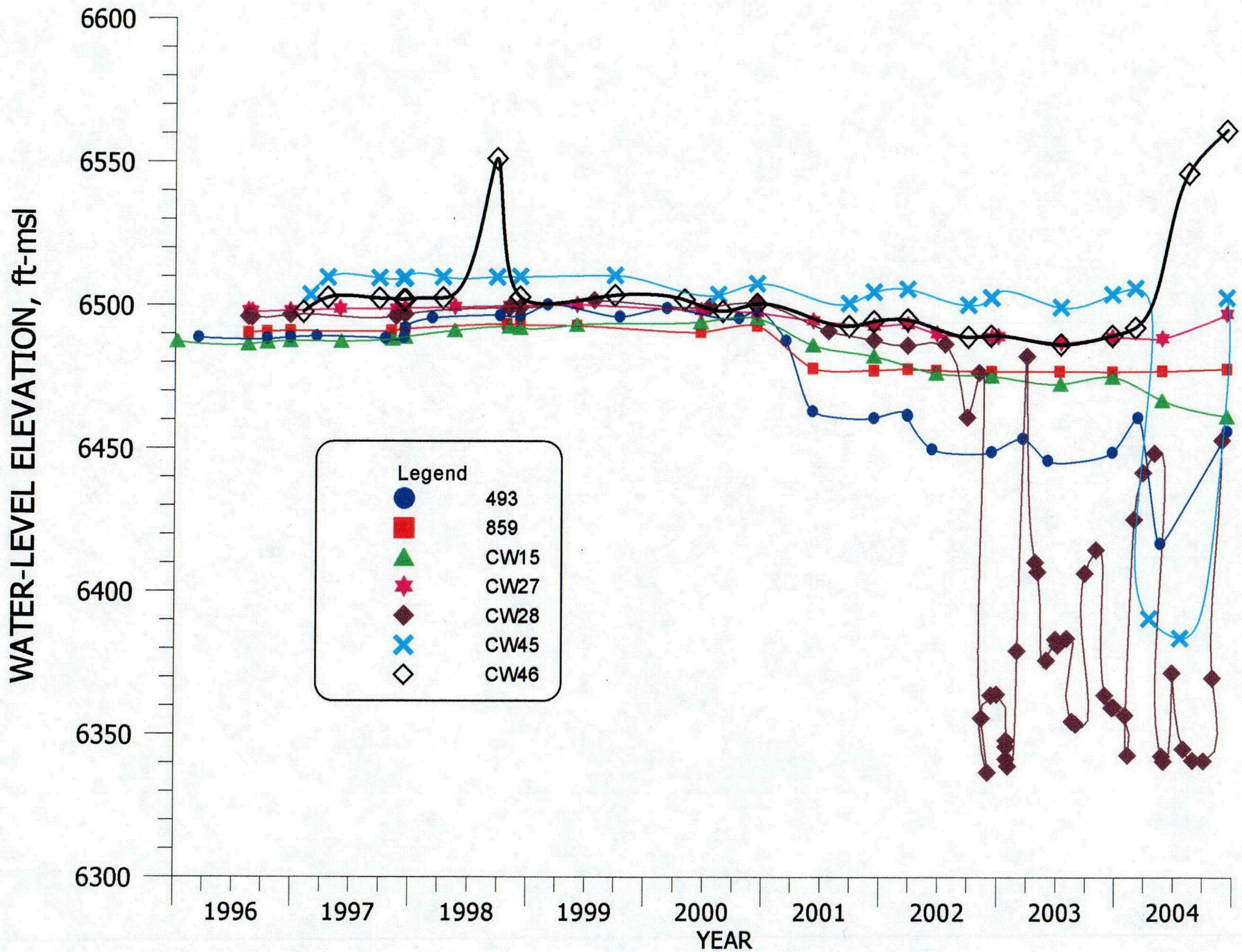

FIGURE 6.2-3. WATER-LEVEL ELEVATION FOR WELLS 493, 859, CW15, CW27, CW28, CW45 AND CW46.

6.2-5

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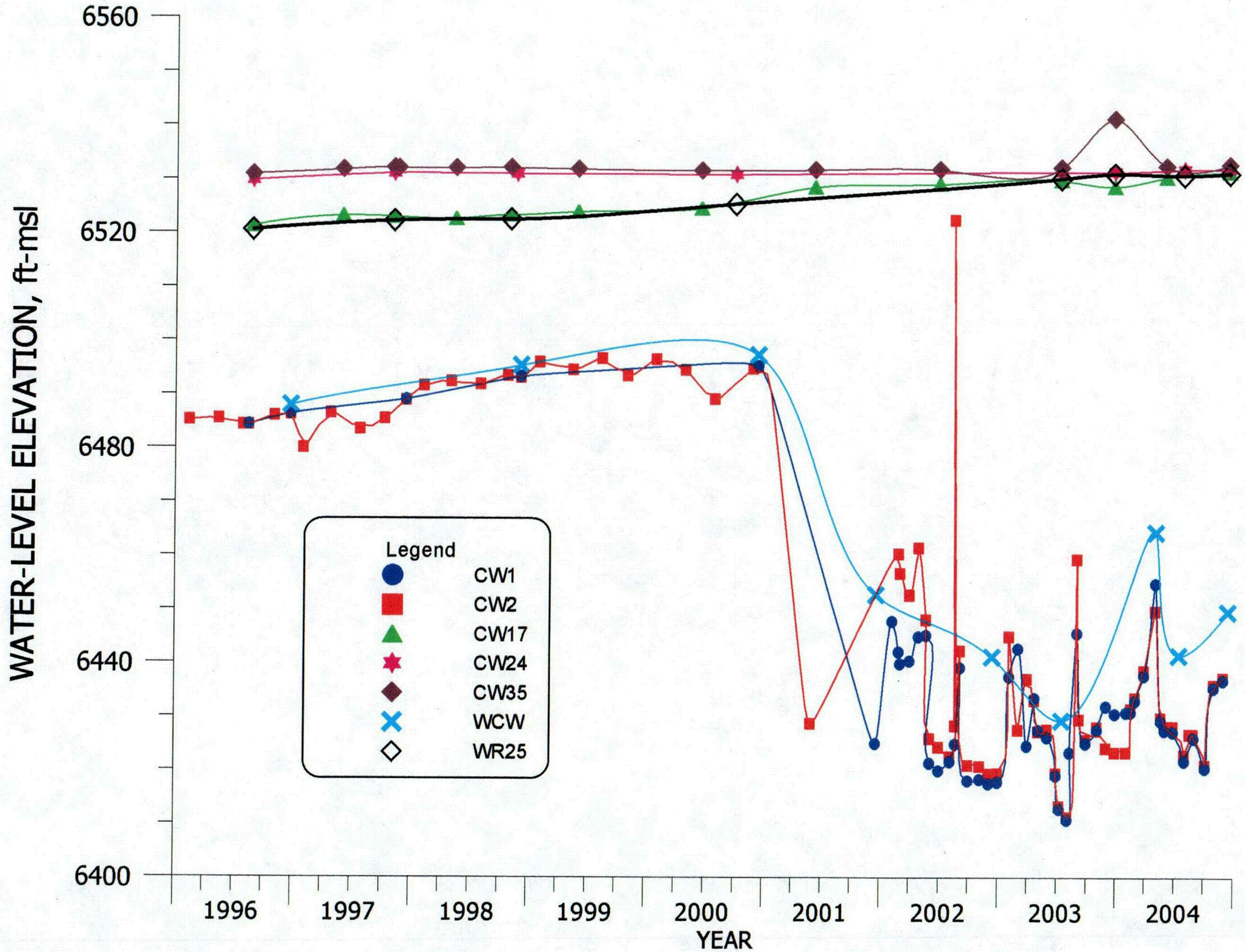

FIGURE 6.2-4. WATER-LEVEL ELEVATION FOR WELLS CW1, CW2, CW17, CW24, CW35, WCW AND WR25.

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6.3 MIDDLE CHINLE WATER QUALITY

The water-quality data for Homestake's Middle Chinle aquifer is presented with that of the other Chinle aquifer wells in Tables B.5-1 and B.5-2 of Appendix B. The Chinle aquifer water-quality results for subdivision wells are also presented in these tables. The basic well data for the Middle Chinle aquifer wells is presented in Tables 5.1-1 through 5.1-4 in the Upper Chinle aquifer monitoring section (Section 5).

The area of water-quality concern in the Middle Chinle aquifer exists in the western portion of Broadview Acres and Felice Acres. All sulfate concentrations are within the range of background concentrations except for the concentrations from wells CW17 and WR25, located in the mixing zone west of the West Fault where these concentrations are natural. Uranium concentrations are above background levels only in western Broadview Acres and Felice Acres and immediately to the west and south of Felice Acres. Selenium concentrations also exceed the background values in the same area. The only significant molybdenum concentrations identified in the Middle Chinle aquifer are at well 434.

6.3.1 SULFATE - MIDDLE CHINLE

Figure 6.3-1 presents sulfate concentration contours for the Middle Chinle aquifer for 2004. This figure shows that the Middle Chinle sulfate concentrations range from 410 to a high of 1990 mg/l at well WR25. Proposed sulfate site standard concentrations are given in the legend of Figure 6.3-1. All mixing-zone sulfate concentrations in the Middle Chinle aquifer are within the upper background level of 1750 mg/l except for the values in wells CW17 and WR25. Sulfate concentrations in wells CW17 and WR25, which are located west of the West Fault, are natural. The sulfates are naturally occurring in this area, because the ground water flow in the Middle Chinle aquifer west of the West Fault is from the north to the southwest. All sulfate concentrations in the non-mixing zone of the Middle Chinle are within the natural background range.

Figure 6.3-2 shows the locations of the Middle Chinle wells for which time concentration plots were developed for this report. The sulfate figure number is shown in the group area to define the figure number for each group of wells. Two groups of wells for the

Middle Chinle aquifer are presented. The colors and symbols on Figure 6.3-2 correspond to those used in the concentration time plots.

Figure 6.3-3 presents sulfate concentrations for the mixing zone Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45. Fairly stable sulfate concentrations were observed in 2004 in wells 859, CW17, CW35, CW44 and CW45. An increase was observed in the sulfate concentration of well CW15 water; future sampling will identify whether there is a trend that must be addressed in the future.

Figure 6.3-4 presents the sulfate concentrations for non-mixing zone Middle Chinle wells 434, 493, CW1, CW2 and WCW, located between the two faults, and well CW28, which is located east of the East Fault. Data presented on this plot demonstrate that sulfate concentrations have been fairly steady over time in these wells. A decrease in the sulfate concentration in well WCW was observed in 2004 and the recent concentration is similar to historical values. Concentrations in Middle Chinle well CW28 have been fairly steady with time, and they are similar to the lower levels observed in well CW2.

6.3.2 TOTAL DISSOLVED SOLIDS - MIDDLE CHINLE

Total dissolved solids (TDS) and sulfate are used to define changes in major constituents at the Grants Project site. Figure 6.3-5 presents contours of TDS concentrations for the Middle Chinle aquifer during 2004 and shows that a few values are approaching or have exceeded 2000 mg/l near the alluvial subcrop area on the southwest side of Felice Acres.

Background data for the Middle Chinle aquifer were used to determine proposed TDS NRC site standards of 3140 and 1560 mg/l for the mixing and non-mixing zones, respectively. All of the TDS values measured in Middle Chinle aquifer water were less than these values in 2004, except for wells CW17, CW24 and WR25, located in the mixing zone, and wells 434 and WCW in the non-mixing zone. No restoration of TDS is needed in the Middle Chinle aquifer at wells CW17, CW24 and WR25 because concentrations from these wells are natural.

Plots of TDS concentrations for Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45 are presented in Figure 6.3-6. The TDS concentrations have been fairly steady over time in wells 859, CW44 and CW45. A very gradual increasing trend has been observed in wells CW15, CW17 and CW35 during the last few years.

Figure 6.3-7 presents TDS concentration-time plots for non-mixing zone Middle Chinle wells 434, 493, CW1, CW2, CW28 and WCW. Analysis of this data indicates stable TDS concentrations in water collected from these wells in 2004 compared to 2003, with the exception of a modest decrease in TDS concentration in Middle Chinle well WCW.

6.3.3 CHLORIDE - MIDDLE CHINLE

Figure 6.3-8 presents chloride concentrations in the Middle Chinle aquifer during 2004, and observed concentrations varied from slightly greater than 50 to slightly less than 200 mg/l. None of the concentrations exceeded the proposed NRC site standard of 250 mg/l for the mixing and non-mixing zones of the Middle Chinle aquifer. Therefore, chloride concentrations are not useful for defining the degree of, or the need for, restoration of the Middle Chinle aquifer.

Time plots of chloride concentration are presented on Figure 6.3-9 for Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45. Chloride concentrations were not measured in any of these Middle Chinle wells in 2004.

A second set of chloride concentration plots for the Middle Chinle aquifer is presented in Figure 6.3-10. Data plotted on this figure shows a small increase in 2004 in wells 493, CW1 and CW2. These small changes are deemed to be within natural variation in the Middle Chinle aquifer.

6.3.4 URANIUM - MIDDLE CHINLE

Uranium is an important constituent in the Middle Chinle aquifer due to the presence of elevated concentrations in the aquifer in the southern and western portions of Felice Acres. These elevated concentrations are a result of alluvial recharge to the Middle Chinle aquifer in this area. Water in the saturated portion of the alluvial aquifer flows across a subcrop of the Middle Chinle aquifer just south of Felice Acres, and alluvial ground water has entered the Middle Chinle aquifer in this area. Figure 6.3-11 presents contours of uranium concentrations in the Middle Chinle aquifer during 2004. An area of concentrations greater than the proposed mixing-zone site standard exists in the southwestern portion of Felice Acres. Uranium concentrations in the Middle Chinle aquifer, west of the West Fault, naturally exceed 0.1 mg/l.

The 2004 values from wells CW35 and WR25 exceed the proposed mixing-zone site standard concentration, but they are naturally occurring because the West Fault isolates this area from impacts by seepage from the tailings. Flow in the Middle Chinle aquifer west of the West Fault moves from the area near well CW35 toward the subcrop area to the south. Uranium concentrations exceed 0.07 mg/l (non-mixing zone proposed site standard) in two areas of the Middle Chinle aquifer, at wells 434 and 493 in Broadview Acres and Felice Acres, respectively.

Figure 6.3-12 presents uranium concentration plots versus time for Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45 (see Figure 6.3-2 for well locations). The 2004 uranium concentrations shown on this plot are fairly steady, except for a continuing decline in uranium concentrations in well CW45. This plot shows that water taken from Middle Chinle wells CW44 and CW45 contains significant concentrations of uranium, but the concentrations are gradually decreasing and are expected to continue to decrease over the next several years. Additional monitoring of these wells with time will better define this collection-induced trend.

The uranium concentration plots for the Middle Chinle wells in the non-mixing zone are presented on Figure 6.3-13. Uranium concentrations were small in wells CW1, CW2, CW28 and WCW in 2004. The uranium concentration in well 434 water had previously been declining during the last few years, and this trend continued in 2004. A small increase in uranium concentration occurred in well 493 in 2004.

6.3.5 SELENIUM - MIDDLE CHINLE

Only well CW27 in the Middle Chinle mixing zone contained water with selenium concentration exceeding 0.14 mg/l in 2004 (see Figure 6.3-14). The selenium concentration in the non-mixing zone wells 493 and CW28 exceeds the proposed background concentration of 0.07 mg/l. These areas of elevated concentrations have resulted from recharge to the Middle Chinle aquifer from the alluvium in the subcrop area just south of Felice Acres. Flow in the Middle Chinle aquifer in this locale is toward the north causing chemical constituents introduced into the Middle Chinle from the alluvium in the subcrop area to move to the north. Analysis of background selenium concentrations in the mixing and non-mixing zones resulted in proposed NRC site standards of 0.14 and 0.07 mg/l, respectively (see legend of Figure 6.3-14).

Selenium concentrations somewhat less than 0.1 mg/l have been measured in Middle Chinle wells west of the West Fault. These concentrations have been determined to be naturally occurring, because the flow is from the north in this area, and therefore the ground water could not have been influenced by tailings seepage. All other selenium concentrations in the Middle Chinle aquifer beyond these areas are low values.

Selenium concentrations with time for the mixing zone Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45 are presented in Figure 6.3-15. A decline in selenium concentration had been observed in well CW45 for the last several years, while the 2004 value exhibited a very modest reversal of this trend.

Selenium concentrations in wells CW1 and CW2, which are located north of the Large Tailings Pile, have increased gradually over the past three years. Figure 6.3-16 presents the selenium concentrations for Middle Chinle wells in the non-mixing zone. In 2004, selenium concentrations measured in water collected from well 434 gradually declined while the concentration from well WCW remained at a low level. Selenium concentrations have varied significantly in well 493. An overall increase in selenium concentrations in water collected from well 493 has been observed over the past fifteen years. The 2004 data indicates a small decrease. The connection between the alluvial aquifer and the Middle Chinle aquifer south of Felice Acres is the cause for the elevated concentrations in well 493. The injection of fresh water into Middle Chinle wells CW14 and CW30 and the use of Middle Chinle wells 498, CW44 and CW45 for irrigation should cause these elevated concentrations to decrease. The 2004 selenium concentration in well CW28 was similar to the 2002 and 2003 concentrations.

6.3.6 MOLYBDENUM - MIDDLE CHINLE

The 2004 molybdenum concentrations in the Middle Chinle aquifer are presented on Figure 6.3-17. None of the molybdenum concentrations for 2004 exceed the detection limit, except for a value of 0.07 mg/l in well 434.

Figure 6.3-18 presents the molybdenum concentrations with time for Middle Chinle wells 859, CW15, CW17, CW35, CW44 and CW45, while Figure 6.3-19 presents the molybdenum concentrations with time for wells 434, 493, CW1, CW2, CW28 and WCW. These plots show that the concentration in each of these wells has been low for 2004 with a small decrease in the small concentration in well 434. Additional monitoring with time is needed to determine if the small molybdenum concentration in this well is of significance.

6.3.7 NITRATE - MIDDLE CHINLE

Nitrate concentrations have always been low in the Middle Chinle aquifer and therefore are not routinely monitored. However, nitrate concentrations were measured in all of the Middle Chinle aquifer wells in 2003 and in several wells in 2004 in order to update the database. Figure 6.3-20 presents the nitrate concentrations in the Middle Chinle aquifer and shows that the only notable levels of nitrate in the Middle Chinle aquifer are west of the West Fault. Nitrate concentrations are greater than 10 mg/l in two of the four Middle Chinle wells west of West Fault. Due to the flow direction in the Middle Chinle aquifer west of the West Fault, these concentrations are determined to be naturally occurring. Therefore, no restoration of nitrate concentrations in the Middle Chinle aquifer is needed and this constituent does not require a site standard for the Middle Chinle aquifer.

6.3.8 RADIUM-226 AND RADIUM-228 - MIDDLE CHINLE

Radium concentrations in the Middle Chinle aquifer have always been low, showing that these two parameters are not important relative to the restoration of the Middle Chinle aquifer. The 2003 updated radium-226 and radium-228 concentrations in the Middle Chinle aquifer showed the recent values of radium as remaining low. All of the radium-226 values measured in 2004 were less than the detection limit of 0.2 pCi/l. The few radium-228 values measured in 2004 were less than the detection level of 1 pCi/l. Radium-226 and radium-228 are not important parameters relative to the Middle Chinle aquifer and a site standard is not warranted for these two constituents.

6.3.9 VANADIUM - MIDDLE CHINLE

Vanadium concentrations in the Middle Chinle aquifer have always been low. Previous monitoring of vanadium in the Middle Chinle aquifer has demonstrated that vanadium is not a significant parameter in this aquifer and the 2003 updated vanadium measurements confirmed the low values. Monitoring of vanadium for the Middle Chinle should be eliminated, because only a few low values have previously been detected in the alluvial aquifer near the tailings piles. All of the 2004 vanadium measurements for the Middle Chinle aquifer are less than detection level of 0.01 mg/l. These values are consistent with values observed previously and, therefore, reinforce the conclusion that continued monitoring of vanadium concentrations in the Middle Chinle aquifer should not be required. A site standard for vanadium is therefore not needed for the Middle Chinle aquifer.

6.3.10 THORIUM-230 - MIDDLE CHINLE

Thorium-230 concentrations are not significant in the alluvial aquifer outside of the Large Tailings. Therefore, the Middle Chinle aquifer does not have the potential for containing significant thorium concentrations from the tailings seepage. Thorium-230 is, therefore, not a significant parameter in the Middle Chinle aquifer and should be eliminated from future monitoring in the Middle Chinle aquifer. Thorium-230 concentrations were measured in all wells sampled from Middle Chinle wells in 2003, and all of these values were less than detection. All of the thorium-230 values measured in 2004 were less than the detection limit. These thorium-230 levels are consistent with concentrations previously measured in the Middle Chinle aquifer, which shows that thorium-230 is not an important parameter in the Middle Chinle aquifer and thus does not warrant establishment of a site standard.

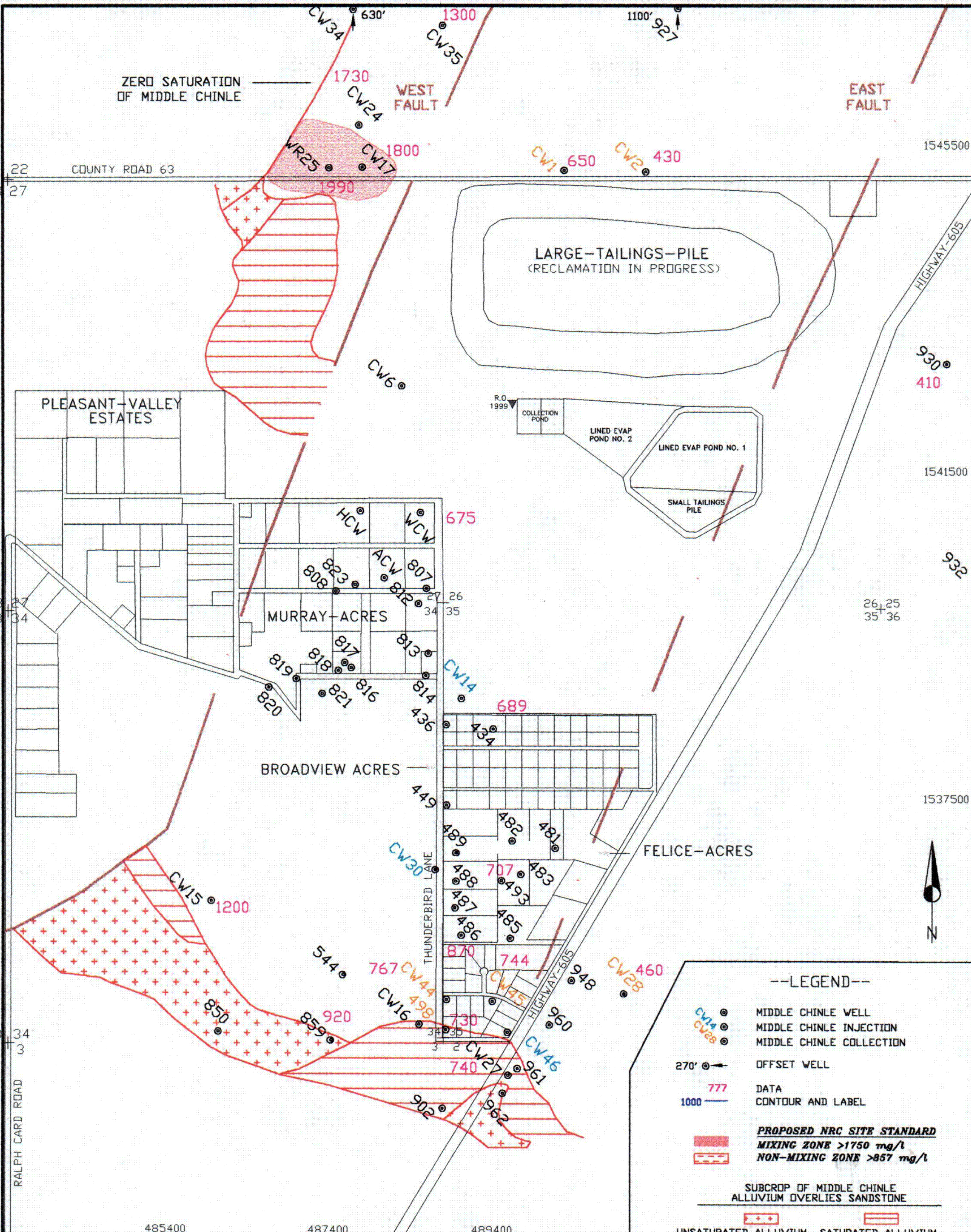

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FIGURE 6.3-1. SULFATE CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l

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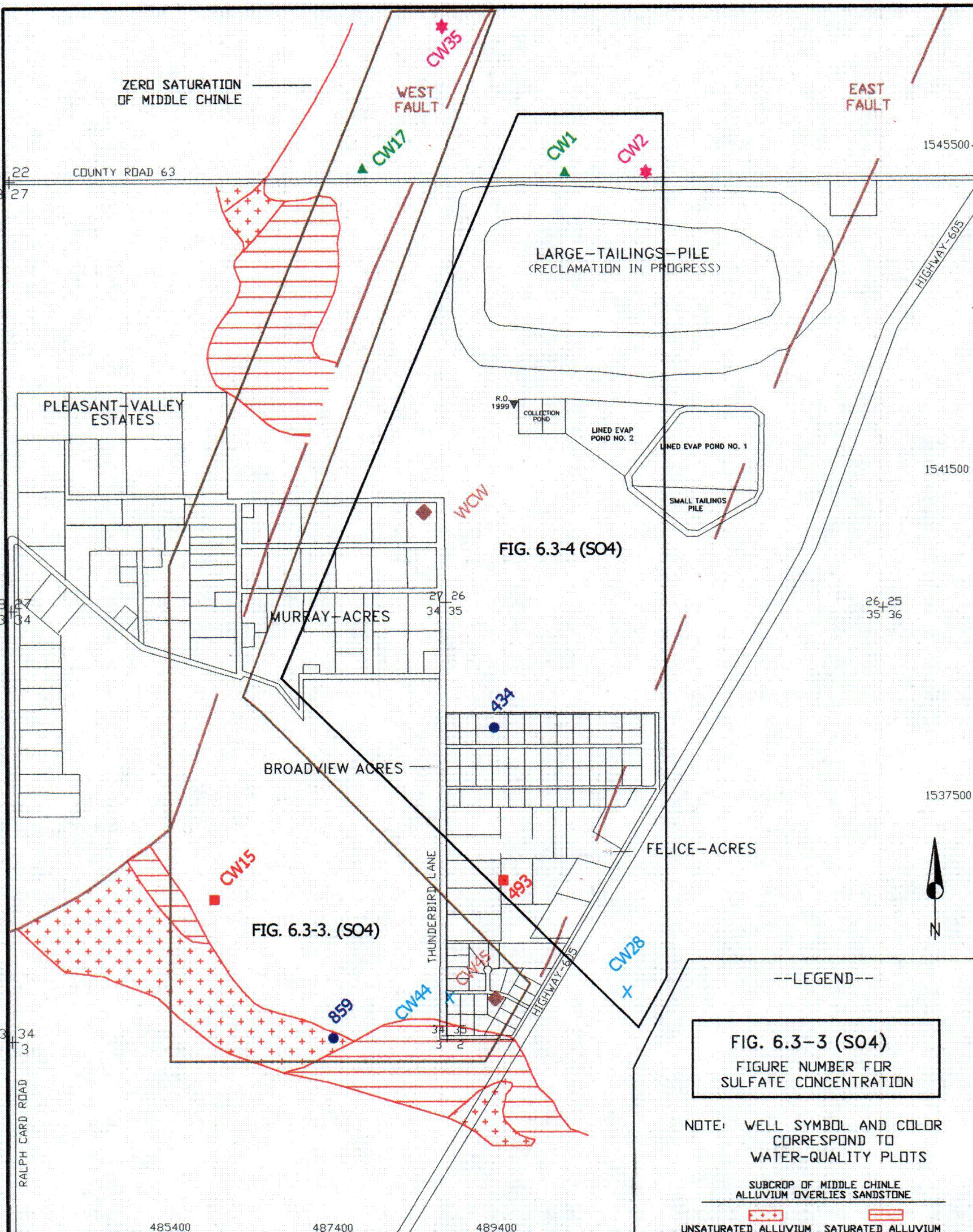

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FIGURE 6.3-2. LOCATION OF MIDDLE CHINLE WELLS WITH WATER-QUALITY PLOTS

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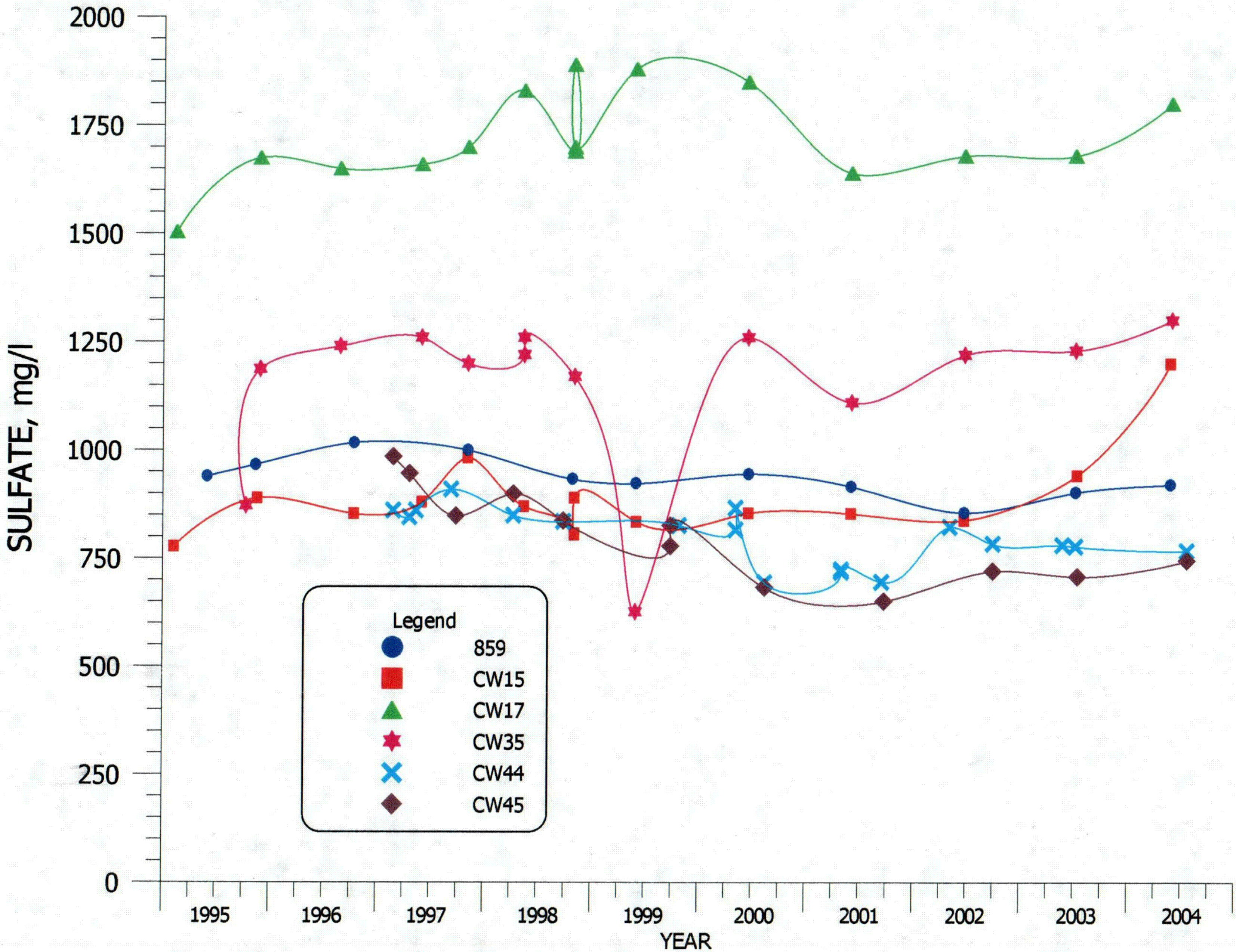

FIGURE 6.3-3. SULFATE CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

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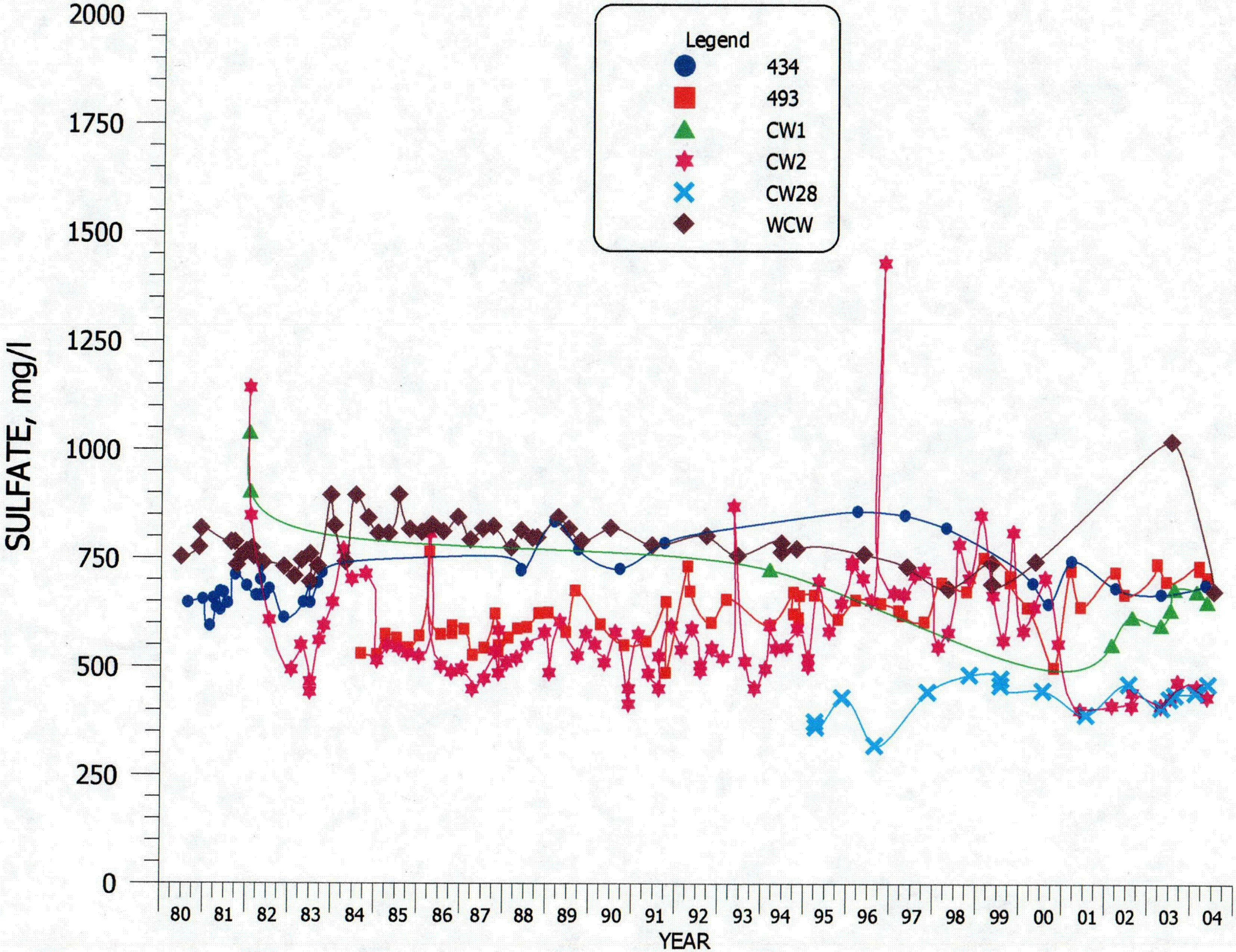

FIGURE 6.3-4. SULFATE CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

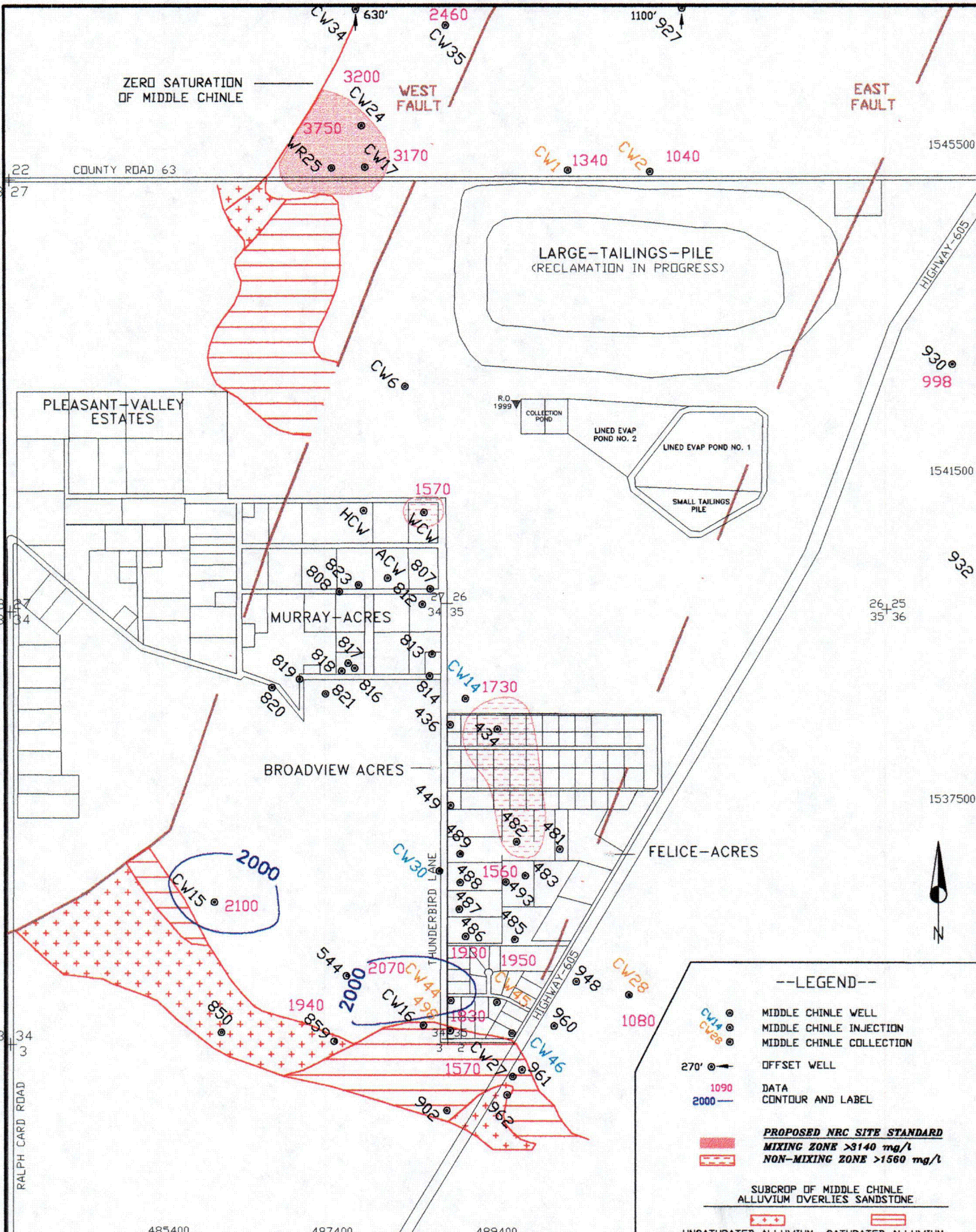

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FIGURE 6.3-5. TDS CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l

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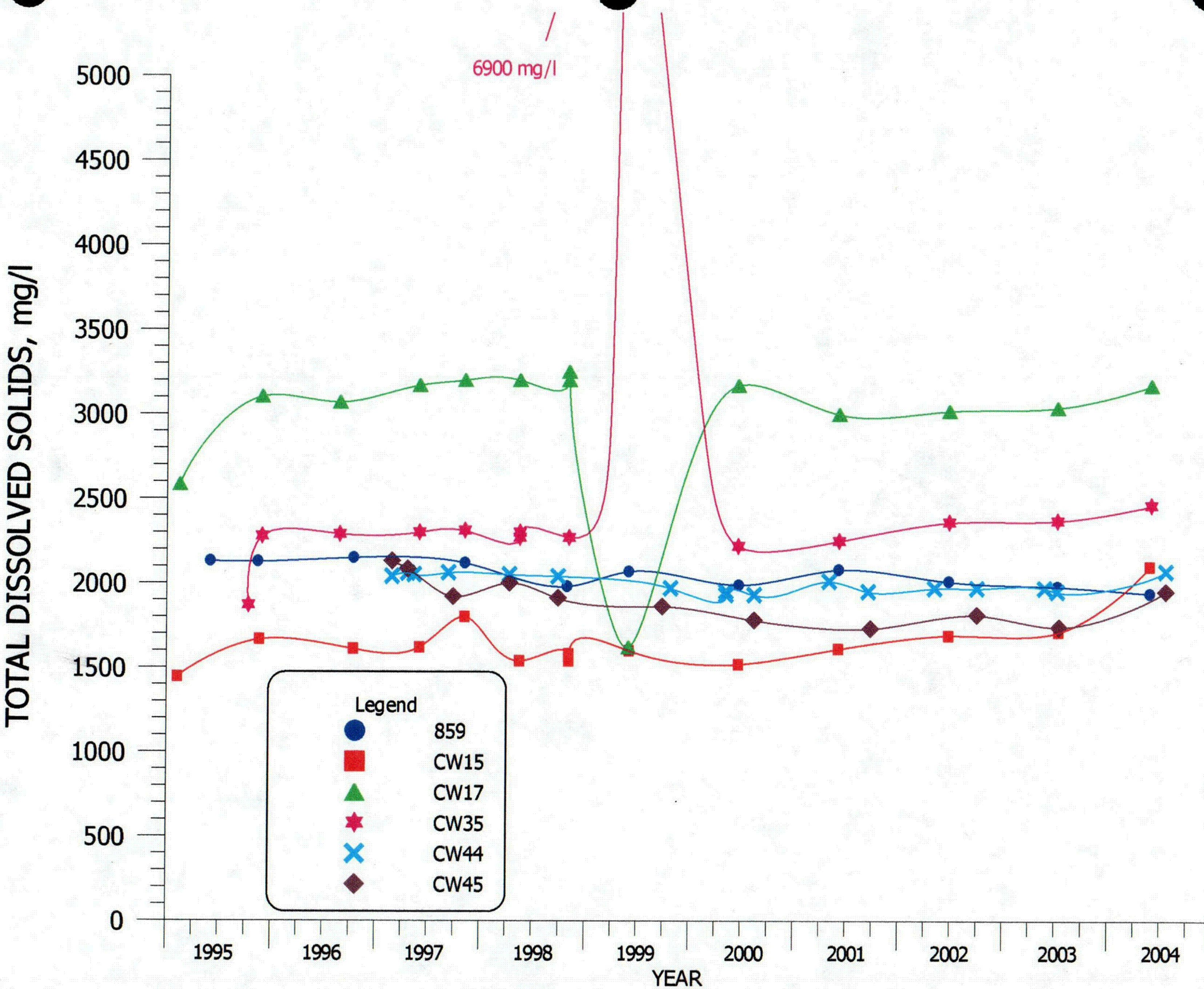

FIGURE 6.3-6. TDS CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

C139

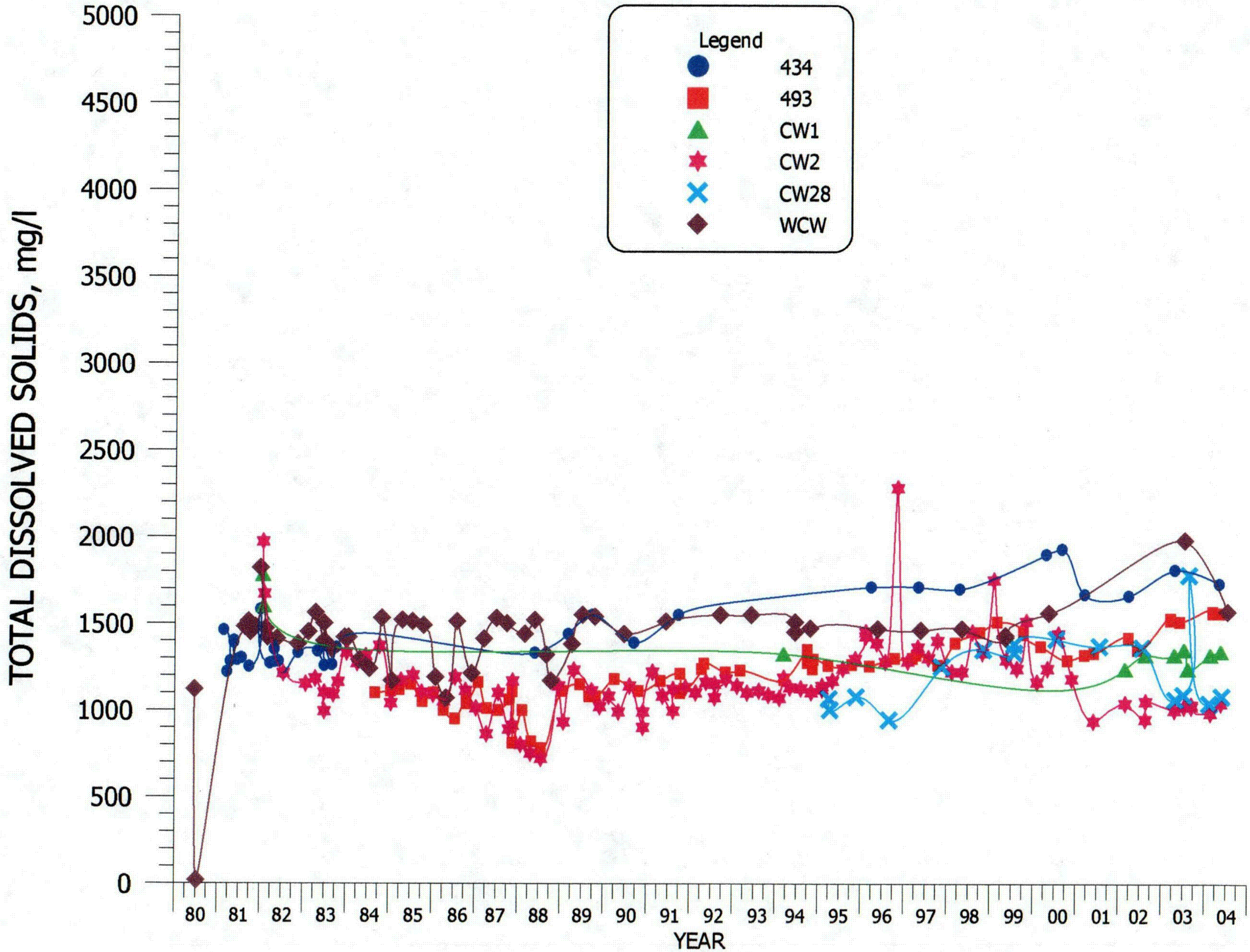

FIGURE 6.3-7. TDS CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

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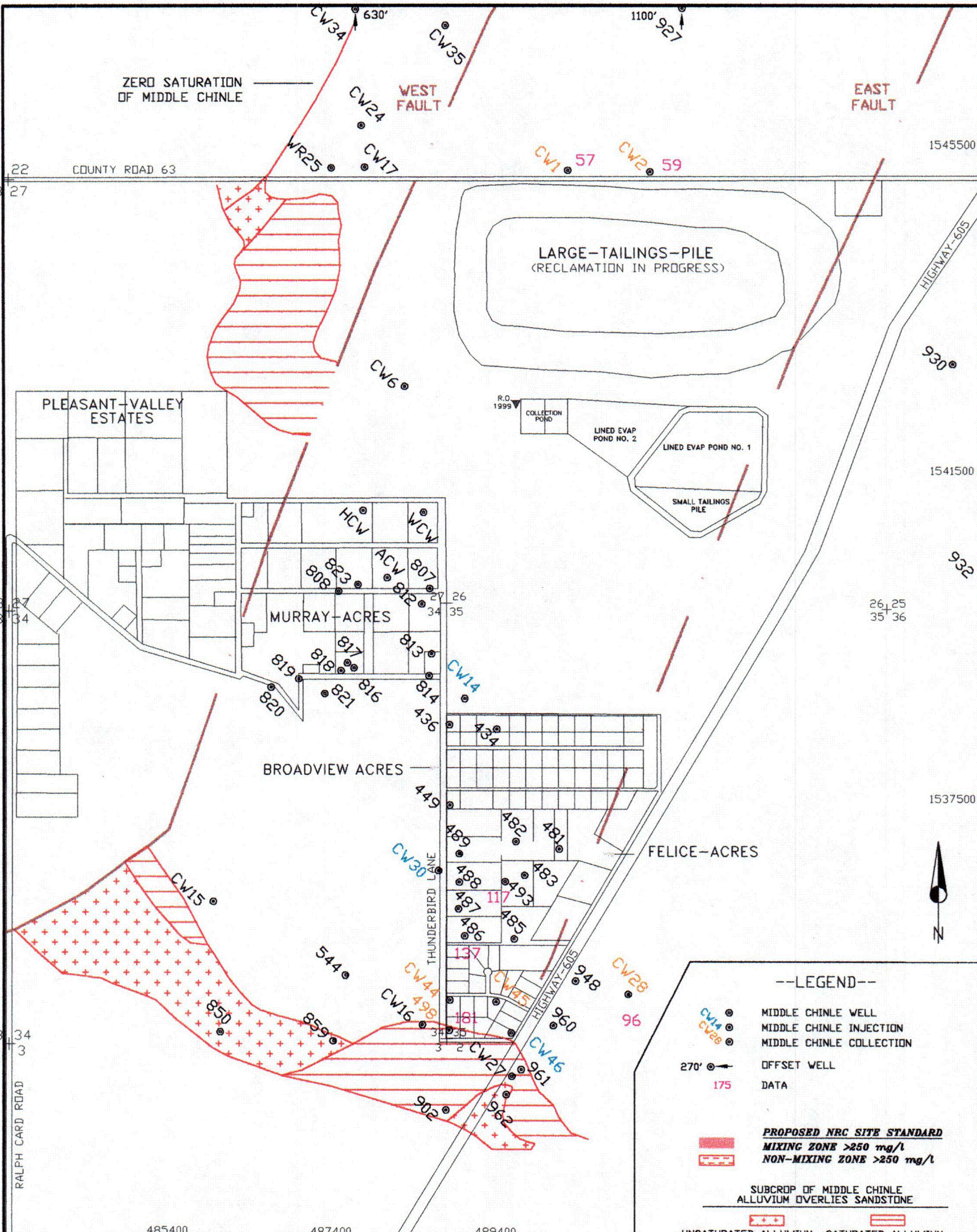

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FIGURE 6.3-8. CHLORIDE CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l

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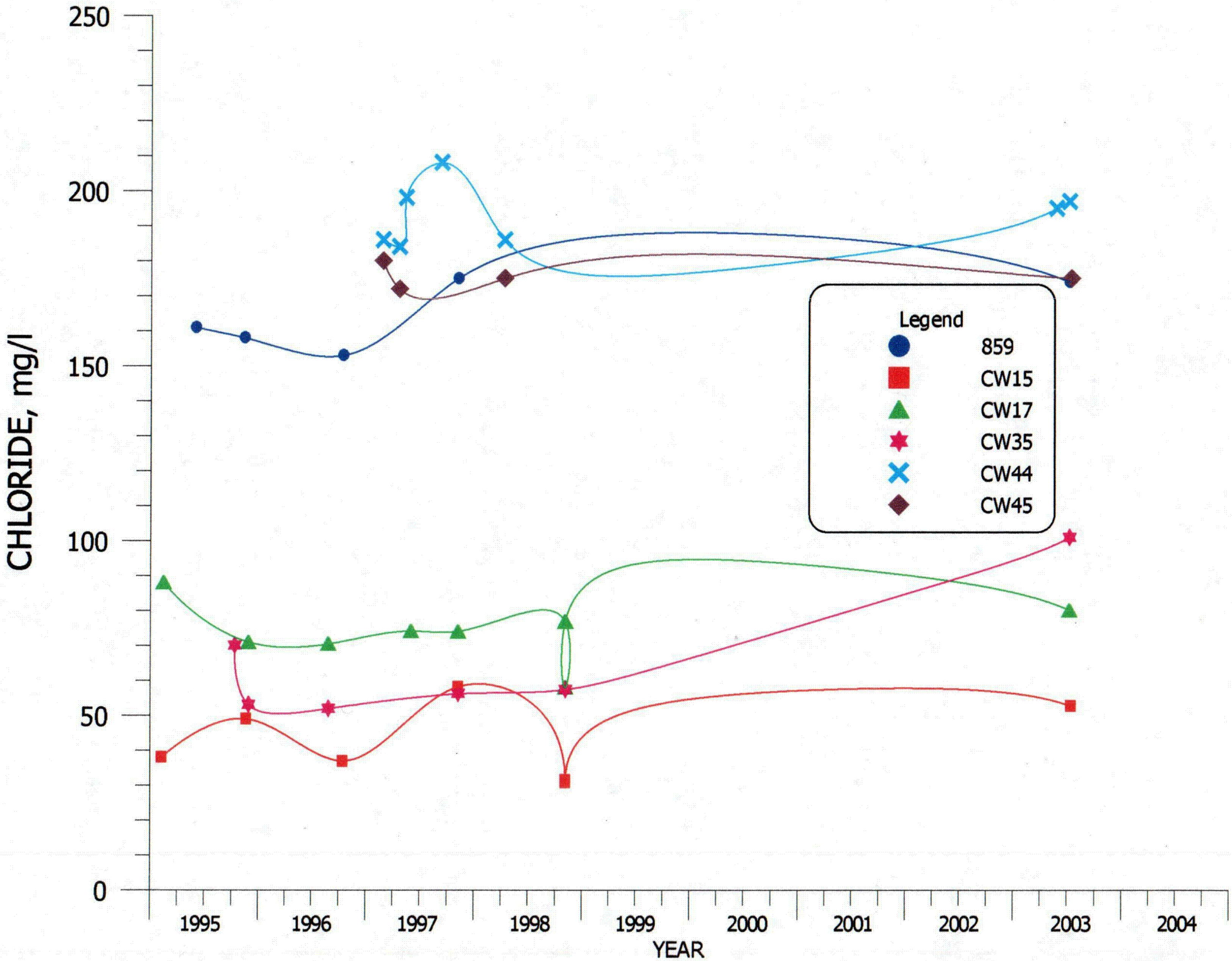

FIGURE 6.3-9. CHLORIDE CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

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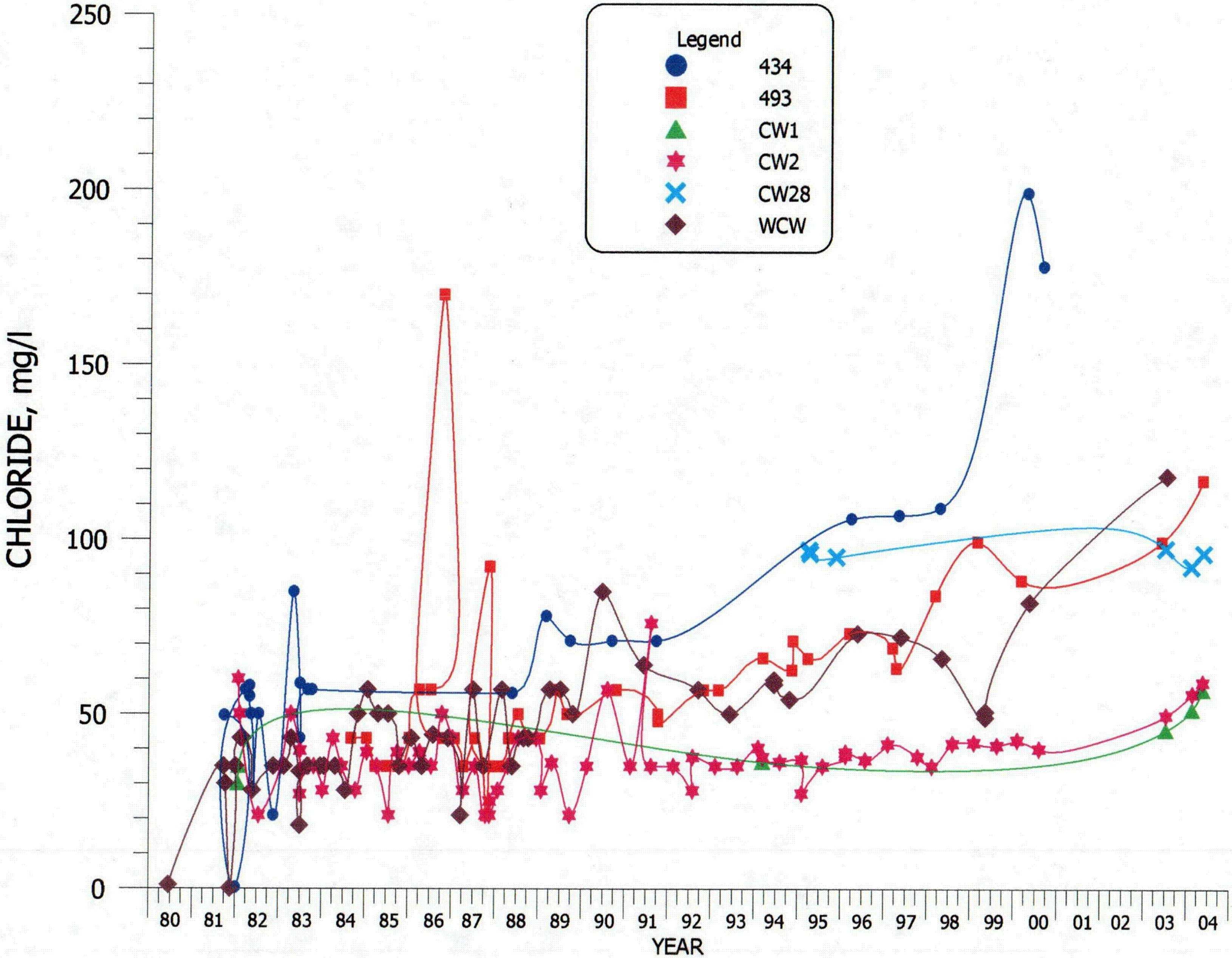

FIGURE 6.3-10. CHLORIDE CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

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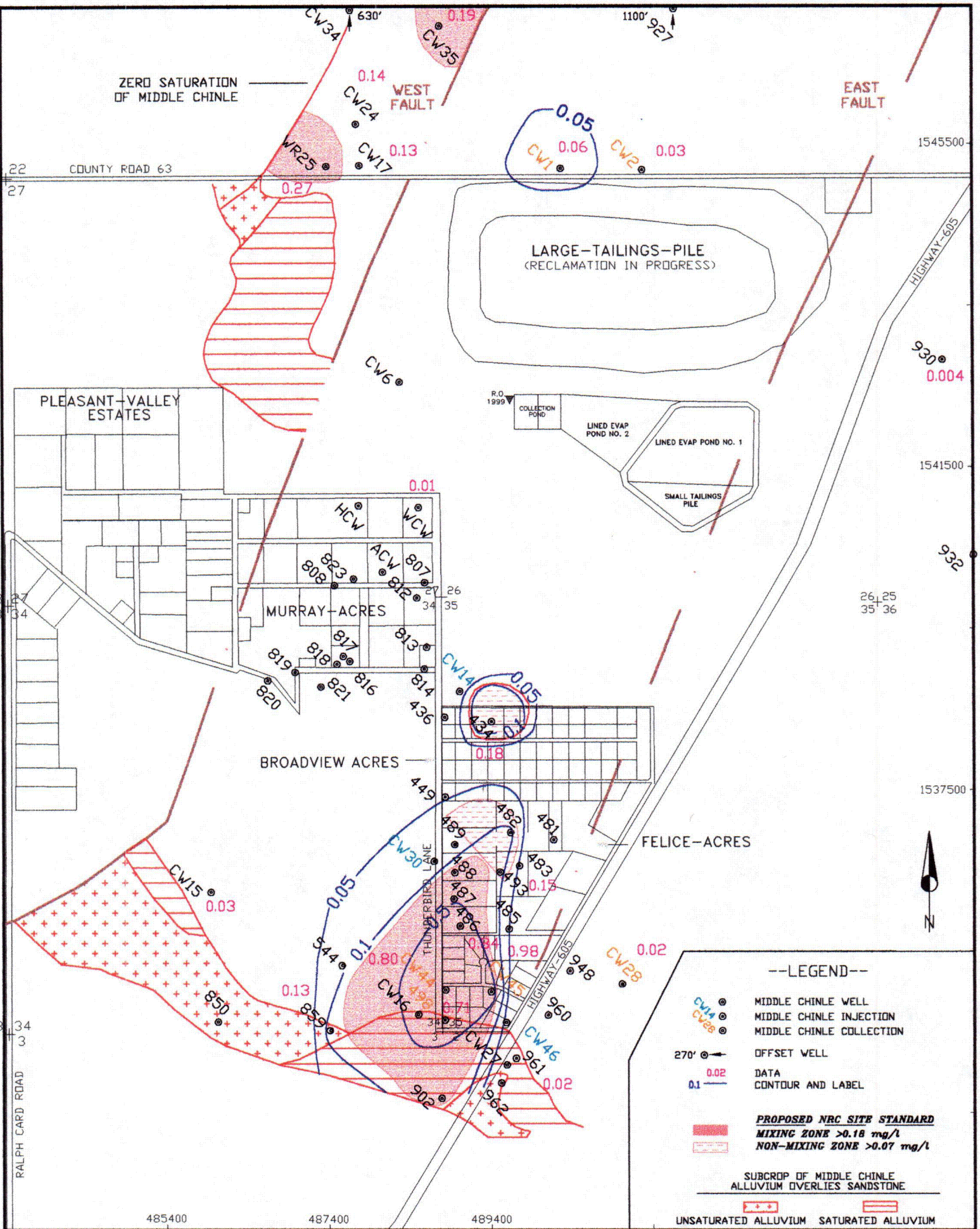

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FIGURE 6.3-11. URANIUM CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l

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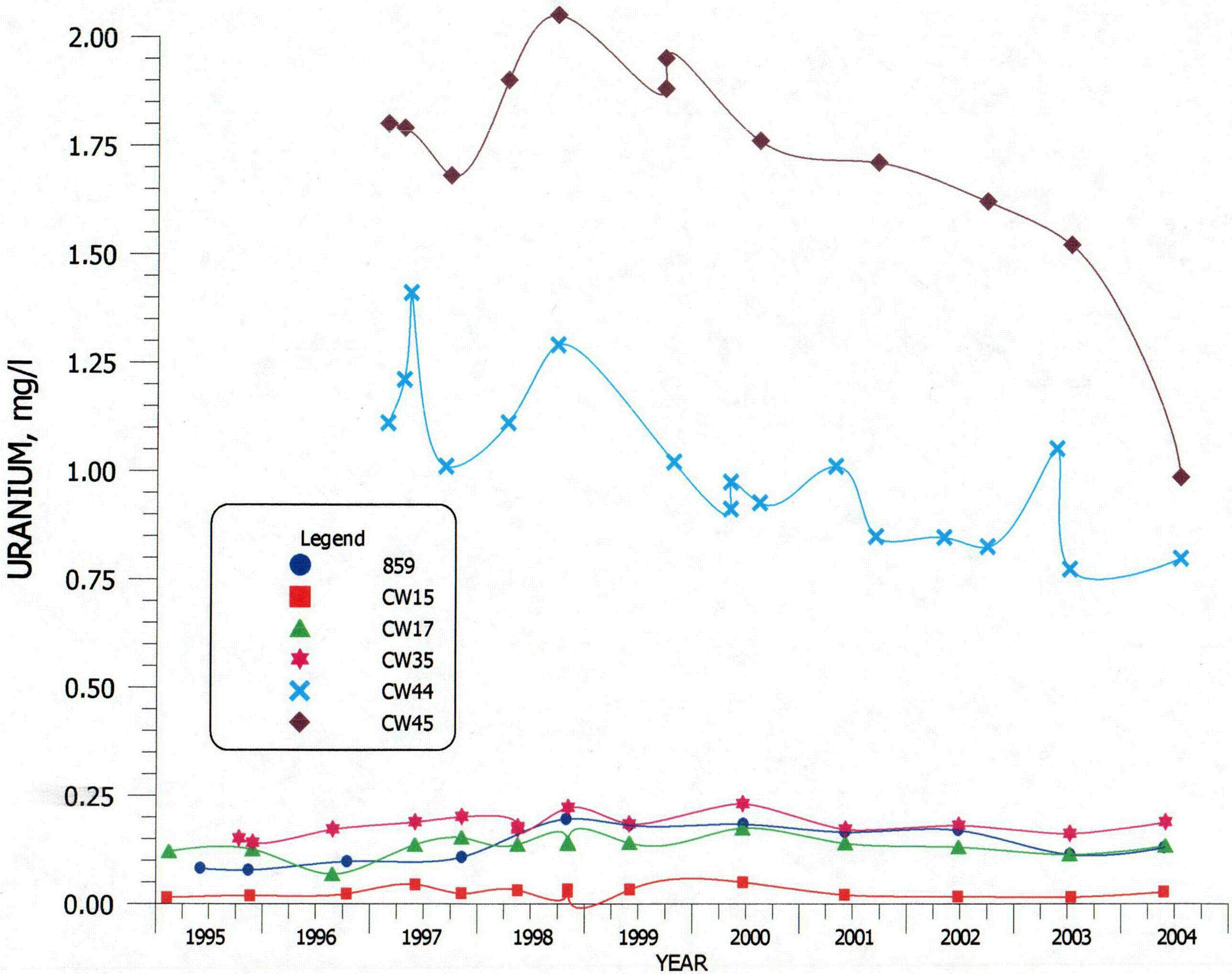

FIGURE 6.3-12. URANIUM CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

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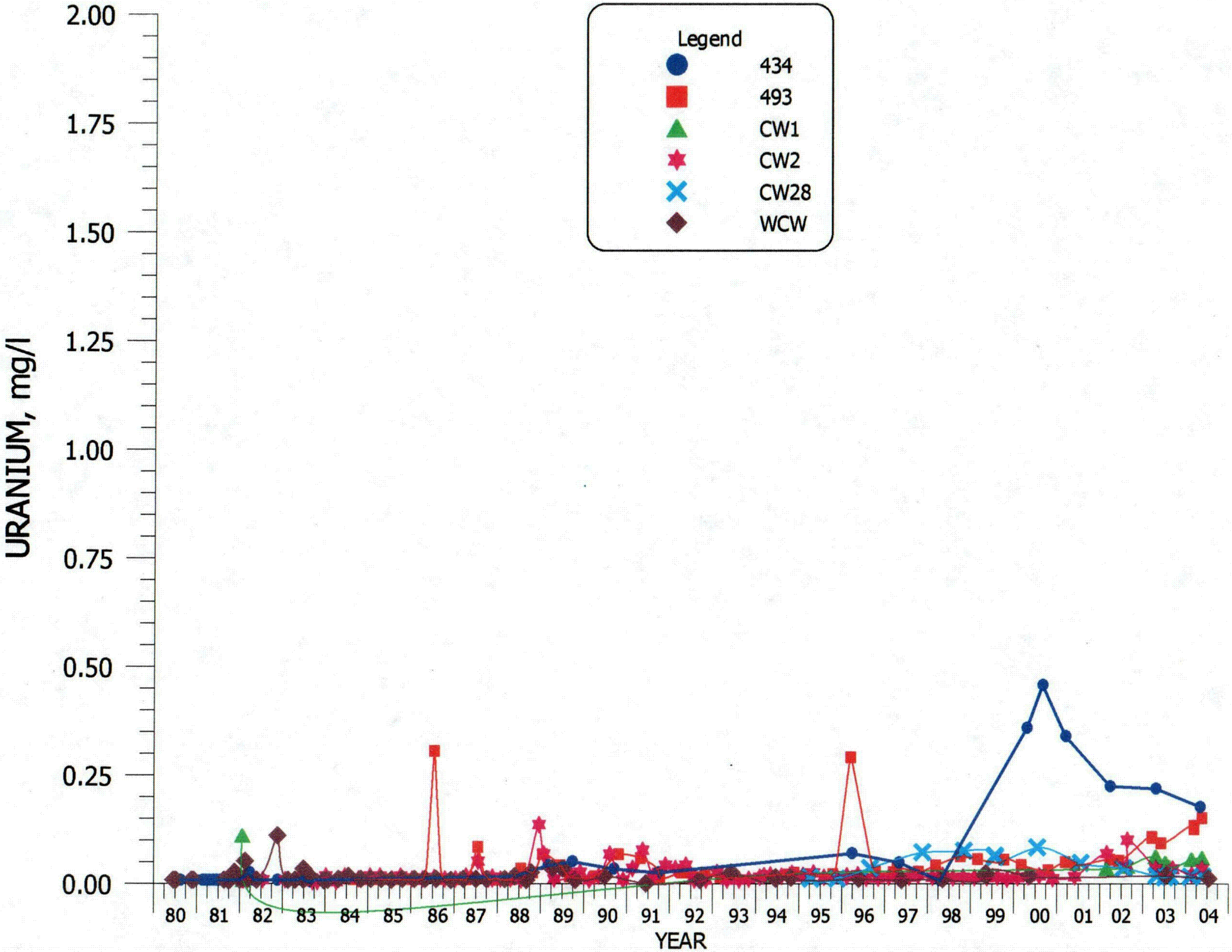

FIGURE 6.3-13. URANIUM CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

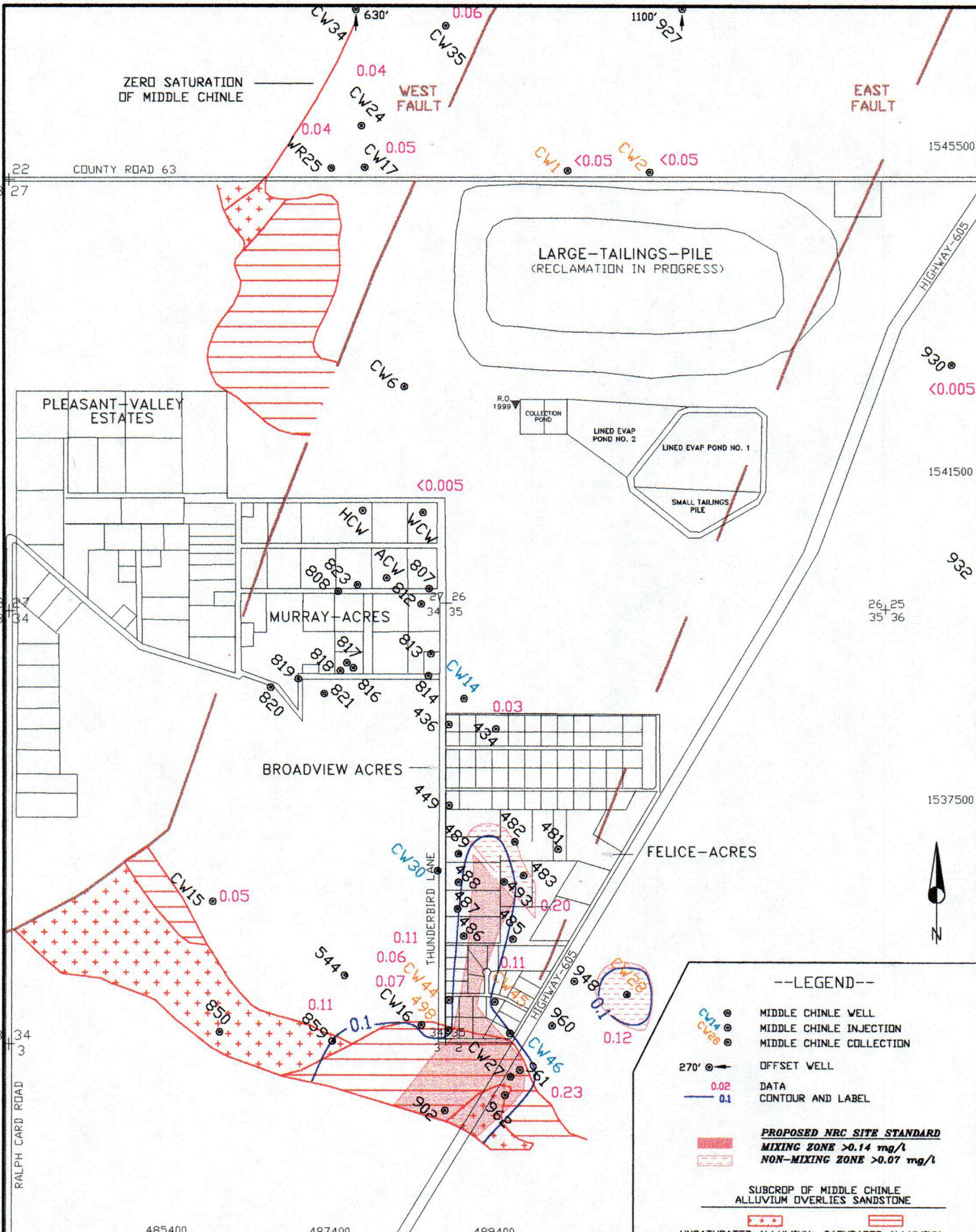

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	FIGURE 6.3-14. SELENIUM CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l	c:\projects\ 2004-06\MID1600 page 6.3-21

C147

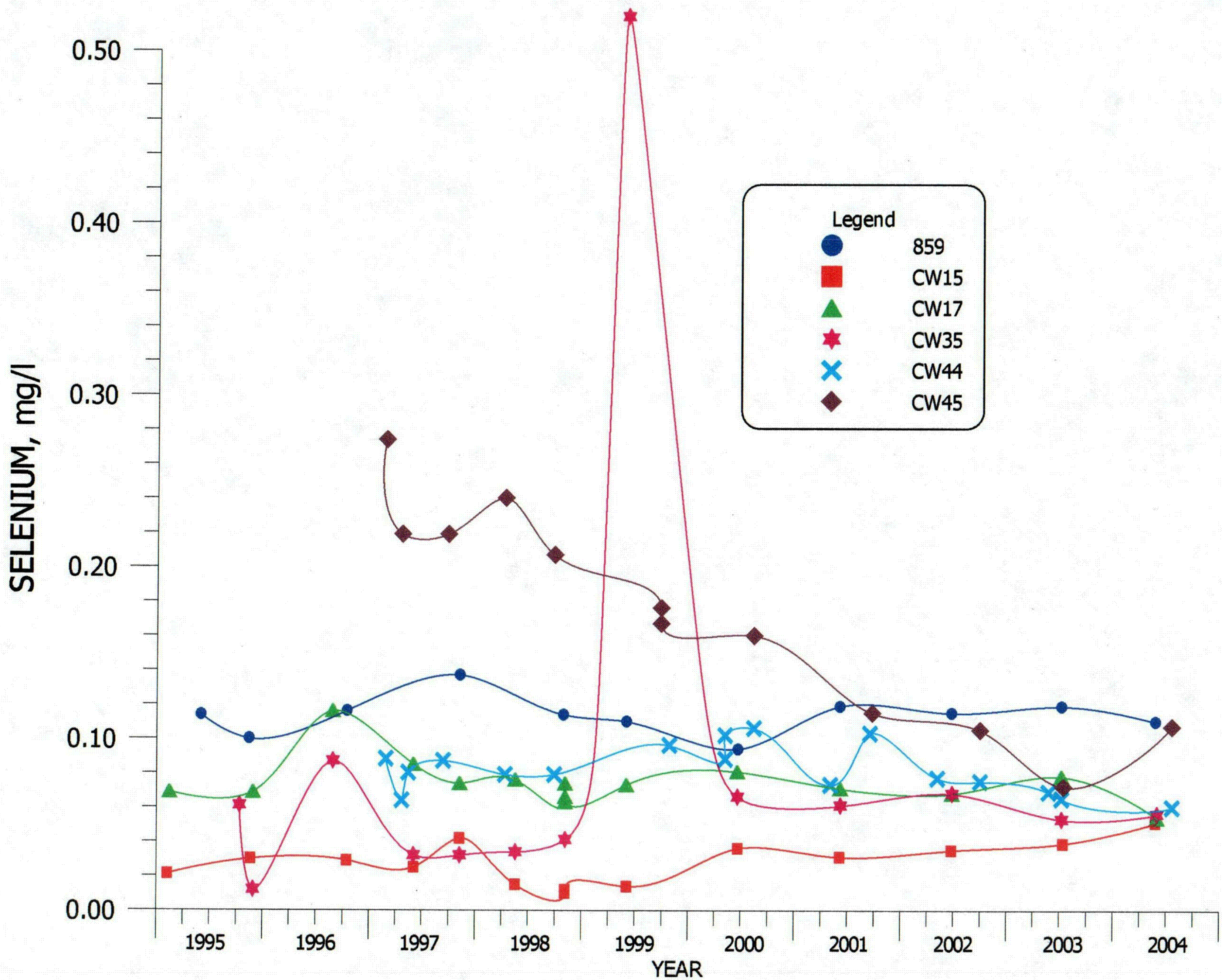

FIGURE 6.3-15. SELENIUM CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

C148

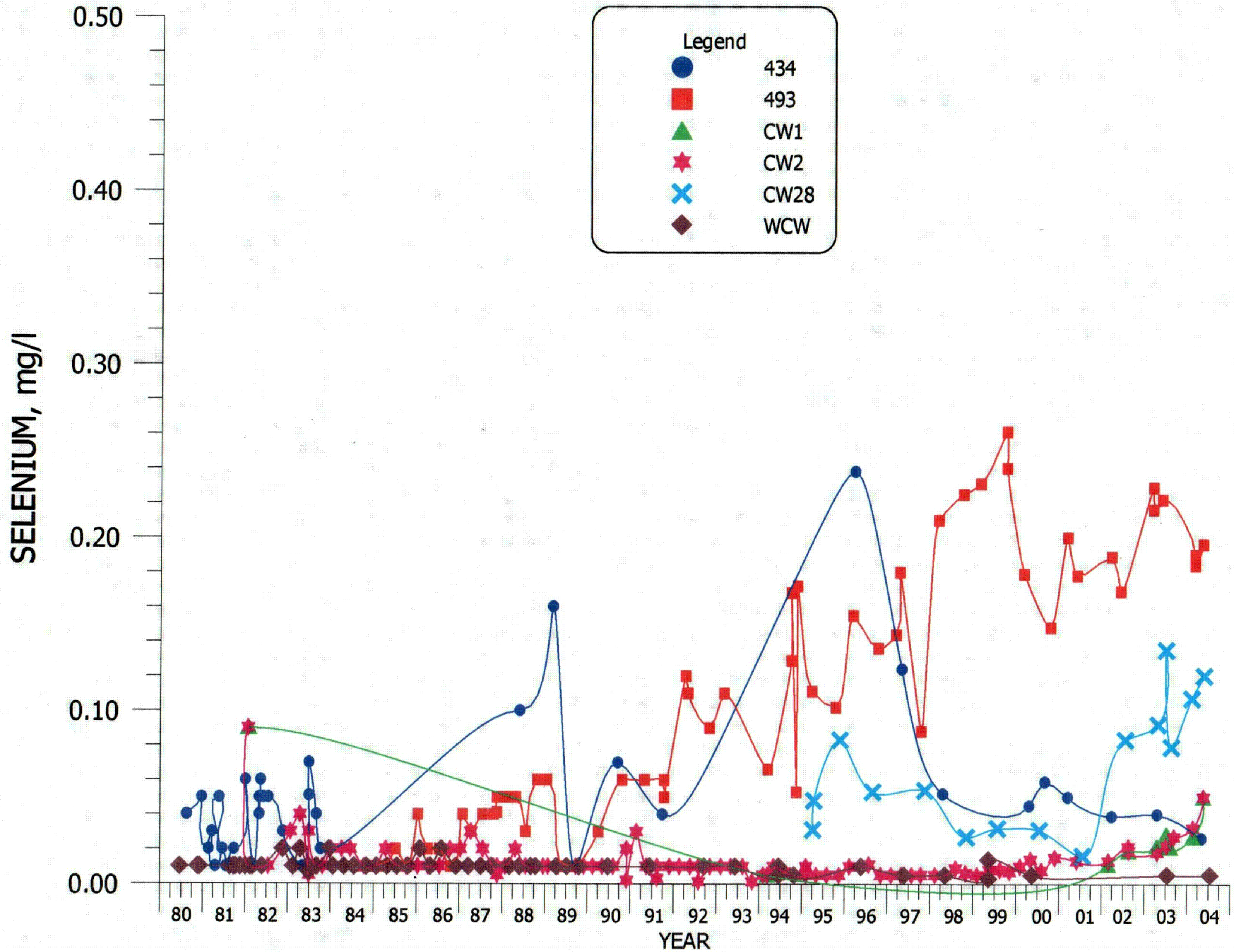

FIGURE 6.3-16. SELENIUM CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

C149

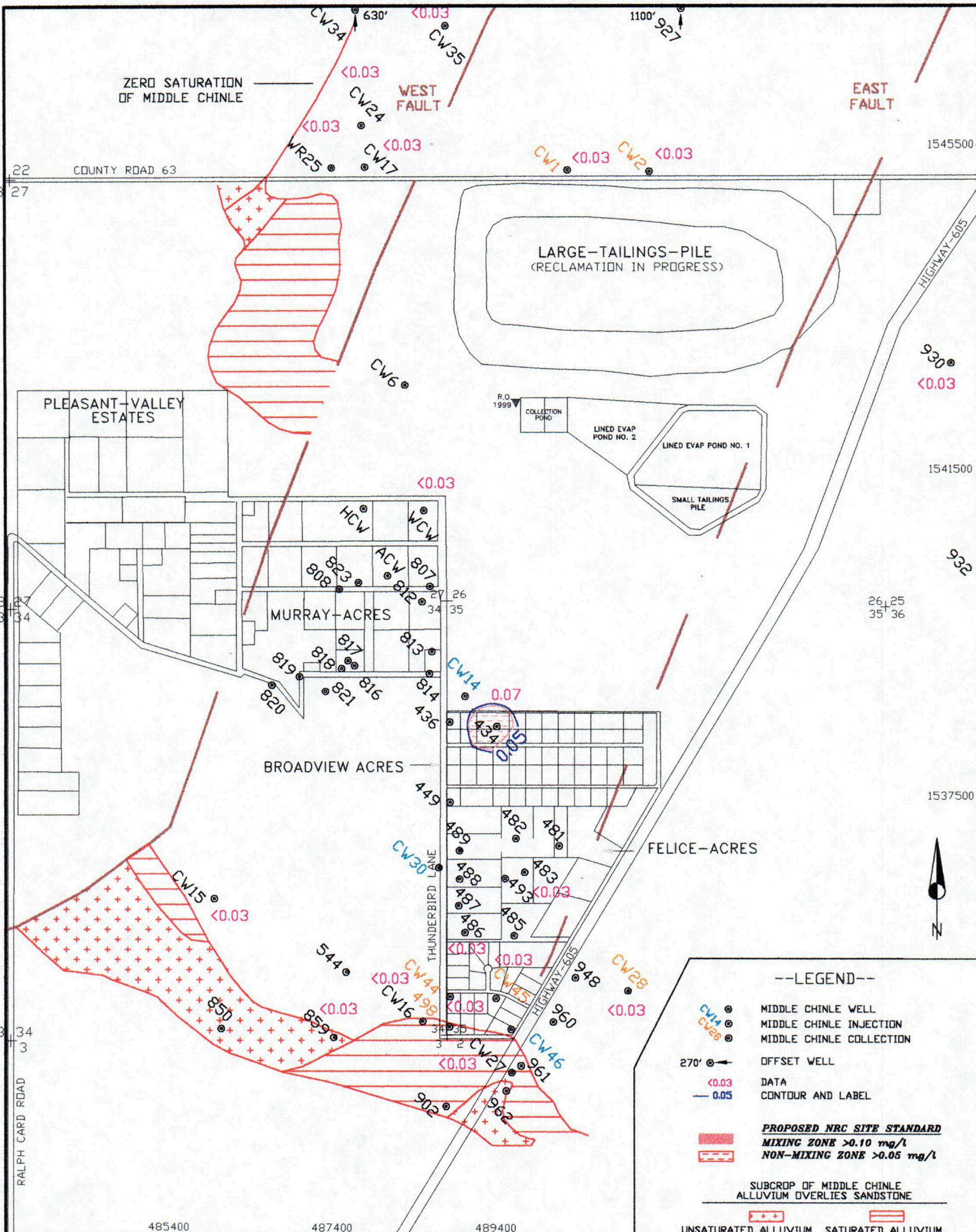

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FIGURE 6.3-17. MOLYBDENUM CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l

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C150

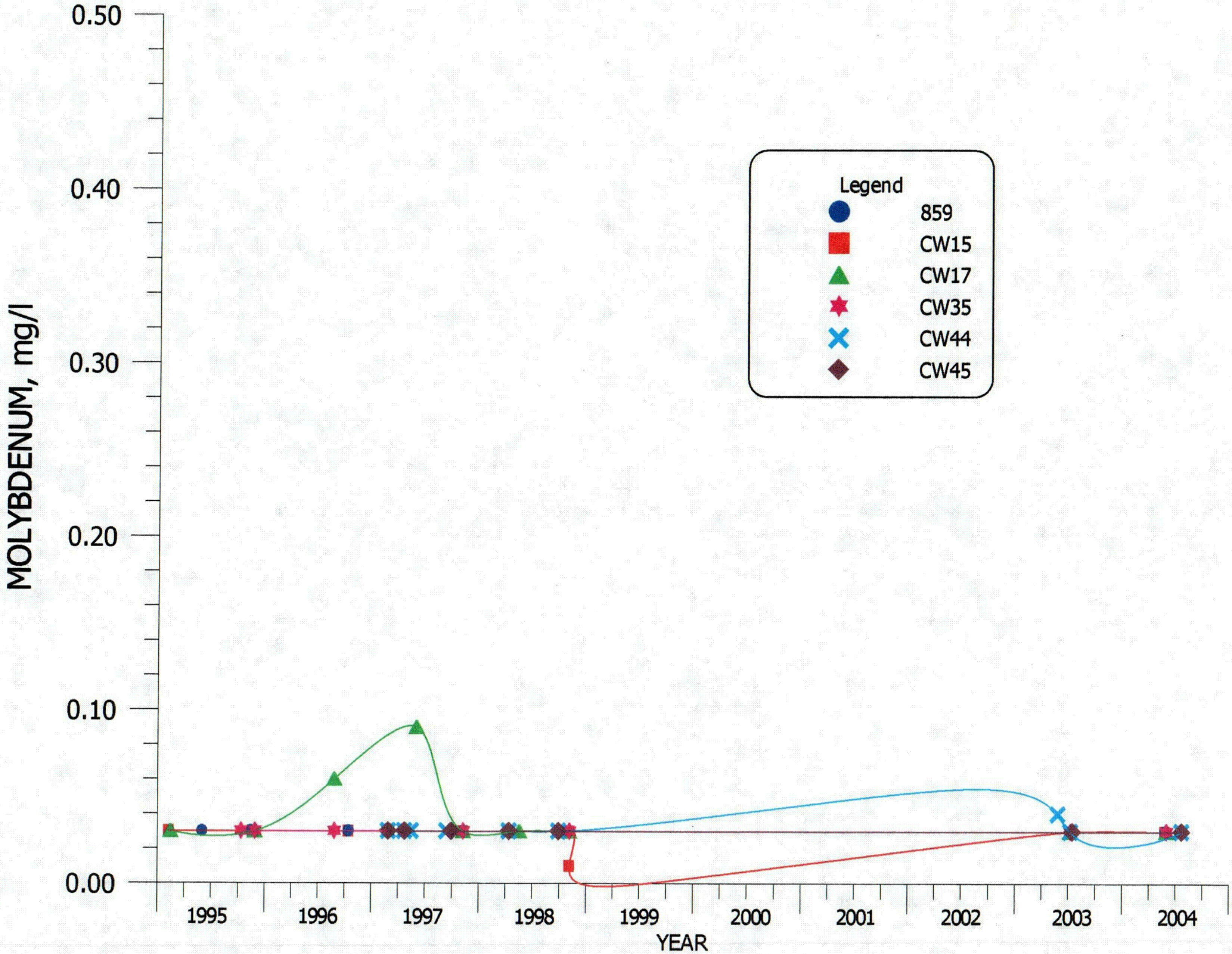


FIGURE 6.3-18. MOLYBDENUM CONCENTRATIONS FOR MIXING ZONE WELLS 859, CW15, CW17, CW35, CW44 AND CW45.

C151

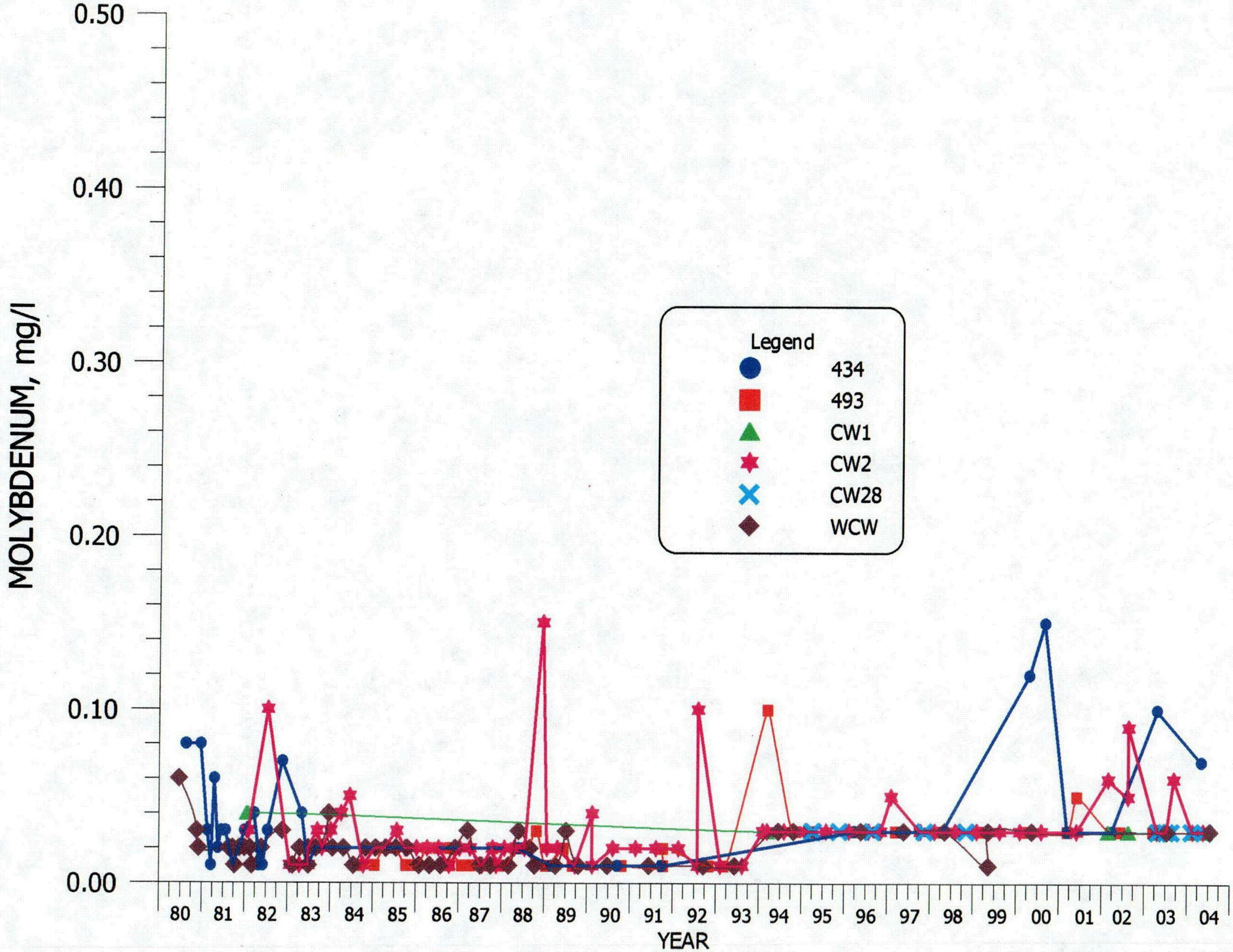
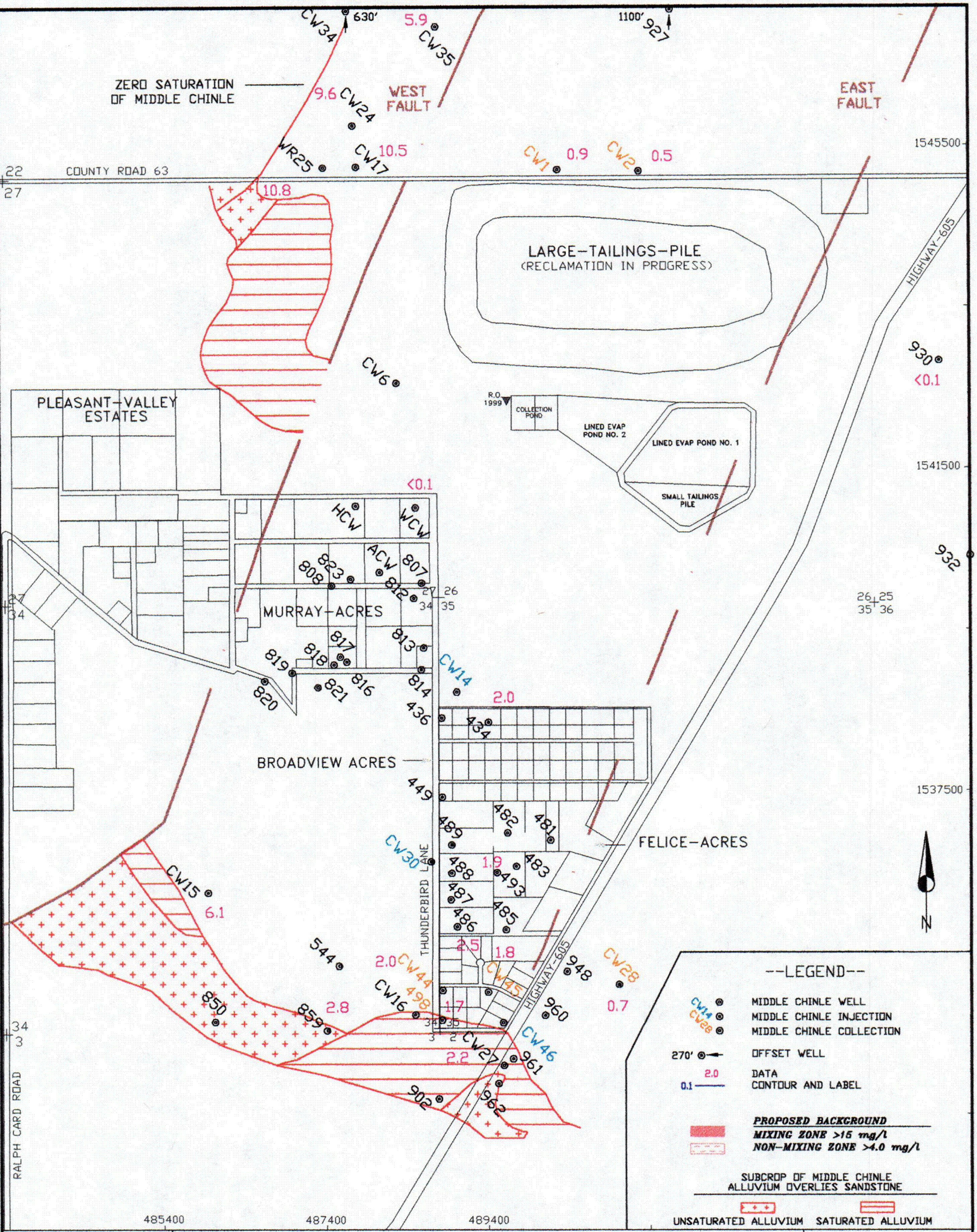


FIGURE 6.3-19. MOLYBDENUM CONCENTRATIONS FOR NON-MIXING ZONE WELLS 434, 493, CW1, CW2, CW28 AND WCW.

C152



SCALE: 1"=1600'	HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W	DATE: 03/25/05
FIGURE 6.3-20. NITRATE CONCENTRATIONS OF THE MIDDLE CHINLE AQUIFER, 2004, mg/l		c:\projects\ 2004-06\MID1600
		page 6.3-27

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SECTION 7

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GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

FIGURES

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GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

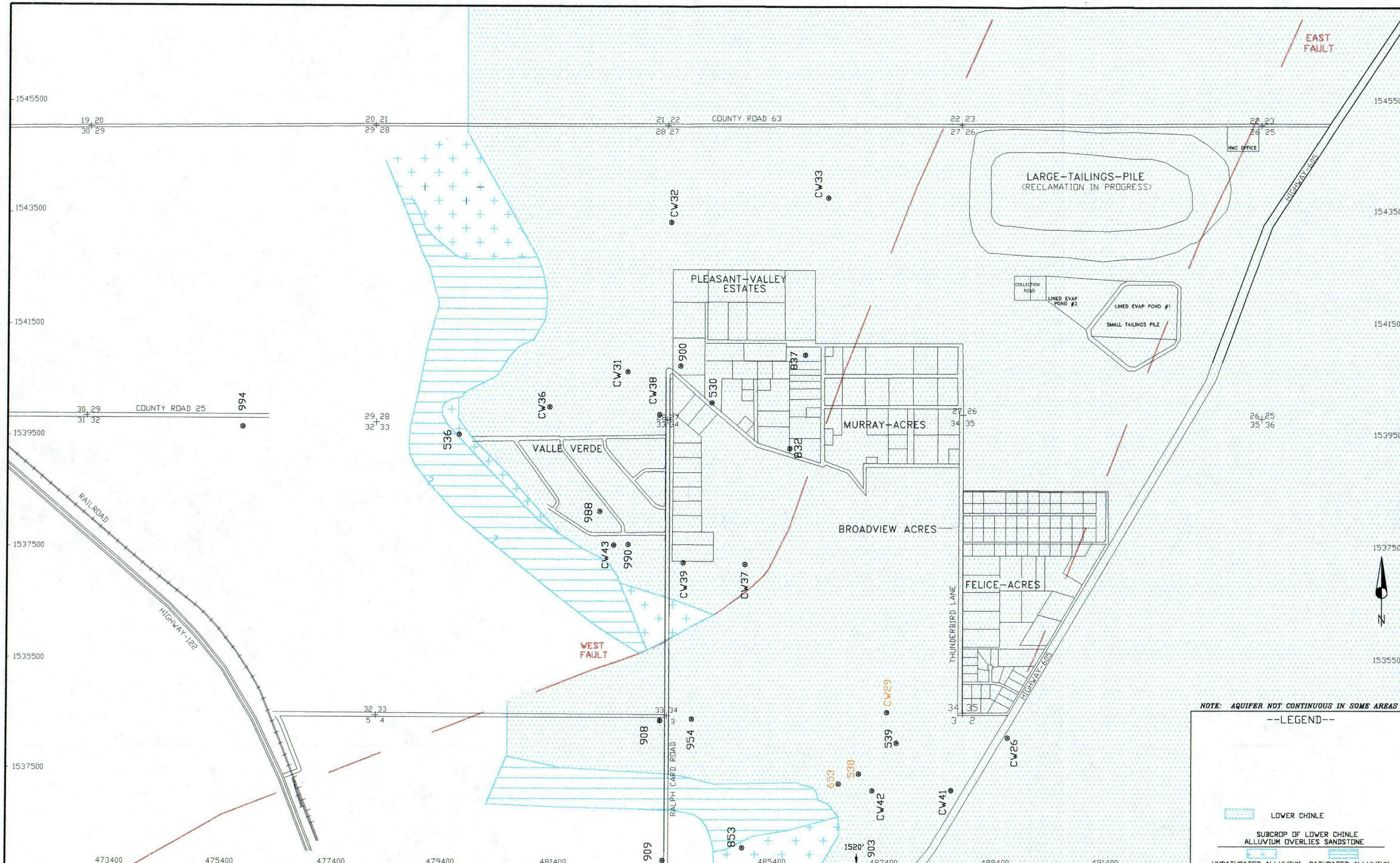
FIGURES (continued)

7.0 LOWER CHINLE AQUIFER MONITORING

7.1 LOWER CHINLE WELL COMPLETION

The Lower Chinle aquifer is a permeable zone in the Chinle shale which exists below the Middle Chinle sandstone and above the San Andres aquifer. The Lower Chinle aquifer becomes important west and southwest of the Homestake Grants Project area where this unit is present at shallower depths. The general permeability of the Lower Chinle aquifer can vary dramatically, because the transmitting ability of this aquifer depends on the presence of a fractured or altered shale that provides secondary permeability. Tables 5.1-1 through 5.1-4 present the Lower Chinle basic well data along with the other Chinle aquifer wells.

Wells that are completed in the Lower Chinle aquifer are shown on Figure 7.1-1. Chinle shale exists above the top of the Lower Chinle aquifer in the area with the dot pattern. This figure also shows the location of the Chinle shale subcrop. The cyan crosshatch pattern shows where the alluvium is saturated in the subcrop area, while the plus-sign pattern shows where the alluvium is not saturated in the subcrop area. Lower Chinle wells 538, 653 and CW29 were used as irrigation supply wells.



SCALE: 1"=1600' C:\PROJECTS\2004-06\C-LOW03 DATE: 03/23/05	HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W	FIGURE 7.1-1. LIMITS OF LOWER CHINLE AQUIFER AND WELL LOCATIONS

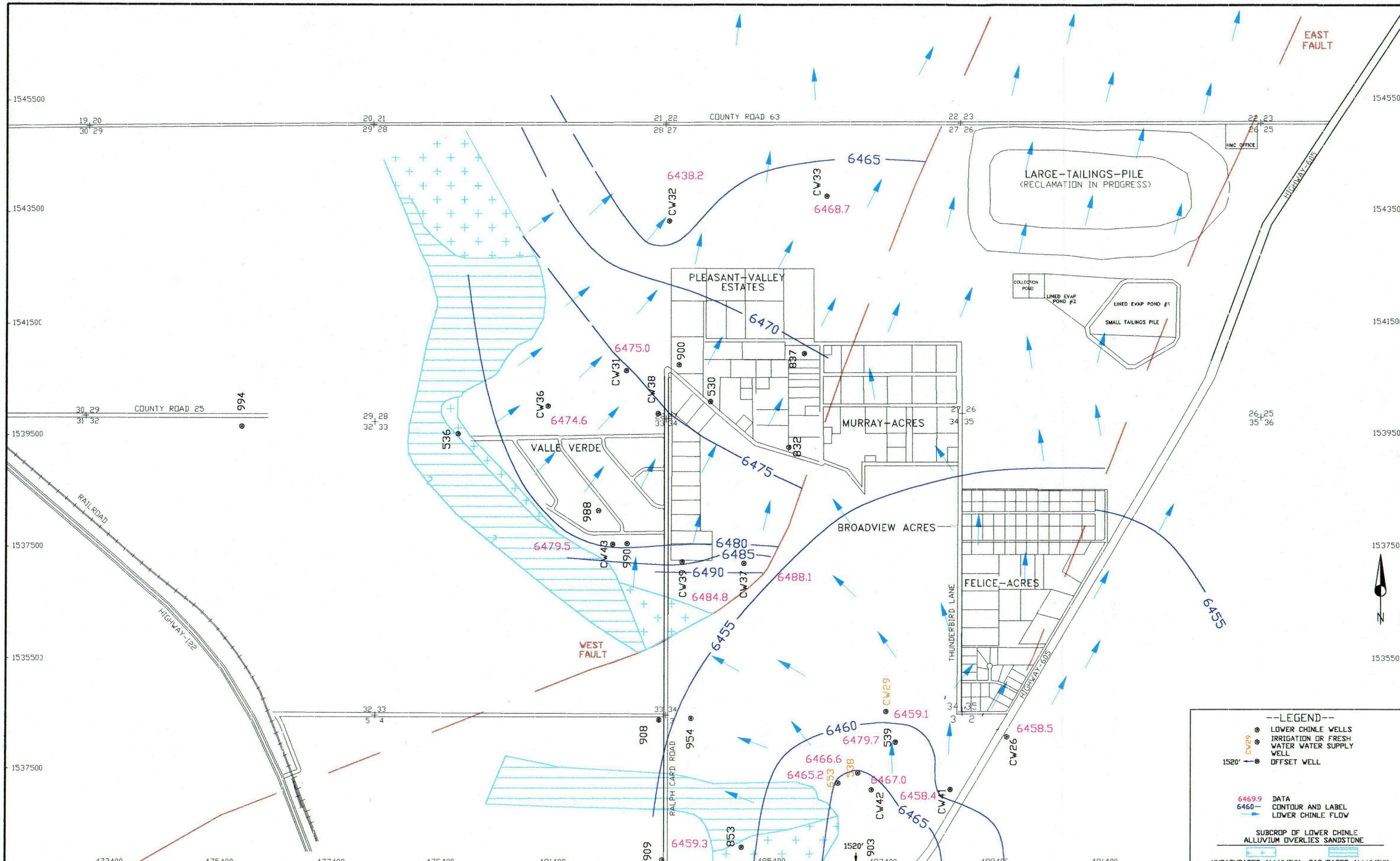
7.2 LOWER CHINLE WATER LEVELS

Water-level elevations in the Lower Chinle wells are presented along with the data for the Upper and Middle Chinle wells in Appendix A. Figure 7.2-1 presents water-level elevations in the Lower Chinle wells and the Fall of 2004 water-level elevation contours. The West and East Faults are also shown on this figure. The approximate alluvial-Lower Chinle subcrop areas are also shown on this figure. Flow west of the West Fault in the Lower Chinle is mainly to the northeast. Flow between the two faults is to the northeast in the area of the tailings. The flow is to the northwest in the southern portion of the Lower Chinle aquifer between the faults. The northwesterly flow direction in this area indicates that the Lower Chinle water moves across the West Fault in the area west of Broadview Acres. Lower Chinle water levels in 2004 were lower in Section 3 as a result of continued pumping for the purpose of providing irrigation supply, and because of the drought. Lower water-level elevation exists in the Lower Chinle piezometric surface around irrigation supply well CW29 due to pumping from this well during the irrigation season.

The Lower Chinle wells for which water-level time plots were prepared are shown on Figure 7.2-2. Water levels are presented for Lower Chinle wells 653, CW26, CW29, CW41 and CW42 on Figure 7.2-3. Water levels in Lower Chinle well 653, which has been used as an irrigation supply well, vary due to the variable pumping rate but have generally declined during the last few years. Water levels gradually decreased in Lower Chinle well CW29 prior to its use as a fresh-water injection supply well in 2003 and irrigation supply in 2004. Small overall water-level decreases have been observed over the last few years in Lower Chinle wells CW26, CW41 and CW42.

Figure 7.2-4 presents water-level elevations versus time for Lower Chinle wells CW31, CW32, CW33, CW37 and CW43 (see Figure 7.2-2 for location of these wells). Water levels have gradually declined over the last few years in wells CW31, CW37 and CW43, while they have been fairly steady in well CW33. Water levels have decreased in Lower Chinle well CW32 for several years, and this overall trend continued in 2004. The rate and magnitude of decrease in this Lower Chinle well is similar to that observed in the alluvial and San Andres aquifers to the west in Sections 29, 32 and 33. These declines are in stark contrast to the steady alluvial water levels near well CW32. This indicates that the Lower Chinle aquifer near well

CW32 is hydrologically connected to the alluvial aquifer west of this area but is isolated from the alluvial aquifer in its immediate area.



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HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
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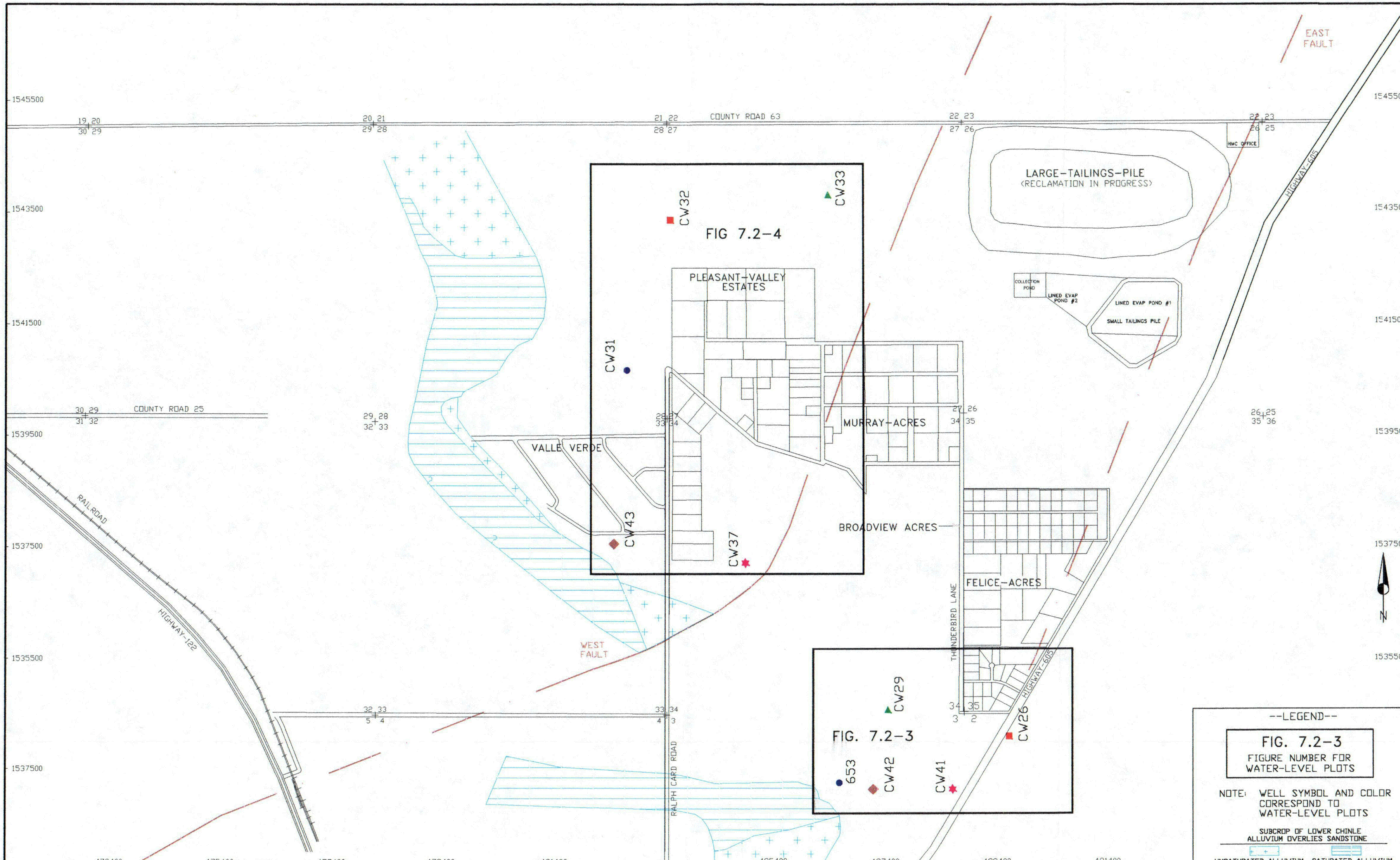
FIGURE 7.2-1. WATER-LEVEL ELEVATIONS OF THE LOWER CHINLE AQUIFER, FALL 2004, FT-MSL

C155



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HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 7.2-2. LOCATION OF LOWER CHINLE WELLS WITH WATER-LEVEL PLOTS

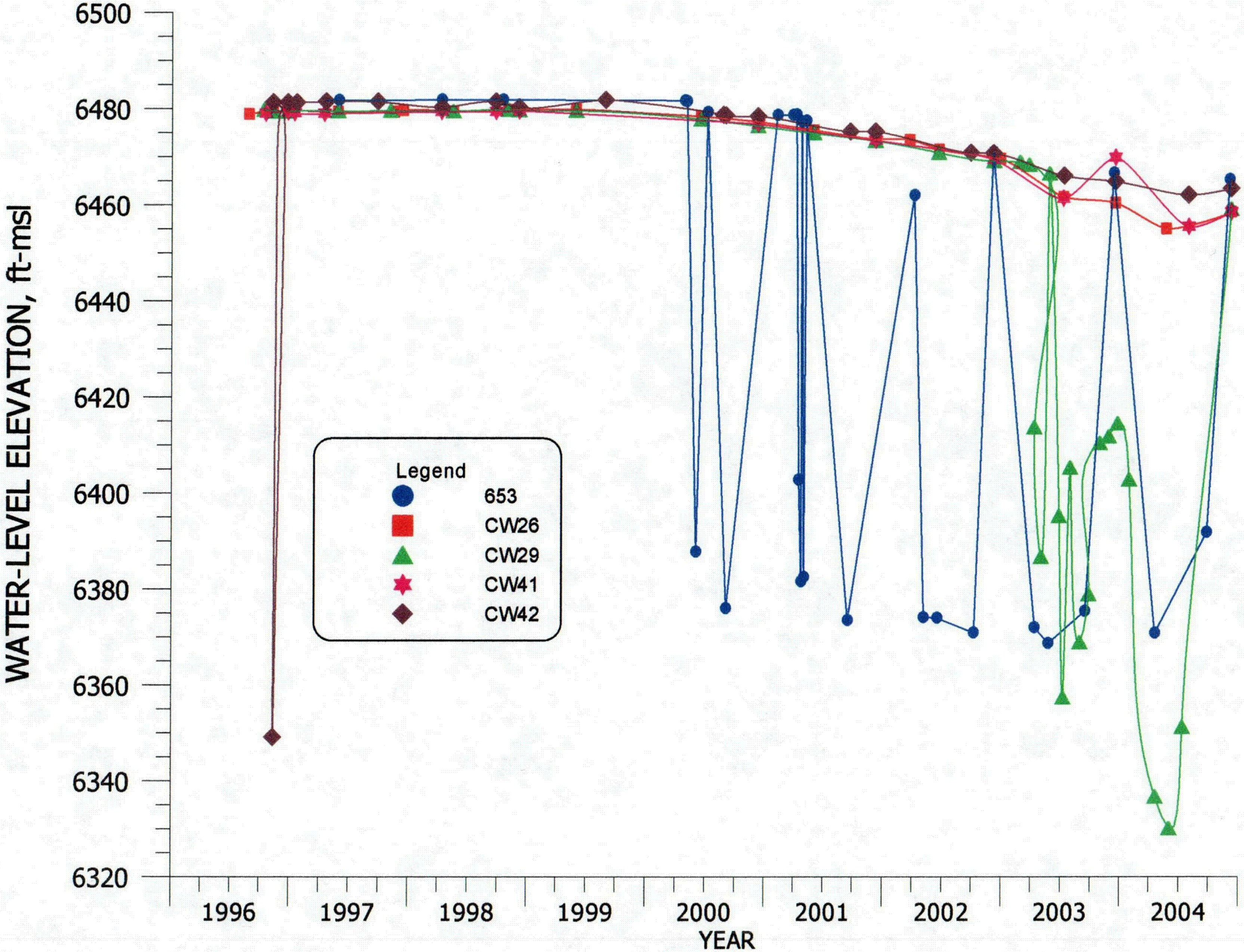

FIGURE 7.2-3. WATER-LEVEL ELEVATION FOR WELLS 653, CW26, CW29, CW41 AND CW42.

C157

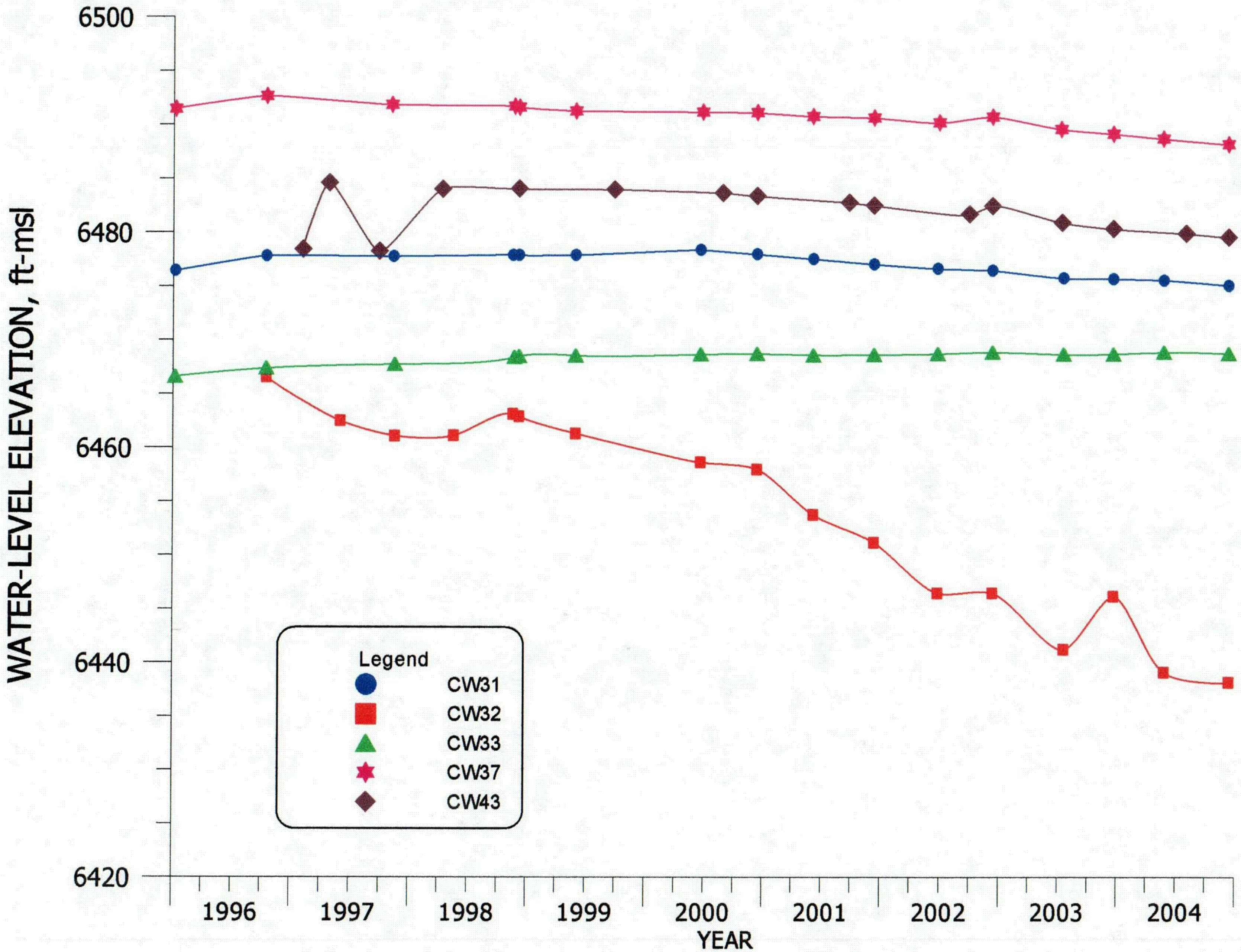

FIGURE 7.2-4. WATER-LEVEL ELEVATION FOR WELLS CW31, CW32, CW33, CW37 AND CW43.

C158

7.3 LOWER CHINLE WATER QUALITY

Water-quality data for 2004 for the Lower Chinle aquifer are presented in Tables B.5-1 and B.5-2 of Appendix B along with water-quality data for the other Chinle aquifer wells. The basic well data presented in Tables 5.1-1 through 5.1-4, and the orientation of the well name on Figure 5.1-1 indicate which of the Chinle wells are completed in the Lower Chinle.

Constituent concentrations in the Lower Chinle aquifer exceed background conditions only in Section 3, except for some natural exceedances in the far down-gradient wells. Sulfate concentrations in the Lower Chinle aquifer are within the proposed NRC standards except in far down-gradient wells CW32 and CW33, where concentrations only slightly exceed the relevant non-mixing background value. These concentrations are deemed to be of natural origin and only slightly exceed the 95th percentile level of the data base. Uranium and selenium concentrations exceed the proposed NRC site standards only in the northeastern and central portions of Section 3. Molybdenum concentrations in the Lower Chinle aquifer are all less than the limit of detection.

7.3.1 SULFATE – LOWER CHINLE

Figure 7.3-1 presents contours of sulfate concentrations in the Lower Chinle aquifer during 2004. Proposed NRC Lower Chinle standards based on background data are presented for sulfate in the legend of Figure 7.3-1. The Lower Chinle concentrations varied from 287 to 2600 mg/l. Only the values from wells CW32 and CW33 exceeded the 2000 mg/l proposed upper limit of background for the non-mixing zone. These concentrations are thought to be naturally occurring and likely exceed the full range of background because the data is limited in the downgradient portion of the Lower Chinle aquifer. None of the Lower Chinle concentrations in the mixing zone (see Section 3 and Figure 7.3-2 for zone areas) exceeded the mixing-zone sulfate background value of 1750 mg/l. Therefore, the Lower Chinle aquifer does not require any restoration with respect to sulfate.

The locations of wells used in the plots of water quality for the Lower Chinle are presented on Figure 7.3-2. Figure 7.3-2 shows that data for mixing zone Lower Chinle wells 653, CW37, CW42 and CW43 are grouped together on the water-quality time plots, and data for non-mixing zone wells CW26, CW29, CW31, CW32, CW33 and CW41 are presented on a second plot.

Figure 7.3-3 presents sulfate concentrations plotted versus time for the Lower Chinle mixing-zone wells. The sulfate concentrations in water collected from each of these wells are less than that in the mixing-zone background level, showing that sulfate restoration of the Lower Chinle is not needed in the southern portion of the aquifer.

Sulfate concentrations plotted for Lower Chinle wells CW26, CW29, CW31, CW32, CW33 and CW41 are presented on Figure 7.3-4 (see Figure 7.3-2 for location of these wells). Sulfate concentrations have been steady in Lower Chinle wells CW26, CW31 and CW41 over the last few years, while an increasing trend has been observed in water from wells CW29, CW32 and CW33. The data collected since mid-2003 was not available when the background level was calculated. The exceedance in sulfate values from wells CW32 and CW33 is thought to be natural.

7.3.2 TOTAL DISSOLVED SOLIDS – LOWER CHINLE

Figure 7.3-5 presents the total dissolved solids (TDS) concentrations in the Lower Chinle aquifer during 2004. All concentrations are less than the non-mixing zone value of 4140 mg/l except the value from well CW32. Concentrations are thought to naturally exceed this level farther down-gradient as shown by the cyan pattern. The TDS concentration naturally increases down-gradient due to the low permeability and correspondingly slow movement of water through this shale aquifer.

Figure 7.3-6 presents TDS concentrations for Upper Chinle wells 653, CW37, CW42 and CW43. TDS concentrations in these wells have been fairly steady. All of these concentrations are below the mixing-zone background level of 3140 mg/l.

TDS concentrations for wells CW26, CW29, CW31, CW32, CW33 and CW41 are presented on Figure 7.3-7. This figure demonstrates that, overall, TDS concentrations have remained fairly stable during the last few years. Additionally, these historical TDS concentrations are well within the range of natural fluctuation in the non-mixing zone of the Lower Chinle aquifer, except for two values from well CW32 and the outlier from well CW26.

7.3.3 CHLORIDE – LOWER CHINLE

Chloride concentration data in the Lower Chinle aquifer were updated during 2003 to confirm that restoration for this constituent is not necessary in the Lower Chinle aquifer. The chloride concentrations measured during 2004 continue to support this conclusion and are all less than the proposed NRC standard.

7.3.4 URANIUM – LOWER CHINLE

Uranium concentration in the Lower Chinle aquifer is an important constituent with respect to aquifer restoration in Section 3. Figure 7.3-8 presents the uranium concentrations in the Lower Chinle aquifer for 2004. Only three of the uranium concentrations in the Lower Chinle exceeded the mixing-zone background concentration, and three exceeded the non-mixing zone background concentration. The highest values are in the central portion of Section 3 in water collected from wells 538, 653 and CW42. These concentrations should gradually decrease to less than background concentrations with the continuing use of this water in the irrigation program.

Uranium concentrations plotted versus time for Lower Chinle wells 653, CW37, CW42 and CW43 are presented on Figure 7.3-9. The small decreases in uranium concentrations in well CW42 are due to the pumping of wells 538 and 653 to obtain a water supply for the irrigation system. This plot also shows an anomalously low uranium concentration in well 653 in early 2003. Uranium concentrations in wells CW37 and CW43 have stayed low.

The uranium concentrations in all of the Lower Chinle wells with data presented on Figure 7.3-10 have remained at low levels with a small increase in well CW29.

7.3.5 SELENIUM – LOWER CHINLE

Selenium concentrations in the Lower Chinle aquifer for 2004 are presented on Figure 7.3-11. Only the selenium concentrations in water from wells 653 and CW42 exceeded the mixing- zone site standard of 0.14 mg/l. The proposed non-mixing zone NRC site standard of 0.32 mg/l was not exceeded in any of the Lower Chinle wells.

Figure 7.3-12 presents selenium concentration versus time plots for wells 653, CW37, CW42 and CW43. The selenium concentrations in these Lower Chinle aquifer wells were fairly similar to levels observed in 2003.

Figure 7.3-13 presents selenium concentrations plotted versus time for Lower Chinle wells CW26, CW29, CW31, CW32, CW33 and CW41. Selenium concentrations measured during 2004 were consistent with the 2003 levels for each of these wells.

7.3.6 MOLYBDENUM – LOWER CHINLE

Molybdenum concentrations in water samples collected from the Lower Chinle wells in 2004 were all less than detection and, therefore, no areal molybdenum concentration figures or time plots were prepared. The 2004 results are consistent with historical measurements of molybdenum in the Lower Chinle aquifer. Molybdenum is not constituent of concern in the Lower Chinle aquifer.

7.3.7 NITRATE – LOWER CHINLE

Nitrate monitoring of the Lower Chinle aquifer was updated in 2003 to confirm that concentrations remain significantly below the proposed background levels of 15 mg/l for the mixing zone and 3.0 mg/l for the non-mixing zone. All nitrate concentrations measured in 2004 were significantly below these background levels except a nitrate concentration of 7.4 mg/l from well CW41 which is still below the level of a potential standard of 10 mg/l. A nitrate concentration figure was not developed and this constituent does not warrant routine monitoring in the Lower Chinle aquifer.

Plots of nitrate concentrations versus time were not prepared, because historically, values measured in Lower Chinle wells contained very low concentrations, similar to those measured in 2004. Nitrate concentrations are not expected to be significant in the future in the Lower Chinle aquifer due to the very limited extent of elevated concentrations in the alluvial aquifer and establishment of a site standard for nitrate in the Lower Chinle aquifer is not warranted.

7.3.8 RADIUM-226 AND RADUIM-228 – LOWER CHINLE

All radium concentrations have been low in past years in the Lower Chinle aquifer. Radium is not an important parameter relative to the Lower Chinle aquifer and an NRC site standard for radium for the Lower Chinle is not warranted. Radium concentrations were analyzed in all Lower Chinle wells in the 2003 update. All radium values measured in 2004 were less than the detection limit, except a radium-228 value of 0.8 pCi/l in well 539. These low levels of radium do not warrant the development of a figure presenting areal distribution of radium. Radium-228 analysis is typically more erratic than other constituents but the available data shows that radium-226 and radium-228 are not significant constituents in the Lower Chinle aquifer at the Homestake site and site standards for these two constituents are not needed for the Lower Chinle aquifer.

7.3.9 VANADIUM - LOWER CHINLE

Vanadium concentrations have always been low in the Lower Chinle aquifer. Significant concentrations in the Lower Chinle aquifer would not be expected because concentrations of this constituent have only been slightly elevated in the alluvial aquifer near the tailings. Vanadium concentrations in the Lower Chinle aquifer have never been large enough to support consideration of this constituent as a site standard. The vanadium concentration data was updated in 2003 for the Lower Chinle aquifer. All the measured vanadium concentrations were less than the limit of detection. A vanadium site standard for the Lower Chinle aquifer is not warranted based on all historical and current data.

7.3.10 THORIUM-230 – LOWER CHINLE

Thorium-230 concentrations have never been significant in the Lower Chinle aquifer and, therefore, should be dropped from the Lower Chinle monitoring list and eliminated from consideration as a Lower Chinle standard. The thorium-230 concentrations measured in the Lower Chinle aquifer during 2003 were all less than the proposed background levels of 0.97 and 0.72 pCi/l for the mixing and non-mixing zones, respectively. No plots of thorium-230 concentrations with time were prepared, because concentrations have historically been low.

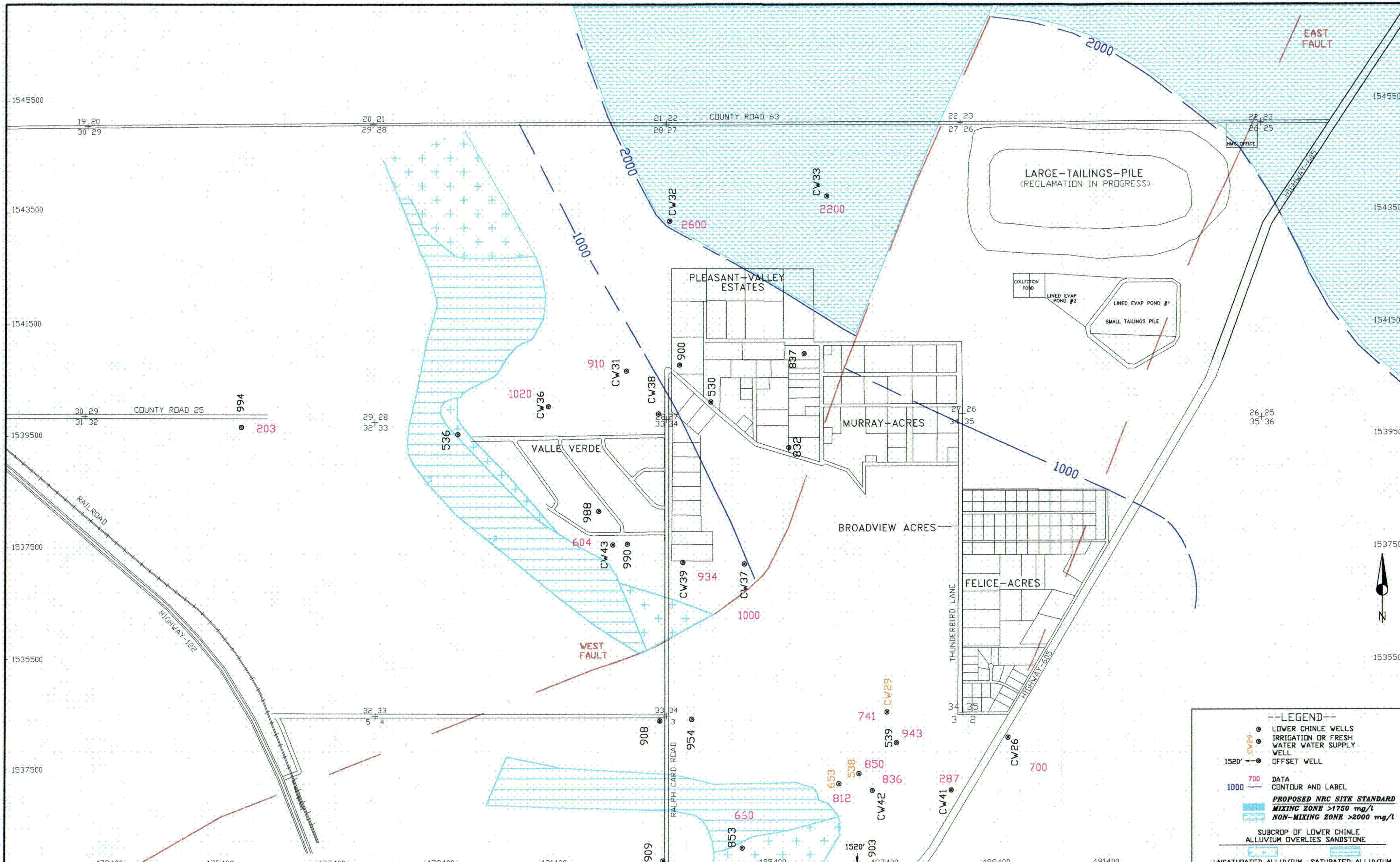

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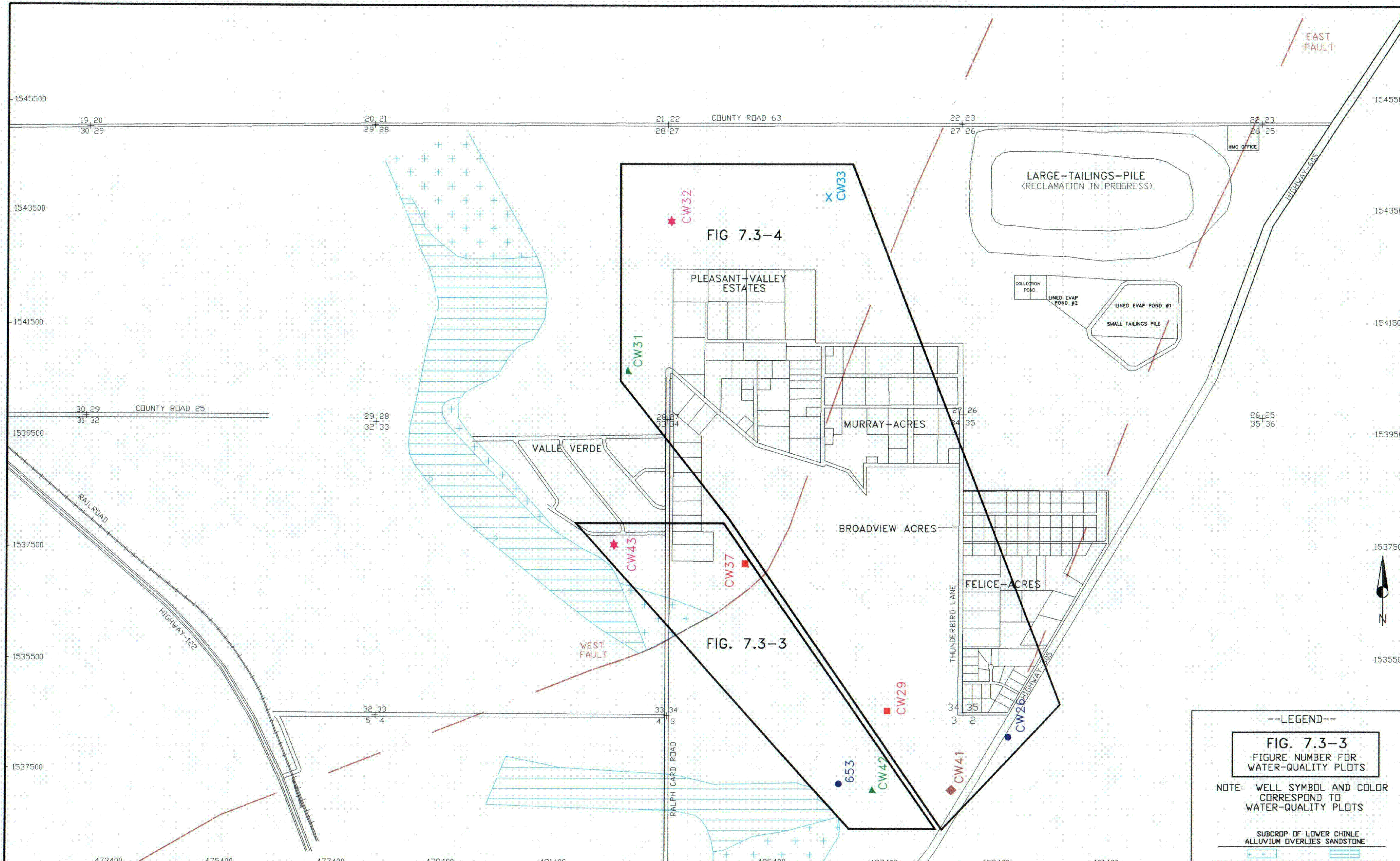
FIGURE 7.3-1 SULFATE CONCENTRATIONS OF THE LOWER CHINLE AQUIFER, 2004, mg/l

C159



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HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
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FIGURE 7.3-2. LOCATION OF LOWER CHINLE WELLS WITH WATER-QUALITY PLOTS

C160

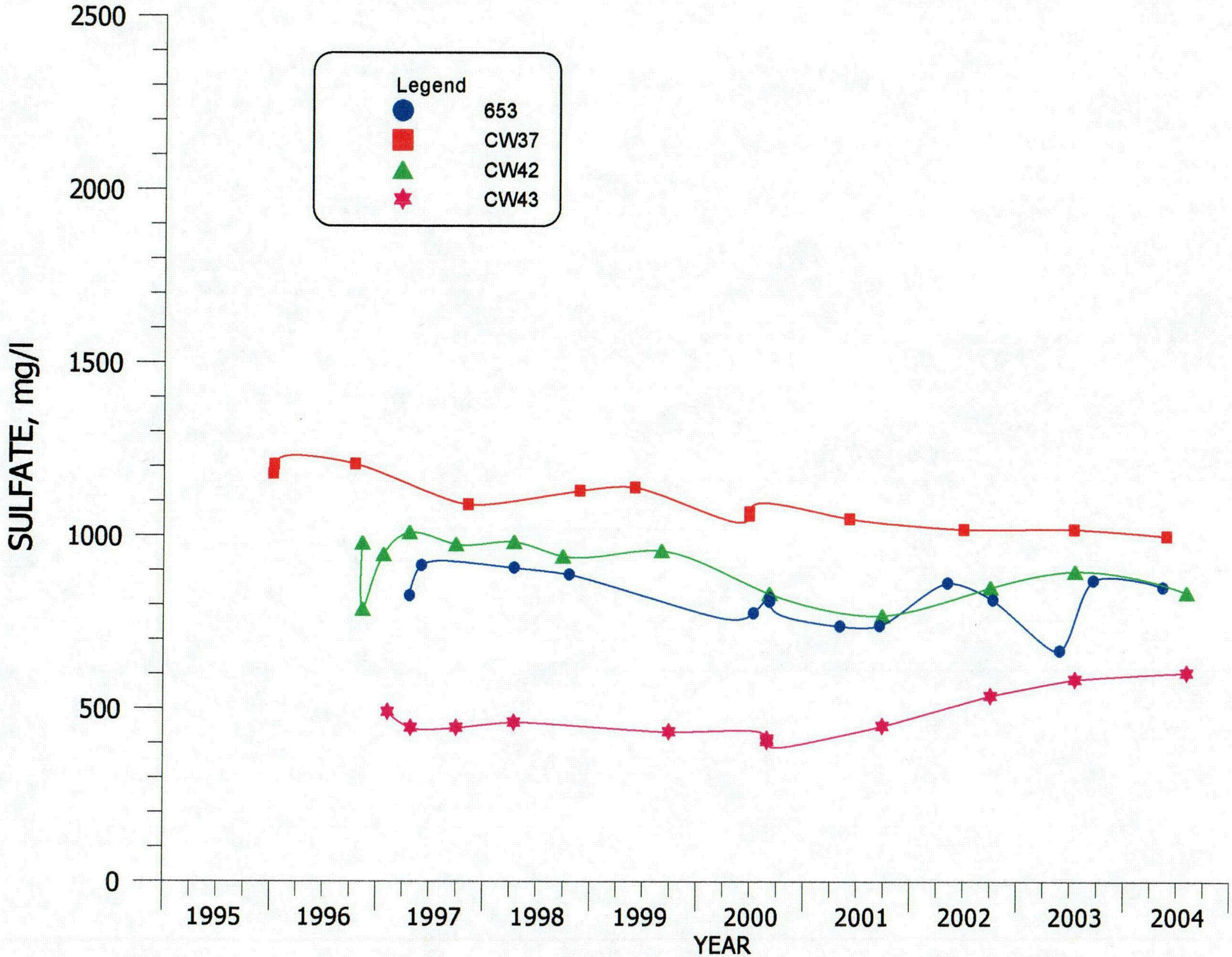


FIGURE 7.3-3. SULFATE CONCENTRATIONS FOR MIXING ZONE WELLS 653, CW37, CW42 AND CW43.

C161

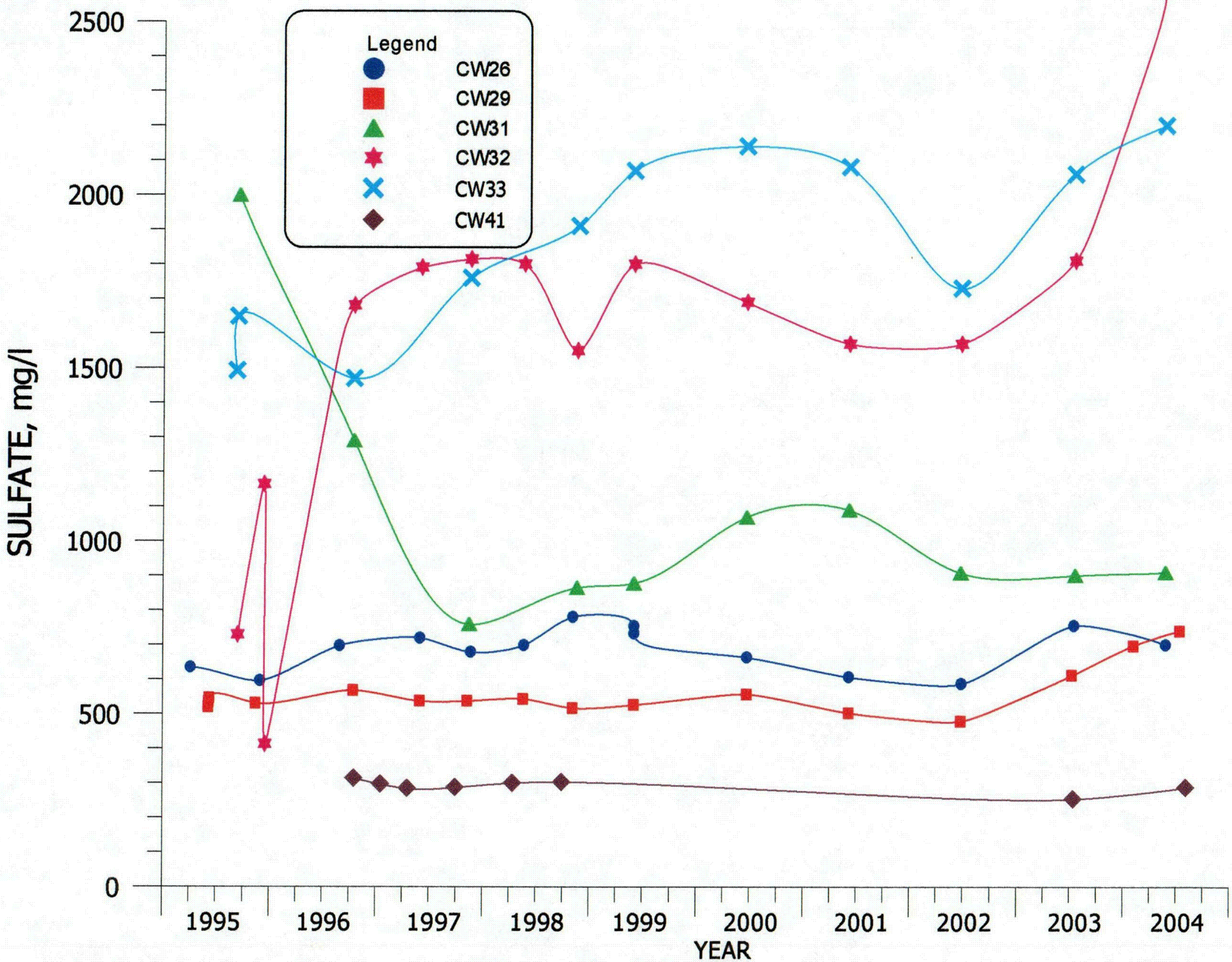
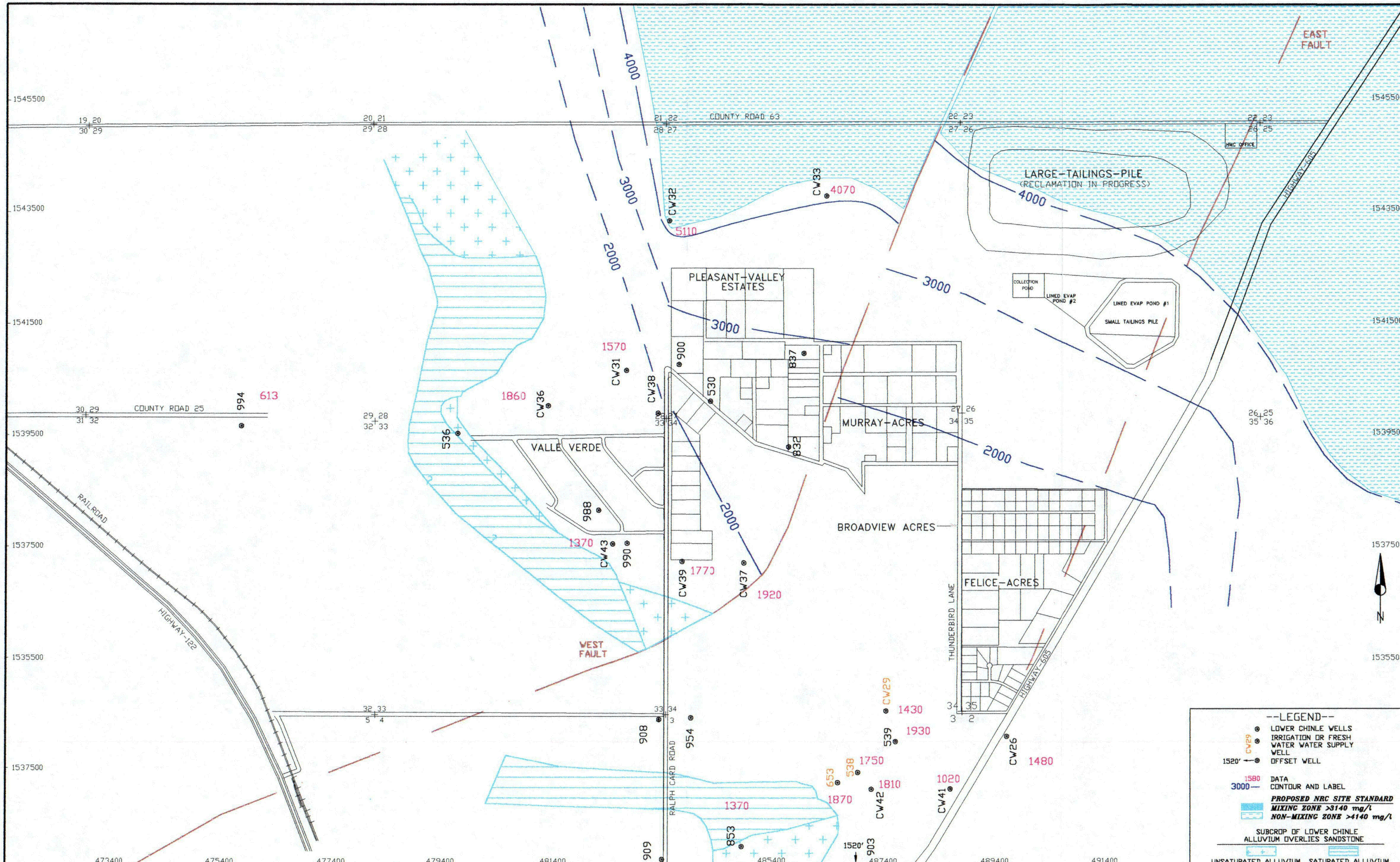


FIGURE 7.3-4. SULFATE CONCENTRATIONS FOR NON-MIXING ZONE WELLS CW26, CW29, CW31, CW32, CW33 AND CW41.

C162



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HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
GRANTS-NM-TOWNSHIP-11&12-N-RANGE-10-W

FIGURE 7.3-5. TDS CONCENTRATIONS OF THE LOWER CHINLE AQUIFER, 2004, mg/l

C163

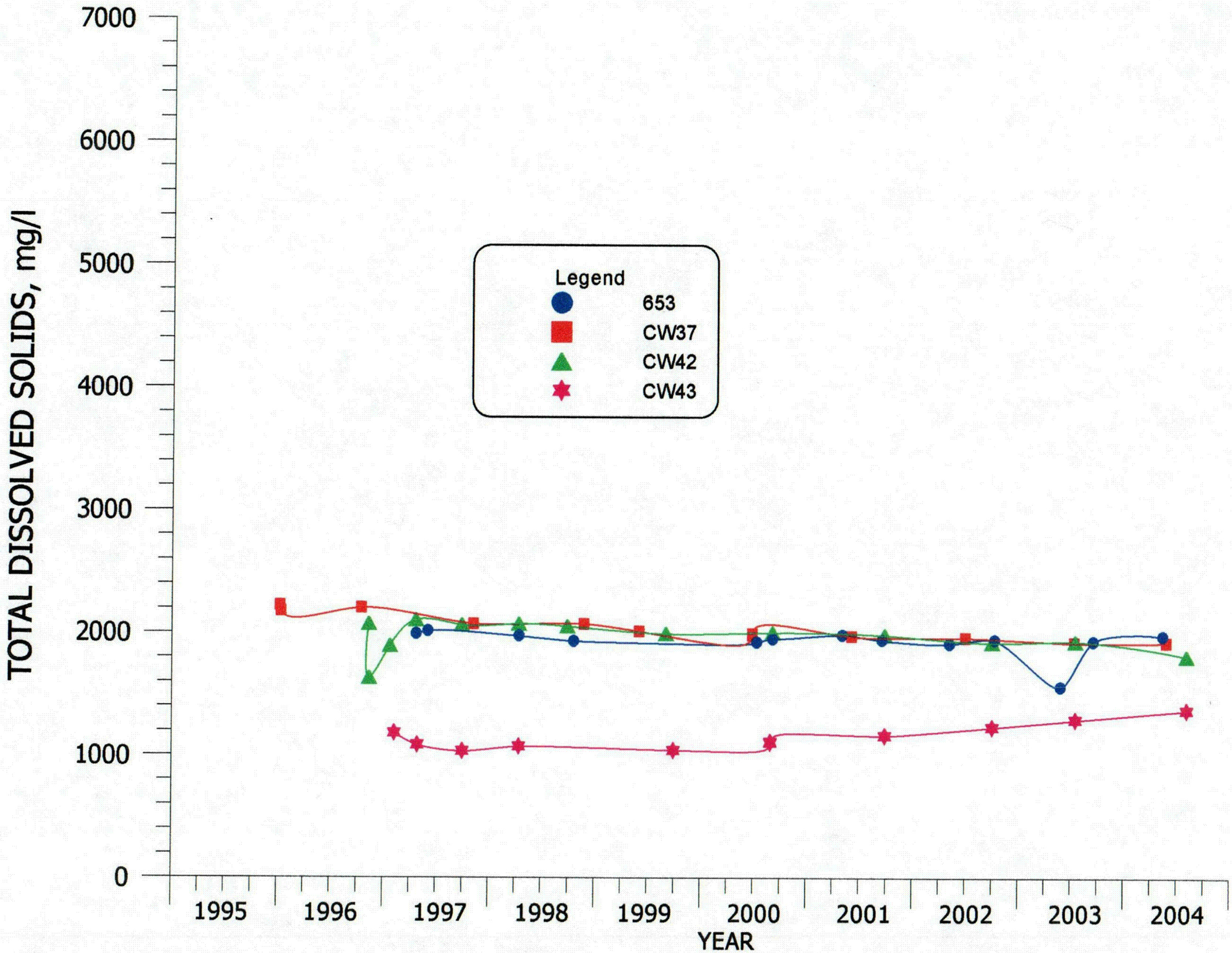


FIGURE 7.3-6. TDS CONCENTRATIONS FOR MIXING ZONE WELLS 653, CW37, CW42 AND CW43.

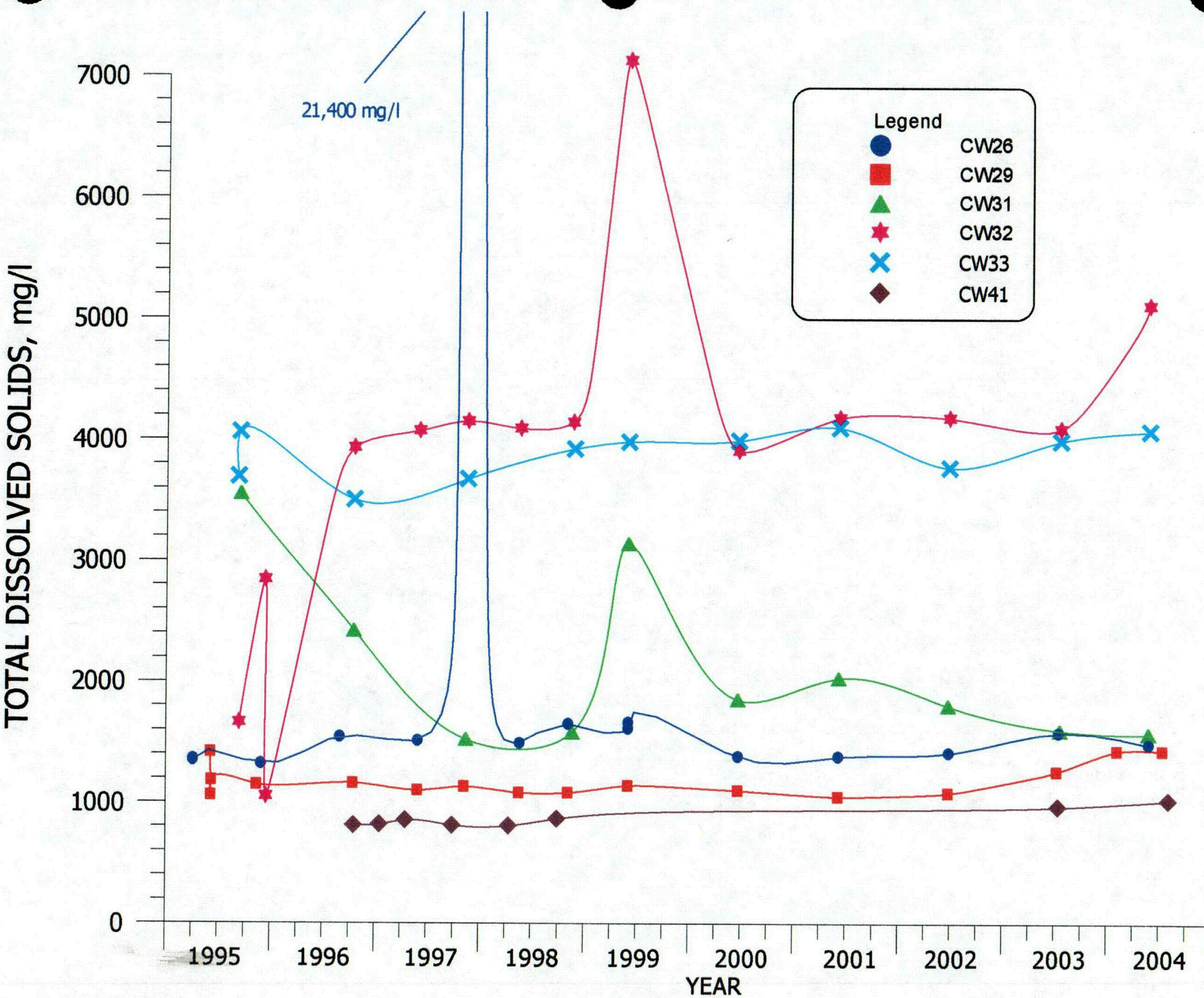
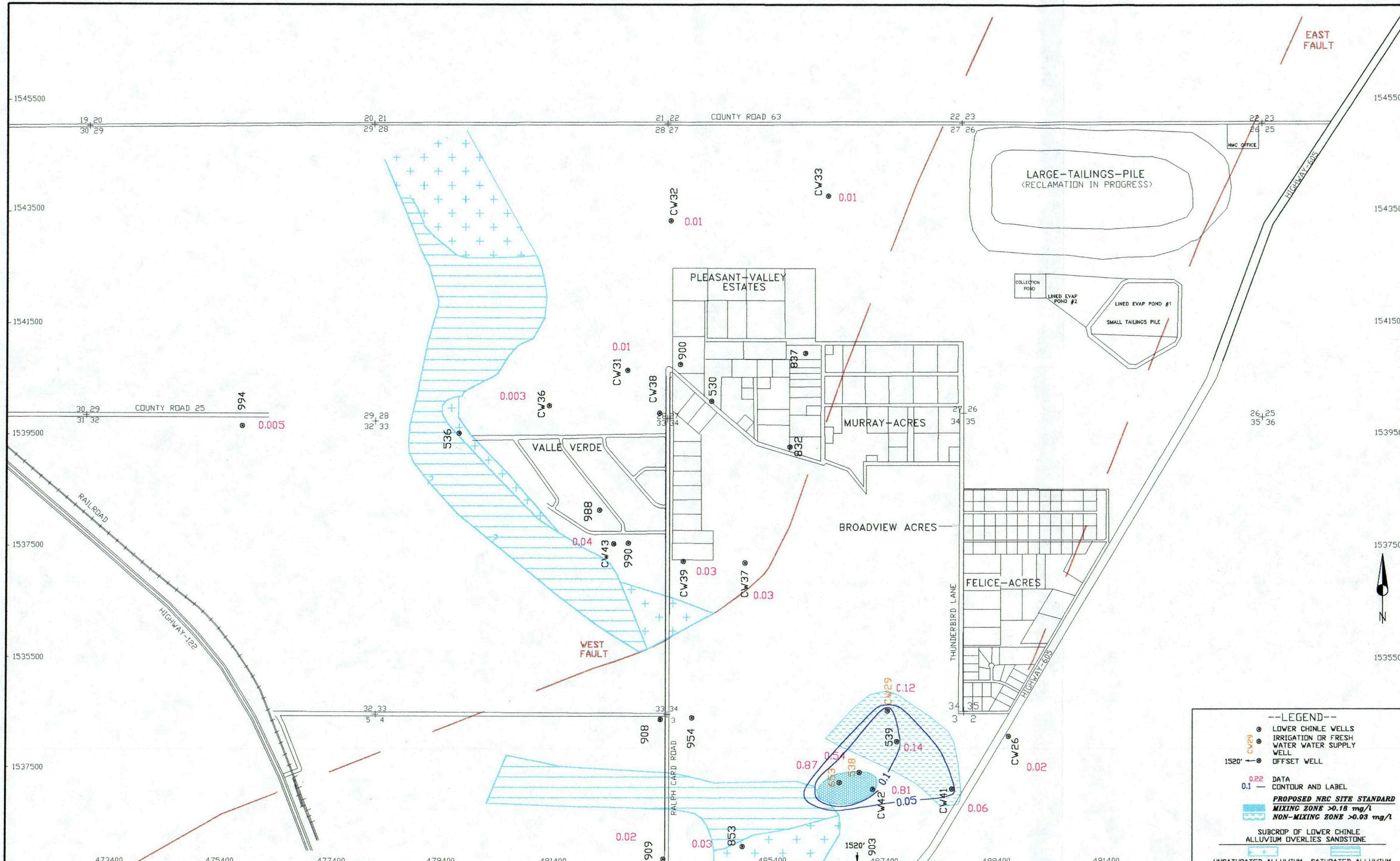


FIGURE 7.3-7. TDS CONCENTRATIONS FOR NON-MIXING ZONE WELLS CW26, CW29, CW31, CW32, CW33 AND CW41.

C166



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HOMESTAKE-MILL-AND-ADJACENT-PROPERTIES
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FIGURE 7.3-8. URANIUM CONCENTRATIONS OF THE LOWER CHINLE AQUIFER, 2004, mg/l

C167

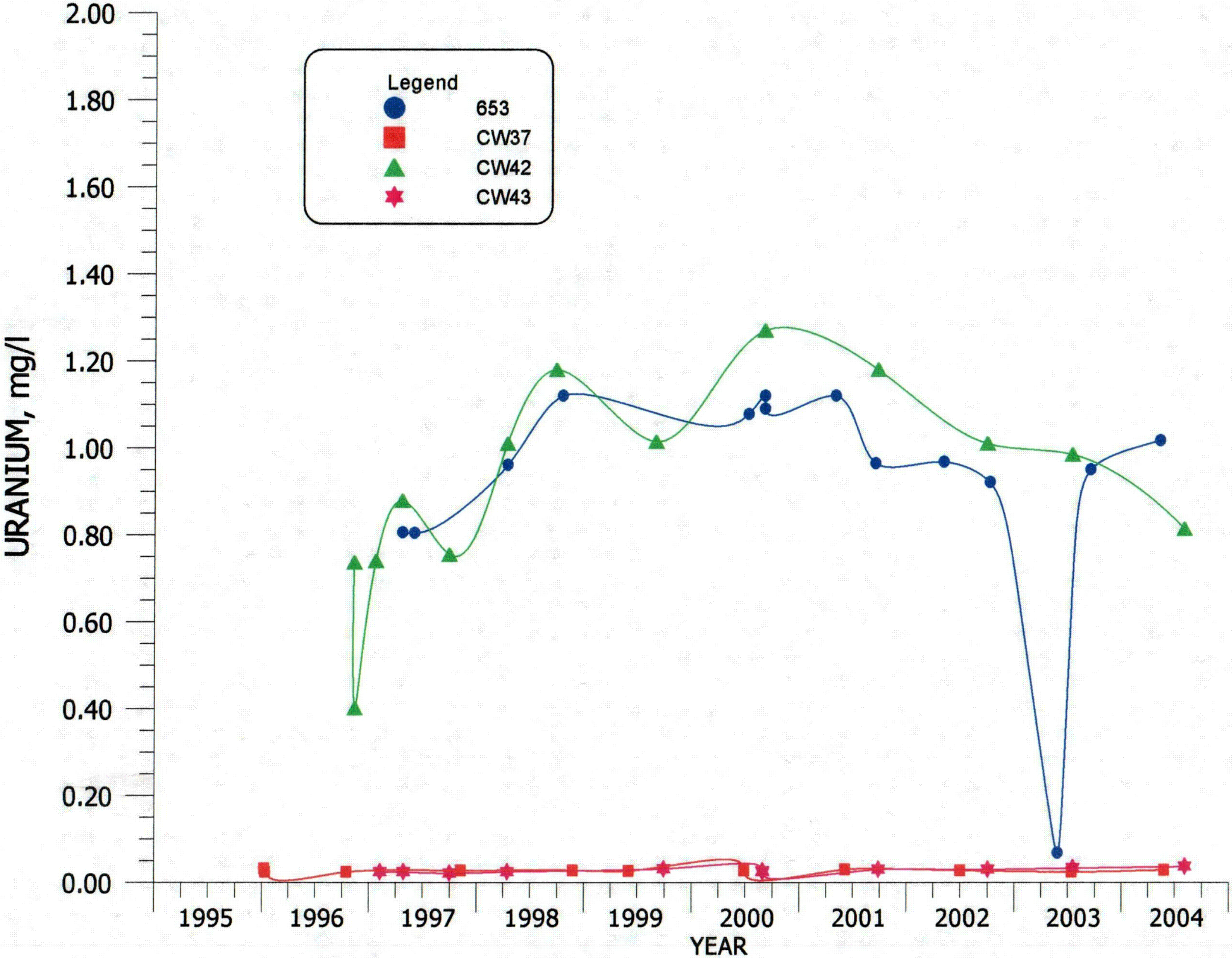

FIGURE 7.3-9. URANIUM CONCENTRATIONS FOR MIXING ZONE WELLS 653, CW37, CW42 AND CW43.

C168

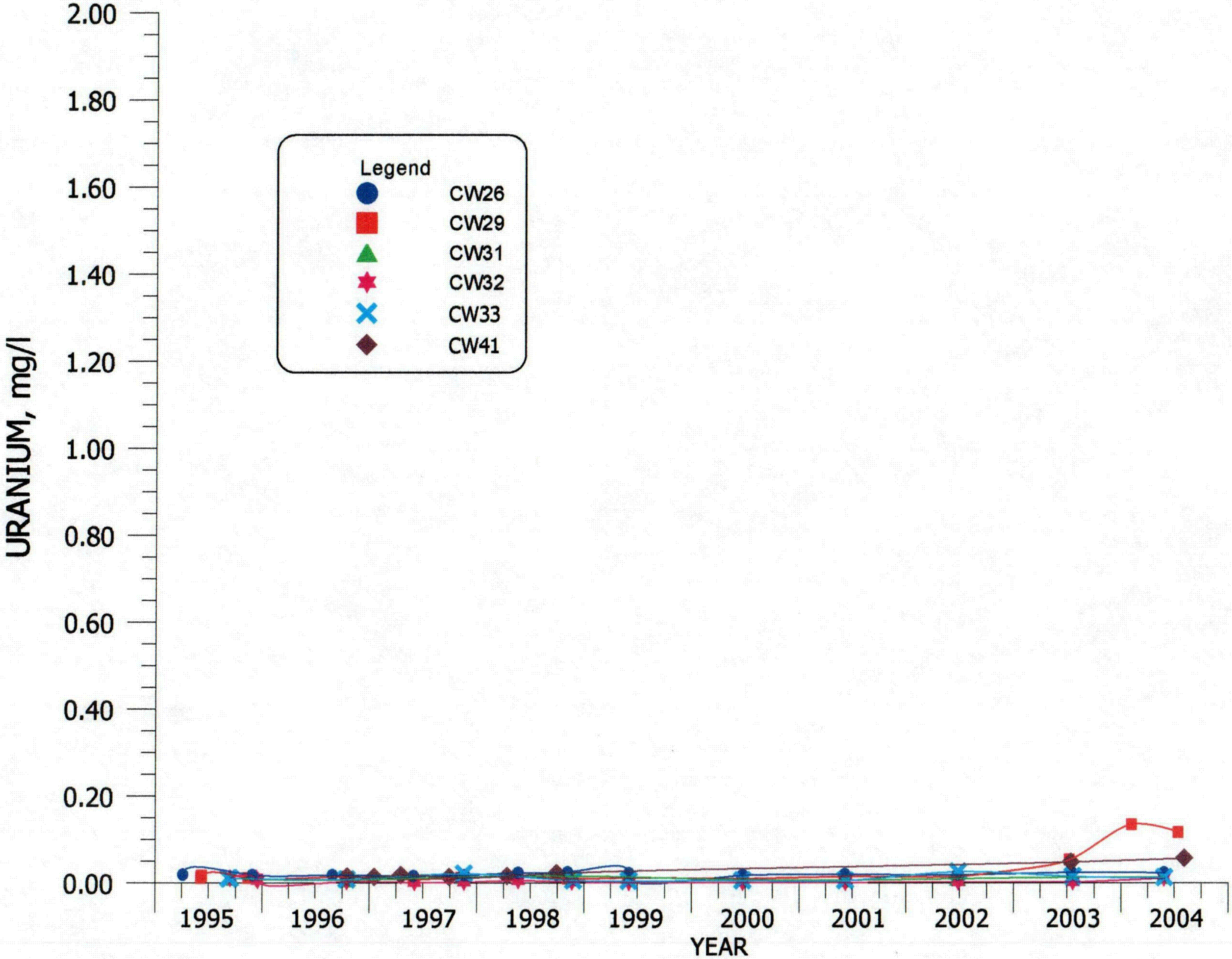

FIGURE 7.3-10. URANIUM CONCENTRATIONS FOR NON-MIXING ZONE WELLS CW26, CW29, CW31, CW32, CW33 AND CW41.

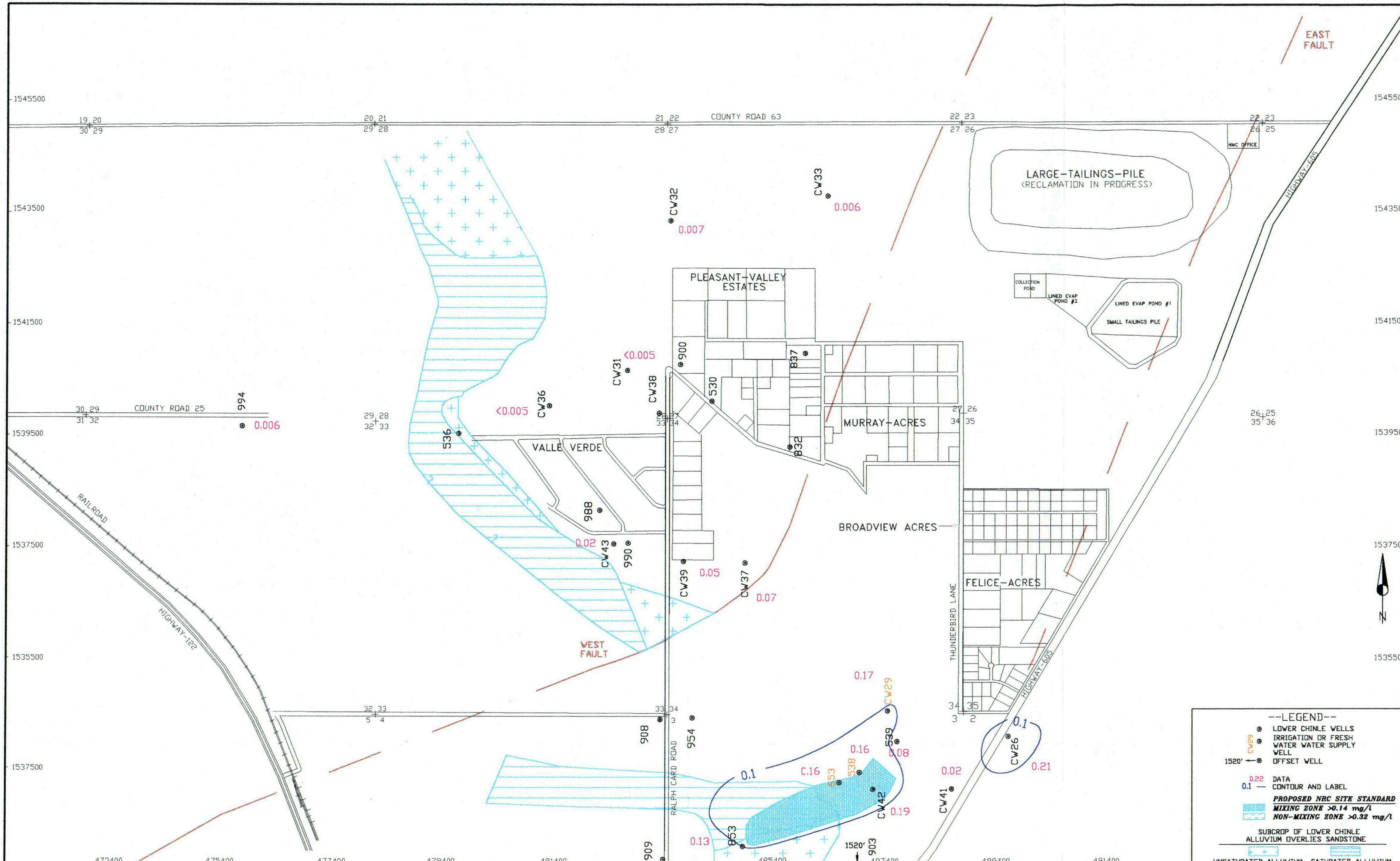

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FIGURE 7.3-11. SELENIUM CONCENTRATIONS OF THE LOWER CHINLE AQUIFER, 2004, mg/l

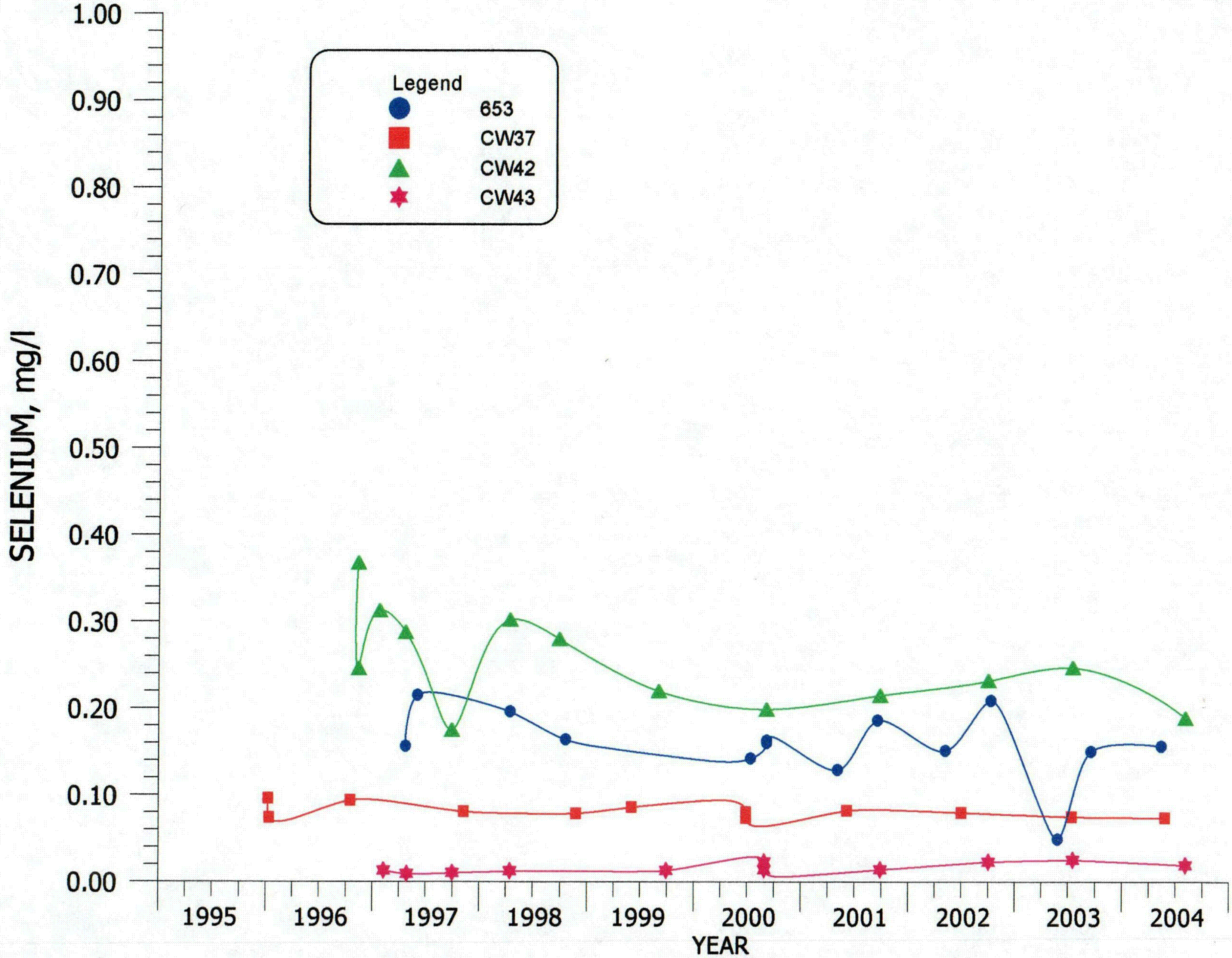

FIGURE 7.3-12. SELENIUM CONCENTRATIONS FOR MIXING ZONE WELLS 653, CW37, CW42 AND CW43.

C171

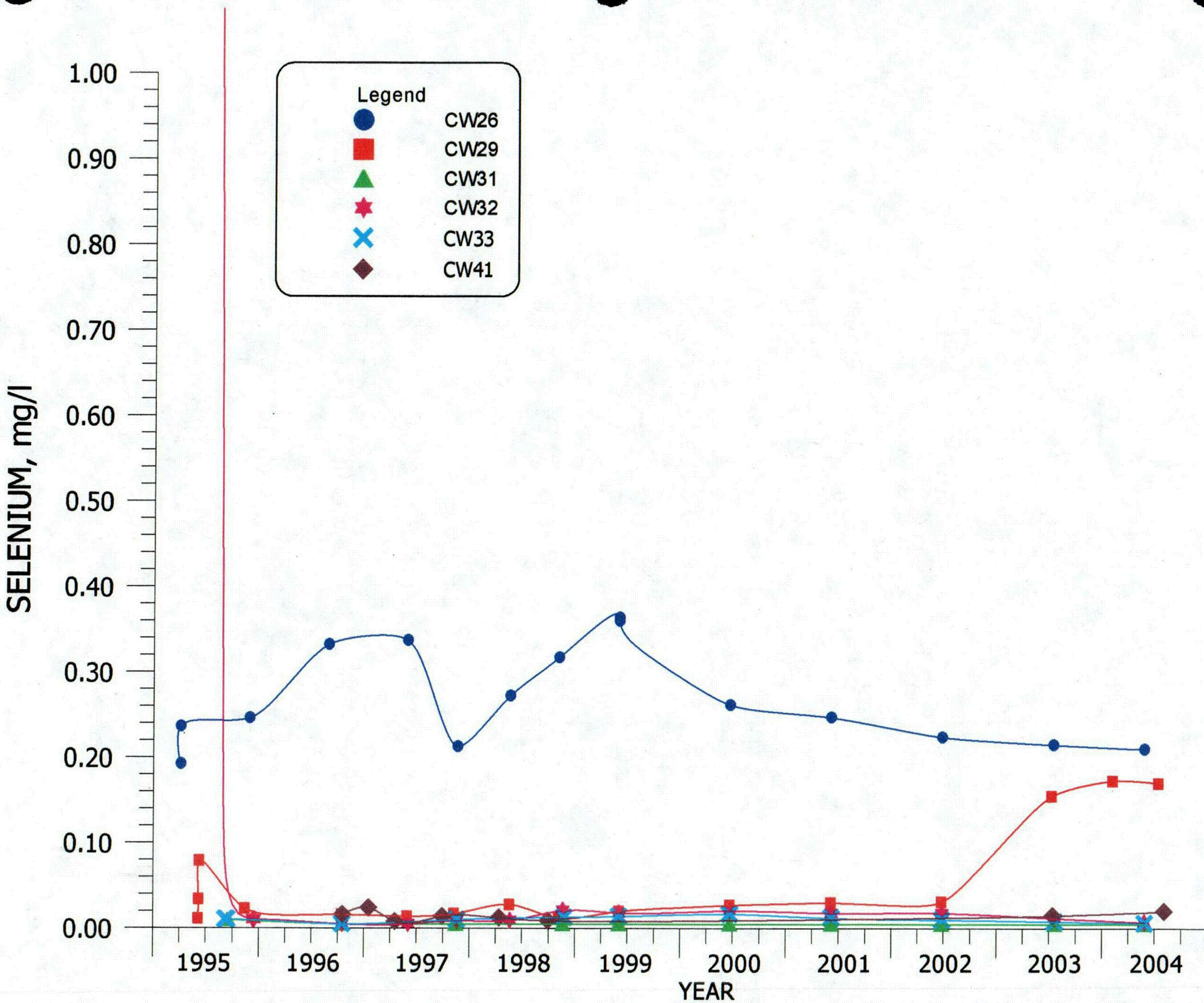

FIGURE 7.3-13. SELENIUM CONCENTRATIONS FOR NON-MIXING ZONE WELLS CW26, CW29, CW31, CW32, CW33 AND CW41.

C172