4.0 Ground-Water Quality

Monitoring ground-water quality in the irrigated area is a very important part of assessing the effects of the irrigation program. Additional monitoring wells have been added to the Section 33 and Section 34 areas for additional ground-water monitoring. The present ground-water monitoring program in Section 28 is adequate. This ground-water monitoring is being used to determine if the irrigation program has any measurable impact on the ground-water system.

4.1 Section 34

The Section 34 irrigation consists of 120 acres of flood irrigation in the northeastern portion in Section 34. This irrigation extends slightly into the other 3 quarters of Section 34 as shown in Figure 4-1. New ground-water monitoring wells 555, 556 and 557 were added in 2010. Existing monitoring wells 844, 845 and 846 have been used to monitor the ground-water quality in this area (see Table 4-1 for well data). Figure 4-1 shows that a zero saturation zone for the alluvial aquifer exists to the south of the Section 34 irrigation area, and alluvial ground-water in this area is forced to move toward the west. The alluvial aquifer exists in the northern portion of Section 3 to the south of the Section 34 irrigation but these two areas are only connected around the zero saturation boundary to the east of Felice Acres.

Table 4-1. Existing and New Section 34 Well Data

WELL NAME	NORTH. COORD.	EAST COORD.	WELL DEPTH (FT-MSP)	CASING DIAM. (IN)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MSP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD	MP ELEV. (FT-MSL)	DEPTH TO BASE OF ALLUVIUM	ELEV. TO BASE OF ALLUVIUM		CASING PERFORA TIONS	SATURATED THICKNESS
						EXISTING ALLUVIAL WELLS								
844	1538376	487002	75	4	8/13/2008	35.28	6520.85	1.2	6556.13	70	6484.9	A	35-75	35.9
845	1537280	487833	65	4	12/1/2008	36.54	6520.51	1.7	6557.05	55	6500.4	A	45-65	20.2
846	1537219	484730	75	4	12/3/2008	45.58	6503.34	0.8	6548.92	65	6483.1	A	40-65	20.2
						NEW ALLUVIAL WELLS								
555	1538575	486249	80	5	—	44	6513	2	6557	80	6477	A	60-80	36
556	1537722	485957	80	5	—	45	6511	2	6556	78	6478	A	60-80	33
557	1537235	485729	70	5	—	47	6509	2	6556	70	6486	A	50-70	23

4.1.1 Sulfate Concentrations

The sulfate concentrations for 1999 and 2010 for the alluvial aquifer in Section 34 are presented in Figure 4-1. The red contour shows the 1999 sulfate concentrations with concentrations exceeding 1000 mg/l in the western portion of the Section 34 Flood area. The 2010 sulfate concentrations are listed adjacent to each of the monitoring wells. The 1000 contour exists in the area near alluvial monitoring wells 844 and 845 and extends to the western edge of section 34.

The sulfate concentrations in alluvial wells 844 and 845 prior to the start of the irrigation in 2000 were gradually declining with time while sulfate concentrations in monitoring well 846 were gradually increasing with time prior to the start of the irrigation program (see Figure 4-2).

Sulfate concentrations in well 844 and 845 have since exhibited a general increase during the period of irrigation, but their concentrations are significantly less than concentrations that were observed prior to the mid-1990s. Overall sulfate concentrations in monitoring well 846 have increased during the operation of the irrigation program. Sulfate concentrations in monitoring wells 844 and 845, which are adjacent to the flood irrigation area were approximately 1,000 mg/l in 2010. The sulfate concentrations are not likely to be affected by the Section 34 flood irrigation but more likely to have been affected by the changes in the restoration program to the east of this area. The higher sulfate concentrations in well 846 are not thought have been influenced at all by the irrigation in Section 34.

4.1.2 TDS Concentrations

The TDS concentrations for 1999 and 2010 are shown on the alluvial aquifer in Section 34. The red contour shows the TDS concentrations in 1999 and the blue contour shows the TDS concentrations in Section 34 in 2010. The width of the zone where the TDS concentrations exceed 2000 mg/l has increased from 1999 to 2010. A light green pattern is shown on Figure 4-3 where concentrations exceed the site standard of 2,734 mg/l. The TDS patterns versus time have shown fairly similar patterns to those of sulfate concentrations (see Figure 4-4). The TDS concentrations of monitoring wells 844 and 845 were 2610 and 2180 mg/l in late 2010. It is difficult to say whether these TDS concentrations have been affected by the Section 34 irrigation. It is more likely the changes in TDS concentrations in these two wells are due to changes in concentrations to the east of these wells. TDS concentrations in monitoring well 846 have become fairly steady over the last few years, which indicates the irrigation in Section 34 has not affected well 846.

4.1.3 Chloride Concentrations

The chloride concentrations for 1999 and 2010 are presented in Figure 4-5 for the alluvial aquifer in this area. The chloride concentration in alluvial well 844 exceeded 200 in 1999 and still exceeds that level in 2010. Additional areas of chloride concentrations to the east and upgradient of this area had values above 200 mg/l in 1999 also. The 200 mg/l TDS contour in 2010 now extends from monitoring wells F, GH, 844 and 845 over to west of monitoring well 846.

Figure 4-6 shows the chloride concentrations for monitoring wells 555, 556, 557, 844, 845 and 846. This figure shows chloride concentrations in 2010 for each of these wells. These chloride concentrations are similar to the freshwater injection concentration and are thought to be due to the freshwater injection that occurred to the east of this area. The chloride concentrations in monitoring wells 844 and 845 have been relatively steady during the operation of the Section 34 flood irrigation. Chloride concentrations have increased since 2000 in monitoring well 846. This increase is thought to be due to the alluvial ground-water moving to the west and not a function of the irrigation program.

4.1.4 Uranium Concentrations

Figure 4-7 presents the 1999 and 2010 uranium concentrations in the alluvial aquifer. This figure shows the concentrations are fairly similar in 1999 and 2010 in the Section 34 irrigation area. Changes in uranium concentration have been small during the irrigation period.

Figure 4-8 presents the uranium concentrations versus time for wells 844, 845 and 846. This shows fairly small uranium concentrations changes with a slight increase in 2004 in well 844. This small increase could be due to higher levels moving into this area or it could be due to the Section 34 irrigation. The fact that uranium concentrations in well 844 have been relatively steady since 2004 likely indicates that the increase in 2004 resulted from ground-water movement caused by the restoration program rather than an ongoing contribution from the irrigation program.

4.1.5 Selenium Concentrations

The selenium concentrations for 2010 are presented in Figure 4-9 for the alluvial aquifer in the area of the Section 34 irrigation. Selenium concentrations were all less than 0.1 mg/l in 1999 in the irrigation area and are presently 0.1 mg/l or less. Figure 4-10 presents the selenium concentrations showing an increase in selenium concentrations in 2001 and 2003 in wells 844 and 845, respectively. An increase in selenium concentrations was observed in well 846 starting in 1996. The selenium concentrations are thought to be caused by variations in water coming into this area but the small increases in wells 844 and 845 could plausibly be a result of the irrigation program.

4.1.6 Molybdenum Concentrations

The molybdenum concentrations for 2010 are presented in Figure 4-11 for the Section 34 area. All of these concentrations are less than 0.03 mg/l. Concentrations in 1999 were similar in this area. Figure 4-12 shows the molybdenum concentrations versus time and shows that these concentrations have been low since the start of irrigation in 2000.

4.1.7 Nitrate Concentrations

The nitrate concentrations are presented in Figures 4-13 and 4-14. Nitrate concentrations have stayed fairly steady and low in wells 844 and 845 during the irrigation operation. The nitrate concentrations in well 846 were on a significant increasing trend prior to irrigation and this trend has continued. Because the increasing trend predates irrigation, these changes are not thought to be a function of the irrigation program.

4.2 Section 28

The Section 28 area has consisted of 60 acres of center pivot irrigation from 2002 through 2004, and, after expansion of the center pivot area, 100 irrigated acres from 2005 through 2009. Figure

4-15 shows the location of the 100 acre center pivot. Numerous monitoring wells exist in this area and have been used to define the water quality changes with time (see Table 4-2).

Table 4-2. Section 28 Monitoring Well Data

WELL NAME	NORTH. COORD.	EAST COORD.	WELL DEPTH (FT-MSP)	CASING DIAM. (IN)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MSP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD	MP ELEV. (FT-MSL)	DEPTH TO BASE OF ALLUVIUM	ELEV. TO BASE OF ALLUVIUM		CASING PERFORATIONS	SATURATED THICKNESS
					EXISTING ALLUVIAL WELLS									
633	1541467	479642	83	8	12/10/2009	73.33	6484.23	0	6557.56	95	6462.6	A	Nov-83	21.7
634	1541652	480362	103	4.5	12/10/2009	70.21	6489.86	2.8	6560.07	95	6462.3	A	80-100	27.6
654	1541994	478636	120	4.5	12/10/2009	72.78	6477.72	1.4	6550.5	106	6443.1	A	60-120	34.6
655	1541620	479830	96	8	12/14/2009	72.61	6485.57	—	6558.18	88	—	A	21-84	—
656	1542578	478333	88	8	10/23/2007	75.1	6478.97	—	6554.07	88	—	A	6-88	—
659	1541689	480772	101	4.5	12/10/2009	69.58	6490.59	2	6560.17	97	6461.2	A	61-101	29.4
680	1543850	478746	80	4.5	10/25/1996	77.39	6481.48	2	6558.87	75	6481.9	A	50-80	0
681	1540676	482734	117	6	9/24/1998	64.18	6496.34	2.1	6560.52	111	6447.4	A	67-117	48.9
684	1540273	478499	143	6	10/20/2009	87.34	6465.94	2	6553.28	118	6433.3	A	83-143	32.7
688	1541257	483955	105	5	12/14/2009	60.92	6501.7	2.9	6562.62	95	6464.7	A	65-105	37
881	1542034	481478	96	4.5	12/10/2009	73.26	6491.78	2.0	6565.04	103	6460	A	76-96	31.7
882	1541404	482396	110	4.5	11/18/2008	68.21	6492.95	2.0	6561.16	95	6461.2	A	70-110	31.7
883	1540097	483039	100	5	12/14/2009	62	6495.13	1.9	6557.13	96	6459.3	A	60-90	35.9
884	1542677	481498	90	5	6/22/2009	74.66	6491.44	1.0	6566.1	85	6480.2	A	58-88	11.3
885	1541919	483474	100	5	12/10/2009	65.25	6499.39	1.5	6564.64	95	6468.1	A	70-100	31.3
886	1542327	482487	90	5	12/10/2009	68.78	6495.77	1.5	6564.55	87	6476.1	A	60-90	19.7
887	1543063	482469	67	5	6/16/2009	57.54	6510.19	1.5	6567.73	60	6506.2	A	42-67	4
888	1542285	479335	105	5	12/10/2009	75.7	6481.63	1.1	6557.33	90	6466.2	A	75-105	15.4
889	1540047	480222	65	5	10/24/1996	63.31	6486.32	1.5	6549.63	60	6488.2	A	35-65	0
890	1541365	480088	101	5	12/10/2009	72.87	6485.56	1.7	6558.43	93	6463.7	A	81-101	21.8
893	1541934	482244	98	4.5	12/8/2008	70.1	6493.87	2.1	6563.97	93	6468.9	A	78-98	25
M16	1543252	485112	93.3	5	12/10/2009	61.54	6509.05	1.4	6570.59	100	6469.2	A	60-100	39.9
MO	1543620	485518	88	4.5	12/10/2009	63.48	6509.41	2	6572.89	80	6490.9	A	45-85	18.5
MR	1542609	483574	100	5	12/10/2009	65.97	6500.29	1.8	6566.26	100	6464.5	A	54-94	35.8
MS	1542607	485570	82	5	12/10/2009	61.25	6509.42	1.5	6570.67	89	6480.2	A	52-82	29.3
MT	1543221	483531	98	4.5	10/14/2009	55.04	6512.39	2.3	6567.43	87	6478.1	A	34-94	34.3
MV	1542618	484418	105	4.5	12/8/2008	67.55	6502.23	1.3	6569.78	95	6473.5	A	75-105	28.7

4.2.1 Sulfate Concentrations

Figure 4-15 shows the sulfate concentrations for 1999 and 2010. The 1000 mg/l contour exists along the central portion of Section 28 during 1999. The 1000 sulfate contour does not exist in this area of Section 28 in 2010 and has retreated to the western edge of Section 27 in 2010.

The sulfate concentration plots for wells 654, 659, 881, 886, 888 and 890 are shown on Figure 4-16. This figure shows that the sulfate concentrations were decreased significantly in monitoring wells 654 and 888 in 2004 and 2005. These two wells are located in the western portion of Section 28 and show the reduction of the western edge of the sulfate concentrations in Section 28. Sulfate concentrations have steadily declined in 2007 through 2009 in irrigation supply well 886 near the center of the Section 28 Pivot with a small increase in 2010. Sulfate concentrations overall have been fairly steady in wells 659, 881 and 890.

4.2.2 TDS Concentrations

TDS concentrations for the alluvial aquifer in Section 28 are presented in Figure 4-17 and show a reduction within the 2000 mg/l contour area which extended west of Section 28 in 1999, and extends only a short distance into Section 28 in 2010. Figure 4-18 shows similar declines in TDS concentrations in wells 654, 886 and 888 as those observed for sulfate concentrations. A small decline has been observed in wells 659, 881 and 890 during the operation of irrigation in Section 28.

4.2.3 Chloride Concentrations

The chloride concentrations in Section 28 are presented in Figure 4-19 for 1999 and 2010. The chloride concentrations have been fairly similar between these two periods except for the declines that have occurred in wells 654, 886 and 888 due to the freshwater injection in this area (see Figure 4-20).

4.2.4 Uranium Concentrations

The uranium concentrations for the alluvial aquifer in Section 28 are presented in Figure 4-21. This figure shows a green pattern which is the area where concentrations exceed the site standard of 0.16 mg/l in 2010. The 1999 0.1 mg/l contour extends further to the north and south of the area than in the more recent 2010 contour which reflects the eleven-year period of off-site operation. Figure 4-22 shows the decrease in concentrations that have been observed in monitoring wells 654, 886 and 888. A small increase in uranium concentrations in irrigation supply well 881 has been observed in the last four years. This increase is thought to be due to ongoing ground-water migration rather than being a function of the irrigation program because the concentration trends in other wells indicate no measurable impacts.

4.2.5 Selenium Concentrations

Figure 4-23 presents the 1999 and 2010 selenium concentrations for the Section 28 area. The selenium concentration contour of 0.1 mg/l extended to the western edge of Section 28 in 1999 and has retreated to the point where it does not extend to the eastern edge of Section 28 in 2010.

Figure 4-24 presents the selenium concentration time plot for the Section 28 monitoring wells. This plot shows a decline in the selenium concentrations in wells 654, 886 and 888. Some increase in selenium concentrations has also been observed in the last four years in well 881. Selenium concentrations in irrigation wells 659 and 890 are presently fairly similar to those observed prior to the start of the irrigation.

4.2.6 Molybdenum Concentrations

The molybdenum concentrations for the alluvial aquifer are presented in Figure 4-25. This area shows very low molybdenum concentrations except for small values in irrigation supply wells 634, 659, 881 and 886. Figure 4-26 shows that these molybdenum concentrations have been small in the past with a small increase in 2009 and 2010 in well 881. These small molybdenum concentrations in Section 28 are likely from the movement of alluvial water from Section 27 into this area. Figure 5-26 shows the molybdenum concentration in 2010 exceeded 0.1 mg/l to the east of Section 28 in Section 27. This higher molybdenum concentration likely caused the increase in the molybdenum concentration in the alluvial aquifer in the Section 28 Center Pivot area. It is very unlikely that the molybdenum concentrations in the Section 28 area have been affected by the application of water to the irrigation area.

4.2.7 Nitrate Concentrations

The nitrate concentrations in 1999 exceeded 10 mg/l in the northern portion of the Section 28 Center Pivot area adjacent to the zero saturation boundary (see Figure 4-27). The nitrate concentrations exceeded 10 mg/l into the western half of Section 27 in 2010. Figure 4-28 presents the nitrate concentrations with time and shows very small changes in nitrate concentrations except for the decrease in wells 888 and 886.

4.3 Section 33

Section 33 has the 150 acre center pivot and 24 acres of flood area. The 24 acre flood area is typically included in the Section 34 analysis because the soil properties in the Section 33 flood area are similar to those in the Section 34 flood area. However, the ground-water evaluation for the Section 33 flood is included in the Section 33 ground-water evaluation. Figure 4-29 shows the location of the 3 new monitoring wells; 551, 553 and 554. These wells were added in 2009 to further define the ground-water concentrations in this area. Wells 551, 553, 554, 647, 649, 657 and 658 are used in evaluating the ground-water concentrations adjacent to the 150 acre center pivot while alluvial well 650 is used to monitor the Section 33 flood area (see Table 4-3 for well completion information). Well 648 has not had enough water in it the last few years to collect a sample.

Table 4-3. Existing and New Section 33 Well Data

WELL NAME	NORTH. COORD.	EAST COORD.	WELL DEPTH (FT-MSP)	CASING DIAM. (IN)	WATER LEVEL DATE	WATER LEVEL DEPTH (FT-MSP)	WATER LEVEL ELEV. (FT-MSL)	MP ABOVE LSD	MP ELEV. (FT-MSL)	DEPTH TO BASE OF ALLUVIUM	ELEV. TO BASE OF ALLUVIUM		CASING PERFORATIONS	SATURATED THICKNESS
						EXISTING ALLUVIAL WELLS								
541	1539831	477236	120	5	12/4/2008	93.6	6462.02	2	6555.62	---	---	A	78-118	---
647	1536623	478308	140	4.5	12/4/2008	106.65	6445.26	1.4	6551.91	132	6418.5	A	80-140	26.7
648	1534730	478343	120	4.5	12/4/2008	115.7	6432.09	2	6547.79	120	6425.8	A	80-120	6.3
649	1534730	479798	124	4.5	12/4/2008	102.82	6440.47	0.3	6543.29	115	6428	A	84-124	12.5
650	1536779	482135	109	4.5	12/4/2008	83.9	6463.21	2.2	6547.11	103	6441.9	A	89-109	21.3
657	1537497	478392	128	6	12/4/2008	2.2	6446.93	2.2	6551.81	120	6429.6	A	87-128	17.3
658	1535922	478436	130	6	12/4/2008	0.4	6441.68	0.4	6550.18	129	6420.8	A	89-130	20.9
685	1539098	478170	100	4.5	12/4/2008	100.17	6456.4	1.7	6556.57	116	6438.9	A	60-100	17.5
687	1539011	477276	102	6	12/4/2008	99.05	6456.91	2.2	6555.96	120	6433.8	A	62-102	23.1
996	1537621	477989	138	5	12/4/2008	105	6447.52	1.7	6552.52	136	6414.8	A	126-136	32.7
NOTE: Wells 635, 657A and 658A do not penetrate the water table.														
						NEW ALLUVIAL WELLS								
551	1536280	479800	130	5	---	105	6450	2	6547.3	120	6433	A	90-130	18
553	1534840	480510	120	5	---	97	6448	2	6547.48	110	6433	A	80-120	15
554	1534840	479110	140	5	---	103	6440	2	6547.17	130	6411	A	100-140	29

4.3.1 Sulfate Concentrations

The sulfate concentrations for the alluvial aquifer are presented in Figure 4-29 for the Section 33 area. This figure shows the 1999 and 2010 alluvial sulfate concentrations in Section 33. The 1999 contour is presented in red while the blue contour presents the 2010 sulfate concentrations. Sulfate concentration data (2010) is also posted on the figure adjacent to each of the wells. The Section 33 center pivot is located in the Rio San Jose alluvial system. The Rio San Jose alluvial system receives water from the San Mateo alluvial system in the western portion of Section 28 and also to the southeast of Section 33 into the eastern edge of Section 4. The Rio San Jose alluvial system typically has a concentration gradient from the west-southwest to the east-northeast. The location of the 500 mg/l sulfate concentration in 1999 was generally slightly further east in Sections 32 and 33 than the present 2010 contour. The movement of the concentration contour line to the east varies due to the amount of natural recharge to the Rio San Jose alluvial system on the west side. The San Andres aquifer also has a direct connection with the alluvial aquifer in the southeast portion of Section 32 and therefore has caused a sink to develop in the alluvial aquifer in this area due to the movement of alluvial ground-water into the San Andres aquifer. This would also tend to shift the sulfate contour to the west.

Figure 4-30 shows the sulfate concentrations for alluvial wells 551, 553, 554, 647, 649 and 658. Three samples were collected from the new alluvial wells 551 and 553 while two additional samples were collected from well 554 in 2010. A small increase in concentration in alluvial well

Figure 4-30 shows the sulfate concentrations for alluvial wells 551, 553, 554, 647, 649 and 658. Three samples were collected from the new alluvial wells 551 and 553 while two additional samples were collected from well 554 in 2010. A small increase in concentration in alluvial well 658 was observed in 2009 followed by a small decrease in sulfate in 2010. Sulfate concentration in alluvial well 649, which is on the south side of the center pivot, has gradually increased from 2006 through 2010. Sulfate concentrations prior to the irrigation in 2000 were higher in well 649 and fairly similar to those that have been observed the last three years.

It is difficult to determine whether any increase in sulfate concentrations has occurred due to the Section 33 irrigation. A very small increase in sulfate concentration could exist in some of these wells due to the Section 33 irrigation but it could also easily be from the slightly higher sulfate concentrations that exist to the northwest in the Rio San Jose alluvial system, or also the shifting of higher concentrations to the west in Section 33. Fairly steady concentrations had been observed in alluvial well 650 until an increase was observed in 2010 which is located on the southwest side of Section 33 flood area.

4.3.2 TDS Concentrations

The TDS concentrations have been monitored in Section 33 since 1997 when the original monitoring wells were drilled. Figure 4-31 presents the TDS concentrations for 1999 and 2010. The data values adjacent to the wells are 2010 concentrations. The 1,000 mg/l contour for TDS in 2010 is slightly west of its location in 1999. This indicates that the higher concentrations in the eastern side of the Rio San Jose have shifted slightly to the west in this area. The TDS concentrations to the north of Section 33 irrigation in the Rio San Jose alluvial system are generally higher than those in the Section 33 Center Pivot area. This shows that the area to the north has a potential to increase the alluvial TDS concentrations in the Section 33 Center Pivot area as this water moves to the south.

Figure 4-32 presents the TDS concentrations for wells 551, 553, 554, 647, 649, 650 and 658. This data shows that, in general, the TDS concentrations for the first few years in wells 647 and 649 gradually decrease, but there has been an overall increase in wells 647, 649 and 658 over the last three years. This very small increase could possibly be showing an effect on TDS in the alluvial aquifer from the Section 33 Center Pivot, but it could also easily result from movement of the slightly higher concentrations to the north or the westerly movement of ground water. Therefore, it is difficult to determine from the TDS concentrations whether the Section 33 irrigation has had a measurable impact on the ground-water quality in this area. TDS concentrations were fairly steady in well 650 until a small increase in 2010.

4.3.3 Chloride Concentrations

The alluvial chloride concentrations are presented in Figure 4-33 for 1999 and 2010. This plot shows that the 1999 chloride concentrations of >100 mg/l extended to the northwest side of the Section 33 Center Pivot. The 2010 chloride concentrations extend down to the southern edge of the center pivot. The movement of the 100 mg/l contour from 1999 to 2010 could possibly be attributed to irrigation in Section 33, but as with other constituents, it could also be a result of movement of the chloride concentrations from the north of the site into the Section 33 Center Pivot area.

Figure 4-34 presents the chloride concentrations for the monitoring wells in the Section 33 area. This figure shows fairly steady chloride concentrations but does show a small increase in chloride concentrations for the last five years in wells 649 and 658. A small increase was also observed in 2009 and 2010 in wells 647 and 649. Present chloride concentrations in well 647 are less than those that were observed in 1997. It is difficult to determine whether the changes in the chloride concentrations in the alluvial aquifer in the area of Section 33 Center Pivot are due to the operation of the center pivot. The chloride concentrations in alluvial well 650 could possible showing the effects on the ground water from the Section 33 flood irrigation but the value is well within natural range of this constituent.

4.3.4 Uranium Concentrations

The uranium concentrations are an important parameter because it is the main hazardous constituent of concern in the irrigation water. Figure 4-35 presents the 1999 and 2010 uranium concentrations for the alluvial aquifer in the Section 33 area. The red contour shows that the uranium concentrations of 0.05 mg/l extended down to the southern edge of Section 33 in 1999. These concentrations extend down to alluvial well 657 which is approximately ¾ of a mile north of well 648 in 2010. A decrease in the area of significant uranium concentrations has occurred in the Section 33 center pivot irrigation area from 1999 to 2010.

Figure 4-36 presents the uranium concentrations versus time for the Section 33 alluvial wells. This plot shows that the uranium concentrations for the last eleven years during the operation of the Section 33 Center Pivot have been relatively steady. These concentrations had declined by the start of the irrigation program to concentrations observed today. The observed uranium concentrations do not indicate any measurable effect on the ground-water quality that is attributable to the Section 33 Center Pivot irrigation. The small and steady concentrations from alluvial well 650 do not indicate any effects from the Section 33 flood system.

4.3.5 Selenium Concentrations

Figure 4-37 presents the 2010 selenium concentrations for the alluvial aquifer in the Section 33 area. No iso-concentration contours are shown on this figure for the 1999 or 2010 concentrations because the selenium concentrations are all very low. The 2010 concentrations are posted by each well.

Figure 4-38 presents the selenium concentrations for the Section 33 monitoring wells. The selenium concentrations in monitoring well 647 have gradually declined from 0.07 in 1997 to 0.04 in 2010. This small decline in selenium concentrations is likely due to the off-site restoration efforts that have been occurring for the last eleven years in this area. An overall very gradual increase in selenium concentrations has occurred in alluvial well 649 from 0.02 to 0.05 over this period of time. An apparent slight increase was also observed in alluvial well 658 during 2009 and selenium values were fairly steady in this well in 2010. These selenium concentration changes are not significant enough to determine if the Section 33 irrigation has had any effect on the selenium concentrations in the alluvial aquifer. Selenium concentrations had been steady in well 650 while a small increase was observed in 2010.

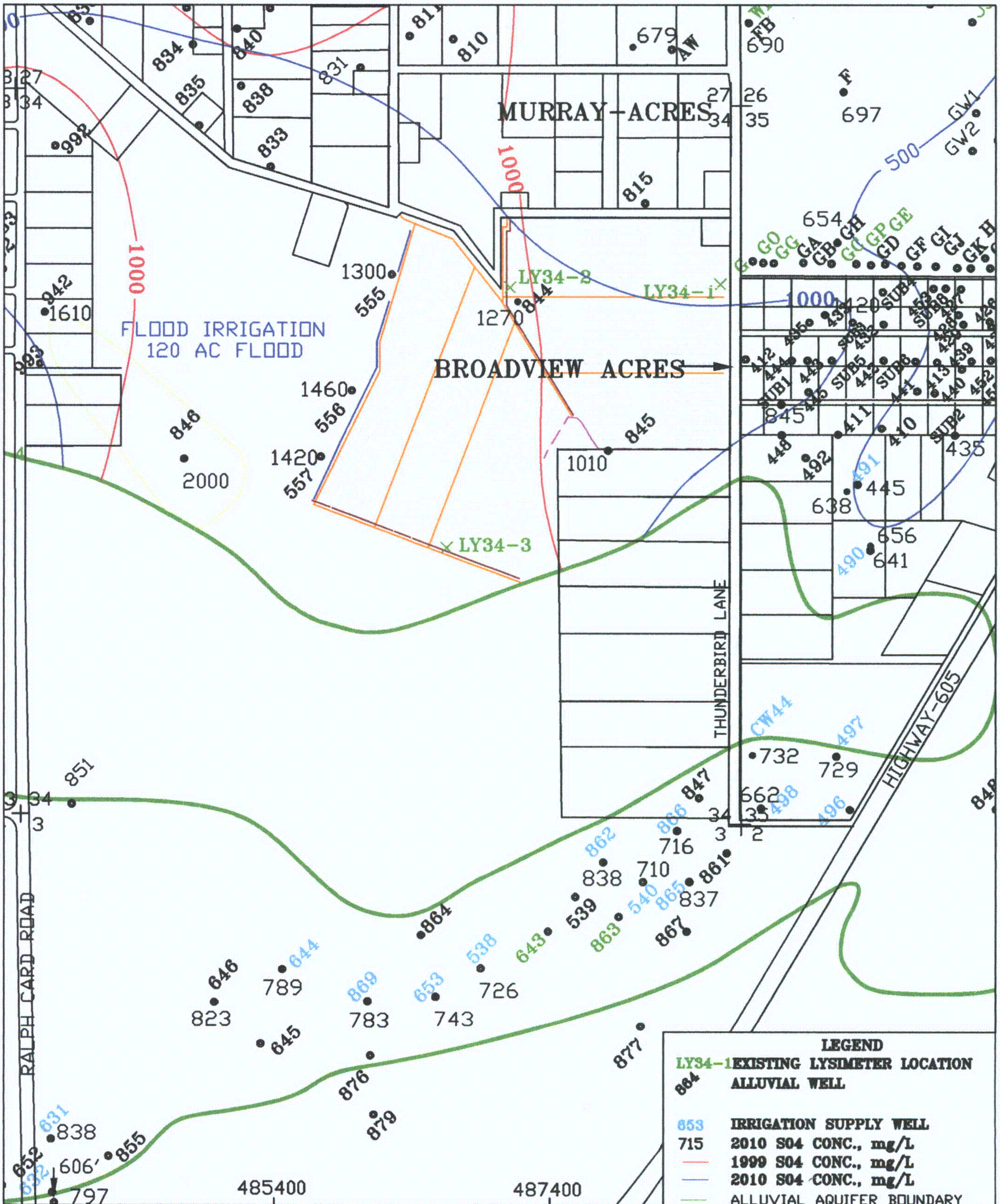
4.3.6 Molybdenum Concentrations

The molybdenum concentrations for 2010 are presented in Figure 4-39. All of these concentrations are less than detection limit for the molybdenum, which is 0.03 mg/l. This figure and Figure 4-40, which shows the molybdenum concentrations with time, shows that no effect on molybdenum concentrations have been observed from the Section 33 irrigation.

4.3.7 Nitrate Concentrations

The nitrate concentrations for 1999 and 2010 are presented in Figure 4-41. This figure shows that the nitrate concentrations approximately ½ mile to the northwest of the Section 33 Center Pivot exist at >10 mg/l during 1999. The highest measured concentration in 2010 in this area was 4.6 mg/l from well 996. The concentration slightly higher concentration in well 996 is likely due to the movement of the slightly higher concentrations from the northwest into this area.

Figure 4-42 presents the nitrate concentrations with time and shows that the nitrate concentrations generally have been fairly steady except for a gradual decline in nitrate concentrations in well 647. These nitrate concentrations do not indicate any observable impacts on alluvial nitrate concentrations as a result of the Section 33 irrigation.



SCALE: 1" = 1000' C:\PROJECTS\2010-06\1600QAL10 DATE: 1/11/10	**FIGURE 4-1. 1999 AND 2010 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L**	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO

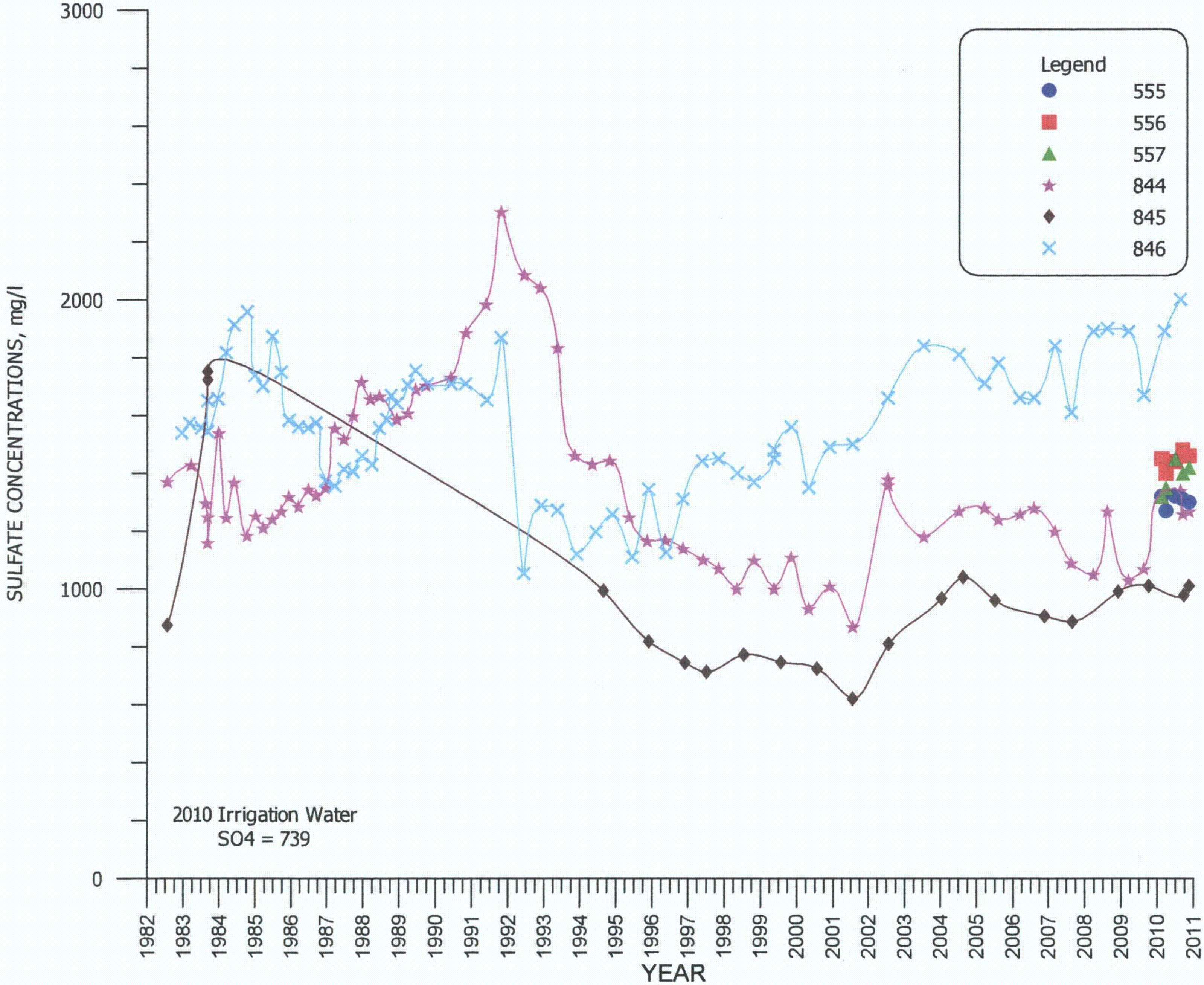
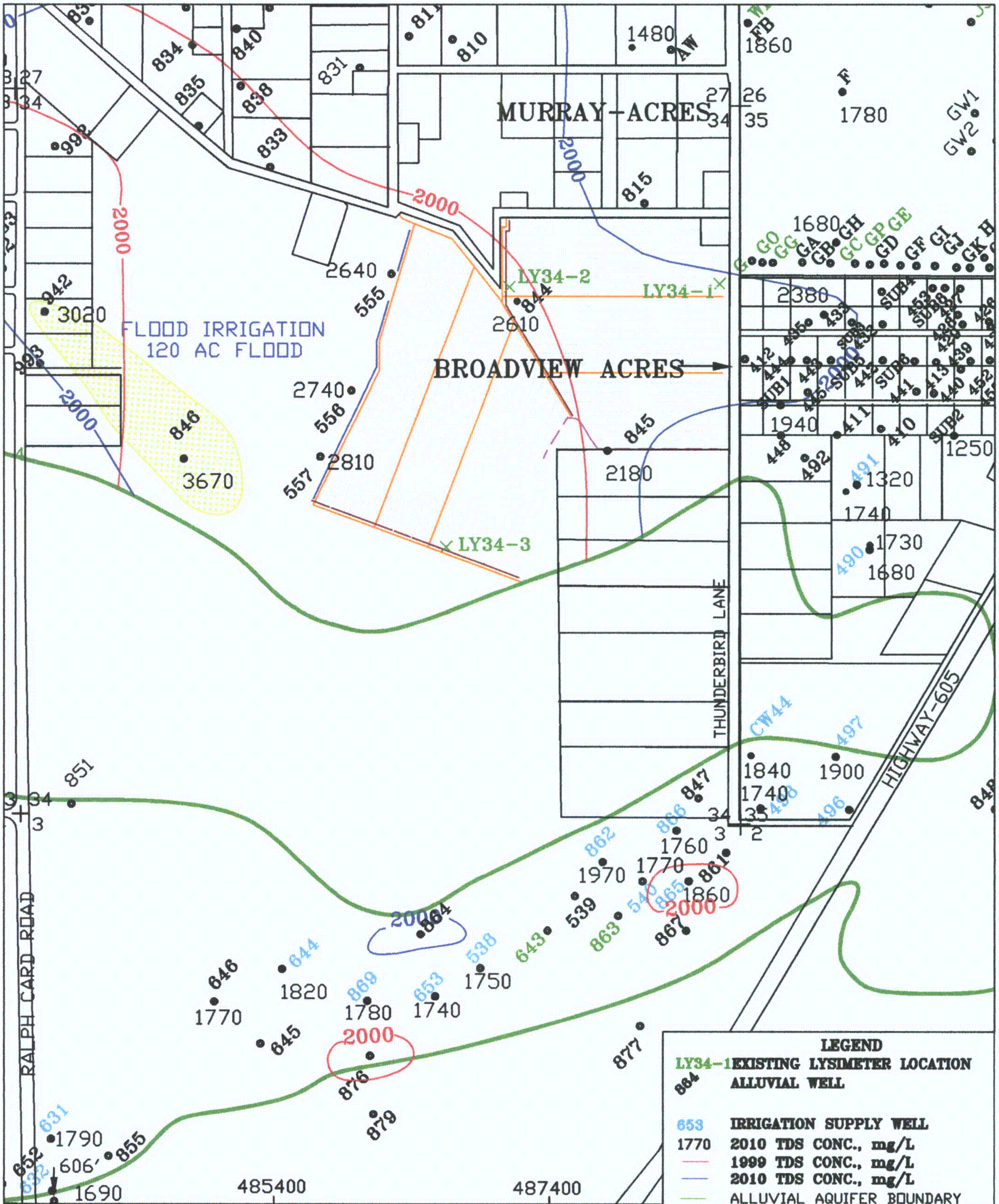


FIGURE 4-2. SULFATE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-3. 1999 AND 2010 TDS ALLUVIAL CONCENTRATION IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

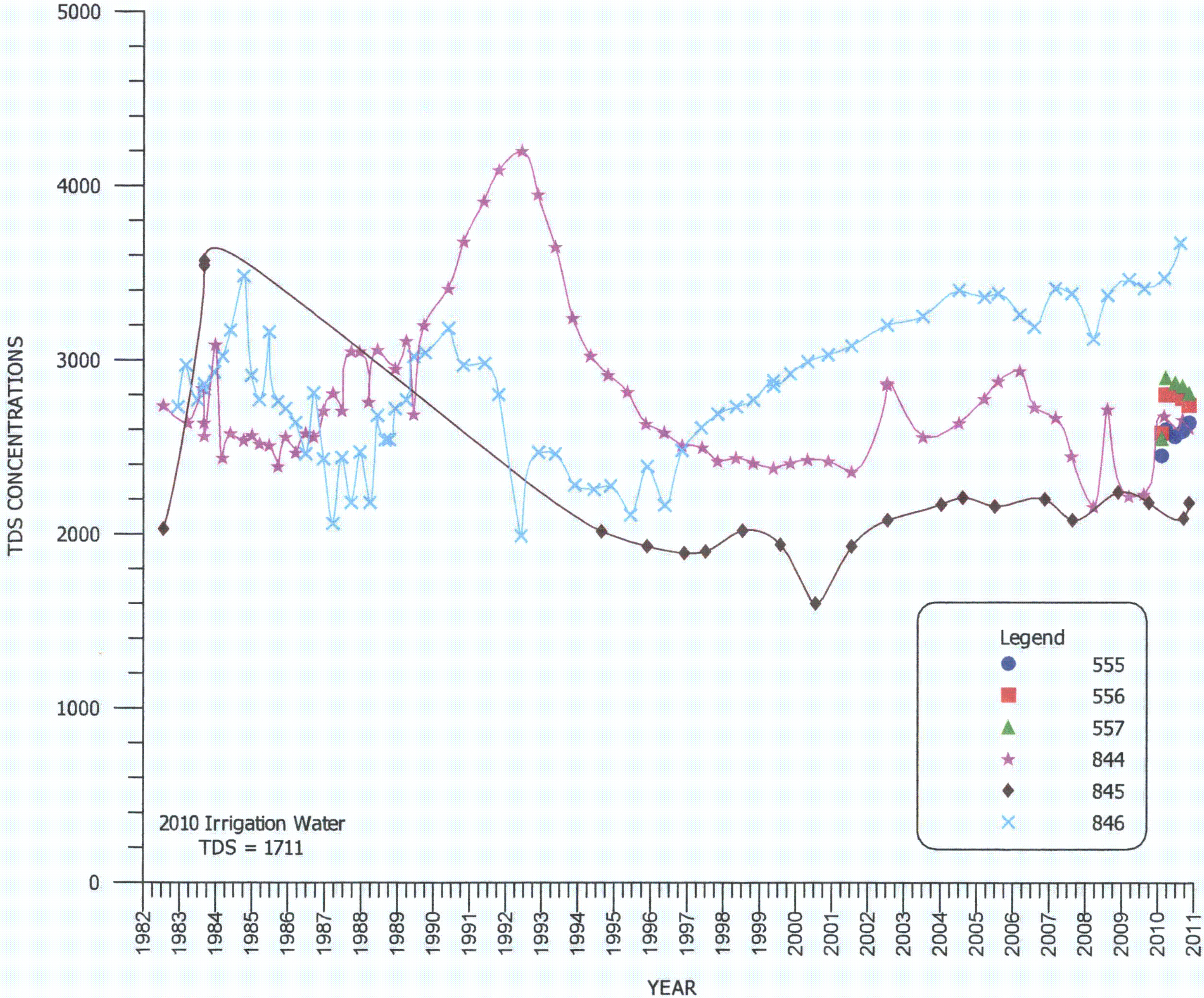
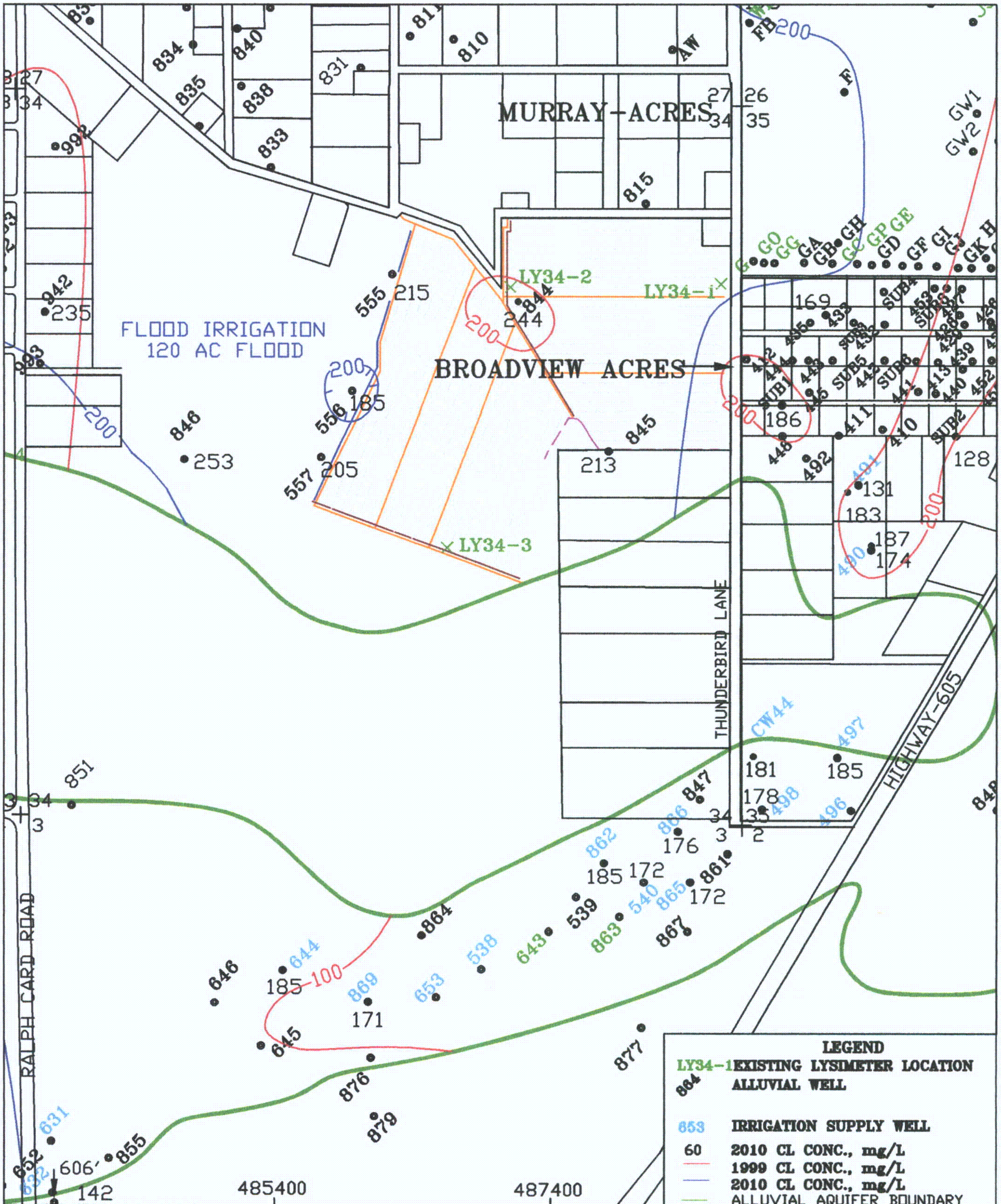


FIGURE 4-4. TDS CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'	FIGURE 4-5. 1999 AND 2010 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO
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DATE: 1/11/10		

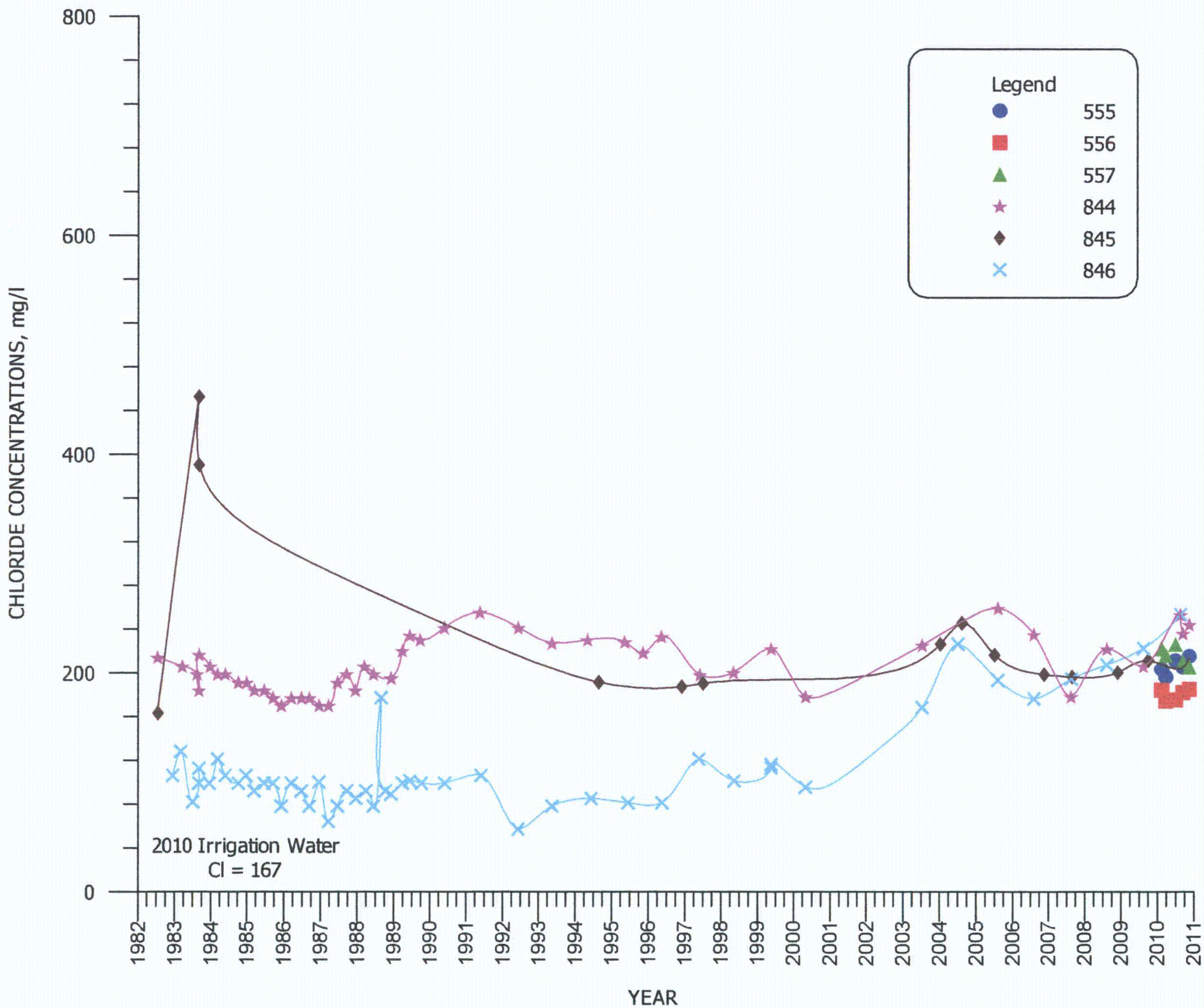
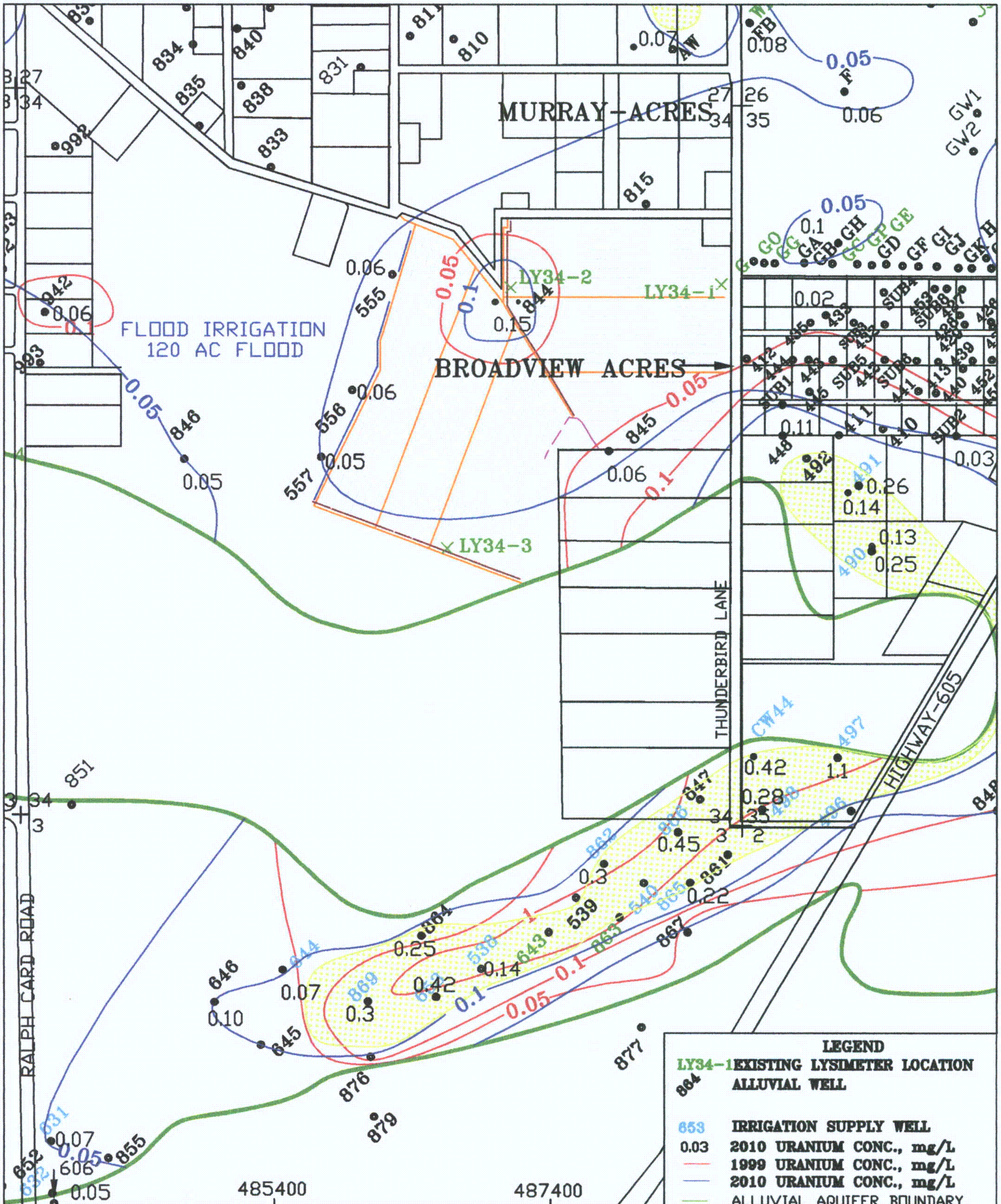


FIGURE 4-6. CHLORIDE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-7. 1999 AND 2010 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

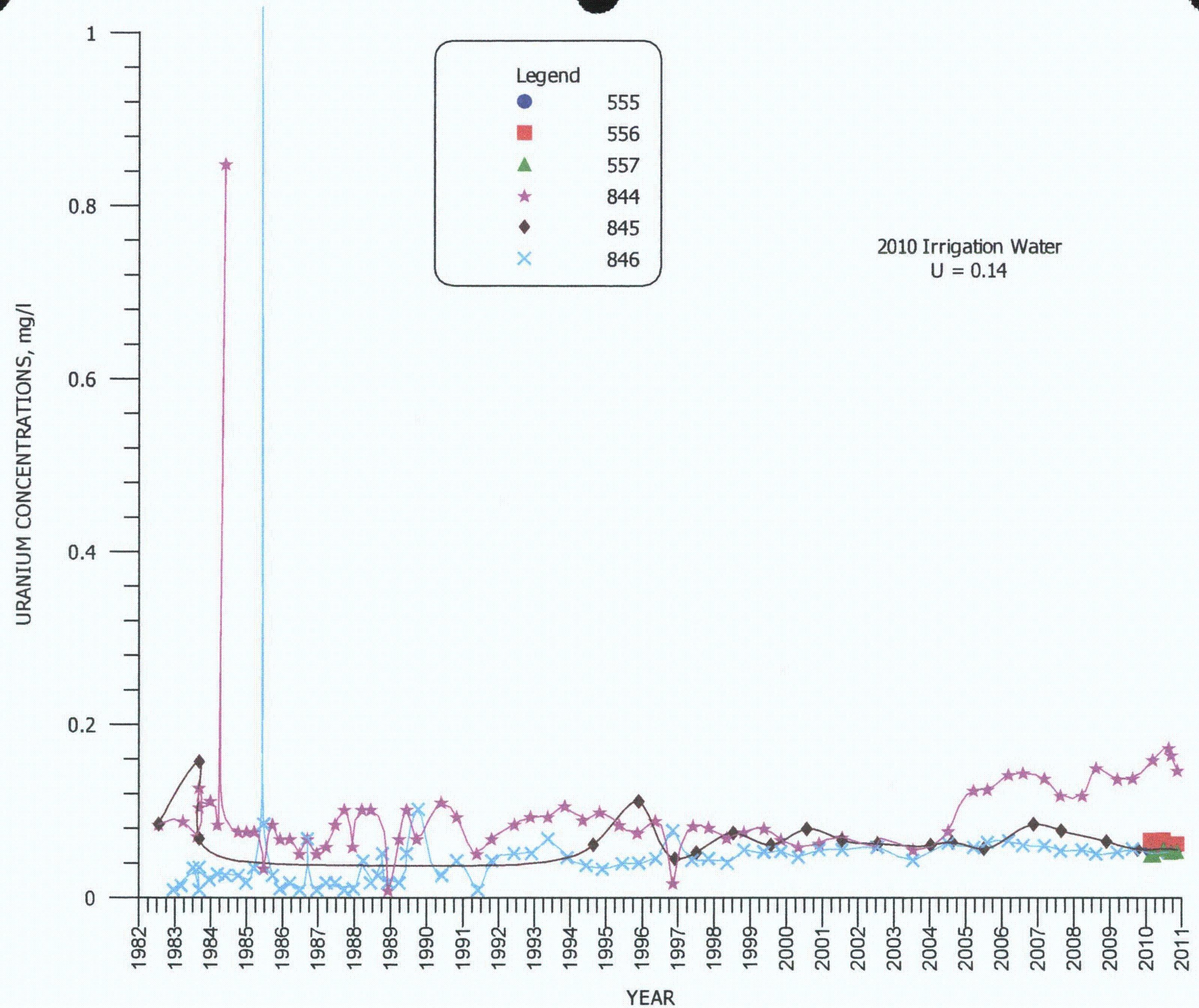
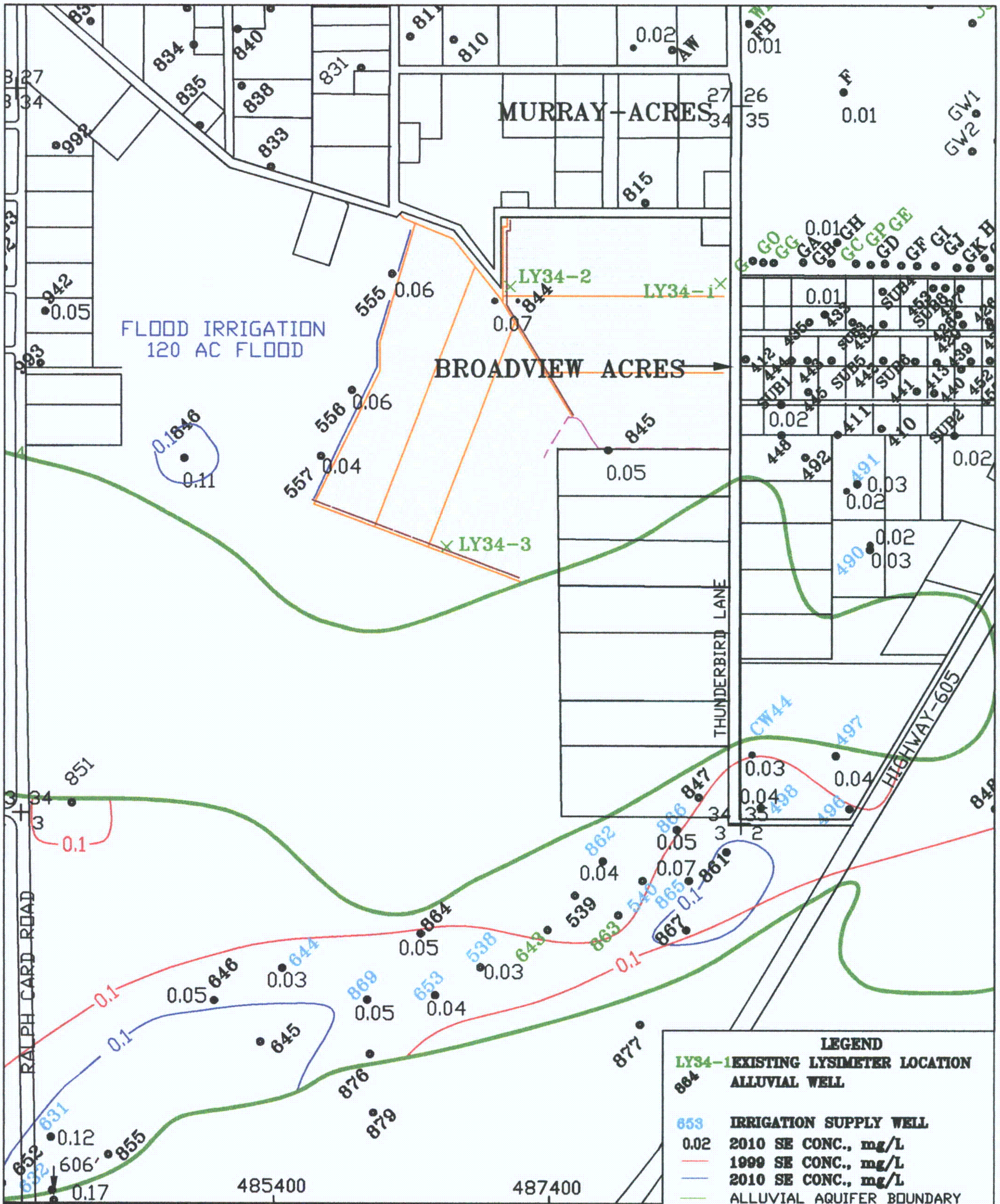


FIGURE 4-8. URANIUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-9. 2010 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

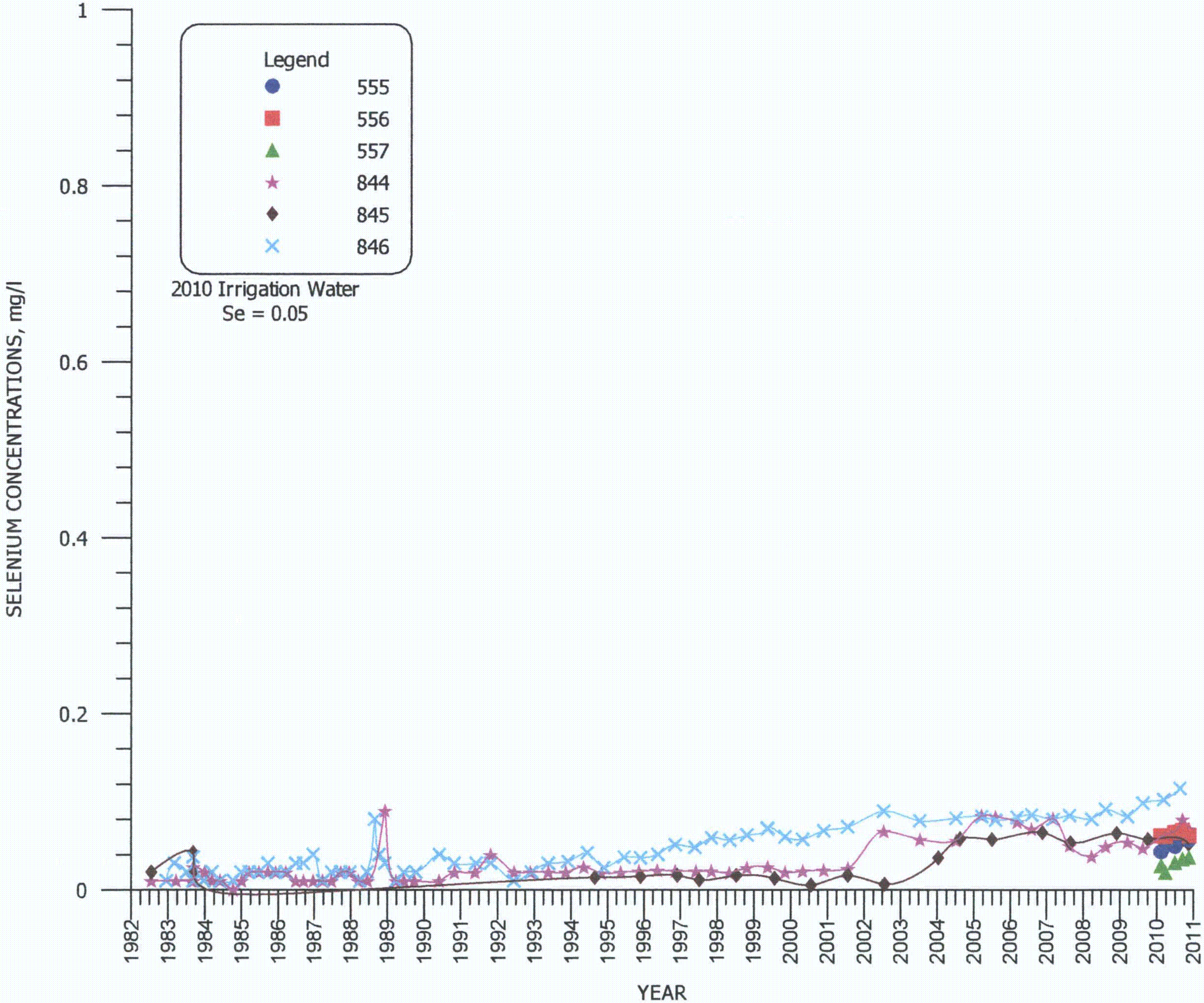
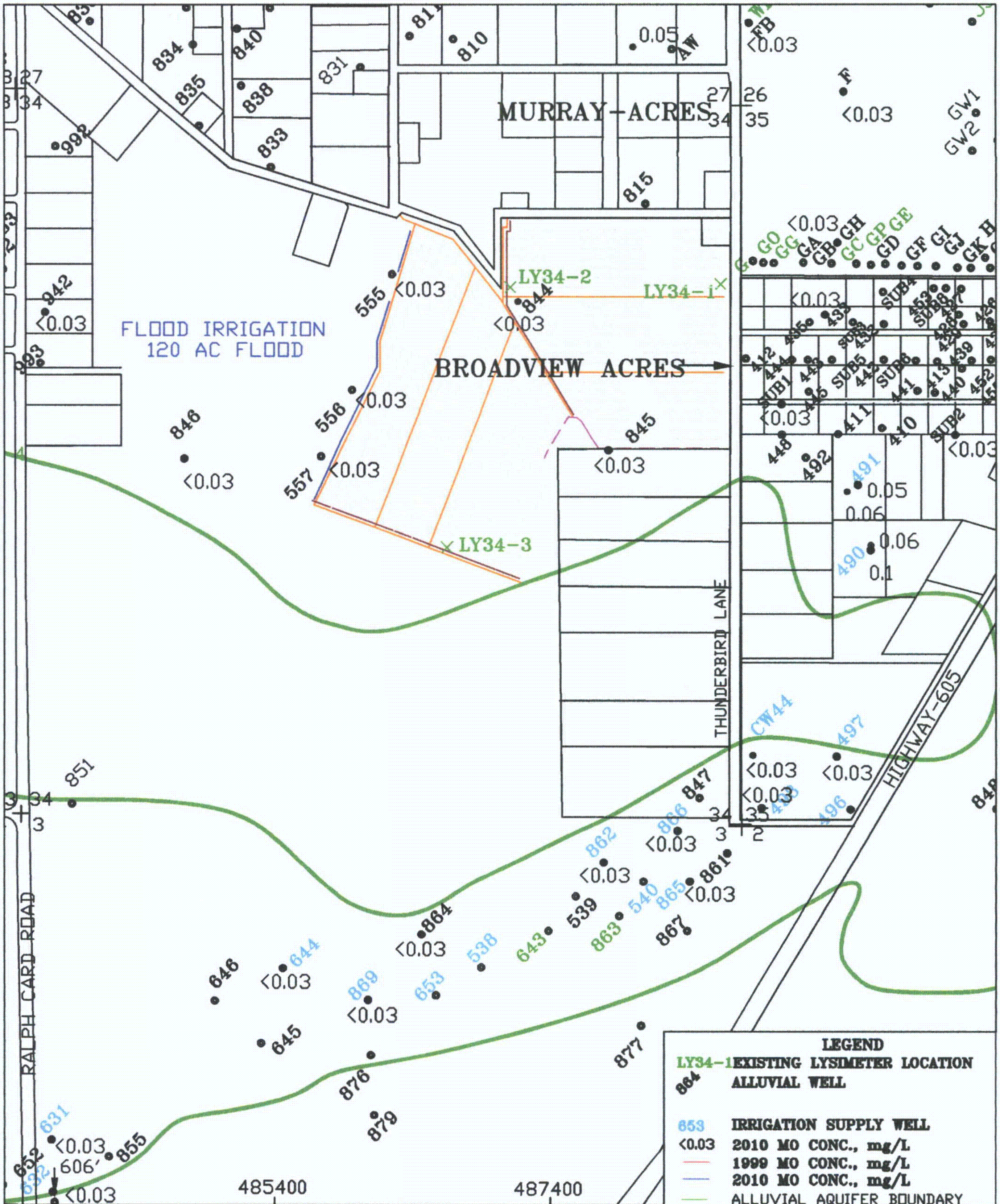


FIGURE 4-10. SELENIUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-11. 2010 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

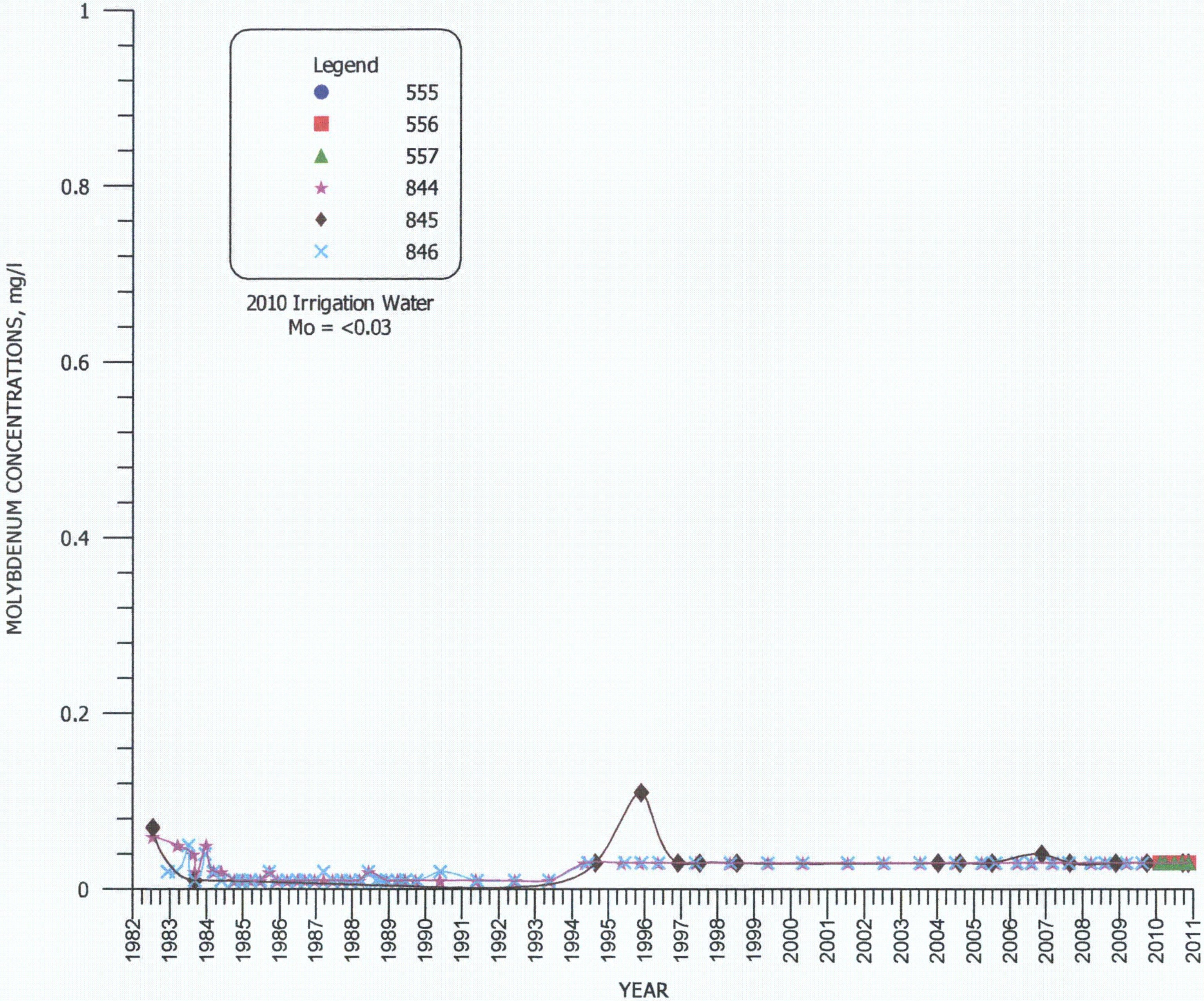
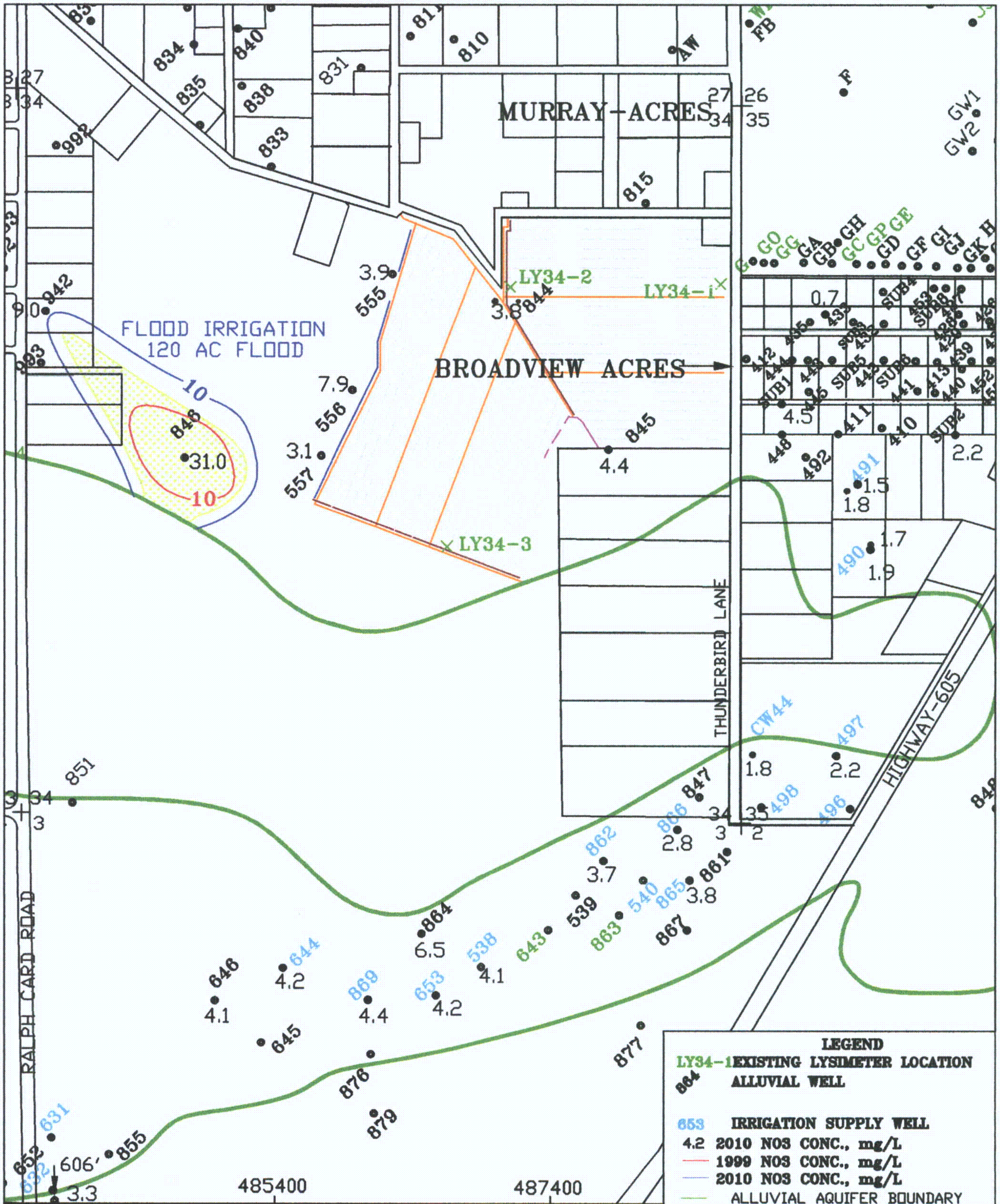


FIGURE 4-12. MOLYBDENUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-13. 1999 AND 2010 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY

GRANTS, NEW MEXICO

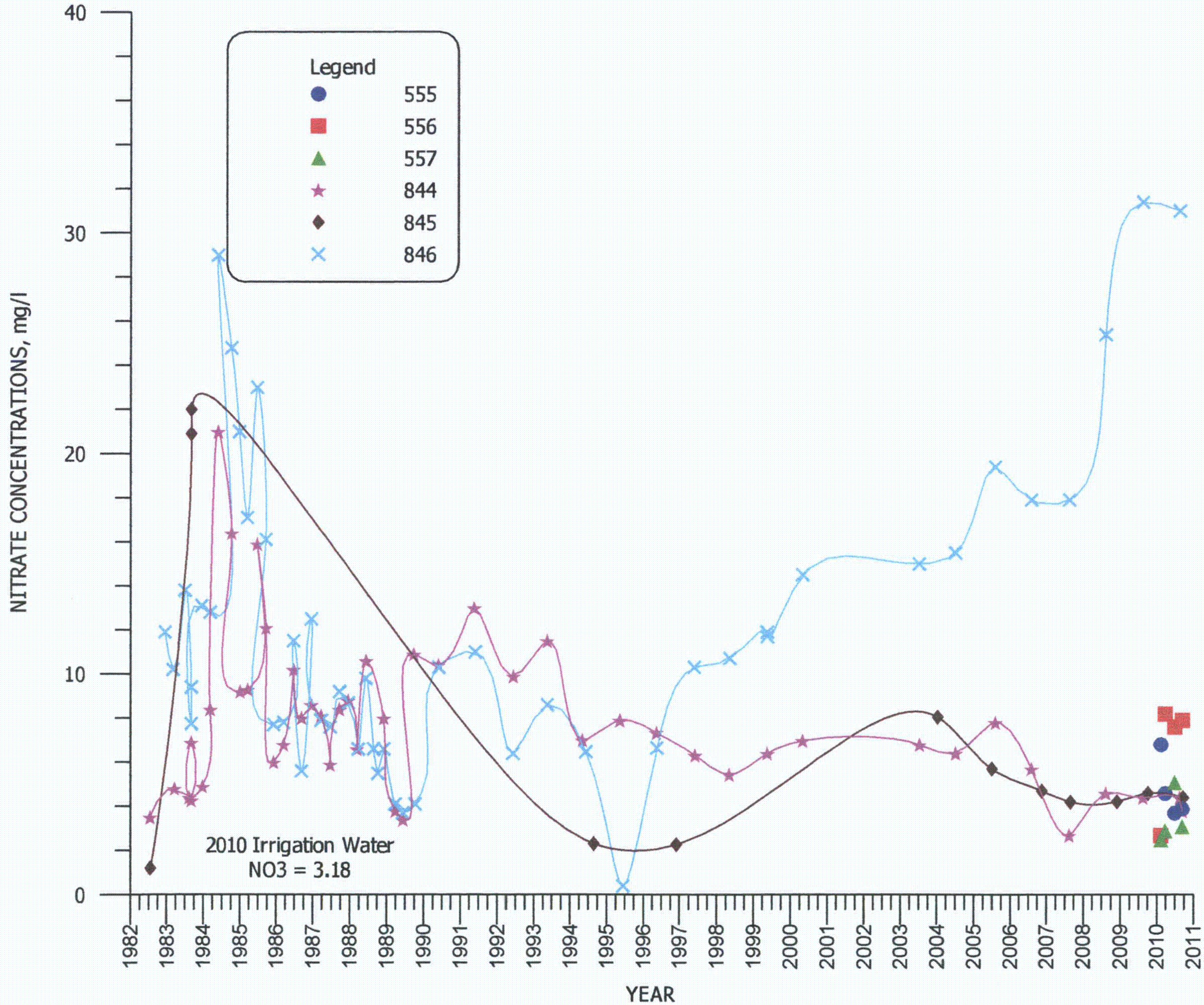
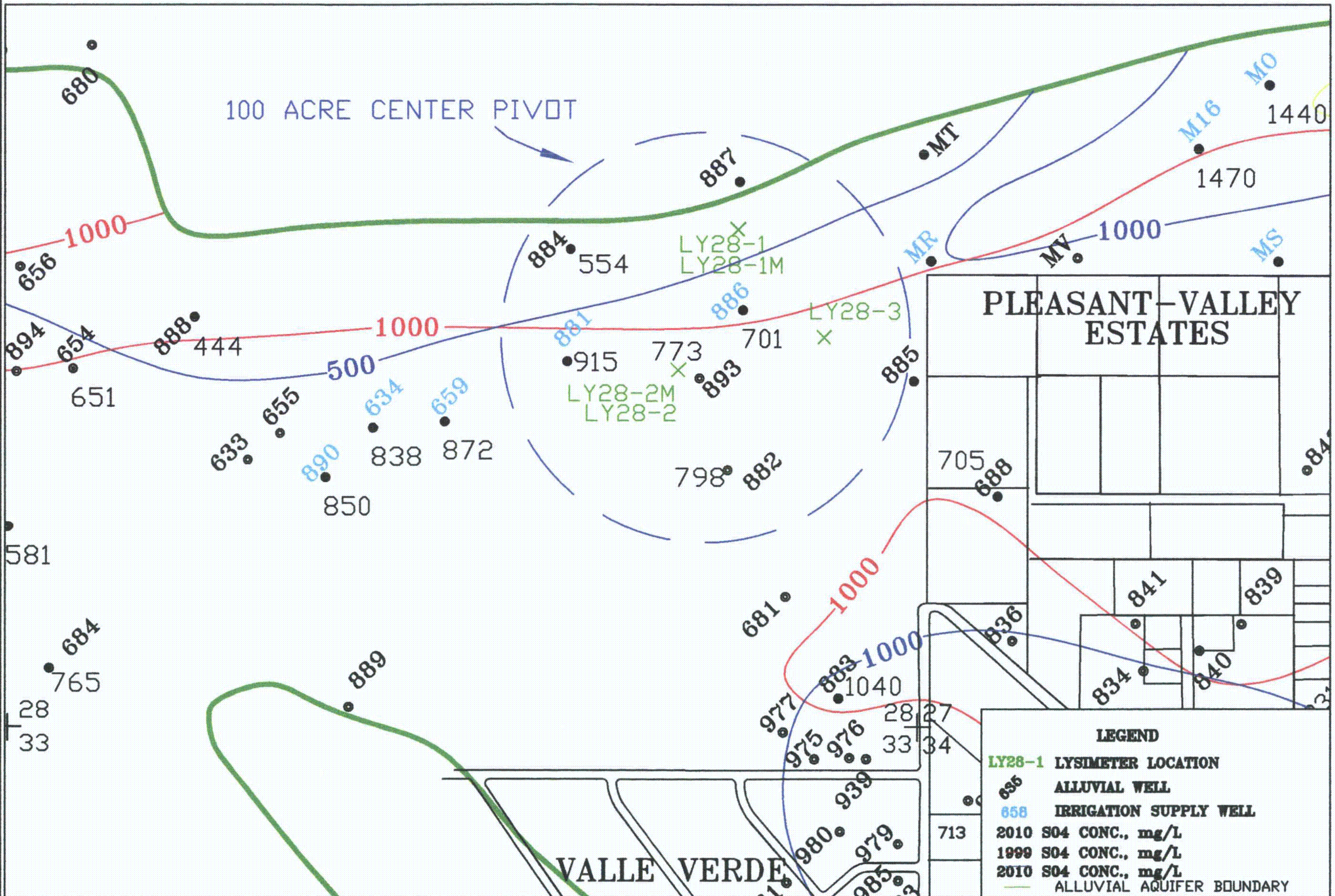


FIGURE 4-14. NITRATE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 800'

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FIGURE 4-15. 1999 AND 2010 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

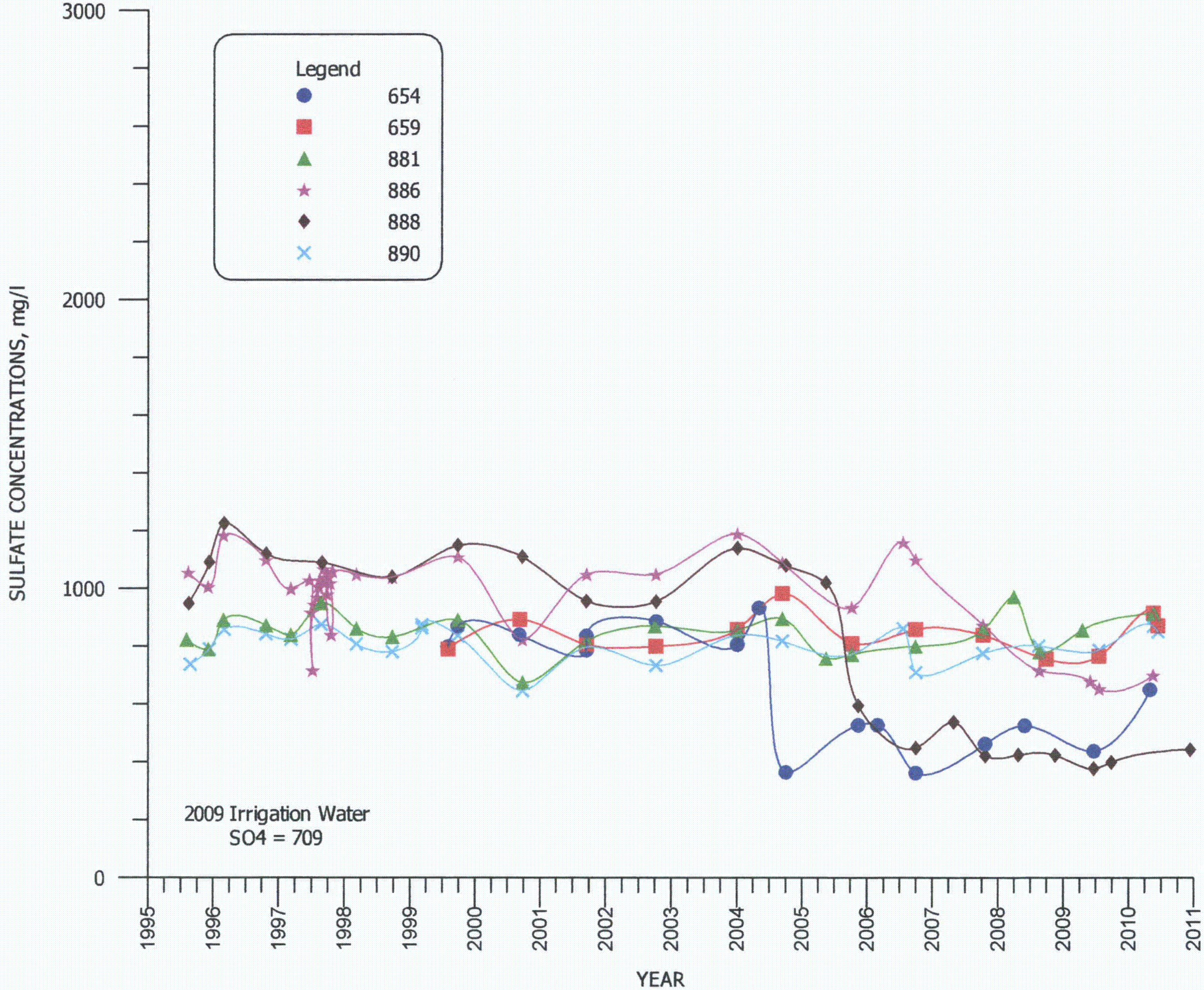
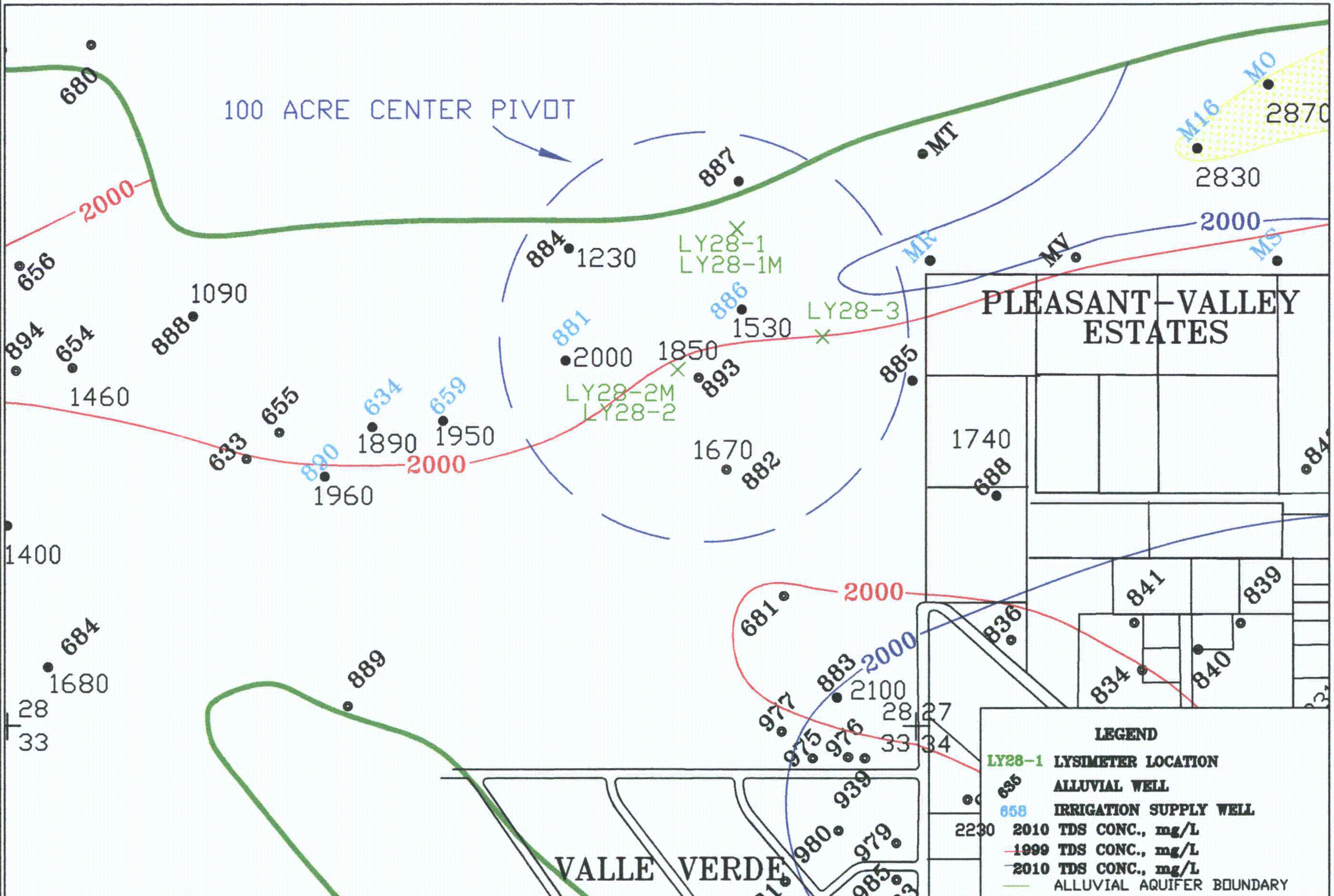


FIGURE 4-16. SULFATE CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'	FIGURE 4-17. 1999 AND 2010 TDS ALLUVIAL CONCENTRATION IN SECTION 28, mg/L	HOMESTAKE MINING COMPANY
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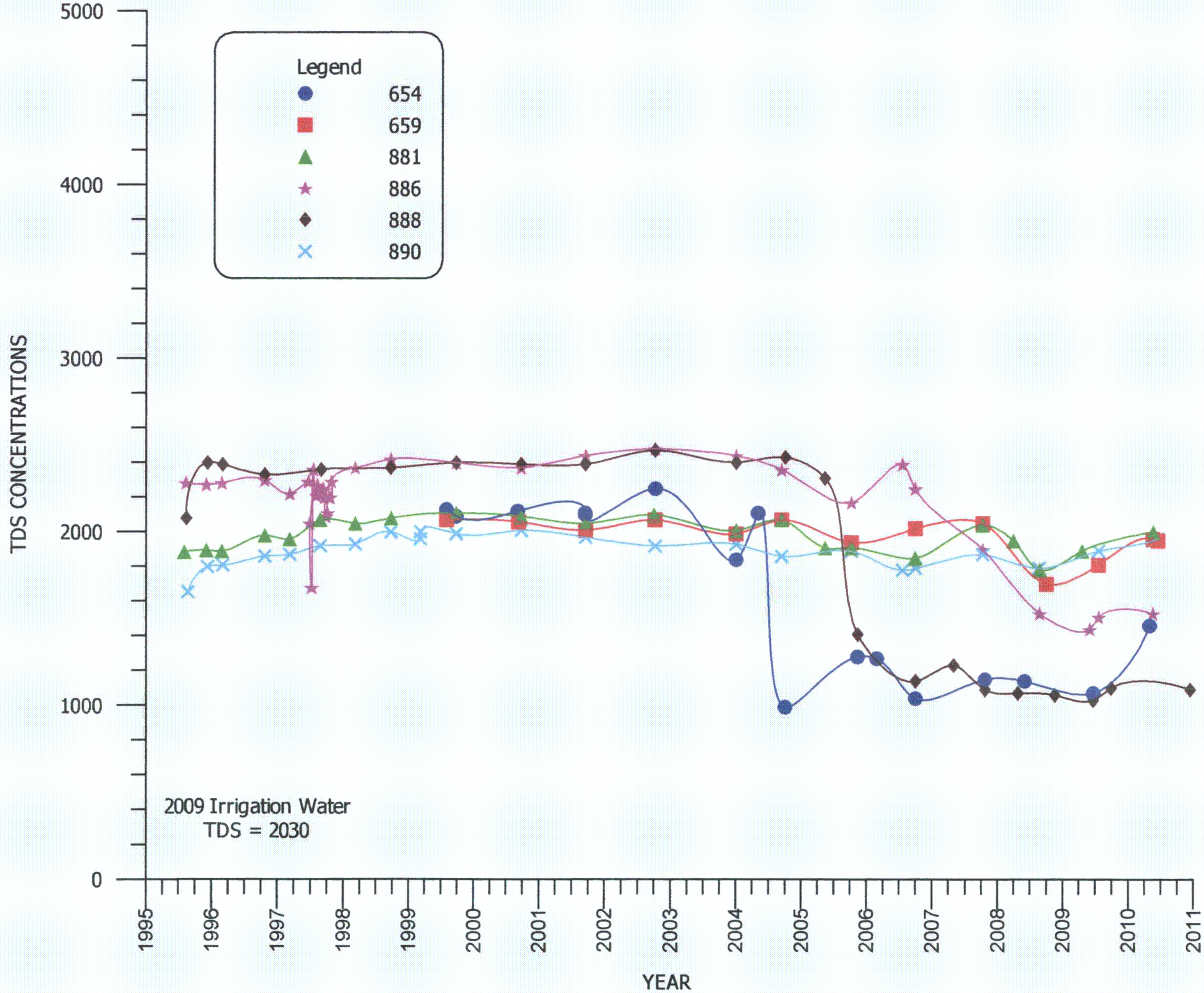
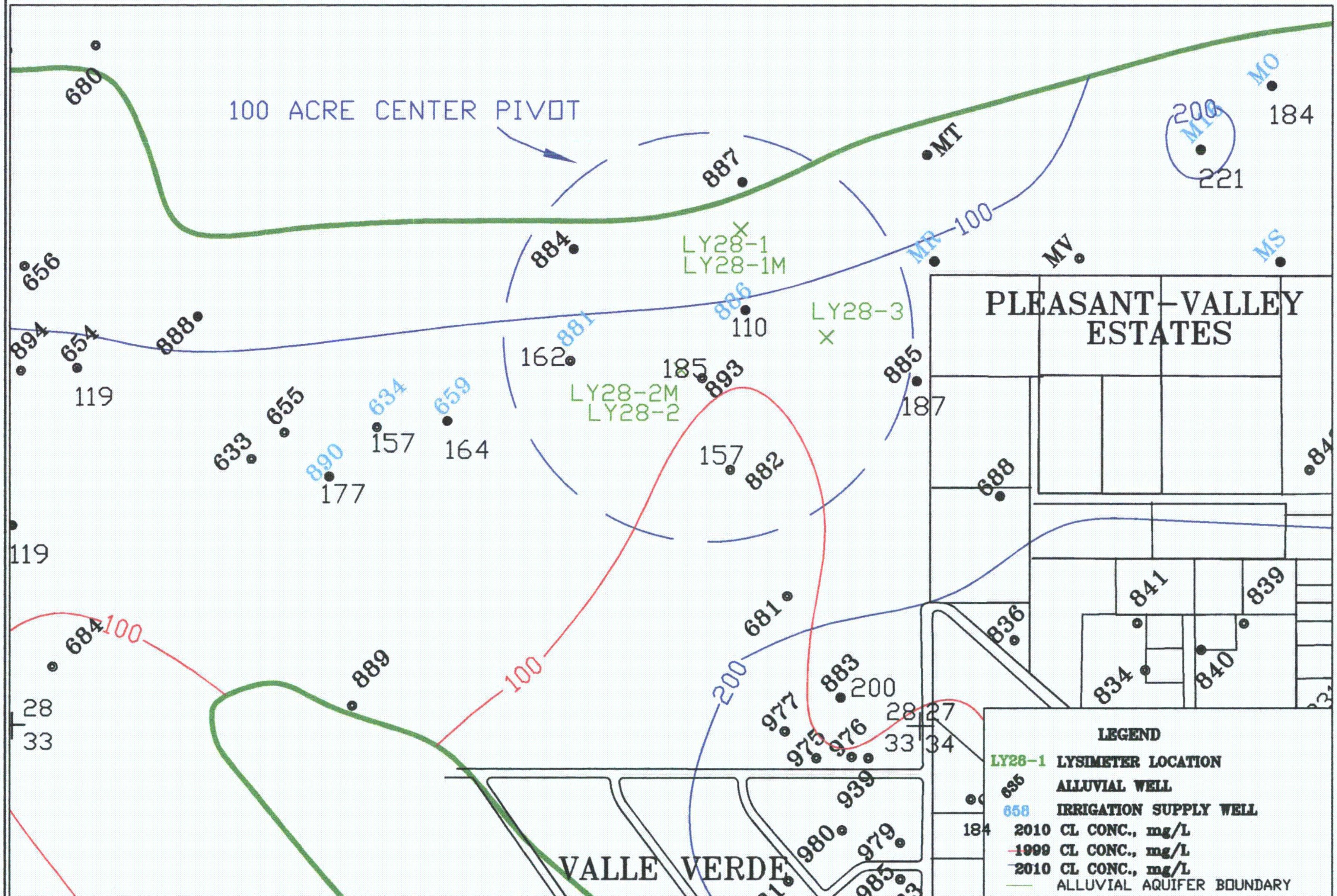


FIGURE 4-18. TDS CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'

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FIGURE 4-19. 1999 AND 2009 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

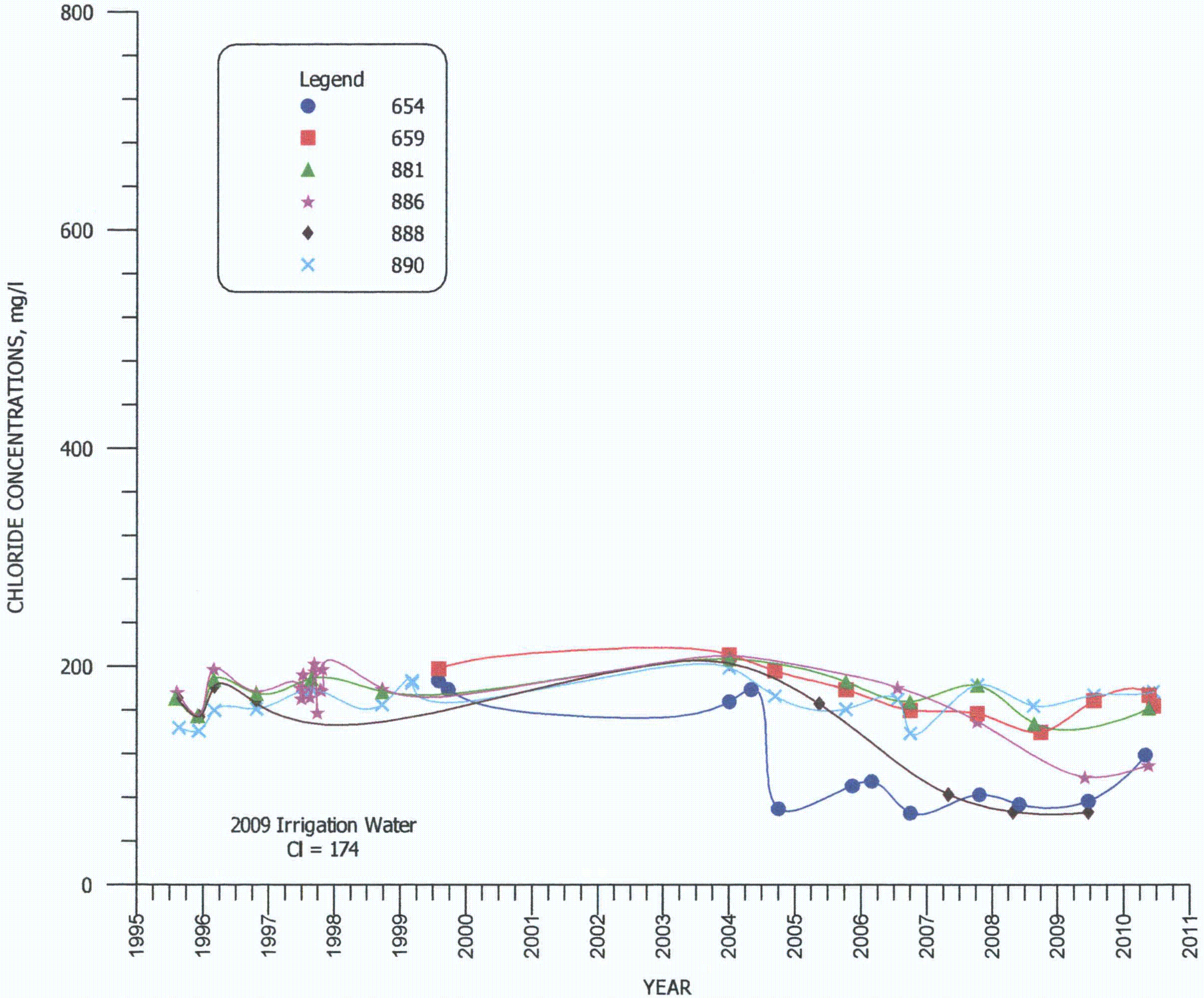
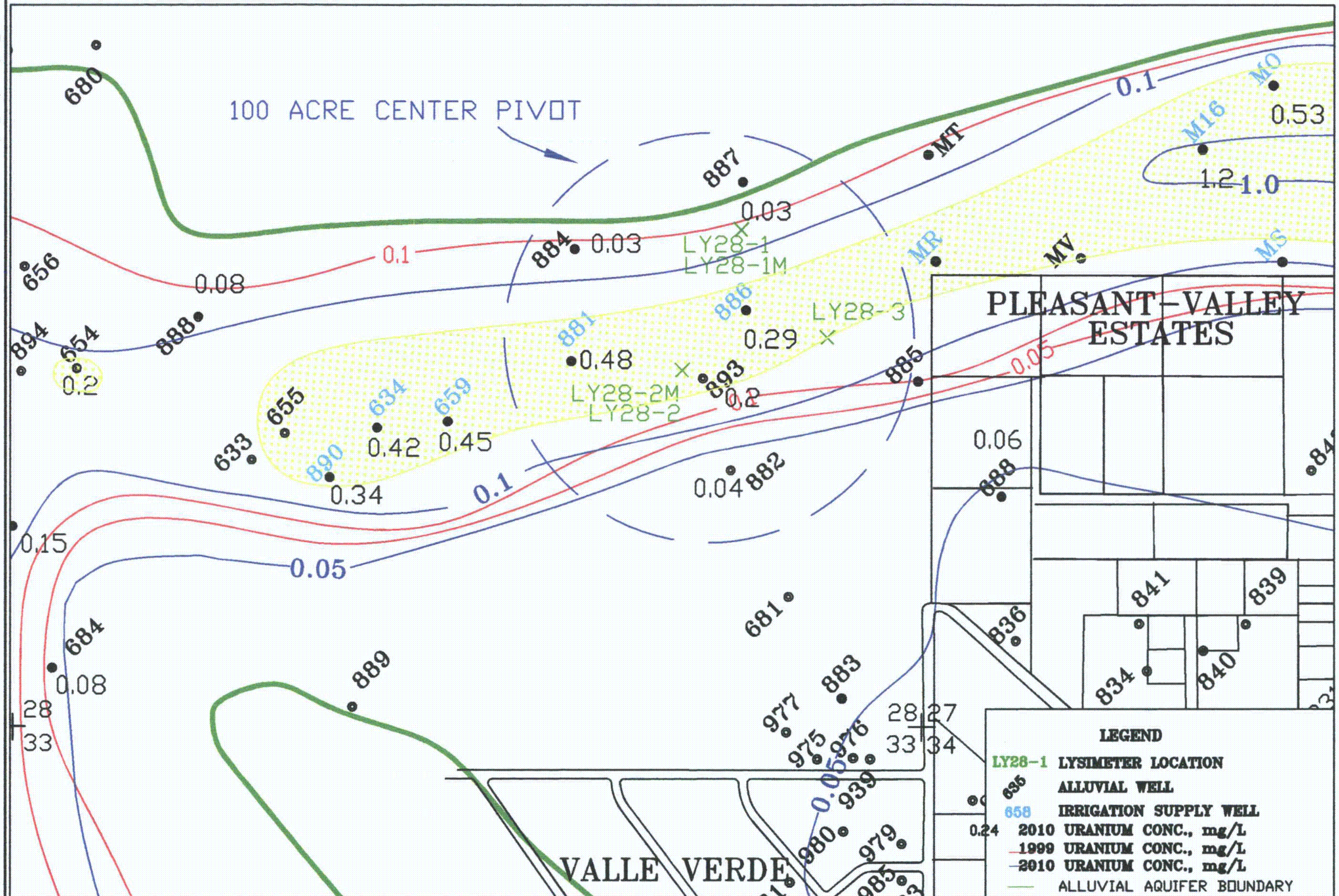


FIGURE 4-20. CHLORIDE CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'	**FIGURE 4-21. 1999 AND 2010 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L**	HOMESTAKE MINING COMPANY
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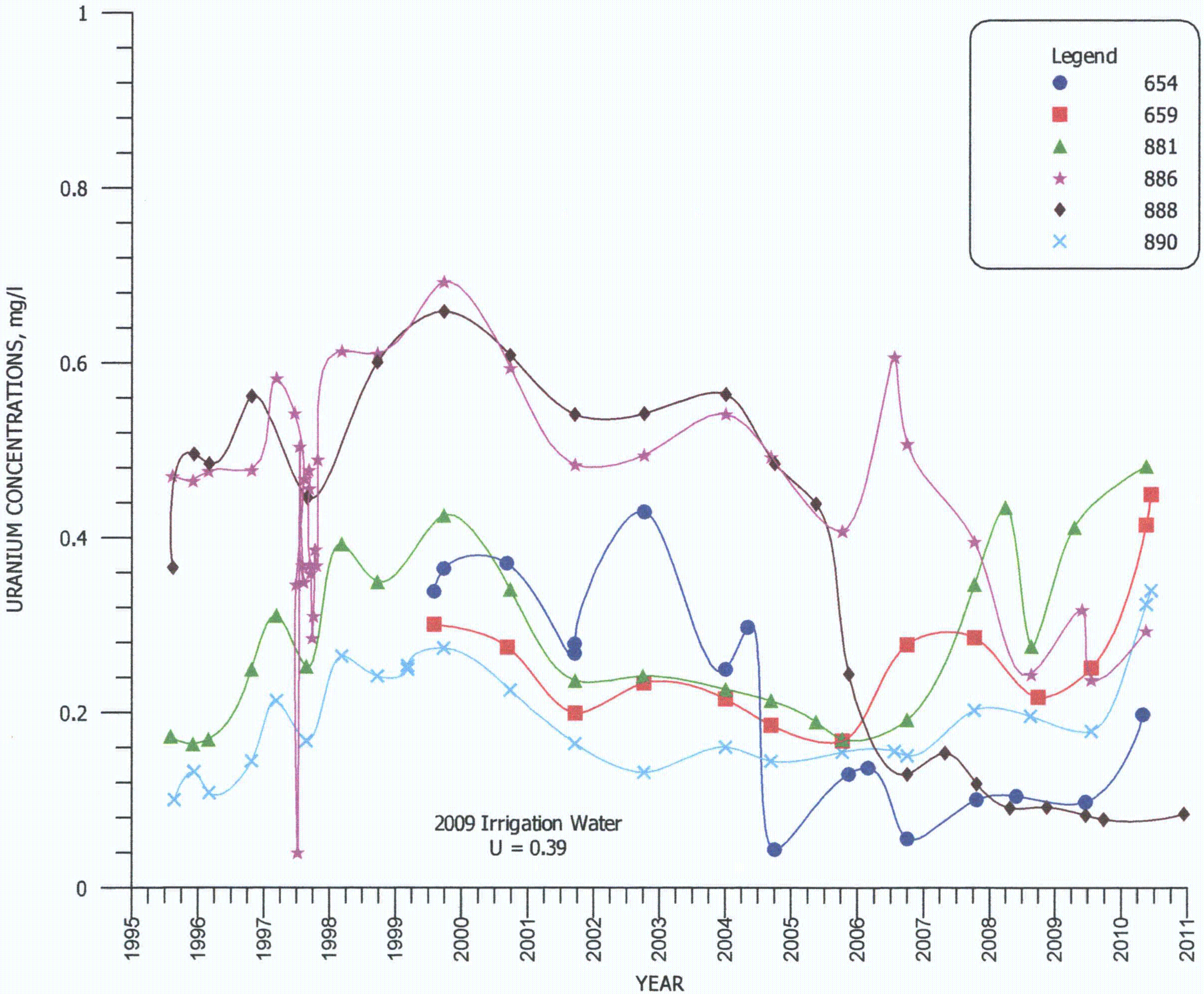
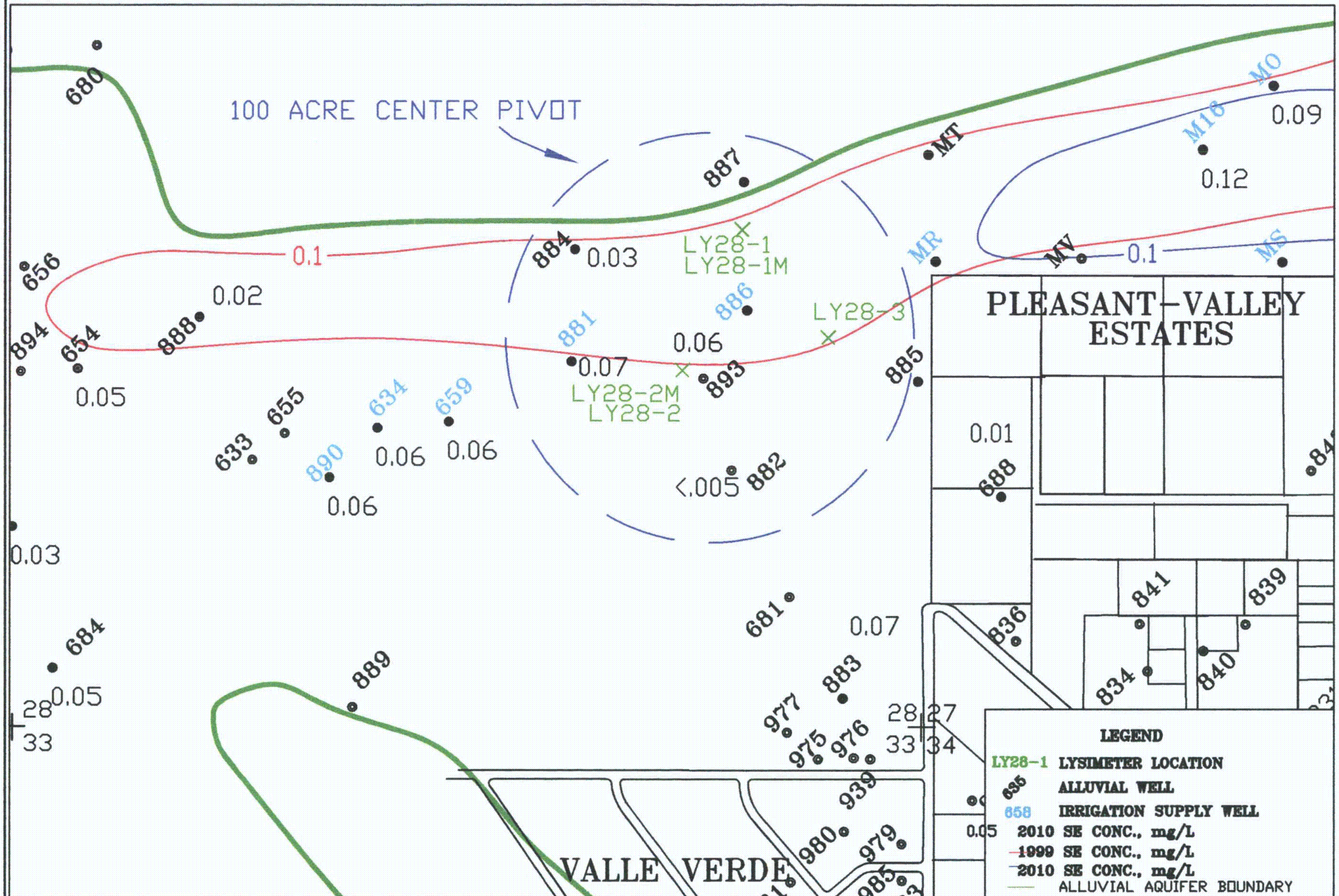


FIGURE 4-22. URANIUM CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'

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FIGURE 5-23. 1999 AND 2010 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

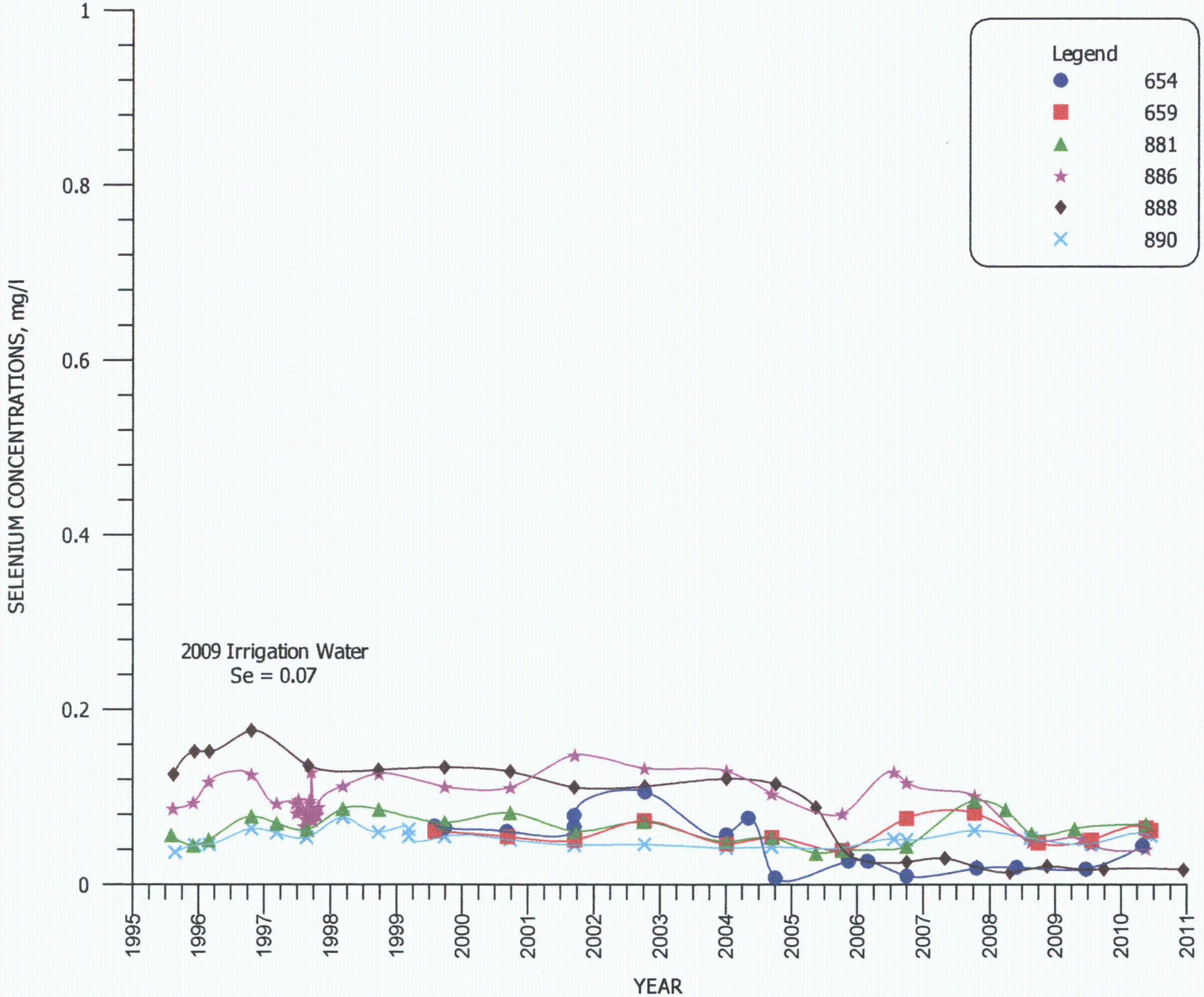
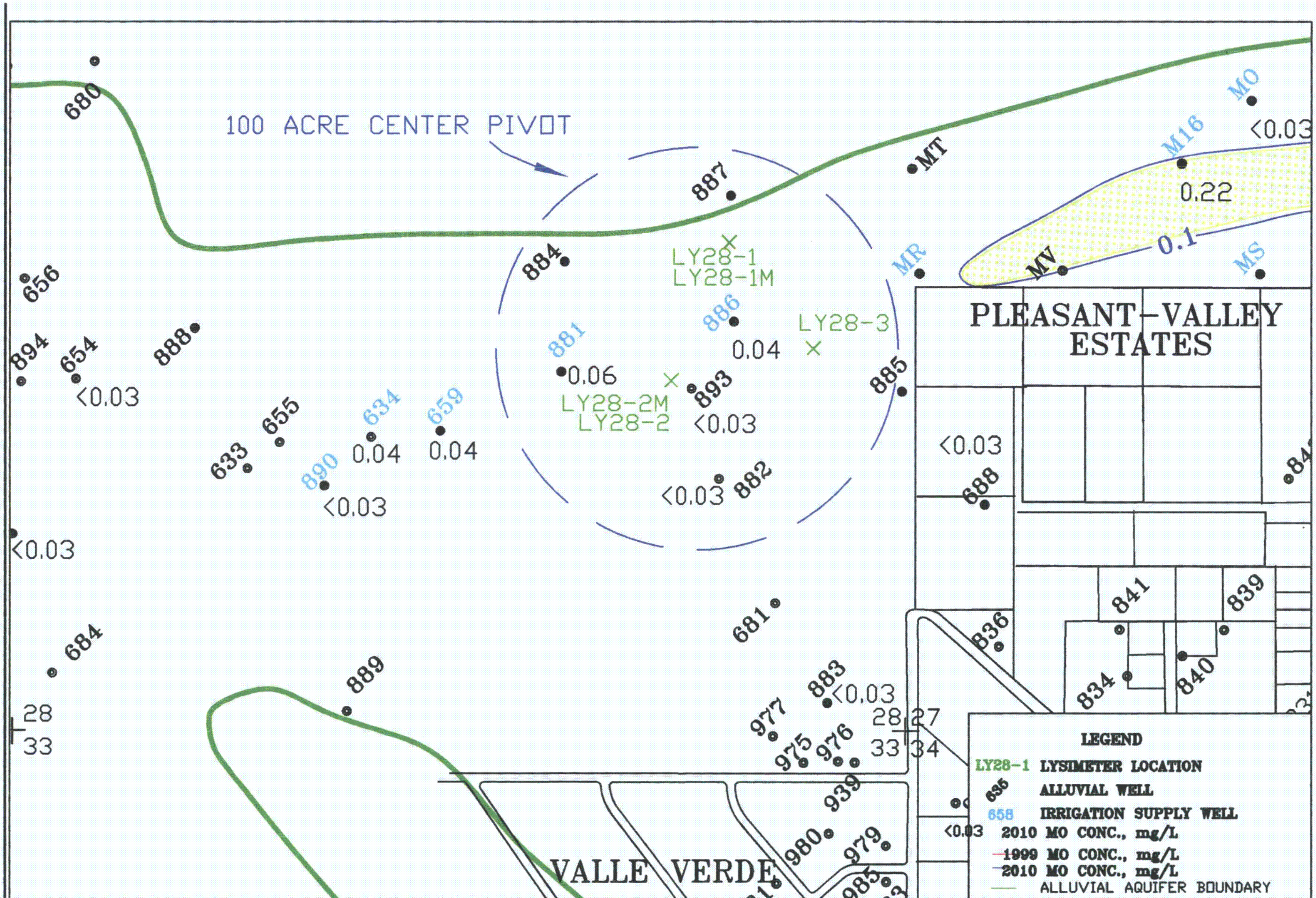


FIGURE 4-24. SELENIUM CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'

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FIGURE 4-25. 2010 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

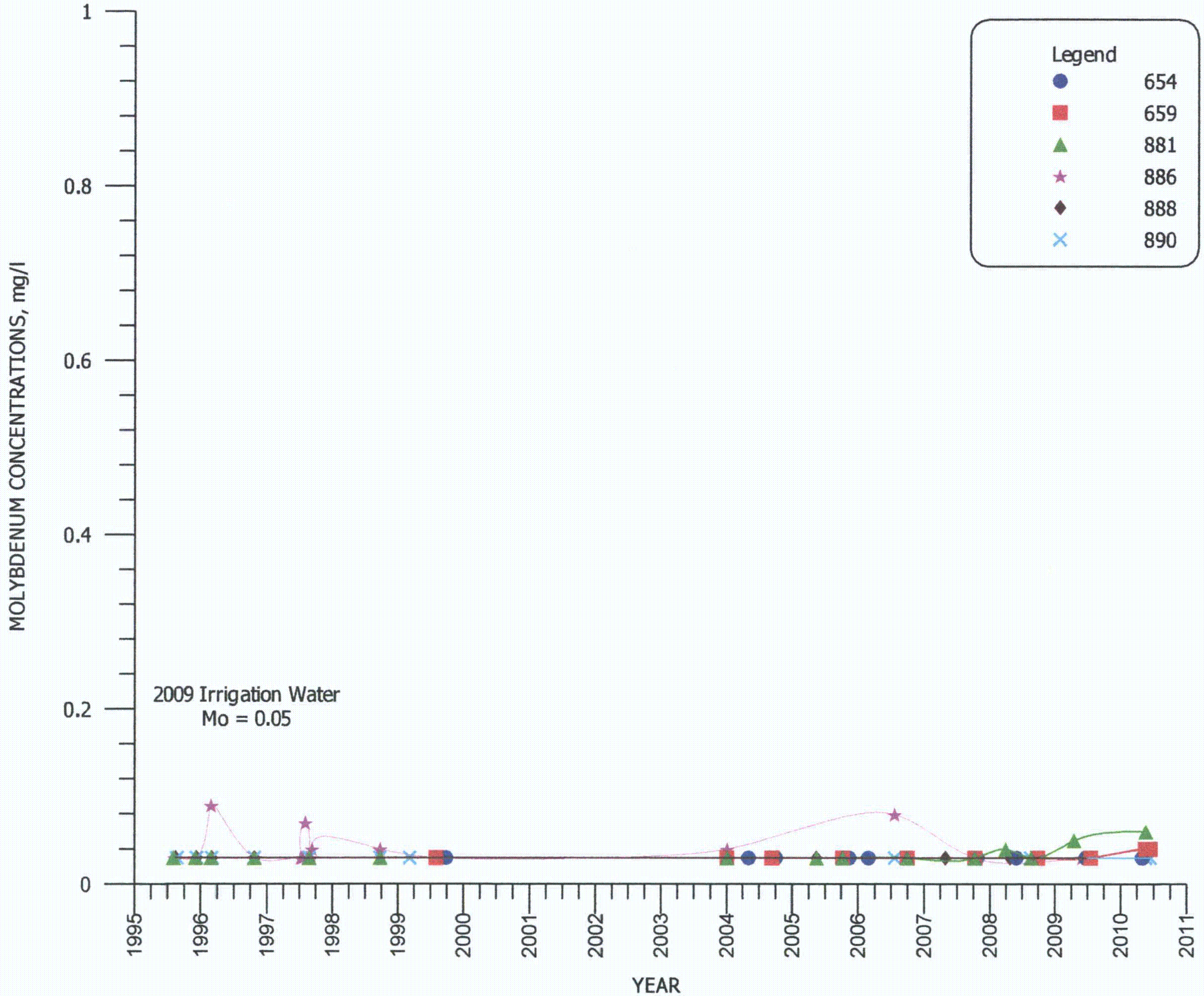
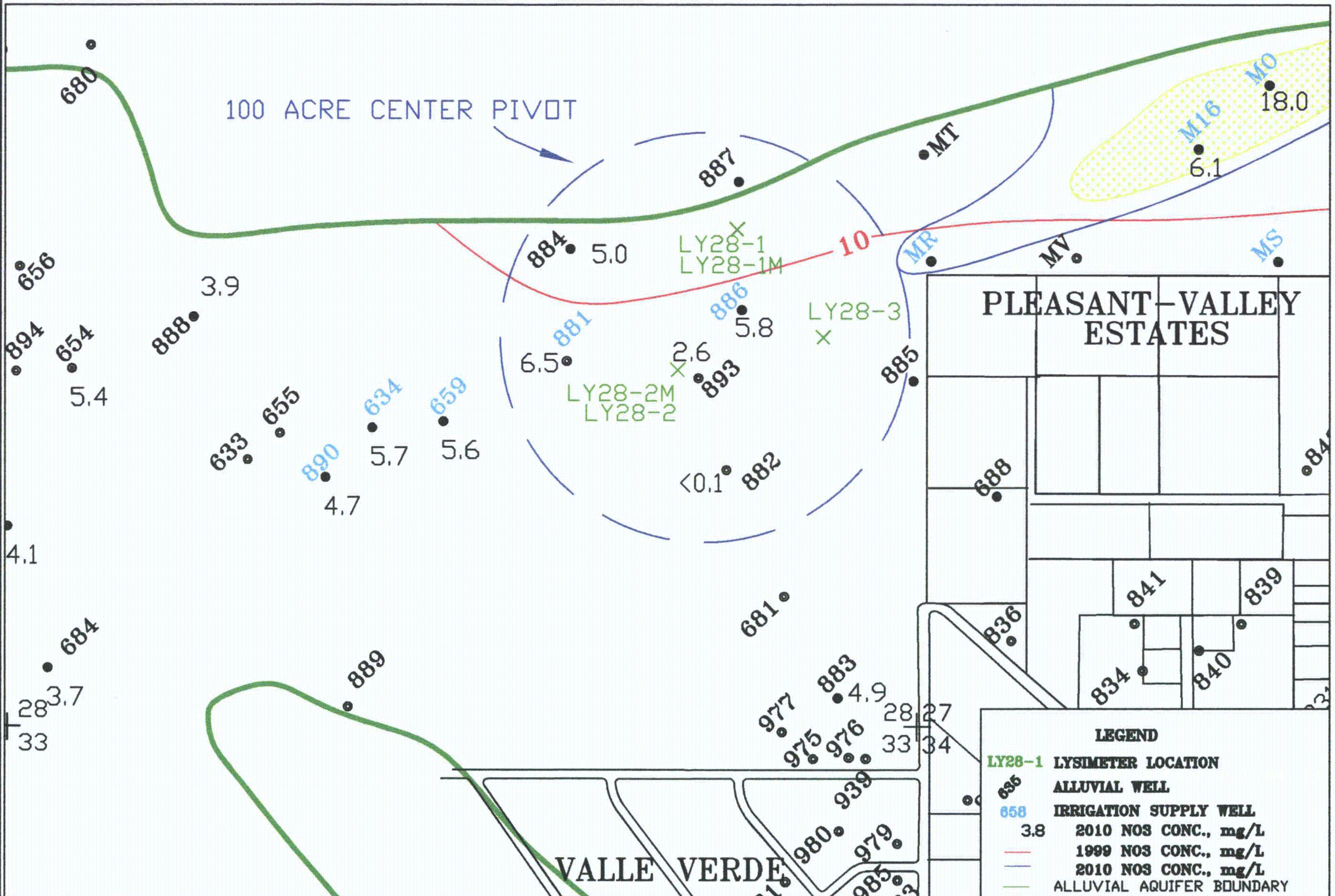


FIGURE 4-26. MOLYBDENUM CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 800'

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FIGURE 4-27. 1999 AND 2010 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

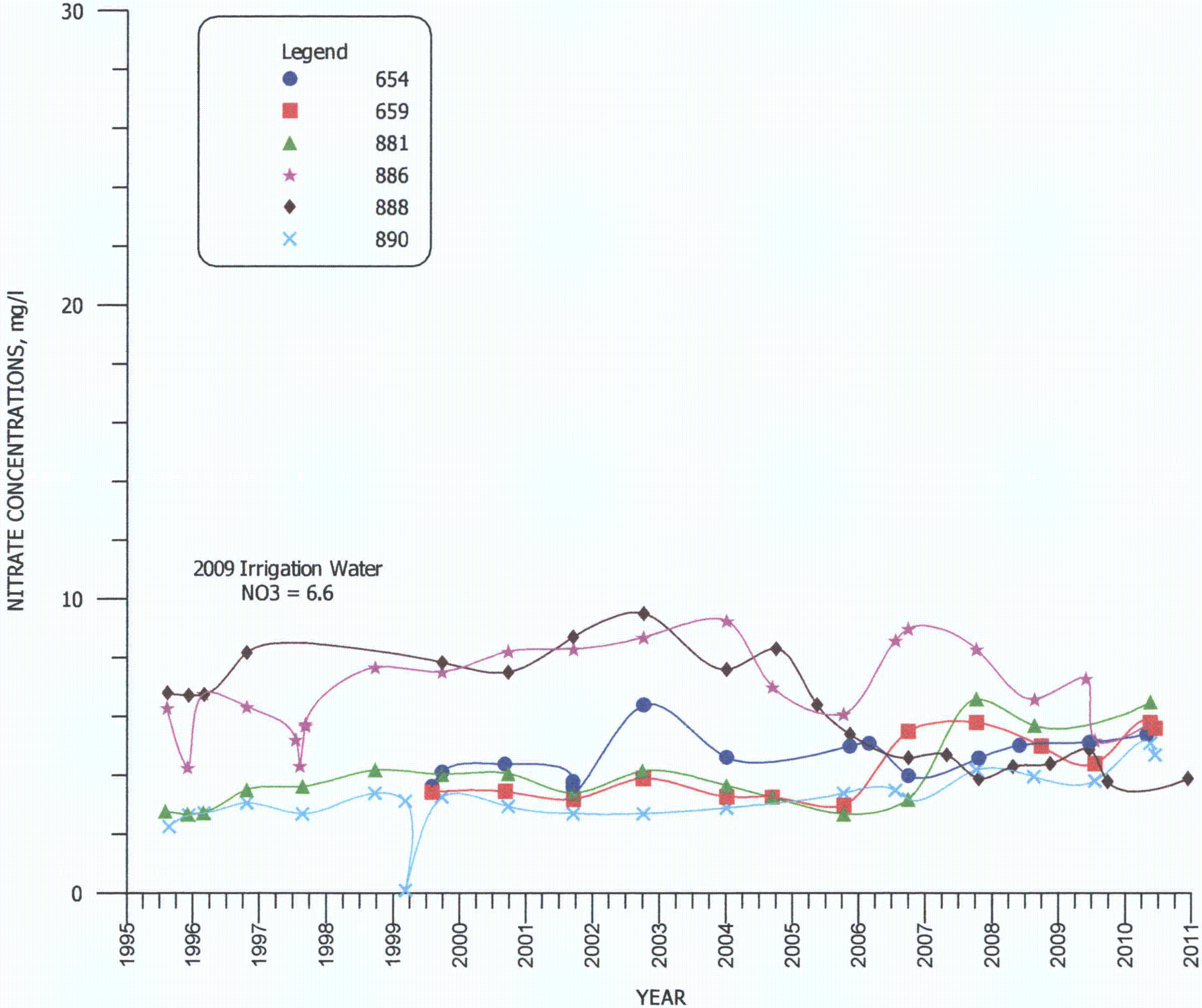
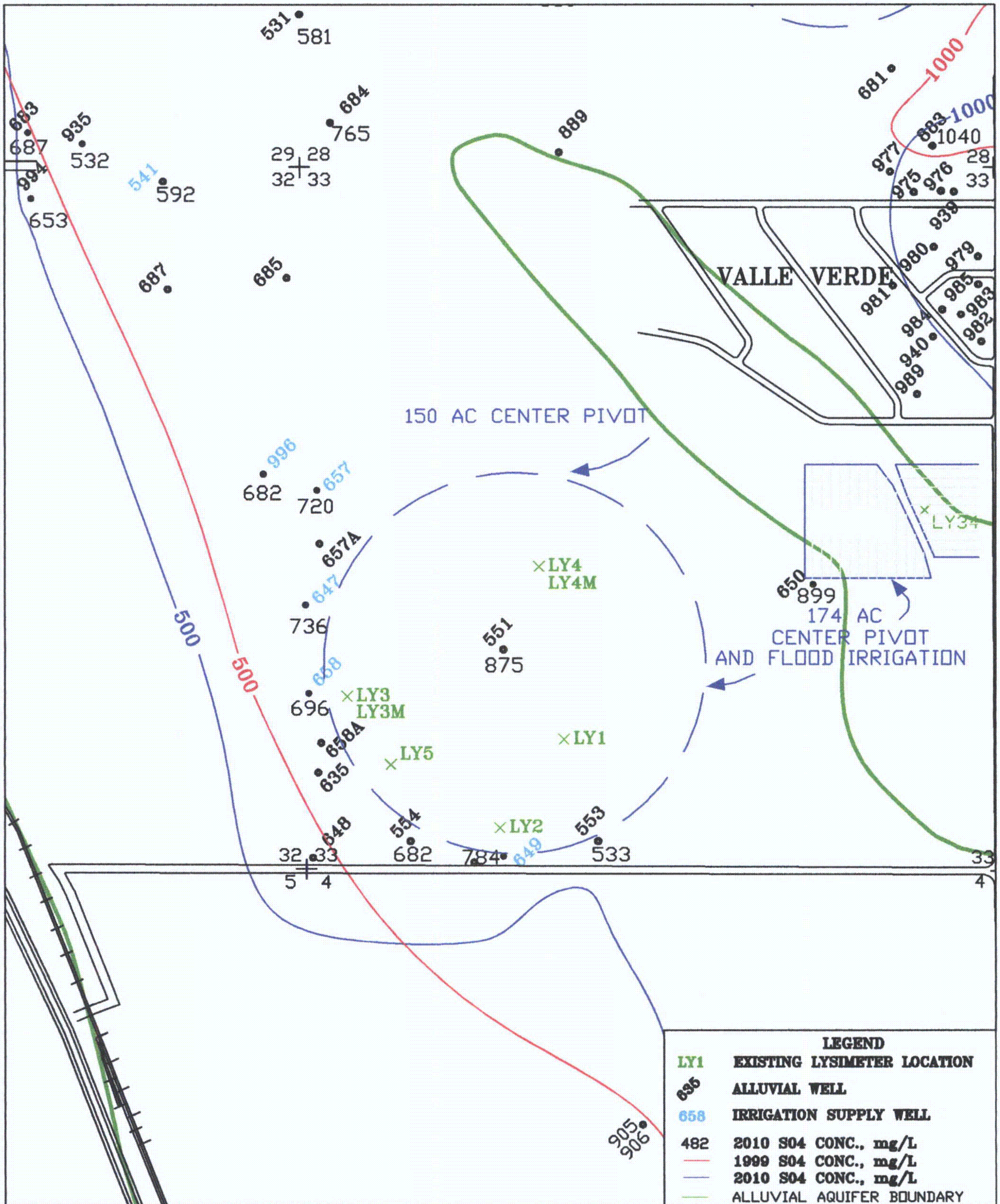


FIGURE 4-28. NITRATE CONCENTRATIONS FOR WELLS 654, 659, 881, 886, 888 AND 890.



SCALE: 1" = 1000'

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FIGURE 4-29. 1999 AND 2010 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

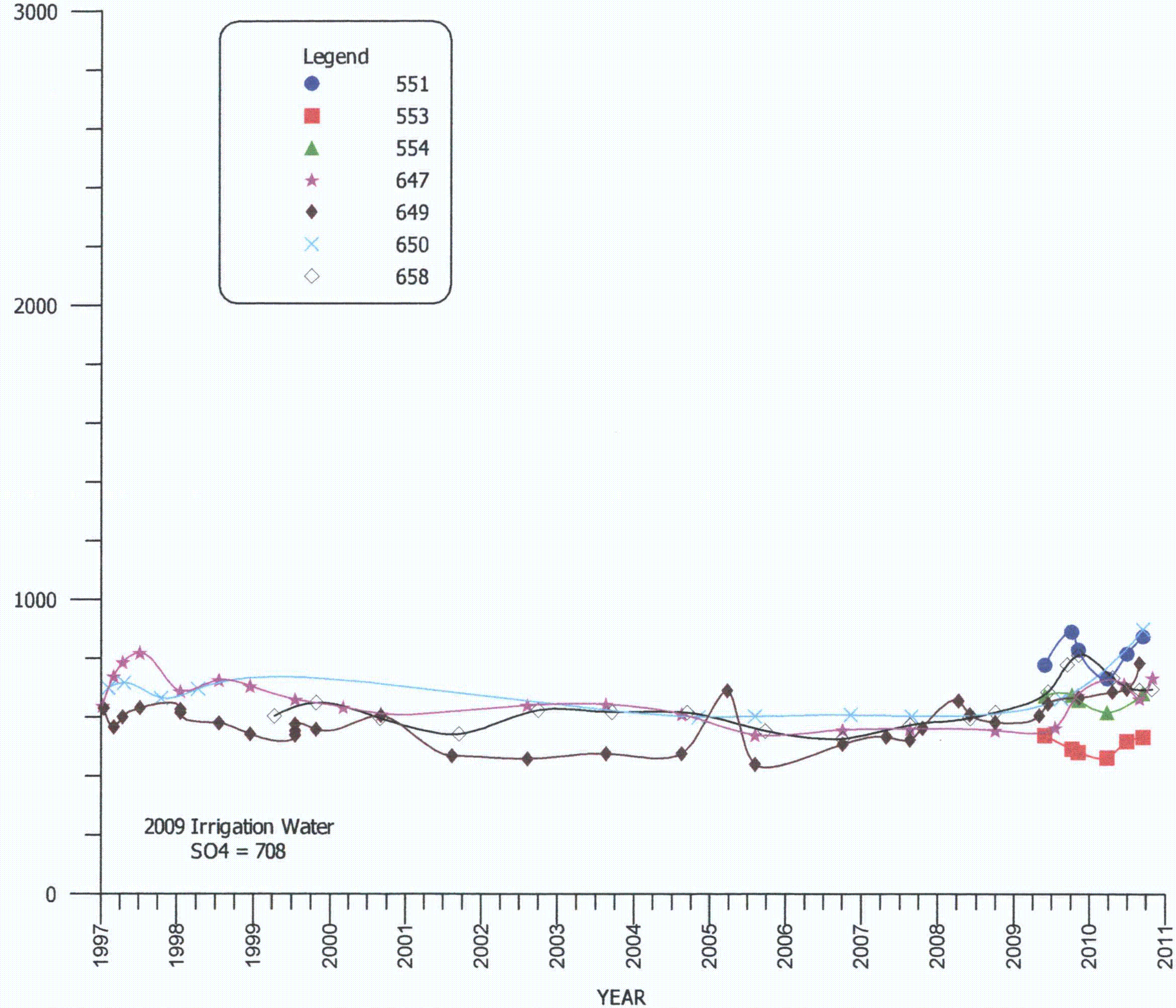
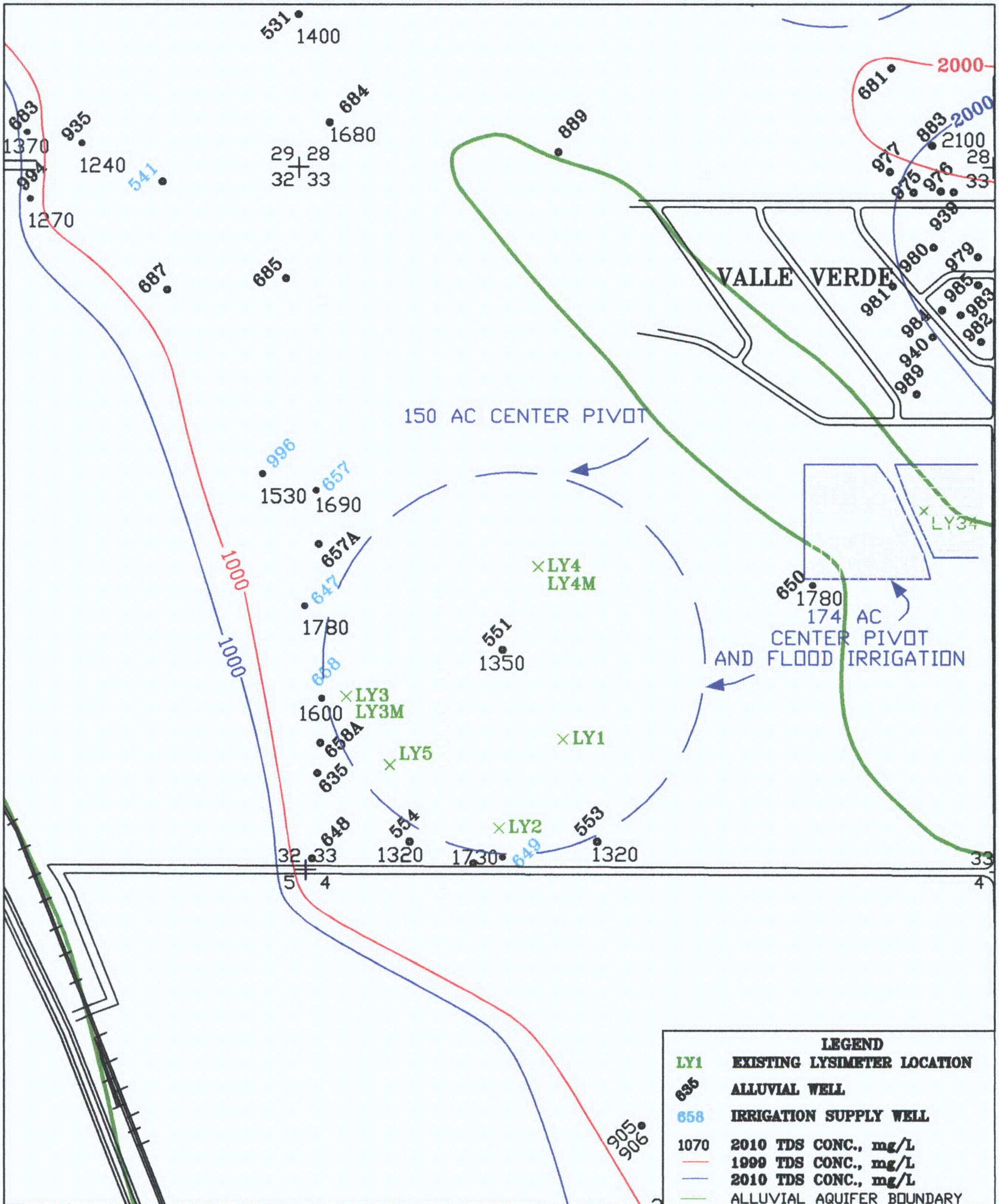


FIGURE 4-30. SULFATE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'	FIGURE 4-31. 1999 AND 2010 TDS ALLUVIAL CONCENTRATION IN SECTION 33, mg/L	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO
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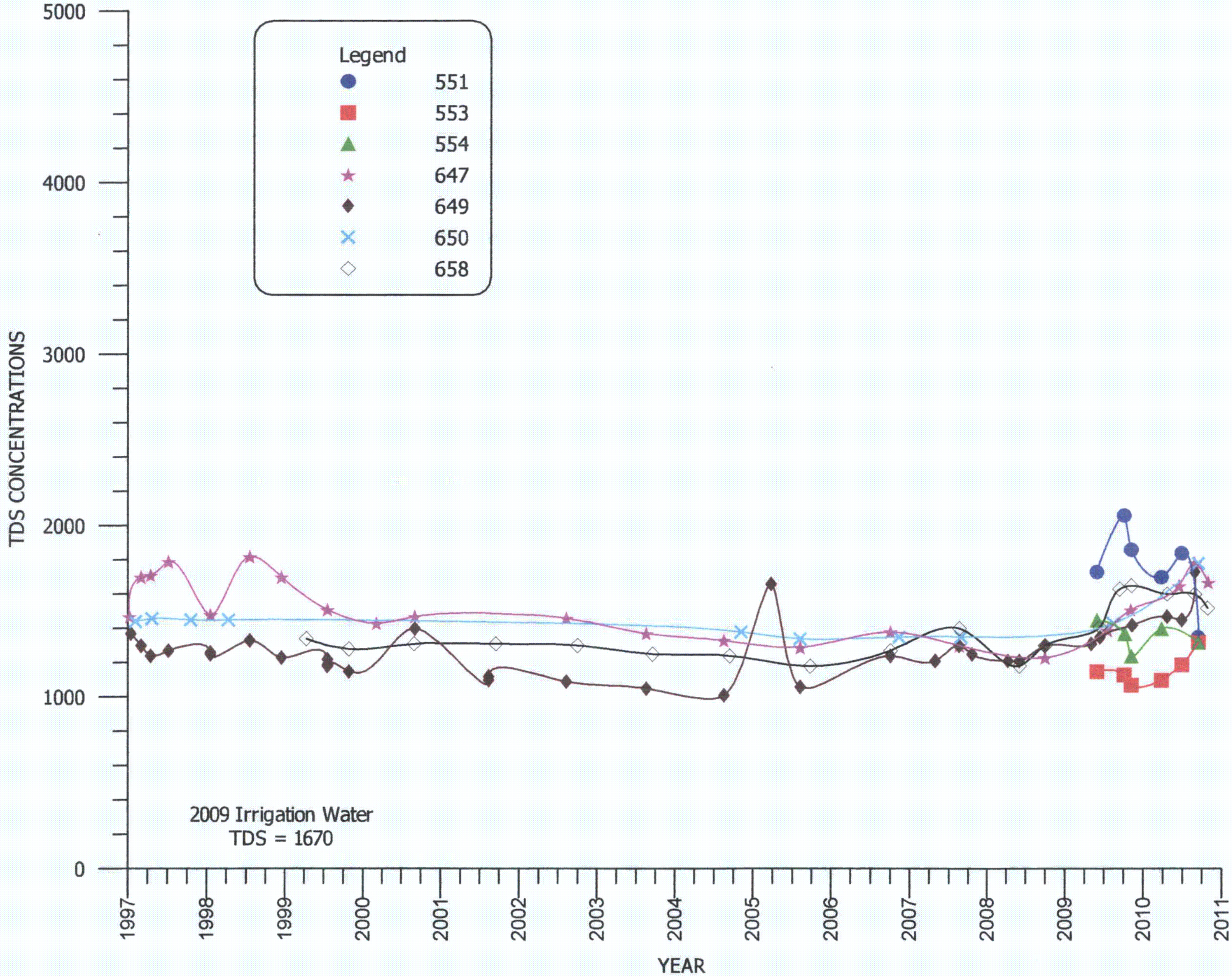
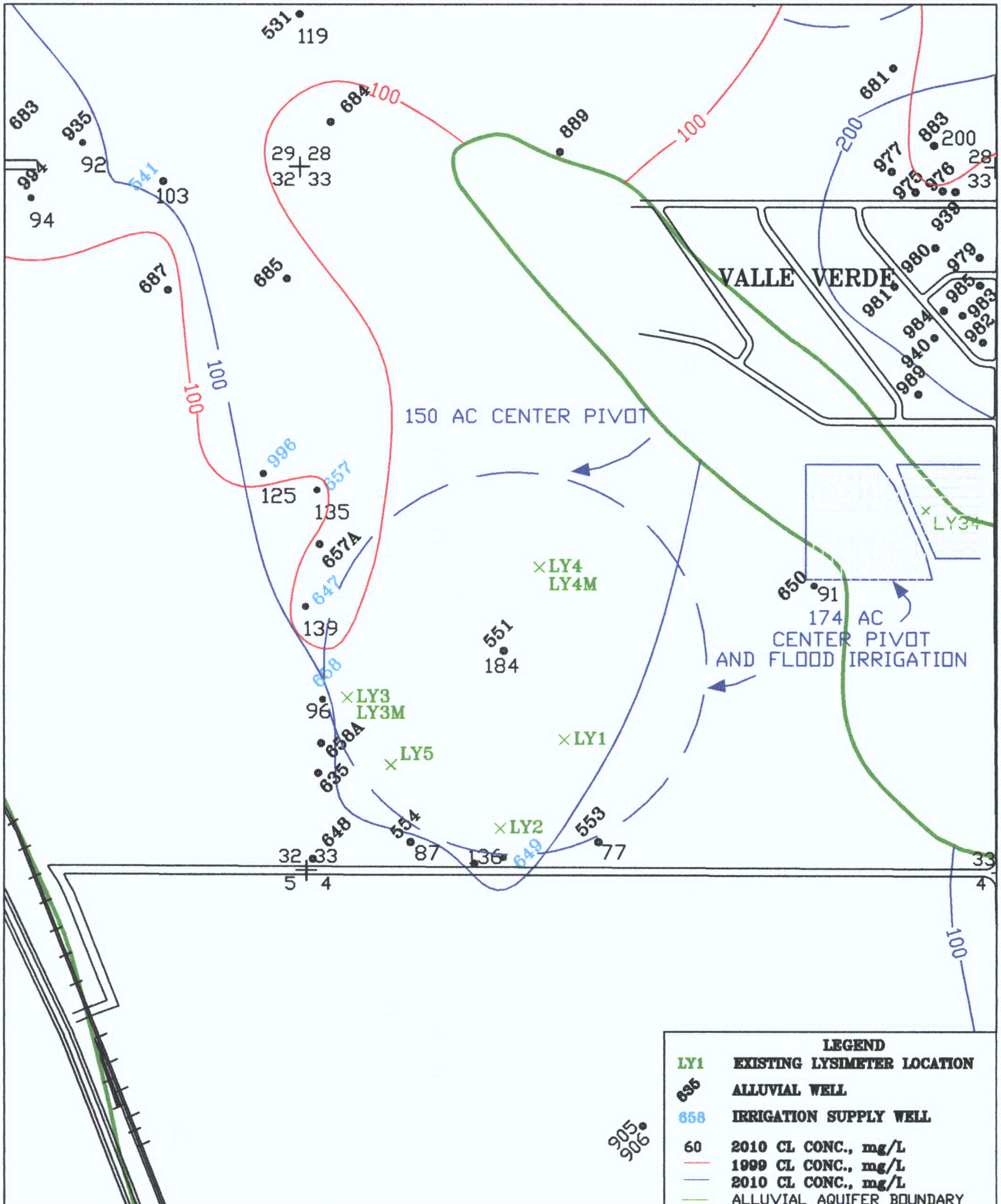


FIGURE 4-32. TDS CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'

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FIGURE 4-33. 1999 AND 2010 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY

GRANTS, NEW MEXICO

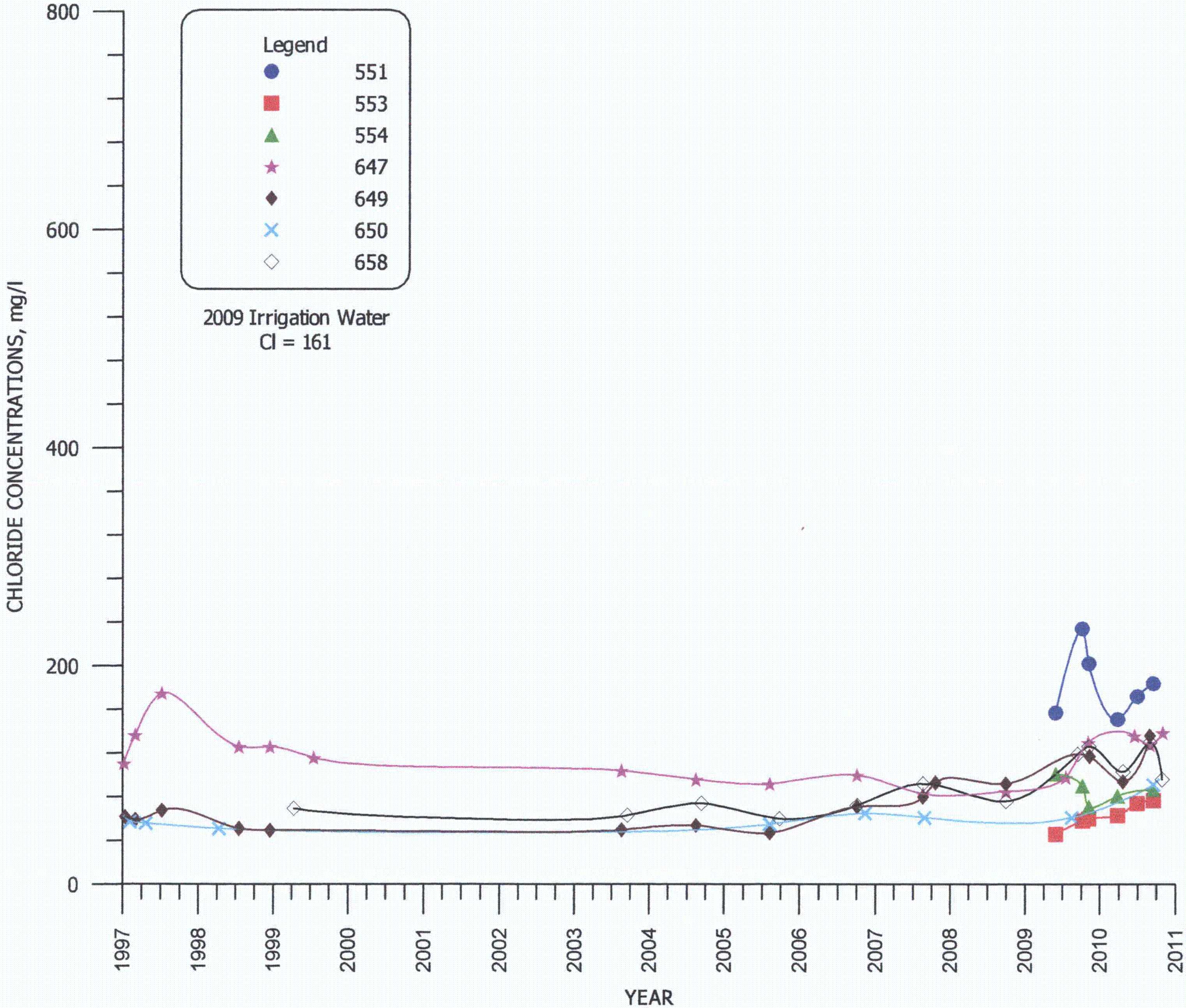
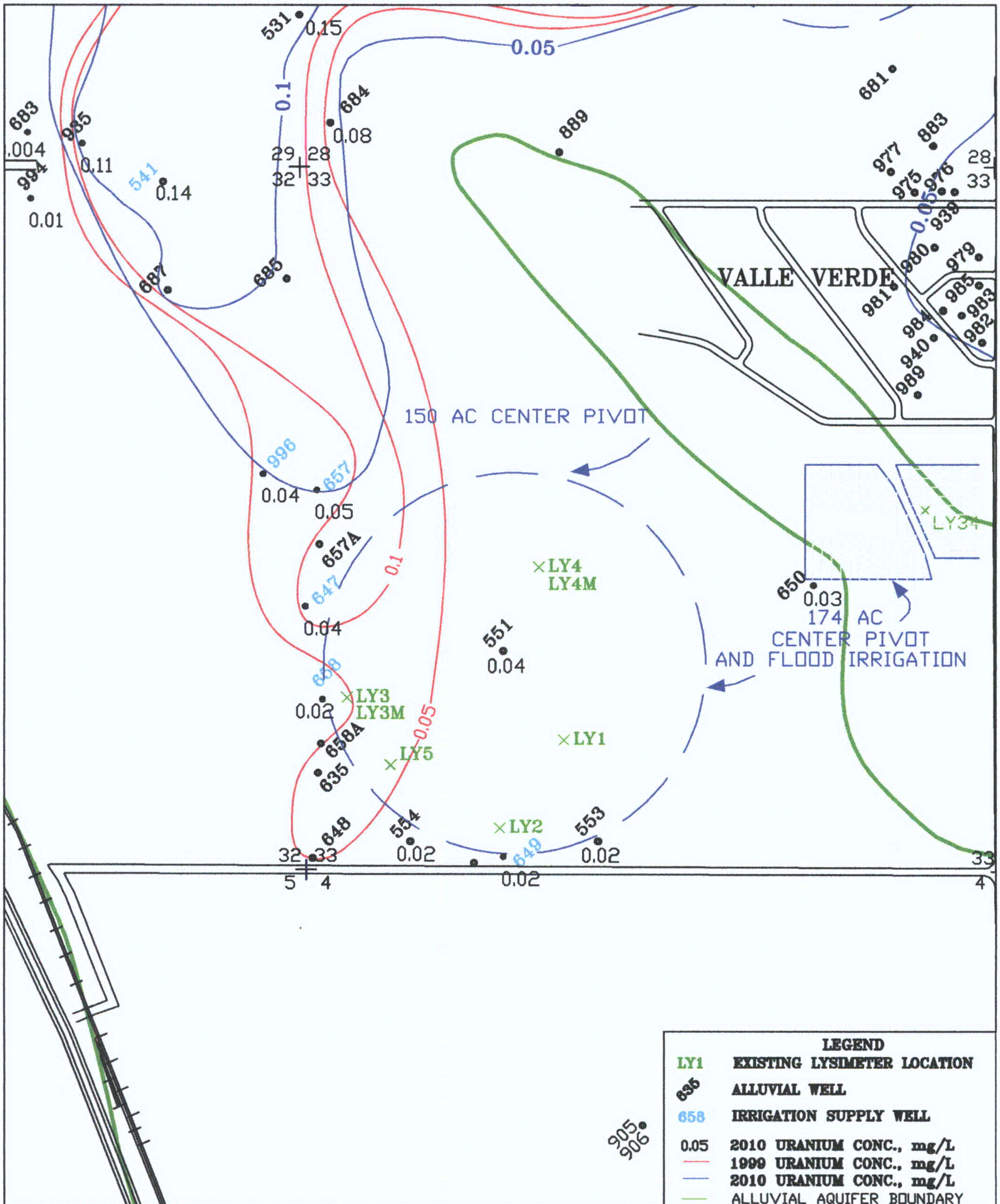


FIGURE 4-34. CHLORIDE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1' = 1000'

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FIGURE 4-35. 1999 AND 2010 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

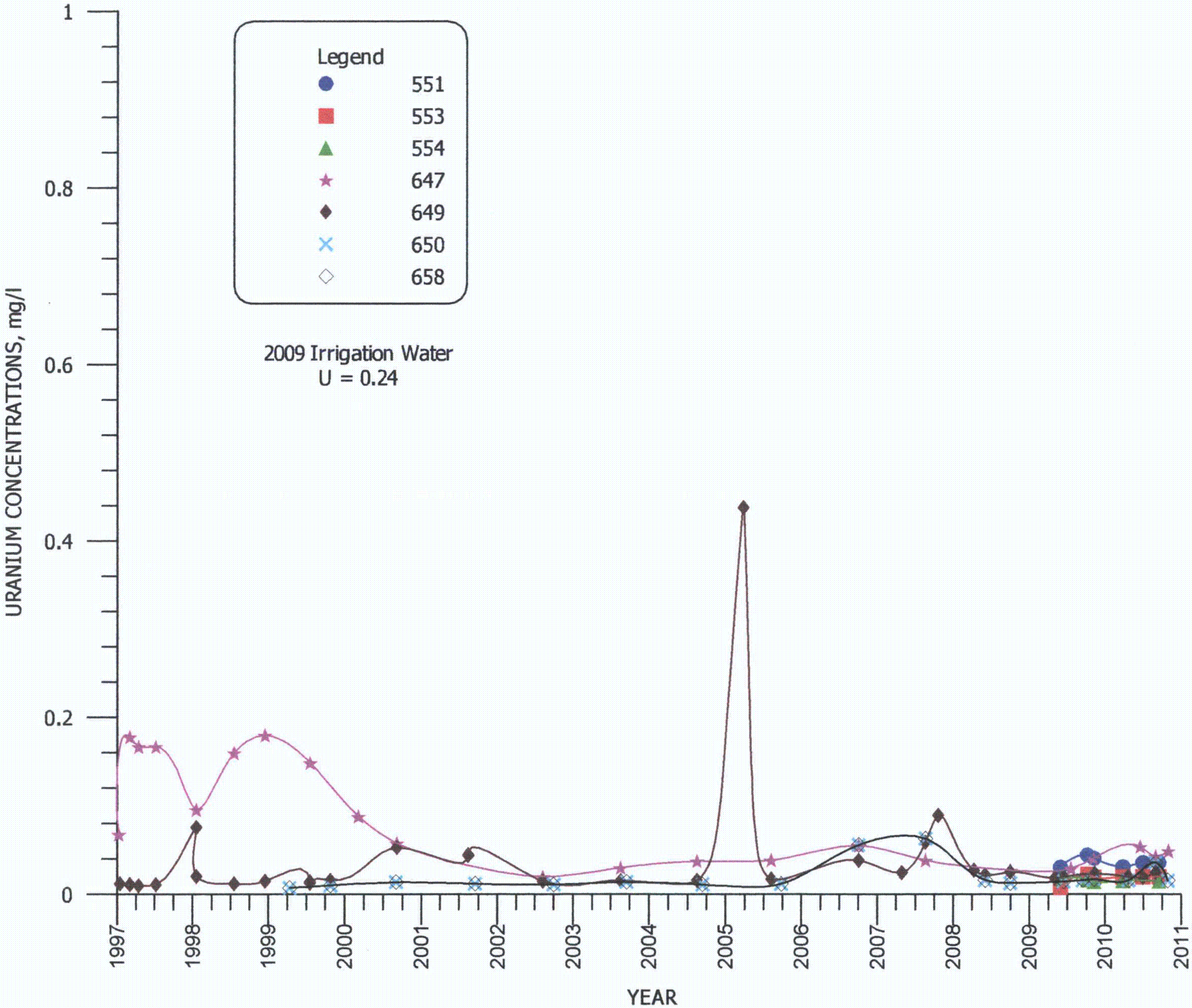


FIGURE 4-36. URANIUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.

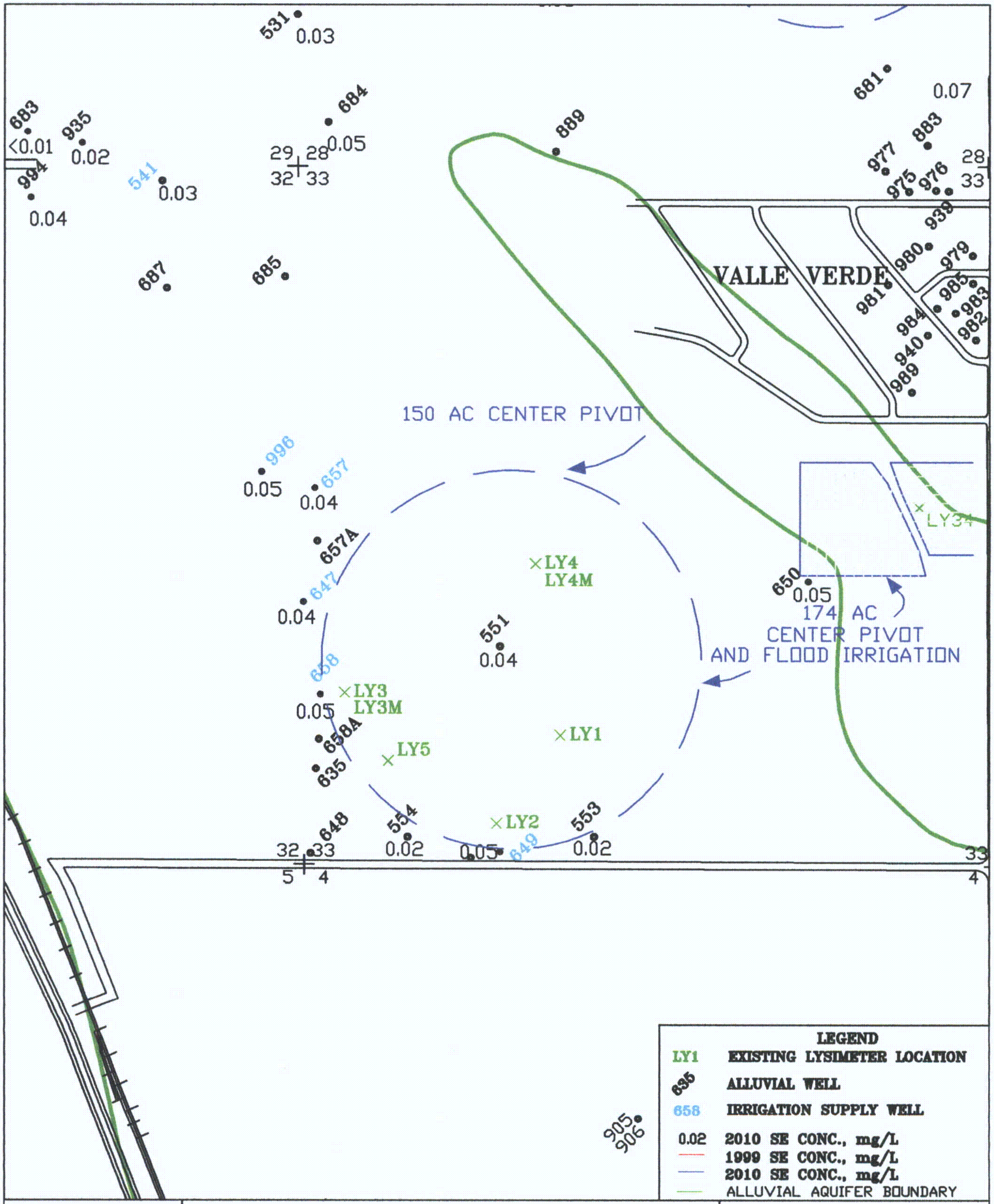


FIGURE 4-37. 2010 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

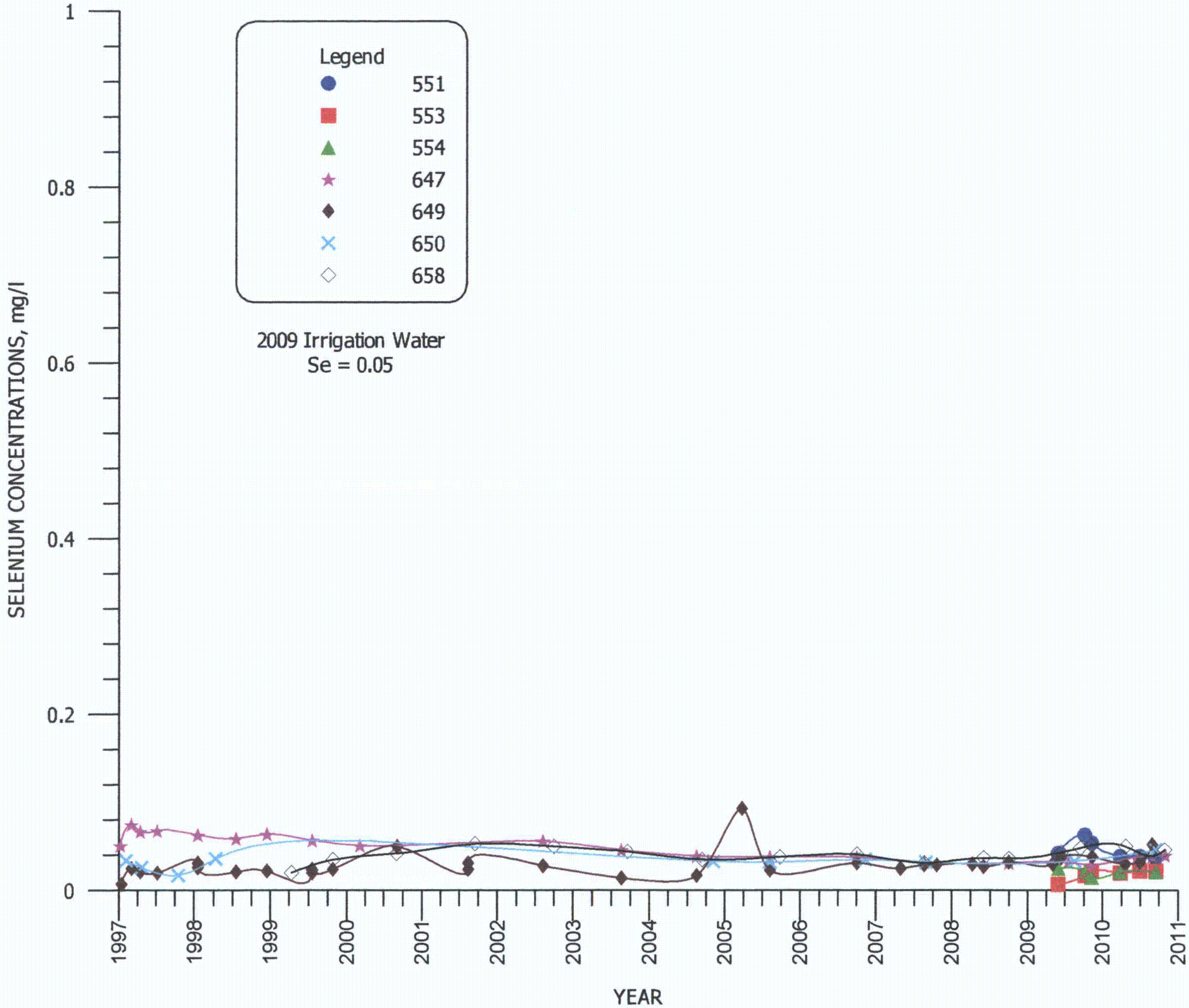
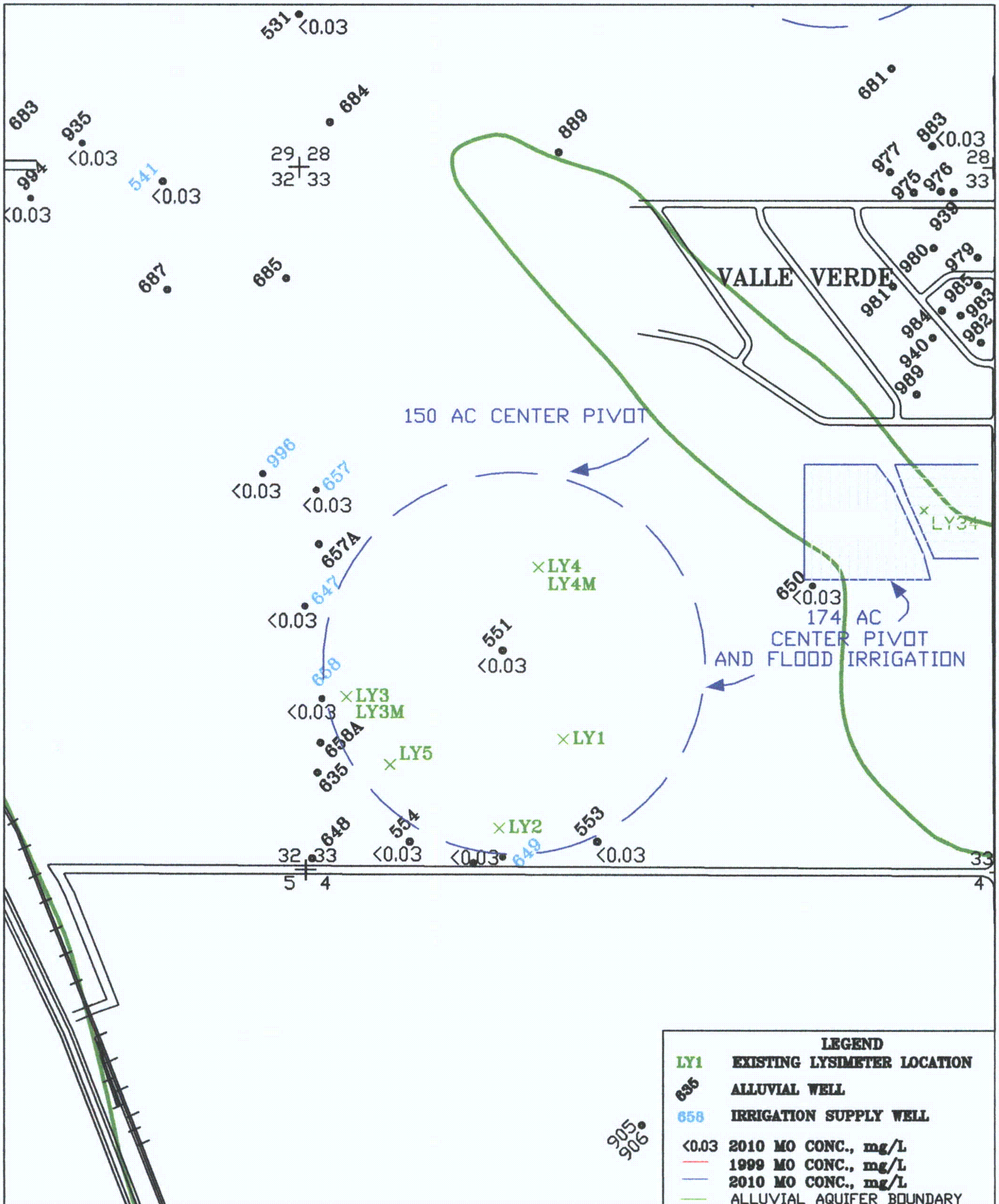


FIGURE 4-38. SELENIUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'	FIGURE 4-39. 2010 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO
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DATE: 1/10/11		

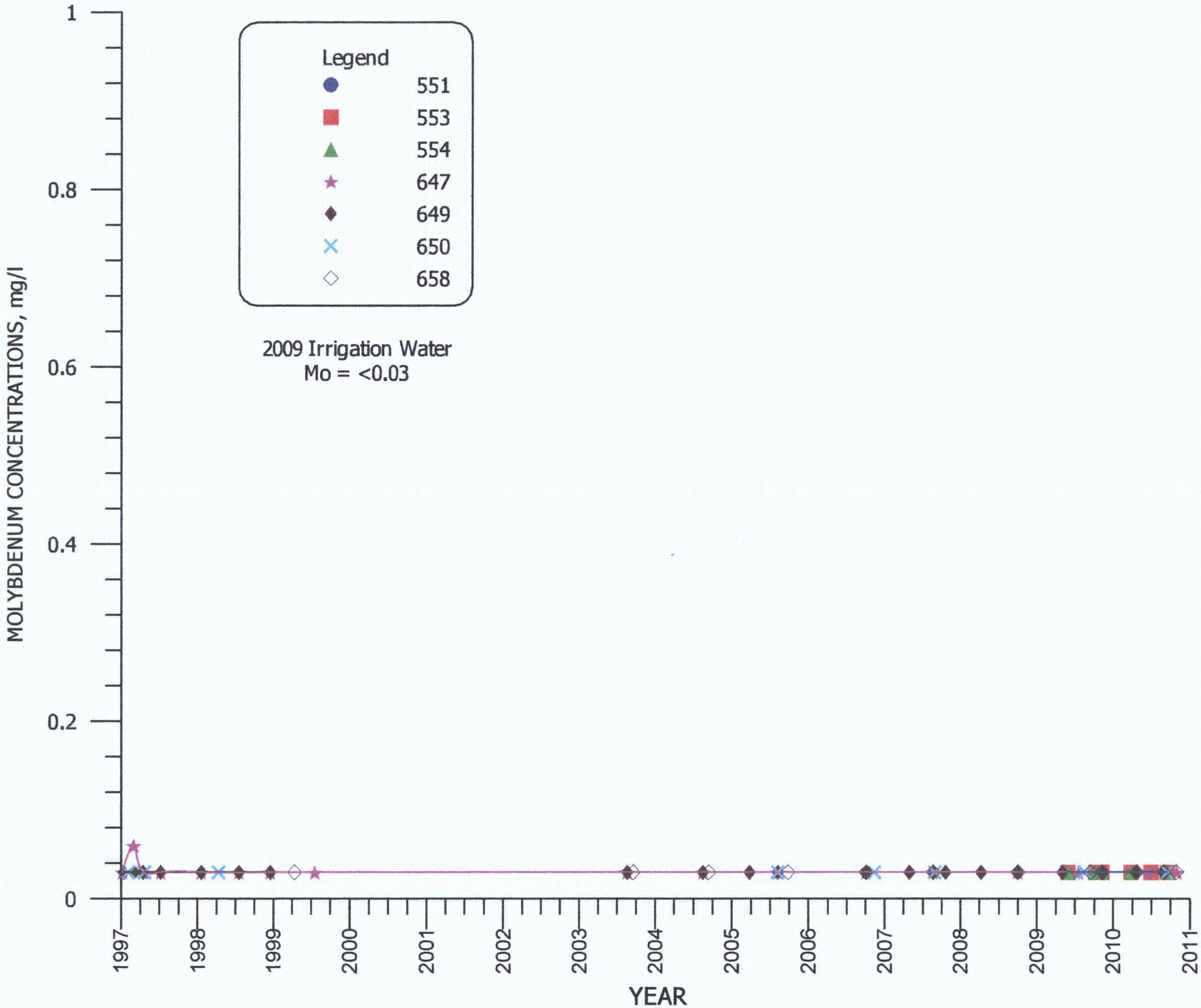
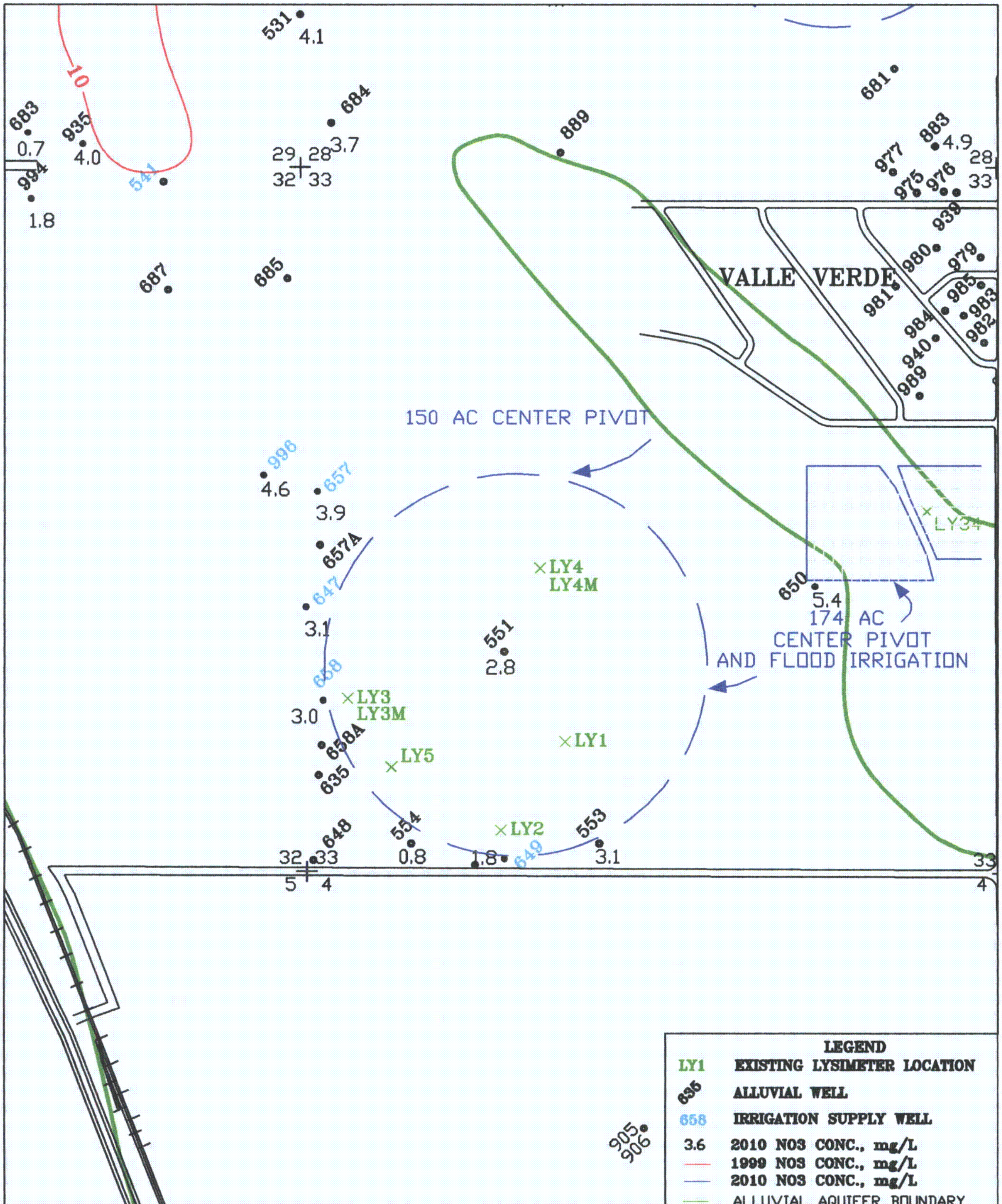


FIGURE 4-40. MOLYBDENUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'

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FIGURE 4-41. 1999 AND 2010 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

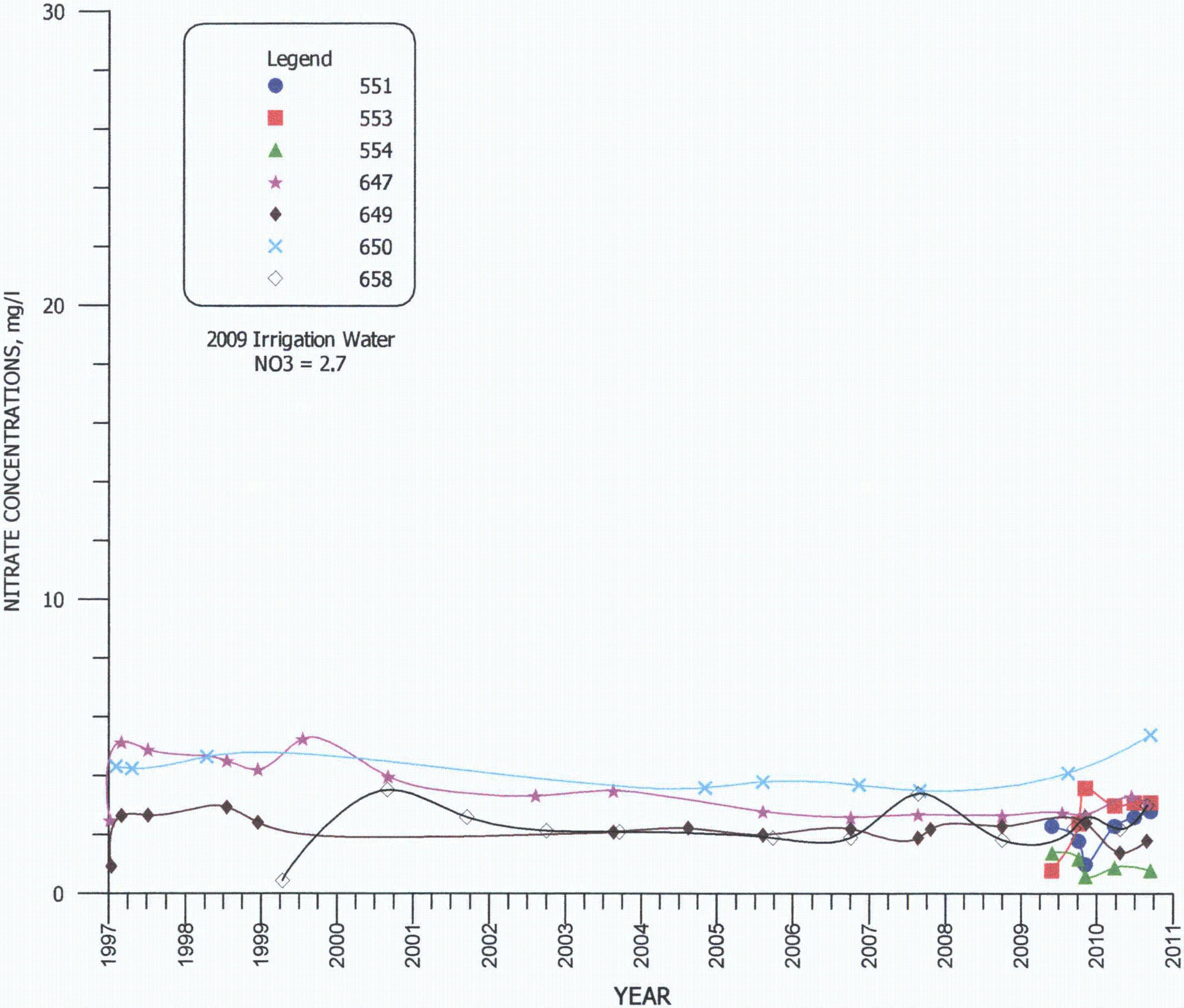

FIGURE 4-42. NITRATE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.

5.0 Predicted Ground-Water Concentrations

Predicted ground-water concentrations due to the irrigation restoration may be obtained by analysis of the mixing the ground-water flow in the area with predicted soil moisture drainage through the soil profile. These mixing calculations were made for each irrigation area to estimate the potential change in the ground water quality. These calculations were made in some cases even when the soil moisture modeling did not indicate the migration of constituents to the water table to present a worst-case scenario.

5.1 Section 34

Modeling predictions shows that the soil moisture from irrigation in the Section 34 Flood area should not reach the water table at 35 feet for more than 90 years. Worst-case calculations were made by assuming that the soil moisture TDS does reach the water table even though modeling does not predict this migration. If the soil moisture would reach the water table, the mixing with the ground-water concentrations would result in a small increase in the TDS concentration, which would still be lower than the site standard.

The ground-water flow through the flood area in the alluvial aquifer is estimated to be at a rate of 37.5 gpm based on a transmissivity of 3,000 gal/day/ft, a width of 3,000 ft and a gradient of 0.006 ft/ft. A typical TDS concentration in the flood irrigation area is 2,600 mg/l. The mixing of this ground water with the long-term flux rate of 3 mm/year at a TDS concentration of 7,000 mg/l in this soil moisture (even though modeling does not indicate TDS will reach the water table) would result in an increase of TDS in the ground water to 2,684 mg/l (see Table C-5 in Appendix C for these calculations). This small increase in TDS would be very difficult to detect and is not expected based on the model predictions of TDS movement.

The ground-water flow through the flood area in the alluvial aquifer as presented in the previous discussion is 37.5 gpm. An average sulfate in the flood irrigation area is 1,292 mg/l. The mixing of this ground water with the long term flux rate of 3 mm/year at a sulfate of 3,100 mg/l in this soil moisture (even though modeling does not indicate sulfate will reach the water table) would result in an increase of sulfate in the ground water to 1,327 mg/l. This small increase in sulfate would be very difficult to detect and is not expected based on the soil moisture predictions of sulfate movement.

Due to the small flux of moisture after irrigation, the potential minimal long-term effects of drainage of water can be estimated based on the above soil moisture drainage rate of 3 mm/year and a ground-water flow of 37.5 gpm. The average uranium concentration in the ground water in the flood area is 0.076 mg/l. Even though the modeling does not indicate this, an assumed uranium concentration of 0.5 mg/l in the soil moisture reporting to the water table was used to see evaluate potential effect on the ground water. The mixing of the ground-water flow rate of 37.5 gpm with the long-term soil moisture flux of 0.73 gpm in the irrigation area results in a conservative estimate of uranium concentration of 0.084 mg/l. This calculation shows that even if the uranium made it to the water table, which modeling does not predict, a very small increase in the uranium concentration would be observed in the ground water.

Even though the modeling indicates that the selenium concentration will never reach the water table, a comparison of impacts of selenium on the ground water could be made assuming that the a selenium concentration of 0.2 mg/l makes it to the water table with the long-term soil moisture flux. The mixing of the above ground water and long-term flow rates of 37.5 and 0.73 gpm, respectively, with an average ground water selenium concentration of 0.05 mg/l and a soil moisture selenium concentration of 0.2 mg/l, which the model does not indicate, produces a mixed concentration of 0.053 mg/l. This small increase in concentration would not be detectable in the ground water.

5.2 Section 28

The flux of soil moisture during the proposed future irrigation varies but is approximately 120 mm/year or 24 gpm for the Section 28 area. The mixing of this 24 gpm with a TDS concentration of 5,000 in the soil moisture and the ground-water flow of 206 gpm (based on a transmissivity of 30,000 gal/day/ft, a width of 2,360 feet and a gradient of 0.0042 ft/ft, see Table C-6 in Appendix C for calculations) can be used to estimate the resulting TDS of the ground water. Analysis of this mixing of the soil moisture water with the ground-water base flow indicates that the resulting ground-water TDS concentration should increase from 1,762 mg/l to 2,100 mg/l. This prediction indicates that a small effect will occur during the initial years of irrigation in Section 28, but this TDS is still similar to most of the existing concentrations in the Section 28 area.

The modeling indicates that the soil moisture drainage rate into the ground water will rapidly diminish after the irrigation ceases and the long-term rate will be approximately 4 mm/year or 0.81 gpm for the Section 28 irrigation area. Mixing of this soil moisture with a TDS concentration of 5,000 mg/l and the 206 gpm of ground-water flow with a TDS of 1,762 would result in a minor TDS increase to 1,775 mg/l. This increase is not expected to be detectable. A small increase in ground water TDS concentration will result during and shortly after the years of irrigation, but this will occur during the years of restoration of ground water in this area and will likely be difficult to detect due to natural variability in this constituent. The long- term effects on TDS concentration from the drainage of irrigation water should not be detectable.

The flux of soil moisture during the proposed future irrigation varies but is approximately 120 mm/year or 24 gpm from the Section 28 area. Analysis of mixing of this 24 gpm with a sulfate of 2,200 in the soil moisture and the ground-water flow of 206 gpm can be used to estimate the impact of irrigation on sulfate concentration in the ground water. This mixing of the soil moisture water with the ground-water base flow indicates that the resulting concentration should increase the sulfate concentration of the ground water from 797 mg/l to 943 mg/l. This prediction indicates that a small effect will occur during the initial years of irrigation in Section 28, but this sulfate concentration is still similar to most of the existing concentrations in the Section 28 area.

Previous discussions have presented the expected long-term rate of drainage from the Section 28 irrigation area as 0.81 gpm. Mixing calculation of this soil moisture with a sulfate of 2,200 mg/l and the 206 gpm of ground-water flow with a sulfate of 797 indicates that the sulfate would increase only to 802 mg/l or an increase that will not be detectable. A small increase in sulfate concentration in the ground water will result from the years of irrigation but this will occur during the years of restoration of ground water in this area and will likely be difficult to detect due to natural variability in concentrations of this constituent. The long-term effects from the drainage of the irrigation water on sulfate should not be detectable.

Mixing of the soil moisture uranium concentrations and the alluvial ground water was evaluated assuming that the uranium concentration in the long term soil moisture reaches 0.5 mg/l at the ground-water table, even though model predictions do not indicate this mobility. The average restored uranium ground-water concentration is expected to be 0.1 mg/l in the Section 28 pivot area. This analysis indicates uranium concentration in the ground water would increase to 0.102 mg/l after mixing. Even if a significant soil moisture uranium concentration did reach the water table, the increase in the ground water uranium concentration would be insignificant due to the very small amount of long-term soil moisture flux.

The mixing of the soil moisture selenium concentrations in the ground-water calculations were also made to estimate the long-term selenium concentrations due to the Section 28 irrigation. The ground-water selenium concentration after restoration is expected to average 0.04 mg/l. This concentration mixed with a long-term selenium concentration of 0.2 mg/l in the irrigation soil moisture, which is not indicated by the modeling, was used to estimate the potential long-term impacts on the ground water for selenium from the irrigation. This mixing of the ground water and soil moisture indicates that the selenium concentration would increase to 0.0406 mg/l, which is not significant.

5.3 Section 33

The flux of soil moisture during the proposed future irrigation varies but is approximately 40 mm/year or 12 gpm for the Section 33 area. The mixing of this 12 gpm of soil moisture with a TDS of 3,400 and the ground-water flow of 100 gpm (based on a transmissivity of 10,000 gal/day/ft, a width of 2,885 feet and a gradient of 0.005 ft/ft, see Table C-7 in Appendix C for calculations) can be used to estimate the TDS of the ground water with the effects from the irrigation. This mixing of the soil moisture water with the ground-water base flow indicates that the resulting concentration should increase the TDS concentration of the ground water from 1,540 mg/l to 1,740 mg/l. This prediction indicates that a small effect will occur during the initial years of irrigation in Section 33, but this TDS is still similar to most of the existing concentrations in the Section 33 irrigation area.

The modeling indicates that the soil moisture drainage rate into the ground water will rapidly diminish after the irrigation ceases and the long-term rate will be approximately 4 mm/year or 1.2 gpm for the Section 33 irrigation area. Mixing of this soil moisture with a TDS concentration of 3,400 mg/l and the 100 gpm of ground-water flow with a TDS of 1,540 indicates that the TDS concentration would increase to only 1,562 mg/l. This increase is not detectable. A small increase in TDS concentration in the ground water will result from the years of irrigation, but this will occur during the years of restoration of ground water and will likely be indistinguishable from natural variability. The long-term effects from the drainage of the irrigation water on TDS concentration should not be detectable.

Mixing of 12 gpm of soil moisture flux with a sulfate concentration of 1,500 and the ground-water flow of 100 gpm can be used to estimate the effects of irrigation on sulfate concentration of the ground water. This mixing of the soil moisture water with the ground-water base flow indicates that the resulting concentration should increase the sulfate concentration of the ground water from 718 mg/l to 802 mg/l. This prediction indicates that a small effect will occur during the years of irrigation in Section 33, but this sulfate is still similar to most of the existing concentrations in the Section 33 area.

Previous discussions have presented the expected long-term rate of drainage from the Section 33 irrigation area as 1.2 gpm. Mixing of this soil moisture with a sulfate concentration of 1,500 mg/l and the 100 gpm of ground-water flow with a sulfate concentration of 718 mg/l indicates that the sulfate would increase to only 727 mg/l. This increase is not detectable. A small increase in sulfate concentration in the ground water will result from the years of irrigation but this will occur during the years of restoration of ground water in this area and will likely be indistinguishable from natural variability. The long-term effects from the drainage of the irrigation water on sulfate should not be detectable.

A mixing of the soil moisture uranium concentrations and the alluvial ground water was made assuming that the uranium concentration in the long-term soil moisture reaches 0.5 mg/l at the ground-water table, even though our predictions do not indicate this mobility. The average restored uranium ground-water concentration is expected to be 0.02 mg/l in the Section 33 pivot area. This analysis indicates a mixed ground water uranium concentration of 0.026 mg/l. Even if a significant soil moisture uranium concentration did reach the water table, the increase in the ground water would be insignificant due to the very small long-term soil moisture flux rate.

Analysis of the mixing of the soil moisture selenium concentrations with the ground water allows estimation of the impacts of the Section 33 irrigation. The ground-water selenium concentration after restoration is expected to be similar to present concentration with an average of 0.034 mg/l. This concentration mixed with a long-term selenium concentration of 0.2 mg/l in the irrigation soil moisture, which is not indicated by the modeling, was used to estimate the potential long-term impacts on the ground water selenium concentration. This mixing of the ground water and soil moisture indicates that the selenium concentration would increase to 0.036 mg/l, which is not significant.

In conclusion, the soil moisture transport modeling for the Section 33 center pivot irrigation shows that the selenium and uranium concentrations will not reach the water table. Even if significant concentrations of these two constituents eventually reach the water table, their concentrations would not measurably increase the observed concentrations in the ground water due to the low rate of soil moisture flux to the ground-water table.

6.0 Vegetation Concentrations and Constituent Uptakes

Alfalfa was grown exclusively as hay crop in the irrigated areas until 2008, except for the outer 40 acres in Section 28, which was planted in grass in 2005. The following changes were made in the irrigated crops in 2008. The field in the western half of the Section 34 flood area was tilled and replanted with triticale. The eastern half also had triticale seeded with the current alfalfa crop, but was not tilled. The 24 acres in the eastern portion of the Section 33 flood area were tilled and replanted with triticale. No crop was obtained from this area in 2008 due to late season planting. The crop in the Section 33 center pivot area had 25 acres of canola and 25 acres of camelina crop seeded into the current alfalfa (see Appendix D).

In 2009 the hay production was limited to the planting of sorghum/sudan grass in the Section 34 flood area. The Section 33 Center Pivot was planted to a permanent pasture in 2009 and a test canola crop was planted in Section 28. The Section 34 flood area was planted in sorghum/sudan grass in 2010 while Section 33 and 28 were planted in winter wheat.

Constituents in soil are known to be taken up by plants. The extent of plant uptake is dependent on many parameters, including the constituent and the plant species. The concentrations of uranium and selenium in each cutting of hay were measured and compared to the soil concentration measured at the end of the growing season. The ratio of the concentration in plants to that in the soil is defined as the transfer coefficient from soil to plant. The transfer coefficients have been calculated and compared to NRC values that are based on published studies. All hay data and transfer coefficients are based on concentrations calculated from dry weights of both soil and vegetation. An analysis and discussion of the production of hay or pasture concludes this section.

6.1 Measured Vegetation Concentrations

The vegetation samples were collected after the hay was cut and prior to the baling of hay. Sections 33 and 28 vegetation samples were collected from the field prior to grazing of these two fields. The samples are collected from a distribution similar to the soil sample site distribution. The vegetation samples were analyzed by an offsite vendor laboratory.

6.1.1 Sections 33 and 34 Flood Areas

In Section 34, ten samples were collected from the first two cuttings in 2001 and eight samples were collected from the third cutting. Six samples were collected from each of four cuttings in 2002. In 2003, twelve, seven and twelve samples were collected from the first, second and third cuttings, respectively. In 2004 and 2005, twelve and six samples were analyzed for the first and second cuttings, while ten and six samples were collected for the first and second cuttings in

2006. Six samples were collected from the first cutting in 2007. Six and twelve samples were collected from the first and second cuttings in 2008. Higher uranium concentrations were observed in the second cutting in 2002 and third cuttings in 2001 and 2003. The highest selenium concentrations for each cutting were similar, and occurred in the first cuttings of 2001, 2003, 2004 and 2005; the second cutting of 2006, and in the fourth cutting in 2002. The hay was not cut on the Section 33 flood area in 2004, 2006, 2007, 2008 and 2009. The 2009 uranium and selenium vegetation concentrations were similar to the previous Section 34 values. The vegetation cuttings produced similar uranium concentrations in 2010. Table 6-1 presents the summary of the uranium and selenium concentrations in the Section 34 cuttings.

6.1.2 Section 28 Center Pivot

Six samples were collected in 2002 from the first hay cutting in the Section 28 irrigation area. Only one cutting was obtained from Section 28 because a crop of millet was used to establish cover over the site prior to alfalfa seeding. Twelve samples were collected from each of the three cuttings in 2003 through 2007. In 2008 and 2009, twelve samples were also collected. Average uranium concentrations have varied from 0.29 to 1.83 mg/kg. Selenium concentrations varied from 0.79 to 1.8 mg/kg. In general, uranium concentrations in the 2009 vegetation samples from Section 28 were similar to those observed in previous years. The 2009 average selenium concentration is slightly higher than previous values and may be due to increased uptake by the canola. The 2010 average uranium concentration is very similar to the 2009 value. Table 6-1 presents the summary of the uranium and selenium concentrations in the Section 28 cuttings.

6.1.3 Section 33 Center Pivot

During the first and second cuttings in Section 33 in 2001, eight samples were taken from various portions of the field. Sixteen samples were collected from the third cutting. Eight samples were taken from each cutting in 2002. Twelve samples were taken from each cutting in 2003 through 2008, but in 2008 only two cuttings were taken. The individual results are reported in Appendix B where the concentrations are reported on a dry-weight basis. The uranium and selenium concentrations were generally slightly higher in the first cutting each year with the exception of 2007 and 2008. Selenium concentrations were generally lower for the second and third cuttings. The average uranium and selenium values from the permanent grass sampled in 2009 and 2010 are similar to the hay values of previous years. Table 6-1 presents the summary of the uranium and selenium concentrations in the Section 33 cuttings.

6.1.4 Background Concentrations in Hay and Special Study

In 2000, a composite sample was prepared from ten samples collected from the second cutting in Section 33 (see Appendix D for data). The sample was split and one of the samples was washed with tap water prior to analysis. The results were 0.62 mg/kg and 0.58 mg/kg for uranium and 1.4 mg/kg and 1.5 mg/kg for selenium. These results indicate that uranium and selenium in the sample did not arise from material deposited on the exterior plant surfaces.

Two samples of baled hay collected from hay fields a few miles to the northwest of the Homestake Mining Company irrigation areas were taken in 2000 for comparison to that grown in this study. While it is not known what the constituent soil concentrations were, it is known that water from the shallow alluvial aquifer near the Grants Project was not used as a source for irrigation. The uranium concentrations were reported as 0.19 and 0.05 mg/kg; the selenium concentrations were 0.2 and 0.1 mg/kg. These data indicate lower levels of uranium and selenium in what is assumed to be background hay samples.

Table 6-1. Summary of Vegetation Analyses

Irrigation Areas										
	Section 33			Section 34				Section 28		
Year	1st Cut	2nd Cut	3rd Cut	1st Cut	2nd Cut	3rd Cut	4th Cut	1st Cut	2nd Cut	3rd Cut
Average Uranium Concentrations (mg/kg)										
2000	1.12	0.62	----	0.73	----	----	----	----	----	----
2001	0.58	0.57	0.30	0.55	0.38	0.71	----	----	----	----
2002	1.32	0.37	0.77	0.92	1.52	0.54	0.88	0.29	----	----
2003	0.73	0.70	0.73	0.89	0.56	1.15	----	0.99	0.98	1.14
2004	1.62	0.51	0.90	1.02	0.88	----	----	1.09	1.17	0.86
2005	0.84	0.64	0.71	1.82	0.88	----	----	1.83	0.94	1.43
2006	0.80	0.62	0.45	0.79	0.78	----	----	1.21	0.77	0.62
2007	1.04	1.18	1.60	1.02	----	----	----	0.90	1.59	1.17
2008	0.47	0.83	----	0.49	0.43	----	----	1.68	----	----
2009	0.73	----	----	0.87	----	----	----	0.92	----	----
2010	0.21	----	----	0.45	----	----	----	0.14	----	----
Average Selenium Concentrations (mg/kg)										
2000	1.10	1.40	----	0.50	----	----	----	----	----	----
2001	1.41	1.05	0.87	1.05	0.82	0.78	----	----	----	----
2002	1.80	1.17	1.81	0.83	1.14	1.06	1.17	0.79	----	----
2003	1.70	1.46	1.54	1.62	0.80	1.11	----	1.62	1.28	1.00
2004	1.24	0.69	1.24	1.19	0.25	----	----	1.03	1.07	1.02
2005	1.25	1.29	1.27	1.90	0.80	----	----	1.50	1.24	1.48
2006	1.25	1.29	1.00	0.75	1.40	----	----	1.17	1.27	0.95
2007	1.30	1.40	1.50	1.43	----	----	----	0.90	1.20	1.33
2008	1.10	1.30	----	1.80	1.30	----	----	1.50	----	----
2009	0.90	----	----	0.70	----	----	----	1.80	----	----
2010	0.9	----	----	0.88	----	----	----	0.9	----	----

Notes:
No cuttings were obtained from the Section 33 Flood in 2004. This was a new field, with no hay production.

6.1.5 Summary of Vegetation Concentrations

Table 6-1 presents a summary of the concentrations observed in hay cuttings from 2000 to 2010. No trends are apparent for uranium or selenium during 2003 to 2010. The data indicate a slight decrease in uranium from the first to the third cutting. No trends are evident for selenium. The average uranium concentrations in the 2009 vegetation cuttings ranged from 0.73 to 0.92 mg/kg. In 2009, the average selenium concentrations in vegetation ranged from 0.7 to 1.8 mg/kg. Prior years' results show a similar range for the upper limit. Recent studies have shown that selenium in cattle diets plays an important role in maintaining cattle health and nutrition. A minimum requirement for selenium in cattle feed appears to be about 0.1 mg/kg and in many regions of the country, selenium is added to feed. The National Research Council (NRC, 2000) has established 2 mg/kg as the Maximum Tolerable Concentration (MTC) for cattle feed. They note that toxicity is possible at levels as low as 5 mg/kg. Since the measured levels are below the MTC, further analysis of selenium in this report is considered unnecessary.

6.2 Measured Uranium Uptake in Vegetation

The uptake of constituents from soil to plants is generally considered to be directly proportional to the concentration in soil. The ratio of the concentration in the plant to that in the soil is called the transfer coefficient. The transfer coefficient from NUREG/CR-5512 for uranium in vegetation is 1.7E-2 pCi/kg-plant/pCi/kg-soil. Since the quantity of uranium is proportional to the activity in units of picoCuries (pCi), the transfer coefficient can also be expressed as 0.017 mg/kg-plant/mg/kg-soil. An estimate of the plant uptake from the application of irrigation water was initially presented in ERG and HYDRO (1999).

To measure an uptake factor in plants, the average soil concentration of the upper three layers was used since mature roots typically extend to a depth of three feet or more. The uranium concentration is tabulated in Table 3-5. Table 6-2 presents the data for the average uranium concentration in soil and hay by section and year. The transfer coefficient from soil to hay is calculated and shown in Table 6-3 for each year.

Table 6-2. Average Uranium Concentrations in Soil and Vegetation

	Avg. Uranium Soil Concentration (mg/kg)			Avg. Uranium Hay Concentration (mg/kg)		
Year	Section 33	Section 34	Secton 28	Section 33	Section 34	Section 28
2000	0.92	2.4	—	0.87	0.73	—
2001	0.69	1.92	—	0.48	0.55	—
2002	0.85	0.52	1.64	0.82	0.97	0.29
2003	1.17	2.23	0.69	0.72	0.87	1.04
2004	1.48	2.7	0.8	1.01	0.95	1.04
2005	1.2	2.66	0.67	0.73	1.35	1.4
2006	1.51	2.78	1.1	0.62	0.79	0.87
2007	1.44	3.27	1.02	1.27	1.02	1.22
2008	1.35	2.93	1.06	0.65	0.46	1.68
2009	1.8	2.82	1.33	0.73	0.87	0.92
2010	1.99	2.5	1.32	0.21	0.45	0.14
				Average:	0.83	

The calculated uranium transfer coefficients have a mean of 0.74 mg/kg-plant/mg/kg-soil and standard deviation of 0.52 mg/kg-plant/mg/kg-soil. This is more than one order of magnitude higher than the published transfer coefficient of 0.017 mg/kg-plant/mg/kg-soil. The fact that the uranium uptake is higher than predicted by the NRC published transfer coefficient might be explained by the fact that the uranium concentration in the soil moisture (and available to the plants) may be significantly higher in fields irrigated with contaminated water than for soil moisture within contaminated soil that is derived from clean groundwater or rain to support plant growth.

Table 6-3. Transfer Coefficient from Soil to Vegetation

Transfer Coefficients (mg/kg hay/mg/kg soil)			
Year	Section 33	Section 34	Section 28
2000	0.95	0.30	----
2001	0.70	0.29	----
2002	0.96	1.87	0.18
2003	0.62	0.39	1.51
2004	0.68	0.35	1.30
2005	0.61	0.51	2.09
2006	0.41	0.28	0.79
2007	0.88	0.32	1.20
2008	0.48	0.16	1.58
2009	0.41	0.31	0.69
2010	0.11	0.18	0.11
	Mean	0.68	
	SDV	0.53	

In 2002, 622 pounds (lbs) of uranium were applied to the sites, based on an average uranium concentration of 0.23 mg/l and 995 ac-ft of water. This is a small amount considering that it was applied over 330 acres. The amount of uranium removed by uptake into the hay can be estimated based on the typical observed uranium concentration of 1 mg/kg in the hay. The amount of uranium contained in the 480 tons of hay produced in 2002 is about one lb. Thus, less than 1% of the uranium that was supplied to the field in 2002 (622 lbs) was removed by the hay.

The amount of uranium and selenium being removed by the hay is insignificant. In 2002, for example, the amount of selenium contained in the 480 tons of hay produced is estimated at one pound. In 2002, less than one-half of one percent of the selenium applied to the field (243 pounds) is being removed by the hay. Similar calculated results for both uranium and selenium can be obtained for the other years.

6.3 Hay and Pasture Production

The Homestake irrigation program has produced a beneficial hay crop each year. The hay production from the irrigated areas is tabulated in Table 6-4. The production for the initial year was lower due to the initiation of a new alfalfa crop in the 270 acres of initial irrigation. Some decline in the hay production was observed starting in 2002 due to a limited amount of water to apply. A longer decline in the hay production was observed from 2004 through 2008 due to the age of the alfalfa and the non-use of fertilizer on the crops except for the initial application.
The bottom half of Table 6-4 presents the fertilizer applications to the irrigated fields. This table shows that each field has only been fertilized during its first year of operation. The hay production would likely have been increased with additional fertilization.

During 2008, a different crop was planted in the Section 34 flood area and this reduced the production. Some test planting of canola in the Section 33 center pivot also was done in 2008 which reduced the production in this area.

The hay production in 2009 was greatly reduced because the Section 33 center pivot was planted in permanent grass for livestock grazing. Therefore no hay production was obtained from this area. The Section 28 center pivot was planted in canola in 2009 and produced an average of 1523 pounds per acre canola from five clippings. This area was also grazed. Herbicides were not used on this area to control weed growth but will be needed in the future if a canola crop is planted. The sorghum/sudan grass planted in the Section 34 flood area in 2009 produced 37 tons of hay. The triticale planted in a portion of Section 33 flood area was not harvested and was eventually mulched into the soil. The crop was only grazed in 2010 and therefore no hay was produced.

Table 6-4. Homestake Irrigation Hay Production and Fertilization

YEAR	ANNUAL HAY (TONS)
2000	230
2001	650
2002	480
2003	370
2004	410
2005	380
2006	350
2007	320
2008	490
2009	*37

FERTILIZER APPLIED TO IRRIGATED FIELDS

		FERTILIZER	
IRRIGATED AREA	APPLICATION DATE	TYPE (N-P-K)	QUANTITY (POUNDS)
SEC 33 PIVOT & SEC 34 FLOOD	4/2000	0-46-60	74,000
SEC 28 PIVOT (60 AC)	5/2002	8-32-4	20,000
SEC 33 FLOOD	8/2003	20-20-0	4,500
SEC 28 PIVOT (OUTSIDE 40 AC)	5/2004	16-8-8	7,000

Note: N-P-K = Nitrogen - Phosphate - Potash
* = Section 33 converted to permanent pasture and test canola crop was grown in Section 28. Only a portion of Section 34 produced hay while the remainder was graze

7.0 Radiation Dose to Public from Irrigation Activities

This report consists of an assessment of the radiological impacts to the public from irrigation activities as well as from using the land for residential use and farming after HMC irrigation activities have been terminated. The agricultural irrigation program at Homestake Mining Company's Grants Reclamation site (Grants site) consists of irrigating soil with ground water extracted from a contaminated aquifer, as part of a ground water remediation/restoration effort.

Potential radiation doses to the public were evaluated for:

- Residents eating beef that were fed hay grown on the irrigated areas
- A hypothetical resident farmer, living on and farming the Section 34 irrigated area;
- Current residents living near the irrigated areas of Sections 28 and 33 during crop irrigation activities.

7.1 Radiation Dose from Eating Beef

The Committed Effective Dose Equivalent (CEDE) to humans from eating beef initially requires a calculation of the uptake to beef from the vegetation followed by the transfer from beef to human. For radiation dose calculation purposes, we have used the average uranium in hay measurements from 2000 through 2010 (Table 6-2 average concentration 0.83 mg/kg = 562 pCi/kg). The measured natural concentrations of uranium and selenium in hay grown in the region are presented in Section 6.1.4. The analysis that follows does not subtract the natural background concentrations in hay grown on untreated soils from the measured values in this study and therefore overstates the impact to humans.

7.1.1 Vegetation to Livestock Uptake

The uranium concentration in meat (C_{bi}), as a result of cattle eating hay produced from the Grants site irrigation fields can be estimated by multiplying the rate of intake of vegetation by the transfer coefficient, then multiplying by the fraction of food supply and the concentration in the hay.

$$C_{bi} = QF_{bi}(F_{pg}C_{pgi} + F_hC_{hi})$$

Where the values of the parameters are discussed below:

Q = assumed feed ingestion rate, 27 kg(wet weight)/d, NUREG/CR-5512

F_{bi} = Transfer coefficient from vegetation to livestock, 2.0E-4, NUREG/CR-5512

F_{pg} = fraction of the total annual feed requirement (including pasture and other feed sources) from hay grown in irrigation area = 0.5

C_{pgi} = measured concentration in vegetation(pCi/kg) = 562 pCi/kg

F_h = fraction of the total annual feed requirement not from irrigated hay, = 0.5. Assumed 50% not grown on irrigated area.

C_{hi} = uranium concentration in the other fraction of feed not grown on the irrigated area = 0

C_{bi} = 27 kg/day (2.0E-4) {(0.5) (562) + (0.5) (0.0)} = 1.5 pCi/kg meat

7.1.2 Beef to Human Uptake

Total activity in the human body from eating only meat produced from the irrigated fields for a year can be calculated as follows:

$I_i = U_{bk} C_{bi}$

Where:

I_i = annual intake rate (pCi/y)

U_{bk} = ingestion rate of beef for an adult = (0.16 kg/d)(365d/y)
C_{bi} = concentration in meat (pCi/kg)

I_i = (1.5 pCi/kg meat) (0.16 kg/d) (365 day/y)

I_i = 88 pCi/y

The ingestion CEDE is calculated from the following equation:

$D_{(ing)} = I_i DCF_{(ing)}$

Where:

$I_{(ing)}$ = ingestion dose, millirem per year (mrem/y)

$DCF_{(ing)}$ = ingestion CEDE conversion factor
= (5 rem/20 μCi, from 10 CFR 20 Appendix B)

$D_{(ing)}$ = (88 pCi/y) (1E-6 μCi/pCi) (5 rem/20 μCi) (1E3 mrem/rem)
$D_{(ing)}$ = 0.02 mrem/y

7.1.3 Results

Uranium is being retained in the upper layers of treated soil. In terms of risk to human health, uranium levels are currently acceptable. The dose to man by from eating beef fed the hay grown on the irrigated land is negligible, at 0.02 mrem/yr. This can be compared to an average dose to the U. S. population from natural background, manmade, and medical exposures of more than 600 mrem/y.

The average increase of uranium in soil appears to be similar to that predicted although distributed to greater depths. The ratio of uranium concentration in the hay to that in the soil (average of 0.68) is approximately 50 times higher than that predicted using the NRC's soil to vegetation transfer coefficient (0.017 mg uranium/kg vegetation per mg uranium/kg soil) as given in Table 6.16 of NUREG-5512. The NRC transfer coefficient may not take into account constituent uptake via water application in addition to soil/vegetation transfer mechanisms. This much larger observed transfer coefficient from water and soil contributions combined still results in negligible radiation doses to the public. Therefore, the use of alluvial water for irrigation of hay fields with slightly elevated concentrations of uranium is not a significant health concern.

Selenium uptakes in the hay are below the recommended upper limit for animal feed. Selenium retention in soils appears to be independent of time and application. The concentrations are not time-dependent, implying that absorption in soil is not retarding the movement of selenium through the soil.

7.2 Radiation Dose to Hypothetical Resident Farmer Living on Irrigation Site

The dose to a hypothetical resident farmer, living and farming on the previously irrigated land, was estimated using the RESRAD Model, version 6.4. The current measured increase in radionuclide concentrations in the surface soils is the principal source of radiation exposure to the hypothetical resident farmer and family. Soil concentrations, irrigation rates, and other site data needed for the model were taken from other sections of this report. The 2010 surface soil data for the four irrigated areas indicates that the Section 34 flood irrigation area had the highest average net uranium concentration (natural background subtracted) in the top one-foot layer of 2.64 mg/kg, or 1.79 pCi/g. Therefore Section 34 will be used in this analysis. The concentration in the surface one-foot thick layer has been used since the uranium concentration is higher than in deeper samples. This selection therefore overestimates the calculated dose.

7.2.1 RESRAD Model

RESRAD is a computer code approved by the NRC and EPA to model the fate and transport of radionuclides in soil. RESRAD uses a pathway analysis method in which the relation between radionuclide concentrations in soil and the dose to a member of a critical population is expressed as a pathway sum, which is the sum of products of "pathway factors". Pathway factors correspond to pathway segments connecting compartments in the environment between which radionuclides can be transported or radiation emitted. Radiation doses account for radioactive decay and ingrowth, leaching, erosion, and mixing. RESRAD uses a one-dimensional ground-water model that accounts for differential transport of parent and daughter radionuclides with different distribution coefficients.

The total dose includes contributions from external gamma rays, inhalation of particulates, radon-222 (radon); and ingestion of soil, plant, meat, milk, and water. The aquatic foods pathway was turned off since there is no potential source of aquatic food at the site. Conservative RESRAD default parameters were selected along with known irrigation rates. Exceptions to the default parameters are discussed in the following sections.

7.2.2 Parameter Inputs

The radionuclide concentrations were input as follows:

The average concentrations of natural uranium in samples collected from the 0-1 foot interval in treated areas was 4.64 mg/kg. The net concentration of natural uranium at 0-1 foot was 2.64 mg/kg, or 1.79 picocuries per gram (pCi/g). Uranium-238 accounts for 48.9 percent of the activity of naturally abundant uranium, thus the uranium-238 concentration input to the model was 0.88 pCi/g.

The immediate long-lived daughters (half-lives greater than 6 months) of uranium-238; uranium-234 and thorium-230 are assumed in the model to be in secular equilibrium with the parent.

As indicated by the laboratory analysis of the irrigation water, radium-226 is not in secular equilibrium with its parent uranium-238. Radium-226 and its long-lived daughters are assumed in the model to be in secular equilibrium. Steady-state concentrations for unsupported radium-226 and radium-228 in soil were determined as follows:

$$\left[{}^{226}Ra\right]_{soil} = I_{Ra} x \, {}^{1}\!/_{\rho_{soil}} \, x \, {}^{1}\!/_{0.4} x1x10^{-3} \qquad \textit{(Equation 1)}$$

Where:

I_{Ra} = Concentration of radium in irrigation water, 0.2 picocuries per liter (pC/L) for Ra-226 and 1.0 pCi/L for Ra-228
P_{soil} = Density of soil, RESRAD default is 1.5 g/cm^3
1×10^{-3} = conversion factor, cm^3 to liters
0.4 = Primary soil porosity, RESRAD default

The irrigation rate was input as 1.67 feet/yr (0.51 meters/year as given in Table 3-7. The irrigation mode parameter in RESRAD was set as ditch irrigation.

The precipitation was input as 0.27 meters/yr, equivalent to 10.5 inches. The area of the contaminated zone was input as 485,640 m^2 (equivalent to 120 acres)

7.2.3 Predicted Dose to Resident Farmer

The output of the RESRAD model provides individual path and total committed doses occurring at 1, 3, 10, 30, 100, 300, and 1,000 years in the future.

The results indicate a gradual decline in the total dose for about 300 years, and then a sharp increase towards 1,000 years. The increase is due to the contributions of water-dependent plant, meat, milk, and fish consumption.

The predicted dose rate for the first few hundred years is approximately 0.2 millirem per year for the first few hundred years with a maximum of 0.7 millirem per year, occurring after 1000 years. The output of the model is in Appendix E.

This dose is insignificant compared to the average radiation dose to the U.S. population from exposure to natural and man-made radiation sources and medical exposures, estimated to be more than 600 mrem/year. The additional 0.2 to 0.7 mrem/year received by the resident farmer is comparable to estimates of the average radiation dose to the public from airborne emissions from coal-fired power plants.

7.3 Exposure to Radon Releases to Current Residents Living Near Irrigation Sites

Release of radon-222 (radon) from water occurs most rapidly from water while it is being aerated or sprayed such as from a shower or spray irrigation system. Measurements of radon release from water bodies have indicated a limited release of radon from the surface (Simonds, 2010). A detailed risk evaluation of existing nearby residents potentially exposed to radon-222 released from the irrigation system was performed using data collected in 2009 (ERG & HYDRO, 2010). The results of the risk analysis concluded that risk to existing residents from potential exposure to radon released from irrigation activities was 1.1 x $^{-10}$, or at negligible levels. The potential radon concentrations have not changed over the years. Thus parameters for calendar year 2009 are similar to the 2010 parameters and the conclusion of negligible risk in 2010 is supported. Another detailed risk evaluation for 2010 is not justified.

7.4 Radiation Dose from Airborne Releases from Irrigation Areas Following the Cessation of Irrigation

If irrigation of the existing sites is discontinued, there is potential for exposure of nearby residents to airborne natural uranium contained in dust from the irrigation areas. The effluent concentration (EC) contained in 10 CFR 20, Appendix B, Table 2 for class Y natural uranium is 9×10^{-14} μCi/ml of air. Assuming an annual average natural uranium concentration equal to the EC, a continuously exposed individual would receive a CEDE dose of 50 mrem per year.

Given the measured natural uranium concentration in surface soil of 1.79 pCi/g above natural background levels, an airborne dust concentration of 50.3 mg/m^3 would be equal to the EC. The Occupational Safety and Health Administration's permissible exposure limit (PEL) for total particulate dusts for any worker is 15 mg/m^3 for an 8 hour time weighted average. It is an unlikely scenario that fugitive dust concentration from the irrigation areas would average 15 mg/m^3 over a year. However it did, it is unlikely that people would choose to live continuously in the area. Therefore, the additional radiation dose under this improbable and extreme upper limit condition is (15/50.30) x 50 mrem/year, or 15 mrem per year.

7.5 Summary

Potential radiation doses to the public were evaluated for:

- Residents eating beef that were fed hay grown on the irrigated areas
- A hypothetical resident farmer, living on and farming the Section 34 irrigated area;
- Current residents living near the irrigated areas during and following cessation of crop irrigation activities.

Each analysis shows that the radiological dose to existing or future occupants of the land on and near the irrigation areas is extremely small (less than one percent) compared to the average dose that the population receives from natural background and medical exposures.

8.0 Conclusion

Uranium is being retained in the upper layers of treated soil. In terms of risk to human health, uranium levels are currently acceptable. The dose to man by way of food web uptake calculations is negligible, at 0.05 mrem/yr.

The average increase of uranium in soil appears to be similar to that predicted although distributed to greater depths. The increase in concentrations in the hay was approximately 50 times higher than that predicted using the NRC's soil to vegetation transfer coefficient. The NRC transfer coefficient may not take into account constituent uptake via water application in addition to soil/vegetation transfer mechanisms. This much larger observed transfer coefficient from water and soil contributions combined still results in negligible radiation doses to the public. Therefore, the use of alluvial water for irrigation of hay fields with slightly elevated concentrations of uranium is not a significant health concern.

Selenium uptakes in the vegetation are below the recommended upper limit for animal feed. Selenium retention in soils appears to be independent of time and application. The concentrations are not time-dependent, implying that absorption in soil is not retarding the movement of selenium through the soil.

The modeling of the soil moisture migration to the ground water and mixing calculations indicate the following:

1. No ground water impacts should results in the Section 34 flood irrigation.
2. A small increase in TDS and sulfate concentration in the ground water should occur during the irrigation of the Section 28 and 33 center pivots.
3. The long-term TDS and sulfate concentrations in the ground water should be so small that it is not detectable in the Section 28 and 33 Center pivot areas.
4. No increase in uranium and selenium concentrations in the ground water should result from the Section 28 and 33 center pivot irrigation.

The monitoring of concentrations of uranium and selenium will continue as part of the ongoing irrigation program.

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APPENDIX A

1999, 2000 and 2009 Soil Analysis

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Tables

Table A-1. 1999 and 2000 Irrigation Soil Analyses for Section 33

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. (mmhos/cm)	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
						SECTION 33						
33A	10/1/1999	0.36	0.1	<1	7.7	0.350	2.51	0.68	0.28	0.22	13	330
33A1	12/7/2000	0.84	0.6	<1	7.8	1.890	7.84	2.28	10.4	4.62	50	220
33A2	12/7/2000	0.65	0.4	<1	7.7	1.950	8.84	2.55	10.1	4.23	53	210
33A3	12/7/2000	0.62	0.2	<1	7.6	2.170	11.70	3.33	10.0	3.65	49	210
33B	10/1/1999	0.82	0.2	<1	7.7	0.445	3.30	0.73	0.17	0.12	7	40
33B1	12/7/2000	1.05	0.2	<1	7.8	0.576	2.33	0.86	3.18	2.52	14	50
33B2	12/7/2000	0.96	0.5	<1	7.8	1.010	3.75	1.21	5.44	3.45	38	370
33B3	12/7/2000	1.44	0.3	<1	7.6	1.270	5.00	1.24	6.66	3.77	22	210
33C	10/1/1999	0.65	<0.1	<1	7.8	0.474	3.10	0.72	0.15	0.10	35	440
33C1	12/7/2000	0.91	0.3	<1	8	0.495	1.84	0.68	3.42	3.05	13	<50
33D	10/1/1999	0.73	0.2	<1	7.7	0.840	5.48	1.24	0.69	0.37	22	130
33D1	12/7/2000	1.14	0.2	<1	7.6	1.240	9.07	2.64	0.64	0.26	18	<50
	1999 AVG:	0.61	0.12	0.5	7.7	0.423	2.97	0.71	0.20	0.15	18	270
	2000-1 AVG:	0.93	0.37	0.5	7.9	0.987	4.00	1.27	5.67	3.40	26	98
	2000-2 AVG:	0.81	0.45	0.5	7.8	1.480	6.30	1.88	7.77	3.84	46	290
	2000-3 AVG:	1.03	0.25	0.5	7.6	1.720	8.35	2.29	8.33	3.71	36	210

NOTE: 2000 Sample: 1 = 0 - 6 inches, 2 = 6 - 18 inches and 3 = 18 - 36 inches

Table A-2. 1999 and 2000 Irrigation Soil Analyses for Section 34

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. (mmhos/cm)	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
						SECTION 34						
34A	9/29/1999	2.72	0.4	<1	7.7	3.56	17.10	7.40	16.6	4.74	36	1280
34A1	12/7/2000	2.78	0.6	<1	7.7	1.94	8.68	3.29	9.32	3.81	40	350
34A2	12/7/2000	2.49	0.4	<1	7.5	3.13	19.50	6.42	13.2	3.67	52	780
34A3	12/7/2000	1.37	0.2	<1	7.5	2.76	16.30	5.08	12.9	3.95	20	450
34B	9/29/1999	2.36	0.4	<1	7.7	3.89	17.60	7.36	20.3	5.75	54	3470
34B1	12/7/2000	3.61	0.6	<1	7.6	4.01	16.70	7.30	24.3	7.01	72	1020
34B2	12/7/2000	3.04	0.4	<1	7.6	5.03	18.90	9.26	32.8	8.74	159	3490
34B3	12/7/2000	2.02	0.3	<1	7.7	6.27	20.10	7.90	47.0	12.6	106	2220
34C	9/29/1999	1.75	0.3	<1	7.6	5.25	22.90	9.00	29.2	7.31	79	4560
34C1	12/7/2000	3.00	0.4	<1	7.8	1.61	5.46	2.13	9.64	4.95	58	470
34D	9/29/1999	3.60	0.6	<1	7.8	1.40	4.60	2.13	7.28	3.97	36	160
34D1	12/7/2000	3.29	0.5	<1	7.6	3.88	20.20	6.97	21.3	5.78	88	2520
34E	9/29/1999	2.31	0.4	<1	7.8	2.67	12.20	5.24	12.8	4.33	25	690
34E1	12/7/2000	4.21	0.7	<1	7.8	2.26	8.49	3.86	13.8	5.55	44	380
34F	9/29/1999	3.03	0.8	<1	7.7	4.76	22.80	8.80	23.1	5.81	68	5040
34F1	12/7/2000	4.68	1.3	2	7.8	4.18	19.40	9.43	23.0	6.06	66	1140
34G	10/6/1999	1.85	0.3	<1	7.6	1.62	9.39	3.60	1.59	0.62	13	100
34G1	12/7/2000	2.64	0.8	<1	7.6	1.69	8.19	3.50	8.18	3.38	25	150
34G2	12/7/2000	1.13	0.3	<1	7.6	1.55	4.85	2.34	9.73	5.13	24	220
34G3	12/7/2000	1.48	0.4	<1	7.7	1.16	4.50	2.08	6.72	3.70	41	270
34H	10/7/1999	3.38	0.7	<1	8	0.969	3.23	1.13	5.28	3.58	43	520
34H1	12/7/2000	4.23	1.0	<1	7.6	2.75	15.90	4.33	15.0	4.72	52	430
34I	10/7/1999	0.99	0.1	<1	7.8	1.46	4.99	0.89	8.29	4.83	42	480
34I1	12/7/2000	1.73	0.2	<1	7.5	1.03	4.57	1.11	6.72	3.99	59	440
	1999 AVG:	2.44	0.44	0.50	7.7	2.84	12.76	5.06	13.83	4.55	44	1811
	2000-1 AVG:	3.35	0.68	0.67	7.7	2.59	11.95	4.66	14.58	5.03	56	767
	2000-2 AVG:	2.22	0.37	0.50	7.6	3.24	14.42	6.01	18.58	5.85	78	1497
	2000-3 AVG:	1.62	0.30	0.50	7.6	3.40	13.63	5.02	22.21	6.75	56	980

NOTE: 2000 Sample: 1 = 0 - 6 inches, 2 = 6 - 18 inches and 3 = 18 - 36 inches

Table A-3. 2009 Irrigation Soil Analyses for Section 33

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
33PV#1-0-1	10/6/2009	1.76	0.43	3	8	1.940	6.88	3.24	11.10	4.93	104	700
33PV#1-1-2	10/6/2009	2.87	0.53	1	7.9	5.530	24.80	12.70	42.10	9.72	270	2100
33PV#1-2-3	10/6/2009	1.24	0.13	1	7.6	4.150	18.60	9.13	21.50	5.77	272	600
33PV#1-3-4	10/6/2009	1.01	0.09	1	7.7	3.420	13.90	6.95	18.50	5.73	152	450
33PV#1-4-5	10/6/2009	0.88	0.23	1	7.8	3.020	12.70	6.34	16.70	5.41	98	500
33PV#1-5-7	10/6/2009	1.04	0.14	1	7.8	2.390	8.68	4.45	13.90	5.42	86	460
33PV#1-7-9	10/6/2009	1.01	0.46	1	7.7	3.500	20.90	9.60	16.30	4.17	44	550
33PV#1-9-11	10/6/2009	0.99	0.19	1	7.6	3.180	21.00	9.24	12.80	3.29	28	460
33PV#1-11-13	10/6/2009	1.90	0.07	1	7.8	1.030	5.93	2.45	2.68	1.31	24	170
33PV#1-13-15	10/6/2009	0.40	0.06	1	7.9	0.652	3.57	1.37	1.73	1.10	26	170
33PV#1-15-17	10/6/2009	0.53	0.08	1	7.6	1.680	12.20	4.98	2.34	0.79	26	160
33PV#2-0-1	10/5/2009	1.47	0.28	1	7.9	2.450	9.02	4.17	13.70	5.33	96	380
33PV#2-1-2	10/5/2009	1.23	0.20	1	8.0	1.840	5.88	2.75	10.60	5.10	80	490
33PV#2-2-3	10/5/2009	1.44	0.16	1	8.0	2.530	8.32	3.76	14.40	5.86	93	530
33PV#2-3-4	10/5/2009	1.05	0.13	1	8.0	3.230	12.80	5.45	19.40	6.42	62	500
33PV#2-4-5	10/5/2009	1.55	0.19	1	8.0	3.390	13.80	6.58	22.30	6.99	68	640
33PV#2-5-7	10/5/2009	0.65	0.12	1	8.1	4.000	16.20	9.00	26.10	7.35	167	970
33PV#2-7-9	10/5/2009	0.60	0.09	1	8.0	2.550	11.20	7.31	12.20	4.01	99	460
33PV#2-9-11	10/5/2009	0.82	0.24	2	7.7	2.960	22.10	13.30	4.59	1.09	199	510
33PV#2-11-13	10/5/2009	1.01	0.10	2	7.8	2.430	16.30	9.75	1.57	0.43	253	380
33PV#2-13-15	10/5/2009	1.09	0.09	2	7.7	2.050	12.70	7.95	2.27	0.70	227	230
33PV#3-0-1	10/6/2009	2.04	0.49	1	7.8	4.380	17.40	8.18	26.80	7.49	160	1200
33PV#3-1-2	10/6/2009	2.53	0.35	1	7.8	6.350	22.80	11.60	53.60	12.90	350	2400
33PV#3-2-3	10/6/2009	1.40	0.49	3	7.6	6.050	28.30	12.90	32.60	7.18	680	1760
33PV#3-3-4	10/6/2009	1.29	0.50	2	7.5	5.040	30.60	13.00	15.90	3.41	610	870
33PV#3-4-5	10/6/2009	1.44	0.36	3	7.7	3.650	25.60	10.50	6.67	1.57	435	730
33PV#3-5-7	10/6/2009	0.84	0.18	2	7.7	1.890	12.30	4.99	3.16	1.07	132	350
33PV#3-7-9	10/6/2009	0.53	<0.5	2	7.9	0.754	4.44	1.65	1.48	0.84	40	260
33PV#3-9-11	10/6/2009	0.72	0.06	4	7.9	0.674	4.10	1.47	1.41	0.84	32	270
33PV#3-11-13	10/6/2009	0.51	0.06	3	7.9	0.736	4.01	1.46	1.75	1.06	40	390
33PV#4-0-1	10/6/2009	1.96	0.43	1	7.7	5.440	21.90	11.00	32.80	8.09	198	980
33PV#4-1-2	10/6/2009	1.15	0.17	3	7.7	2.550	10.50	3.74	13.00	4.87	90	540
33PV#4-2-3	10/6/2009	1.71	0.24	1	7.6	2.080	8.44	3.88	9.03	3.64	57	430
33PV#4-3-4	10/6/2009	2.28	0.34	3	7.7	4.320	20.80	11.30	24.30	6.07	64	2100
33PV#4-4-5	10/6/2009	1.60	0.33	2	7.8	5.380	21.50	13.90	34.30	8.15	91	2800
33PV#5-0-1	10/6/2009	1.57	0.27	3	7.9	1.430	3.34	1.44	8.59	5.56	150	830
33PV#5-1-2	10/6/2009	1.97	0.22	4	7.9	1.920	4.80	2.02	11.00	5.96	80	650
33PV#5-2-3	10/6/2009	1.66	0.20	2	7.7	5.030	17.70	6.48	31.10	8.94	230	860
33PV#5-3-4	10/6/2009	1.09	0.15	4	7.8	4.100	16.00	5.97	20.40	6.16	251	640
33PV#5-4-5	10/6/2009	0.92	0.17	3	8.0	1.980	5.62	2.42	9.98	4.98	128	380
33PV#5-5-7	10/6/2009	0.88	0.10	2	8.0	1.700	4.27	1.88	9.24	5.27	76	550
33PV#5-7-9	10/6/2009	0.84	0.14	2	8.0	1.590	4.19	1.72	8.41	4.89	80	470
33PV#5-9-11	10/6/2009	0.95	0.15	2	7.7	2.490	14.40	7.68	6.26	1.88	72	590
33PV#5-11-13	10/6/2009	0.92	0.15	1	7.7	1.950	12.30	7.53	2.33	0.74	82	370
33PV#5-13-15	10/6/2009	1.08	0.22	2	7.7	1.830	11.70	7.12	2.10	0.68	87	320
33PV#5-15-17	10/6/2009	1.08	0.19	2	7.7	2.000	13.40	8.26	2.36	0.71	111	340
LY1-1	5/21/2008	2.35	0.44	1	7.8	3.310	14.10	5.69	20.20	6.42	184	1000
LY1-2	5/21/2008	2.32	0.21	1	7.8	2.330	8.39	3.03	14.80	6.19	360	1500
LY1-3	5/21/2008	1.81	0.22	1	7.8	2.030	7.74	2.95	12.10	5.23	190	970
LY1-4	5/21/2008	1.31	0.18	1	7.8	2.220	9.09	3.53	13.40	5.33	330	1400
LY1-5	5/21/2008	1.36	0.26	1	7.7	2.130	9.08	3.83	12.50	4.92	97	700
LY1-5-7	5/21/2008	1.14	0.20	1	7.9	1.655	7.02	3.10	9.03	4.01	52	545
LY1-7-9	5/21/2008	1.17	0.15	1	7.8	1.615	10.26	4.65	5.16	1.87	42	475
LY1-9-11	5/21/2008	0.92	0.13	1	7.7	1.460	10.55	4.72	2.76	1.00	40	305
LY1-11-13	5/21/2008	0.57	0.13	1	7.9	0.805	4.64	2.02	1.99	1.06	60	295
LY1-13-15	5/21/2008	0.53	0.10	1	7.9	1.200	7.03	3.14	3.16	1.41	70	410
LY1-15-17	5/21/2008	0.59	0.14	1	7.8	1.285	8.95	4.21	2.20	0.85	38	240

Table A-3. 2009 Irrigation Soil Analyses for Section 33 (continued)

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
LY2-1	5/21/2008	1.18	0.29	2	7.8	2.660	12.60	4.98	17..7	5.97	90	700
LY2-2	5/21/2008	1.81	0.32	2	7.9	4.240	16.20	5.97	34.70	10.40	430	2500
LY2-3	5/21/2008	1.45	0.29	2	7.8	4.410	18.20	6.47	33.70	9.60	227	990
LY2-4	5/21/2008	1.17	0.30	1	7.8	4.640	16.30	6.37	35.00	10.40	359	940
LY2-5	5/21/2008	0.73	0.27	2	7.7	3.900	16.75	9.58	26.15	7.21	233	735
LY2-5-7	5/21/2008	0.78	0.26	2	7.7	3.710	15.80	7.09	25.85	7.65	234	625
LY2-7-9	5/21/2008	0.87	0.33	2	7.6	3.905	19.65	9.44	23.50	6.18	167	800
LY2-9-11	5/21/2008	1.49	0.40	1	7.5	2.270	18.10	4.95	7.25	2.11	96	585
LY2-11-13	5/21/2008	1.16	0.24	1	7.5	1.500	12.15	2.96	3.39	1.23	75	575
LY2-13-15	5/21/2008	1.06	0.22	1	7.5	1.455	10.95	2.68	3.80	1.46	82	425
LY2-15-17	5/21/2008	0.79	0.22	1	7.6	1.710	13.20	3.37	4.83	1.69	75	405
LY3-1	5/21/2008	2.04	0.54	1	7.7	4.250	22.70	11.20	30.30	7.36	104	2100
LY3-2	5/21/2008	1.70	0.34	1	7.6	5.650	21.10	13.60	52.20	12.50	251	2000
LY3-3	5/21/2008	1.52	0.37	1	7.9	7.280	20.40	8.93	64.10	16.70	316	1600
LY3-4	5/21/2008	0.73	0.22	1	8.0	6.530	17.70	6.61	60.10	17.20	270	900
LY3-5	5/21/2008	0.65	0.15	1	8.1	4.840	13.90	5.33	37.00	11.90	230	600
LY3-5-7	5/21/2008	0.69	0.19	1	7.9	5.190	15.55	8.85	38.70	11.10	291	860
LY3M20-25	4/7/2009	0.22	0.12	1	8.1	5.860	6.51	3.45	8.44	3.78	35	180
LY3M25-35	4/7/2009	0.24	0.11	1	8.1	1.290	4.41	2.22	1.34	4.03	32	150
LY4-1	4/7/2009	2.37	0.48	1	7.7	3.720	17.90	8.97	20.20	5.51	198	900
LY4-2	4/7/2009	1.33	0.21	1	8.0	1.810	6.67	2.78	10.00	4.60	120	670
LY4-3	4/7/2009	1.77	0.29	1	7.9	1.740	6.82	2.55	10.40	4.80	120	880
LY4-4	4/7/2009	2.13	0.43	2	7.9	1.830	9.22	3.52	9.50	3.76	68	600
LY4-5	4/7/2009	1.70	0.43	1	7.9	2.540	14.30	6.28	12.20	3.80	90	870
LY4-5-7	4/7/2009	1.55	0.38	1	8.0	1.855	8.41	3.25	10.55	4.37	124	1205
LY4-7-9	4/7/2009	0.91	0.16	1	7.9	1.470	6.44	2.27	8.42	4.03	125	885
LY4-9-11	4/7/2009	0.61	0.15	1	9.3	1.570	6.95	2.33	7.77	3.61	135	1610
LY4-11-13	4/7/2009	0.65	0.13	1	9.4	1.690	9.41	2.77	6.32	2.59	46	570
LY4-13-15	4/7/2009	0.66	0.16	1	9.5	1.425	10.55	3.21	3.28	1.30	50	420
LY4-15-17	4/7/2009	1.16	0.32	2	9.3	2.560	23.15	7.29	3.92	1.01	100	580
LY4M20-30	4/7/2009	0.33	0.15	1	7.8	1.370	9.23	3.02	3.26	1.32	42	230
LY4M40-50	4/7/2009	0.16	0.09	1	8.3	0.550	2.52	0.94	1.87	1.42	23	103
LY5-0-1	10/5/2009	3.58	0.49	3	7.9	5.140	20.50	10.60	41.10	10.40	185	1800
LY5-1-2	10/5/2009	1.48	0.34	2	7.9	6.840	23.40	15.80	58.10	13.10	397	1200
LY5-2-3	10/5/2009	1.21	0.37	3	7.8	7.410	27.70	20.80	53.10	10.80	600	1100
LY5-3-4	10/5/2009	1.10	0.32	2	7.8	5.800	25.50	16.00	32.70	7.18	415	710

AVERAGES OF TREATED AREA SAMPLES	DEPTH	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
	1	2.03	0.41	2	7.82	3.472	14.63	6.95	22.75	6.71	147	1059
	2	1.84	0.29	2	7.85	3.906	14.45	7.40	30.01	8.53	243	1405
	3	1.52	0.28	1	7.77	4.271	16.22	7.79	28.20	7.85	279	972
	4	1.32	0.27	2	7.80	4.113	17.19	7.87	24.92	7.17	258	911
	5	1.20	0.27	2	7.85	3.426	14.81	7.20	19.76	6.10	163	884
	5-7	0.95	0.20	1	7.87	2.799	11.03	5.33	17.07	5.78	145	696
	7-9	0.85	0.22	1	7.83	2.198	11.01	5.23	10.78	3.71	85	557
	9-11	0.93	0.19	2	7.91	2.086	13.89	6.24	6.12	1.97	86	619
	11-13	0.96	0.12	1	7.99	1.449	9.25	4.13	2.86	1.20	83	393
	13-15	0.80	0.14	1	8.03	1.435	9.42	4.24	2.72	1.11	90	329
	15-17	0.83	0.19	1	7.98	1.847	14.18	5.62	3.13	1.01	70	345

Table A-4. 2009 Irrigation Soil Analyses for Section 34 and 33 Flood Area

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
34FA#1 0-1	10/6/2009	3.70	0.87	4	8.0	5.580	24.90	10.90	40.60	9.60	317	3700
34FA#1 1-2	10/6/2009	1.58	0.41	3	7.8	5.310	28.50	11.30	34.10	7.64	350	2900
34FA#1 2-3	10/6/2009	0.56	0.08		7.8	3.770	23.40	8.31	21.00	5.27	95	690
34FA#1 3-4	10/6/2009	0.60	0.08	2	7.8	3.700	25.80	8.60	18.60	4.48	66	670
34FA#1 4-5	10/6/2009	0.41	0.06	<1	7.9	2.950	16.40	5.69	16.60	4.99	49	480
34FA#1 5-7	10/6/2009	0.39	0.07	<1	8.1	1.930	7.10	2.52	12.20	5.56	60	500
34FA#1 7-9	10/6/2009	0.46	0.06	<1	8.2	1.380	4.45	0.99	8.72	5.29	70	580
34FA#1 9-11	10/6/2009	0.62	0.05	1	7.8	2.100	7.46	1.72	13.10	6.11	120	510
34FA#1 11-11.5	10/6/2009	2.15	0.09	<1	7.7	3.460	26.90	11.60	13.90	3.17	41	1500
34FA#1 11.5-13	10/6/2009	0.71	0.07	3	8.1	0.983	2.29	1.04	6.45	5.00	70	650
34FA#2 0-1	10/8/2009	4.02	0.88	<1	8.0	4.850	18.80	10.60	35.00	9.13	240	6100
34FA#2 1-2	10/8/2009	3.09	0.72	<1	7.9	5.990	19.20	9.07	46.70	12.40	384	7400
34FA#2 2-3	10/8/2009	2.44	0.54	<1	7.9	5.320	19.70	6.78	39.10	10.70	351	6800
34FA#2 3-4	10/8/2009	0.92	0.13	<1	7.5	3.560	21.10	5.23	18.00	4.96	57	1500
34FA#2 4-5	10/8/2009	0.51	0.04	1	7.4	2.980	18.00	4.48	13.50	4.03	45	2000
34FA#2 5-7	10/8/2009	0.54	0.04	<1	7.7	2.790	15.70	6.19	12.30	3.72	25	600
34FA#2 7-9	10/8/2009	0.54	0.03	1	7.9	1.610	3.59	1.35	12.10	7.70	90	820
34FA#2 9-11	10/8/2009	1.20	0.07	1	7.4	3.430	23.40	5.96	16.00	4.18	47	1400
34FA#2 11-13	10/8/2009	2.35	0.08		7.5	2.880	19.30	9.15	9.34	2.48	27	7700
34FA#3 0-1	10/8/2009	5.52	1.38	5	7.7	5.100	22.00	10.00	30.40	7.60	303	5500
34FA#3 1-2	10/8/2009	3.40	0.81	4	7.7	4.400	22.40	7.92	25.10	6.45	367	3500
34FA#3 2-3	10/8/2009	2.86	0.80	4	7.6	4.460	25.30	6.98	21.70	5.40	540	2100
34FA#3 3-4	10/8/2009	2.36	0.64	3	7.6	4.640	28.60	7.29	20.50	4.84	550	5000
34FA#3 4-5	10/8/2009	1.18	0.19	2	7.7	3.380	14.40	3.71	17.10	5.68	270	400
34FA#3 5-7	10/8/2009	0.37	0.07	<1	8.0	1.580	6.17	1.75	8.07	4.06	100	370
34FA#3 7-9	10/8/2009	0.33	0.07	<1	8.2	0.840	2.63	0.80	4.39	3.35	40	310
34FA#3 9-11	10/8/2009	0.40	0.23	<1	8.0	0.870	2.93	1.26	4.06	2.81	30	290
34FA#3 11-13	10/8/2009	0.42	0.20	<1	7.9	1.540	9.72	4.43	3.19	1.20	15	330
34FA#4 0-1	10/8/2009	5.32	0.99	5	7.9	5.170	20.30	9.97	34.10	8.77	278	7000
34FA#4 1-2	10/8/2009	2.86	0.55	5	7.8	5.380	21.70	8.60	33.50	8.61	402	5800
34FA#4 2-3	10/8/2009	2.43	0.59	5	7.7	6.020	27.10	8.23	34.10	8.11	960	6900
34FA#4 3-4	10/8/2009	1.84	0.54	8	7.6	6.880	36.10	9.34	35.80	7.51	1330	7700
34FA#4 4-5	10/8/2009	0.66	0.16	<1	7.6	5.780	33.60	8.87	27.70	6.01	497	2500
34FA#4 5-7	10/8/2009	0.21	0.03	<1	7.9	2.920	20.10	5.22	10.10	2.84	118	400
34FA#4 7-9	10/8/2009	0.19	0.03	<1	8.2	1.160	4.52	2.94	4.25	2.20	80	690
34FA#4 9-11	10/8/2009	0.37	0.03	4	8.0	1.780	7.52	6.49	5.64	2.13	30	410
34FA#4 11-13	10/8/2009	0.71	0.10	3	8.0	2.120	10.00	8.85	6.17	2.00	16	310
34FA#5 0-1	10/7/2009	3.85	0.90	3	7.8	5.900	20.60	6.96	42.70	11.50	690	6900
34FA#5 1-2	10/7/2009	2.21	0.61	1	7.6	5.380	22.40	5.12	35.20	9.49	800	6600
34FA#5 2-3	10/7/2009	1.66	0.46	1	7.7	5.410	25.20	4.67	30.80	7.97	760	5100
34FA#5 3-4	10/7/2009	0.52	0.12	<1	7.7	4.120	21.40	4.47	23.40	6.51	92	2400
34FA#5 4-5	10/7/2009	0.27	0.04	<1	7.9	4.050	21.00	6.23	22.70	6.15	58	930
34FA#5 5-7	10/7/2009	0.24	0.04	<1	7.9	3.820	22.40	7.33	16.40	4.25	92	720
34FA#5 7-9	10/7/2009	0.19	0.04	<1	8.1	1.550	6.22	3.66	5.38	2.42	94	179
34FA#5 9-11	10/7/2009	0.20	0.23	<1	8.1	1.340	4.63	3.98	4.85	2.34	71	160
34FA#5 11-13	10/7/2009	1.03	0.21	<1	7.7	4.680	20.40	21.70	15.10	3.29	297	630
LY 34 #1 0-1	10/7/2009	3.44	1.08	3	7.8	3.240	12.70	5.98	18.90	6.18	87	1200
LY 34 #1 1-2	10/7/2009	2.57	0.74	5	7.9	4.690	17.30	9.88	30.30	8.22	197	2500
LY 34 #1 2-3	10/7/2009	1.73	0.49	2	7.8	4.590	19.50	10.80	26.60	6.83	146	3700
LY 34 #1 3-4	10/7/2009	0.58	0.06	4	7.9	1.480	2.96	1.43	9.19	6.20	80	790
LY 34 #1 4-5	10/7/2009	0.75	0.07	2	7.8	3.220	15.50	5.66	15.00	4.61	100	150
LY 34 #1 5-7	10/7/2009	0.22	0.04	<1	8.6	0.738	1.97	0.62	4.06	3.57	30	125
LY 34 #1 7-9	10/7/2009	0.38	0.06	3	8.4	1.225	4.15	1.03	6.96	4.83	90	970
LY 34 #1 9-11	10/7/2009	0.34	0.10	<1	8.3	1.190	2.78	0.82	7.28	5.43	70	700
LY 34 #2 0-1	10/7/2009	4.64	1.22	<1	7.8	5.160	21.70	11.50	31.30	7.68	308	2600
LY 34 #2 1-2	10/7/2009	3.53	0.80	<1	7.8	4.880	20.20	9.64	29.60	7.66	409	4300
LY 34 #2 2-3	10/7/2009	2.20	0.50	1	7.7	5.360	24.70	9.96	32.20	7.73	332	3100
LY 34 #2 3-4	10/7/2009	0.64	0.10	1	7.8	3.080	11.40	5.63	17.60	6.03	120	570
LY 34 #2 4-5	10/7/2009	0.52	0.07	1	8.0	2.740	9.94	4.84	15.30	5.63	120	620
LY 34 #2 5-7	10/7/2009	0.44	0.04	1	8.2	1.165	3.32	1.60	6.65	4.24	95	530
LY 34 #2 7-9	10/7/2009	0.34	0.07	2	8.1	1.213	3.77	1.94	6.46	3.87	105	775
LY 34 #2 9-11	10/7/2009	0.64	0.07	2	7.8	2.065	8.12	4.59	9.46	3.80	95	640
LY 34 #2 11-12	10/7/2009	0.77	0.09	1	7.8	1.950	8.18	4.77	8.06	3.17	100	620

Table A-4. 2009 Irrigation Soil Analyses for Section 34 and 33 Flood Area (continued)

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
LY 34 #3 0-1	10/7/2009	4.43	1.00	9	7.8	4.040	20.20	5.10	25.40	7.14	174	2200
LY 34 #3 1-2	10/7/2009	2.33	0.58	4	7.6	3.530	18.70	3.37	20.00	6.02	480	3100
LY 34 #3 2-3	10/7/2009	1.48	0.40	6	7.5	3.320	16.10	2.65	17.40	5.68	550	900
LY 34 #3 3-4	10/7/2009	0.77	0.12	3	7.8	1.090	3.69	0.81	6.10	4.07	74	169
LY 34 #3 4-5	10/7/2009	0.40	0.06	1	8.0	0.857	2.85	0.75	4.66	3.47	63	260
LY 34 #3 5-7	10/7/2009	0.48	0.05	<1	8.2	0.883	2.63	0.96	4.98	3.73	79	540
LY 34 #3 7-9	10/7/2009	0.59	0.05	2	8.1	0.967	2.55	1.30	5.40	3.90	66	365
LY 34 #3 9-11	10/7/2009	0.60	0.10	1	8.0	0.858	2.11	1.09	5.02	3.98	51	440
LY34-4-0-1	10/5/2009	1.62	0.39	1	7.8	2.740	12.90	5.46	14.20	4.69	114	820
LY34-4-1-2	10/5/2009	1.77	0.43	2	7.9	2.050	10.10	3.84	10.90	4.13	100	640
LY34-4-2-3	10/5/2009	0.98	0.24	1	7.7	3.690	26.80	8.31	15.70	3.75	139	970
LY34-4-3-4	10/5/2009	0.36	0.07	2	7.6	2.840	21.00	5.49	11.90	3.27	46	560
LY34-4-4-5	10/5/2009	0.34	0.06	3	7.8	2.020	11.20	3.06	9.56	3.58	40	410
LY34-4-5-7	10/5/2009	0.22	0.04	1	8.0	1.485	7.97	2.02	7.07	3.17	35	345
LY34-4-7-9	10/5/2009	0.24	0.04	1	8.1	1.460	7.90	1.88	6.57	2.98	46	420
LY34-4-9-11	10/5/2009	0.34	0.05	2	8.0	1.635	9.08	2.24	7.51	3.22	38	310
LY34-4-11-13	10/5/2009	0.35	0.00	1	8.2	0.978	4.48	1.24	4.08	2.45	43	310
LY34-4-13-14	10/5/2009	0.61	0.10	2	7.9	1.510	8.60	2.41	5.93	2.53	50	330

AVERAGES OF SECTION 34 TREATED AREA SAMPLES	DEPTH	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
	1	4.06	0.97	4	7.8	4.642	19.34	8.50	30.29	8.03	279	4002
	2	2.59	0.63	3	7.8	4.623	20.06	7.64	29.49	7.85	388	4082
	3	1.82	0.46	3	7.7	4.660	23.09	7.41	26.51	6.83	430	3362
	4	0.95	0.21	3	7.7	3.488	19.12	5.37	17.90	5.32	268	2151
	5	0.56	0.08	2	7.8	3.109	15.88	4.81	15.79	4.91	138	861
	5-7	0.35	0.05	1	8.1	1.923	9.71	3.13	9.09	3.90	70	459
	7-9	0.36	0.05	2	8.1	1.267	4.42	1.77	6.69	4.06	76	568
	9-11	0.52	0.10	2	7.9	1.696	7.56	3.13	8.10	3.78	61	540
	11-13	1.06	0.11	2	7.8	2.515	14.14	8.82	8.55	2.54	77	1629
	13-15	0.61	0.10	2	7.9	1.510	8.60	2.41	5.93	2.53	50	330

SECTION 33 FLOOD TREATED AREA SAMPLE	DEPTH	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
33 FA #3 0-1	10/5/2009	1.17	0.10	<1	8.1	0.493	1.37	0.48	3.03	3.15	120	<50
33 FA #3 1-2	10/5/2009	1.17	0.09	<1	8.1	0.727	1.98	0.85	4.15	3.49	80	<50
33 FA #3 2-3	10/5/2009	0.67	0.08	3	8.2	0.705	2.13	0.98	4.10	3.29	80	500
33 FA #3 3-4	10/5/2009	0.38	<0.05	<1	8.5	0.528	1.23	0.86	2.87	2.81	70	680
33 FA #3 4-5	10/5/2009	0.33	<0.05	<1	8.4	0.538	1.22	1.02	2.81	2.66	50	500
33 FA #3 5-7	10/5/2009	0.35	<0.05	<1	8.4	0.710	1.57	1.57	3.65	2.91	60	500
33 FA #3 7-9	10/5/2009	0.27	<0.05	<1	8.6	0.440	1.01	0.86	2.19	2.26	20	170
33 FA #3 9-11	10/5/2009	0.52	0.06	<1	8.5	0.534	1.13	1.00	2.78	2.69	40	230

Table A-5. 2009 Irrigation Soil Analyses for Section 28

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
28CPTA#1 0-1	10/14/2009	1.30	0.22	<1	7.7	3.480	14.90	7.74	17.90	5.32	84	600
28CPTA#1 1-2	10/14/2009	1.61	0.19	<1	7.8	4.200	24.40	11.80	21.30	5.01	46	890
28CPTA#1 2-3	10/14/2009	1.15	0.17	<1	8.0	5.100	21.20	14.60	32.20	7.61	44	880
28CPTA#1 3-4	10/14/2009	0.37	0.08	<1	8.3	2.480	4.79	4.93	15.90	7.21	34	420
28CPTA#1 4-5	10/14/2009	0.48	0.06	<1	8.0	4.950	22.90	18.70	26.20	5.74	43	630
28CPTA#1 5-7	10/14/2009	0.45	0.03	<1	7.8	4.600	22.90	13.30	21.60	5.08	129	610
28CPTA#1 7-9	10/14/2009	0.28	0.03	<1	7.8	3.110	9.69	4.57	17.80	6.67	236	530
28CPTA#1 9-11	10/14/2009	0.28	0.07	<1	7.7	3.650	13.70	5.17	19.00	6.19	273	440
28CPTA#1 11-13	10/14/2009	0.56	0.31	1	7.8	4.490	17.60	7.05	25.80	7.35	266	460
28CPTA#1 13-15	10/14/2009	0.88	0.68	2	7.8	4.480	17.30	7.38	28.20	8.03	224	790
28CPTA#1 15-17	10/14/2009	0.60	0.43	2	7.7	5.000	24.80	11.20	29.40	6.93	115	900
28CPTA#2 0-1	10/13/2009	1.18	0.28	2	7.6	4.120	24.00	10.90	17.90	4.29	139	1300
28CPTA#2 1-2	10/13/2009	1.30	0.25	1	7.6	3.160	21.30	11.50	8.87	2.19	59	1110
28CPTA#2 2-3	10/13/2009	0.99	0.12	1	7.9	3.040	20.60	12.50	9.31	2.29	8	650
28CPTA#2 3-4	10/13/2009	0.81	0.10	1	8.1	3.440	16.90	13.40	15.90	4.08	7	650
28CPTA#2 4-5	10/13/2009	0.85	0.09	2	8.5	1.960	3.03	2.16	15.50	9.62	70	850
28CPTA#2 5-7	10/13/2009	0.58	0.07	2	8.4	3.060	3.50	3.40	26.20	14.00	100	800
28CPTA#2 7-9	10/13/2009	0.66	0.10	1	8.2	6.430	20.00	20.50	45.40	10.10	125	970
28CPTA#2 9-11	10/13/2009	0.41	0.07	2	8.1	2.980	11.50	5.84	17.80	6.05	76	320
28CPTA#2 11-13	10/13/2009	0.39	0.10	<1	7.9	3.270	18.20	6.85	13.00	3.67	160	290
28CPTA#2 13-15	10/13/2009	0.12	0.57	<1	7.4	2.860	13.30	5.33	11.60	3.80	188	260
28CPTA#2 15-17	10/13/2009	0.22	0.06	1	7.8	1.410	5.48	2.38	5.94	3.00	90	370
28CPTA#3 0-1	10/9/2009	1.66	0.45	2	7.8	5.320	23.30	14.80	30.60	7.01	155	1400
28CPTA#3 1-2	10/9/2009	1.25	0.22		7.8	4.500	22.10	15.30	22.20	5.13	133	1500
28CPTA#3 2-3	10/9/2009	1.21	0.17	2	8.2	4.530	18.50	14.80	27.40	6.71	44	990
28CPTA#3 3-4	10/9/2009	0.85	0.10	1	8.3	3.420	9.98	8.31	22.80	7.56	27	640
28CPTA#3 4-5	10/9/2009	0.87	0.11	<1	8.5	5.540	7.26	5.71	54.40	20.60	201	890
28CPTA#3 5-7	10/9/2009	0.59	0.12	<1	8.6	5.990	5.72	7.69	56.40	21.80	265	700
28CPTA#3 7-9	10/9/2009	0.47	0.15	<1	8.2	5.390	20.20	21.80	28.50	6.22	211	780
28CPTA#3 9-11	10/9/2009	0.50	0.16	1	7.8	6.770	37.20	16.60	24.90	4.80	470	540
28CPTA#3 11-13	10/9/2009	0.27	0.10	<1	8.1	1.460	3.27	1.21	9.52	6.36	142	800
28CPTA#3 13-15	10/9/2009	0.49	0.09	<1	7.8	3.480	15.90	6.95	19.50	5.77	71	670
28CPTA#4 0-1	10/6/2009	1.55	0.35	1	7.7	2.550	13.40	5.76	11.70	3.78	127	480
28CPTA#4 1-2	10/6/2009	1.26	0.21	1	7.7	3.120	26.60	8.70	9.37	2.23	25	940
28CPTA#4 2-3	10/6/2009	1.09	0.26	<1	7.7	3.040	22.10	9.03	10.10	2.55	21	560
28CPTA#4 3-4	10/6/2009	0.98	0.17	2	7.9	2.240	13.00	7.90	5.79	1.79	23	350
28CPTA#4 4-5	10/6/2009	1.53	0.35	3	8.1	3.340	12.50	11.70	17.60	5.06	70	570
28CPTA#4 5-7	10/6/2009	1.01	0.09	2	8.3	2.330	3.89	3.76	16.90	8.64	30	350
28CPTA#4 7-9	10/6/2009	0.59	0.08	<1	8.2	1.640	3.36	2.36	11.40	6.74	37	350
28CPTA#4 9-11	10/6/2009	0.47	0.03	<1	8.3	1.600	1.90	1.64	12.20	9.17	53	600
28CPTA#4 11-13	10/6/2009	0.65	0.07	<1	7.9	2.560	7.67	3.72	17.70	7.42	71	1070
28CPTA#4 13-15	10/6/2009	1.74	0.12	2	7.9	3.580	14.10	6.06	25.20	7.94	49	1130
28CPTA#5 0-1	10/9/2009	1.05	0.29	<1	8.0	2.850	18.40	6.82	10.40	2.93	35	580
28CPTA#5 1-2	10/9/2009	0.78	0.12	<1	8.0	3.760	24.00	13.80	14.10	3.24	48	1010
28CPTA#5 2-3	10/9/2009	0.93	0.13	<1	8.0	3.670	21.70	13.40	15.30	3.65	34	1090
28CPTA#5 3-4	10/9/2009	0.76	0.11	<1	8.2	3.010	12.60	9.31	15.80	4.77	30	530
28CPTA#5 4-5	10/9/2009	0.88	0.07	<1	8.6	1.950	3.95	2.38	14.30	8.04	78	370
28CPTA#5 5-7	10/9/2009	0.46	0.05	<1	8.9	1.410	1.21	0.61	11.70	12.30	79	430
28CPTA#5 7-9	10/9/2009	0.98	0.11	<1	8.2	6.200	19.00	17.60	48.30	11.30	62	1890
28CPTA#5 9-11	10/9/2009	0.73	0.09	<1	8.1	4.800	18.20	14.50	31.60	7.81	41	960
28CPTA#5 11-13	10/9/2009	0.52	0.08	<1	8.2	2.930	8.43	5.31	18.70	7.13	83	520
28CPTA#5 13-15	10/9/2009	1.14	0.16	1	8.1	4.440	18.00	11.20	27.00	7.07	148	1610
28LY#1 0-1	10/8/2009	1.29	0.35	<1	7.8	1.830	7.06	2.37	8.88	4.09	120	750
28LY#1 1-2	10/8/2009	0.58	0.12	<1	7.9	1.620	6.06	2.25	7.87	3.86	70	1000
28LY#1 2-3	10/8/2009	0.60	0.10	1	8.1	1.070	3.11	1.07	5.64	3.90	80	690
28LY#1 3-4	10/8/2009	0.44	0.03	<1	8.3	0.715	1.79	0.57	3.56	3.28	90	710
28LY#1 4-5	10/8/2009	0.52	0.06	<1	8.2	0.702	1.73	0.56	3.67	3.43	100	740
28LY#1 5-7	10/8/2009	0.61	0.06	<1	8.0	0.917	2.65	0.90	4.50	3.38	95	615
28LY#1 7-9	10/8/2009	0.42	0.03	<1	8.1	0.759	2.09	0.86	3.71	3.05	95	770
28LY#1 9-11	10/8/2009	0.41	0.03	<1	8.0	0.988	3.04	1.79	4.23	2.75	80	750
28LY#1 11-13	10/8/2009	0.79	0.03	<1	7.8	1.380	4.89	1.92	6.11	3.35	150	1340
28LY#1 13-15	10/8/2009	1.75	0.08	1	7.9	1.530	5.47	1.81	8.31	4.41	135	1225

Table A-5. 2009 Irrigation Soil Analyses for Section 28 (continued)

Sample Site	Date	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
28LY#2 0-1	10/9/2009	1.46	0.49	1	7.8	5.160	24.20	13.40	27.30	6.30	134	950
28LY#2 1-2	10/9/2009	1.23	0.24	<1	7.9	5.070	23.30	15.60	29.70	6.73	68	1100
28LY#2 2-3	10/9/2009	2.68	0.51	<1	8.2	8.390	21.20	24.90	69.70	14.50	242	2900
28LY#2 3-4	10/9/2009	1.18	0.12	<1	8.2	8.830	20.20	18.60	84.30	19.10	165	1500
28LY#2 4-5	10/9/2009	0.69	0.08	<1	8.1	7.790	18.80	12.90	66.60	17.20	214	1400
28LY#2 5-7	10/9/2009	0.74	0.15	<1	7.6	4.640	21.10	10.59	20.05	5.36	532	620
28LY#2 7-9	10/9/2009	1.35	0.23	<1	7.6	3.650	25.10	12.30	8.04	1.86	344	920
28LY#2 8M	10/12/2009	0.38	0.10	2	8.0	2.630	12.60	5.85	12.00	3.95	67	290
28LY#2 15M	10/12/2009	0.41	0.12	2	8.0	2.710	12.20	5.72	12.90	4.31	70	590
28LY#3 0-1	10/8/2009	3.49	0.85	<1	7.6	4.170	20.20	9.86	20.40	5.26	138	1100
28LY#3 1-2	10/8/2009	0.94	0.13	1	7.7	3.140	17.50	7.45	11.80	3.34	69	540
28LY#3 2-3	10/8/2009	1.25	0.13	<1	7.7	4.210	23.10	10.70	18.80	4.57	46	670
28LY#3 3-4	10/8/2009	0.87	0.07	<1	7.7	3.600	22.10	10.10	13.40	3.34	21	660
28LY#3 4-5	10/8/2009	0.84	0.10	<1	7.7	3.950	21.50	13.30	17.10	4.10	21	810
28LY#3 5-7	10/8/2009	1.27	0.07	<1	7.8	4.370	18.65	8.77	25.75	6.99	42	705
28LY#3 7-9	10/8/2009	1.70	0.09	2	7.8	5.325	20.50	9.41	34.70	8.99	84	1335

AVERAGES OF TREATED AREA SAMPLES	DEPTH	U (mg/kg)	Se (mg/kg)	Mo (mg/kg)	pH (units)	Cond. mmhos/cm	Ca (meq/l)	Mg (meq/l)	Na (meq/l)	SAR (ratio)	Cl (mg/kg)	SO4 (mg/kg)
	1	1.62	0.41	2	7.8	3.685	18.18	8.96	18.14	4.87	117	895
	2	1.12	0.19	1	7.8	3.571	20.66	10.80	15.65	3.97	65	1011
	3	1.24	0.20	1	8.0	4.131	18.94	12.63	23.56	5.72	65	1054
	4	0.78	0.10	1	8.1	3.467	12.67	9.14	22.18	6.39	50	683
	5	0.83	0.12	3	8.2	3.773	11.46	8.43	27.17	9.22	100	783
	5-7	0.71	0.08	2	8.2	3.415	9.95	6.13	22.89	9.69	159	604
	7-9	0.76	0.10	2	8.0	3.904	14.73	10.58	23.32	6.54	140	871
	9-11	0.47	0.08	2	8.0	3.465	14.26	7.59	18.29	6.13	166	602
	11-13	0.53	0.12	1	7.9	2.682	10.01	4.34	15.14	5.88	145	747
	13-15	1.02	0.28	2	7.8	3.395	14.01	6.45	19.97	6.17	136	948
	15-17	0.41	0.20	2	7.8	3.040	14.16	6.43	16.08	4.75	92	620

APPENDIX B

Soil Sodium Risk Assessment

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Tables

Table B-1. Critical ESP in Soils Where Reduction in Hydraulic Conductivity Occurs

%Clay	Critical ESP at Selected Electrolyte Concentrations 1000 umhos/cm	2000 umhos/cm	4000 umhos/cm
10%	27%	33%	44%
20%	22%	27%	37%
30%	17%	23%	31%
40%	12%	18%	25%
50%	7%	13%	18%
60%	3%	7%	13%

Based on 25% reduction in hydraulic conductivity

Table B-2. Water Quality Class vs. Soil Quality for Soil Health Risk Assessment

Class	SAR	EC mmhos	Sandy	Coarse Loamy	Coarse Silty	Fine Loamy	Fine Silty	Fine
C4S1	0-10	>2250	VL	VL	VL	VL	VL	L
C3S1	0-10	750-2250	VL	VL	VL	VL	VL	L
C2S1	0-10	250-750	VL	VL	VL	L	L	L
C4S2	10-18	>2250	VL	VL	VL	L	L	L
C3S2	10-18	750-2250	VL	L	L	L	L	M
C4S3	18-26	>2250	VL	LL	M	M	M	MH
C4S4	26-32+	>2250	VL	L	L	M	M	MH
C2S2	10-18	250-750	VL	M	M	M	M	MH
C1S1	0-10	0-250	VL	M	M	M	M	MH
C3S3	18-26	750-2250	VL	M	M	M	M	H
C2S3	18-26	250-750	VL	M	M	MH	MH	H
C3S4	26-32+	750-2250	L	M	M	MH	MH	H
C2S4	26-32+	250-750	L	M	M	MH	MH	H
C1S2	10-18	0-250	L	M	M	H	H	VH
C1S3	18-26	0-250	L	H	H	H	H	VH
C1S4	26-32+	0-250	L	H	H	VH	VH	VH

Based on modified USDA Handbook 60 and published lieterature sources.

Texture	Soil Textures % Clay	% Silt	% Sand
sand	0-10	0-15	85-100
silt	0-12	80-100	0-20
loamy sand	0-15	0-30	70-90
sandy loam	0-20	0-50	44-80
silt loam	0-27	50-80	0-50
loamy sand	7-27	28-50	33-52
sandy clay loam	20-35	0-28	45-80
silty clay loam	27-40	40-73	0-20
clay loam	27-40	15-52	20-45
sandy clay	35-55	0-20	45-65
silty clay	40-60	40-60	0-20
clay	40-100	0-40	0-45

Soil textural families

Sandy - sand or loamy sand, <15% clay
Coarse loamy - >15% fine sand or coarser and <18% clay
Fine loamy - >15% fine sand and coarser and 18 to 34% clay
Coarse silty - <15% fine sand and coarser and <18% clay
Fine silty - <15% fine sand and coarser and 18 to 34% clay
Fine - 35-59% clay
Very fine - >60% clay

APPENDIX C

LeachP Model Input and Results
And
Soil Moisture and Ground-Water
Mixing Calculation Sheets

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Tables

Table C-1. LEACHP Section 34 Flood Irrigation Inputs and Results

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
1999	3005.4	0	0	0	0
2000	3026.9	1210	142	170	876
2001	2997.8	1134	121	166	876
2002	3033.6	1271	185	170	880
2003	3034.9	1283	229	170	882
2004	3033.8	1250	197	169	885
2005	3028.1	1219	180	170	874
2006	2950.9	1060	107	163	868
2007	2743.4	563	39	100	632
2008	2925.2	1085	-25	150	778
2009	2764.4	731	20	117	755
2010	2793.7	875	-25	129	741
2011	2859.4	996	-31	150	812
2012	2880.3	996	-14	153	836
2013	2844.9	582	0	239	378
2014	2830.2	582	-13	230	380
2015	2823.8	582	-20	227	381
2016	2821.9	582	-22	230	376
2017	2820.5	582	-22	228	377
2018	2838.1	265	-20	167	101
2019	2852.5	265	-10	155	105
2020	2857	265	-3	158	105
2021	2859.1	265	1	157	105
2022	2860.1	265	2	157	105
2023	2861.2	265	2	157	105
2024	2862.6	265	2	157	105
2025	2863.9	265	2	157	105
2026	2865.3	265	2	156	105
2027	2863.5	265	3	159	105
2028	2862.5	265	4	157	105
2029	2862.9	265	3	157	105
2030	2863.5	265	3	157	105
2031	2861.5	265	3	159	105
2032	2860.3	265	4	157	105
2033	2860.9	265	3	157	105
2034	2861.5	265	2	157	105
2035	2862.4	265	3	157	105
2036	2863.8	265	2	156	105
2037	2864.8	265	2	157	105
2038	2862.7	265	3	159	105
2039	2861.5	265	4	158	105
2040	2862.3	265	3	157	105
2041	2863.9	265	2	156	105
2042	2862	265	3	159	105
2043	2860.5	265	4	158	105
2044	2860.8	265	3	157	105
2045	2861.4	265	3	157	105
2046	2862.4	265	2	157	105
2047	2863.2	265	3	157	105
2048	2864.8	265	2	156	105
2049	2862.8	265	3	159	105
2050	2867.5	265	4	165	91
2051	2862.4	264.9	4.5	163.8	101.8
2052	2859.2	264.9	5.7	157.6	104.8
2053	2858	265	3.7	157.4	104.9
2054	2857.9	264.9	2.8	157.5	104.8
2055	2858.8	264.9	2.2	157	104.8
2056	2859.5	264.9	2.2	157.2	104.8
2057	2858	264.9	2.6	158.9	104.9
2058	2857.5	264.9	3.4	157.2	104.8
2059	2857.8	265	2.6	157.3	104.8
2060	2861	264.9	1.8	154.9	105
2061	2861.1	264.9	1.5	158.6	104.7
2062	2861	264.9	3	157.2	104.8
2063	2861.4	264.9	2.6	157.1	104.8
2064	2862.6	264.9	2.3	156.6	104.8
2065	2863.9	264.9	2.2	156.6	104.8
2066	2865.5	264.9	2.4	156.2	104.8
2067	2867	265	2.7	156	104.8
2068	2864.7	264.9	3.4	158.9	104.7
2069	2863.6	264.9	4.1	157.2	104.8
2070	2863.6	264.9	3.2	156.9	104.8
2071	2864.3	264.9	2.7	156.8	104.8
2072	2862.8	264.9	3.1	158.5	104.7
2073	2861.3	264.9	4.1	157.6	104.8
2074	2861.5	264.9	3.1	156.8	104.8
2075	2862.7	264.9	2.4	156.5	104.8
2076	2863.5	264.9	2.5	156.8	104.8
2077	2864.3	264.9	2.6	156.7	104.8
2078	2865.6	264.9	2.5	156.3	104.9
2079	2864	264.9	2.9	158.9	104.7
2080	2862.9	264.9	4	157.2	104.8
2081	2863.5	264.9	3.1	156.5	104.8
2082	2864.6	264.9	2.6	156.5	104.8
2083	2865.5	264.8	2.7	156.6	104.8
2084	2864.1	264.9	3.2	158.3	104.7
2085	2862.5	264.9	4	157.8	104.8
2086	2862.7	264.8	3.1	156.8	104.8
2087	2860.8	264.9	3.2	159	104.7
2088	2859.5	264.9	3.8	157.7	104.8
2089	2859.7	264.9	2.7	157.3	104.8
2090	2860.3	264.8	2.3	157.2	104.8
2091	2861.5	264.9	2.1	156.8	104.8
2092	2860.1	264.9	2.5	159.1	104.7
2093	2859.3	264.9	3.5	157.5	104.8
2094	2859.8	264.8	2.8	156.9	104.8
2095	2860	264.9	2.4	157.5	104.8
2096	2861.3	264.9	2.1	156.8	104.8
2097	2859.6	264.9	2.7	159.2	104.7
2098	2859	264.8	3.6	157.2	104.8
2099	2865.3	264.9	2.6	165.6	90.4

Table C-2. LEACHP Section 28 Pivot Irrigation Input and Results

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
1999	2001.5	0	0	0	0
2000	2004.9	265	43	219	0
2001	2014.5	265	12	243	0
2002	2245.6	935	8	149	547
2003	2583.9	1048	7	156	547
2004	2892.1	1191	176	158	549
2005	2798.8	991	389	153	542
2006	2777.9	975	299	154	543
2007	2803.3	1003	278	155	544
2008	2885.8	1107	321	157	547
2009	2641.2	829	383	151	540
2010	2374.5	265	153	197	182
2011	2610.4	966	119	433	179
2012	2800.6	966	133	465	178
2013	2419.4	418	318	303	179
2014	2263.7	418	122	272	180
2015	2175.6	418	71	262	173
2016	2117.8	418	48	260	168
2017	2078.1	418	35	258	165
2018	2087.1	265	27	132	97
2019	2083.7	265	21	147	100
2020	2075	265	18	157	100
2021	2067.4	265	15	158	100
2022	2061.3	265	13	159	100
2023	2056.1	265	11	160	99
2024	2053.2	265	10	159	99
2025	2050.7	265	8	160	99
2026	2049.2	265	8	160	99
2027	2044	265	7	164	99
2028	2042.2	265	6	161	99
2029	2040.9	265	6	161	99
2030	2040.9	265	5	160	99
2031	2037.1	265	5	164	99
2032	2036.2	265	5	162	99
2033	2036	265	5	161	99
2034	2035.8	265	5	161	99
2035	2036	265	5	161	99
2036	2037.5	265	4	160	99
2037	2038.8	265	4	160	99
2038	2036	265	4	164	99
2039	2035.5	265	4	162	99
2040	2035.9	265	4	161	99
2041	2036.5	265	4	161	99
2042	2033.8	265	4	164	99
2043	2033.2	265	4	162	99
2044	2033.5	265	4	161	99
2045	2033.9	265	4	161	99
2046	2034.9	265	4	160	99
2047	2035.7	265	4	161	99
2048	2037.8	265	4	159	99
2049	2035.2	265	4	164	99
2050	2039.9	265	4	169	87
2051	2034.5	264.9	4.2	169.8	96.3
2052	2032.5	264.9	4.2	163.4	99.4
2053	2031.9	265	4.2	162	99.3
2054	2032	264.9	4.1	161.2	99.4
2055	2032.4	264.9	4.2	161	99.3
2056	2032.7	264.9	4.1	161	99.4
2057	2030.3	264.9	4.2	163.8	99.3
2058	2030.2	264.9	4.1	161.5	99.4
2059	2030	265	4.2	161.6	99.4
2060	2033.6	264.9	4.1	157.5	99.5
2061	2032.8	264.9	4.2	162.2	99.3
2062	2032.6	264.9	4.2	161.5	99.3
2063	2032.7	264.9	4.1	161.2	99.4
2064	2033.6	264.9	4.2	160.5	99.3
2065	2035.1	264.9	4.1	159.7	99.5
2066	2036.6	264.9	4.2	159.9	99.4
2067	2038.7	265	4.1	159.2	99.4
2068	2036.5	264.9	4.2	163.8	99.2
2069	2036.3	264.9	4.2	161.6	99.3
2070	2036.9	264.9	4.1	160.9	99.3
2071	2038	264.9	4.2	160.4	99.4
2072	2035.2	264.9	4.1	164.4	99.2
2073	2034.7	264.9	4.2	162	99.4
2074	2035.4	264.9	4.1	160.7	99.3
2075	2035.9	264.9	4.2	160.9	99.4
2076	2036.8	264.9	4.2	160.7	99.3
2077	2038	264.9	4.1	160.2	99.4
2078	2040.3	264.9	4.2	159.1	99.4
2079	2037.5	264.9	4.1	164.2	99.3
2080	2036.9	264.9	4.2	162.1	99.3
2081	2037.8	264.9	4.1	160.5	99.4
2082	2038.9	264.9	4.2	160.2	99.4
2083	2040.3	264.8	4.1	159.9	99.4
2084	2038.5	264.9	4.2	163.3	99.2
2085	2037.9	264.9	4.2	162	99.4
2086	2038	264.8	4.1	161.3	99.3
2087	2035.1	264.9	4.2	164.4	99.2
2088	2035	264.9	4.1	161.4	99.4
2089	2035	264.9	4.2	161.4	99.3
2090	2035.4	264.8	4.1	160.9	99.4
2091	2036.3	264.9	4.2	160.3	99.4
2092	2033.9	264.9	4.2	163.9	99.3
2093	2032.9	264.9	4.1	162.2	99.3
2094	2033.3	264.8	4.2	160.9	99.4
2095	2033.7	264.9	4.1	160.9	99.4
2096	2034.2	264.9	4.2	160.8	99.3
2097	2031.6	264.9	4.1	164.1	99.3
2098	2031	264.8	4.2	161.9	99.3
2099	2037	264.9	4.2	168.9	85.8

Table C-3. LECHP Section 33 Pivot Irrigation Inputs and Results with Irrigation 2012

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
1999	2001.5	0	0	0	0
2000	2270.6	963	43	136	515
2001	2468.2	908	12	154	544
2002	2739.5	984	12	155	545
2003	2858.8	1063	241	156	547
2004	2889.9	1134	396	158	549
2005	2875.5	1079	398	153	542
2006	2659.7	856	375	154	543
2007	2888	1137	210	155	544
2008	2885.6	1103	403	156	547
2009	2520.5	701	382	144	540
2010	2286	265	126	193	180
2011	2216.7	387	74	203	180
2012	2164.9	387	53	206	179
2013	2150.4	265	40	143	97
2014	2134.3	265	30	151	100
2015	2120	265	24	156	100
2016	2104.9	265	19	161	99
2017	2093.4	265	16	161	99
2018	2084.6	265	14	161	99
2019	2078.2	265	12	160	99
2020	2070	265	10	164	99
2021	2064.5	265	9	162	99
2022	2060.5	265	8	161	99
2023	2057.6	265	8	161	99
2024	2055.8	265	7	160	99
2025	2054.4	265	7	160	99
2026	2053.6	265	6	160	99
2027	2049.1	265	6	164	99
2028	2047.4	265	6	162	99
2029	2046.5	265	5	161	99
2030	2046.4	265	5	160	99
2031	2042.7	265	5	164	99
2032	2041.4	265	5	162	99
2033	2040.5	265	5	162	99
2034	2040.2	265	5	161	99
2035	2039.9	265	5	161	99
2036	2041.1	265	5	160	99
2037	2042.6	265	5	160	99
2038	2039.3	265	5	164	99
2039	2038.4	265	5	162	99
2040	2038.7	265	5	161	99
2041	2039.3	265	4	160	99
2042	2036.4	265	5	164	99
2043	2035.6	265	4	162	99
2044	2035.5	265	4	161	99
2045	2036	265	4	161	99
2046	2036.3	265	4	161	99
2047	2037.2	265	4	160	99
2048	2038.9	265	5	160	99
2049	2036.2	265	4	164	99
2050	2040.9	265	4	169	87
2051	2035.2	264.9	4.3	170	96.3
2052	2033.8	264.9	4.1	162.7	99.4
2053	2033	265	4.2	162.2	99.3
2054	2032.9	264.9	4.1	161.4	99.3
2055	2032.8	264.9	4.2	161.3	99.5
2056	2032.7	264.9	4.1	161.3	99.4
2057	2030.5	264.9	4.2	163.6	99.3
2058	2030.1	264.9	4.2	161.7	99.4
2059	2029.9	265	4.1	161.5	99.3
2060	2033.7	264.9	4.2	157.3	99.6
2061	2032.2	264.9	4.1	162.8	99.3
2062	2032.4	264.9	4.2	161.2	99.3
2063	2032.5	264.9	4.1	161.1	99.4
2064	2033.7	264.9	4.2	160.1	99.3
2065	2035.2	264.9	4.2	159.9	99.4
2066	2037.1	264.9	4.1	159.4	99.4
2067	2038.6	265	4.2	159.9	99.4
2068	2036.1	264.9	4.1	164	99.2
2069	2036	264.9	4.2	161.6	99.3
2070	2037	264.9	4.1	160.5	99.3
2071	2037.8	264.9	4.2	160.7	99.4
2072	2035.1	264.9	4.2	164.3	99.2
2073	2034.3	264.9	4.1	162.3	99.3
2074	2034.8	264.9	4.2	161	99.4
2075	2035.6	264.9	4.1	160.6	99.3
2076	2036.3	264.9	4.2	160.8	99.4
2077	2037.6	264.9	4.1	160.2	99.3
2078	2039.8	264.9	4.2	159.2	99.4
2079	2037.1	264.9	4.1	164.2	99.2
2080	2036.4	264.9	4.2	162.1	99.3
2081	2037.2	264.9	4.2	160.6	99.4
2082	2038.2	264.9	4.1	160.4	99.3
2083	2039.4	264.8	4.2	160.1	99.4
2084	2037.3	264.9	4.1	163.7	99.3
2085	2036.9	264.9	4.2	161.7	99.3
2086	2037.5	264.8	4.1	160.9	99.3
2087	2034.5	264.9	4.2	164.5	99.2
2088	2034.3	264.9	4.2	161.5	99.4
2089	2034.2	264.9	4.1	161.5	99.3
2090	2034.9	264.8	4.2	160.7	99.4
2091	2036	264.9	4.1	160.2	99.4
2092	2033.4	264.9	4.2	164.1	99.2
2093	2032.5	264.9	4.1	162.2	99.4
2094	2033.2	264.8	4.2	160.6	99.3
2095	2033.4	264.9	4.2	161.1	99.4
2096	2033.9	264.9	4.1	160.9	99.3
2097	2031.5	264.9	4.2	163.9	99.2
2098	2030.9	264.8	4.1	161.9	99.4
2099	2037.1	264.9	4.2	168.8	85.7

Table C-4. Leachp Section 33 Pivot Irrigation Inputs and Results with Irrigation through 2009

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
1999	2001.5	0	0	0	0
2000	2270.6	963	43	136	515
2001	2468.2	908	12	154	544
2002	2739.5	984	12	155	545
2003	2858.8	1063	241	156	547
2004	2889.9	1134	396	158	549
2005	2875.5	1079	398	153	542
2006	2659.7	856	375	154	543
2007	2888	1137	210	155	544
2008	2885.6	1103	403	156	547
2009	2520.5	701	382	144	540
2010	2286	265	126	193	180
2011	2241.8	265	74	138	97
2012	2204	265	53	150	100
2013	2173.5	265	40	156	100
2014	2150.5	265	30	158	99
2015	2133	265	24	159	99
2016	2115.8	265	19	164	99
2017	2103.5	265	16	162	99
2018	2094.3	265	14	161	99
2019	2087	265	12	161	99
2020	2078.4	265	11	164	99
2021	2072.4	265	10	162	99
2022	2068.2	265	9	161	99
2023	2064.2	265	8	162	99
2024	2061.5	265	8	161	99
2025	2060.2	265	7	160	99
2026	2059.1	265	7	160	99
2027	2054.3	265	6	164	99
2028	2052.3	265	6	162	99
2029	2051.1	265	6	161	99
2030	2049.9	265	6	161	99
2031	2046.2	265	6	164	99
2032	2044.8	265	5	162	99
2033	2043.7	265	5	161	99
2034	2043.2	265	5	161	99
2035	2042.8	265	5	161	99
2036	2043.6	265	5	160	99
2037	2044.5	265	5	160	99
2038	2041.3	265	5	164	99
2039	2040.4	265	5	162	99
2040	2040.4	265	5	161	99
2041	2040.9	265	5	160	99
2042	2037.8	265	5	164	99
2043	2036.7	265	5	162	99
2044	2036.8	265	4	161	99
2045	2037.2	265	5	161	99
2046	2037.4	265	4	161	99
2047	2038.4	265	4	160	99
2048	2040.2	265	4	159	99
2049	2037.5	265	4	164	99
2050	2041.9	265	4	169	87
2051	2035.4	264.9	4.3	170	96.3
2052	2033.4	264.9	4.1	163.3	99.4
2053	2032.6	265	4.2	162.1	99.3
2054	2032.4	264.9	4.1	161.4	99.4
2055	2032.4	264.9	4.2	161.3	99.4
2056	2032.7	264.9	4.1	161	99.4
2057	2030.2	264.9	4.2	163.9	99.3
2058	2029.6	264.9	4.2	161.9	99.3
2059	2029.6	265	4.1	161.3	99.4
2060	2033.4	264.9	4.2	157.3	99.5
2061	2032.3	264.9	4.1	162.5	99.3
2062	2032.2	264.9	4.2	161.3	99.4
2063	2032.5	264.9	4.1	161	99.3
2064	2033.5	264.9	4.2	160.3	99.4
2065	2035	264.9	4.2	159.8	99.5
2066	2036.7	264.9	4.1	159.6	99.3
2067	2038.7	265	4.2	159.4	99.5
2068	2036.3	264.9	4.1	164	99.2
2069	2036.2	264.9	4.2	161.6	99.3
2070	2036.6	264.9	4.1	161	99.3
2071	2037.8	264.9	4.2	160.3	99.4
2072	2035.1	264.9	4.2	164.3	99.2
2073	2034.3	264.9	4.1	162.3	99.4
2074	2034.8	264.9	4.2	160.9	99.4
2075	2035.4	264.9	4.1	160.9	99.3
2076	2036.3	264.9	4.2	160.5	99.4
2077	2037.6	264.9	4.1	160.2	99.4
2078	2039.8	264.9	4.2	159.1	99.4
2079	2037.6	264.9	4.1	163.8	99.2
2080	2036.8	264.9	4.2	162.2	99.3
2081	2037.9	264.9	4.2	160.4	99.4
2082	2038.6	264.9	4.1	160.5	99.4
2083	2040.3	264.8	4.2	159.8	99.3
2084	2037.7	264.9	4.1	164.1	99.3
2085	2037.6	264.9	4.2	161.4	99.3
2086	2037.6	264.8	4.1	161.5	99.4
2087	2034.7	264.9	4.2	164.2	99.2
2088	2034.2	264.9	4.2	162	99.4
2089	2034.1	264.9	4.1	161.3	99.4
2090	2034.7	264.8	4.2	160.9	99.3
2091	2035.5	264.9	4.1	160.4	99.4
2092	2033.2	264.9	4.2	163.8	99.3
2093	2032.6	264.9	4.1	161.9	99.3
2094	2032.7	264.8	4.2	161.2	99.4
2095	2033	264.9	4.2	161	99.3
2096	2033.6	264.9	4.1	160.7	99.4
2097	2030.9	264.9	4.2	164.2	99.2
2098	2030.7	264.8	4.1	161.5	99.4
2099	2037.5	264.9	4.2	168.3	85.6

TABLE C-5. MIXING CALCULATION SHEET

SECTION 34 FLOOD

Ground-Water Flow Estimate (GWF)
T = 3,000 gpd/ft — Width (L) = 3,000 ft — Gradient (i) = 0.006 ft/ft
Q = TiL = 37.5 gpm

Soil Moisture Long-Term Model Flux (SMF): = 3 mm/yr
= 0.73 gpm for 120 Ac

TDS: GW TDS = 2,600 mg/l
SM TDS = 7,000 mg/l (model does not indicate)

$$Mixture\ TDS = \frac{GW\ TDS(GWF) + SM\ TDS(SMF)}{GWF + SMF}$$

$$Mixture\ TDS = \frac{2600(37.5) + 7000(0.73)}{38.23}$$

Mixture TDS = 2684 mg/l

SO4: GW SO4 = 1,292 mg/l
SM SO4 = 3,100 mg/l (model does not indicate)

$$Mixture\ SO4 = \frac{GW\ SO4(GWF) + SM\ SO4(SMF)}{GWF + SMF}$$

$$Mixture\ SO4 = \frac{1292(37.5) + 3100(0.73)}{38.23}$$

Mixture SO4 = 1327 mg/l

U: GW U = 0.076 mg/l
SM U = 0.5 mg/l (model does not indicate)

$$Mixture\ U = \frac{GW\ U(GWF) + SM\ U(SMF)}{GWF + SMF}$$

$$Mixture\ U = \frac{0.076(37.5) + 0.5(0.73)}{38.23}$$

Mixture U = 0.084 mg/l

Se: GW Se = 0.05 mg/l
SM Se = 0.2 mg/l (model does not indicate)

$$Mixture\ Se = \frac{GW\ Se(GWF) + SM\ Se(SMF)}{GWF + SMF}$$

$$Mixture\ Se = \frac{0.05(37.5) + 0.2(0.73)}{38.23}$$

Mixture Se = 0.053 mg/l

TABLE C-6. MIXING CALCULATION SHEET

SECTION 28 PIVOT

Ground-Water Flow Estimate (GWF)

T = 30,000 gpd/ft | Width (L) = 2,360 ft | Gradient (i) = 0.0042 ft/ft

Q = TiL =206 gpm

Soil Moisture Model Flux During Irrigation (SMFI): = 120 mm/yr
= 24 gpm for 100 Ac

Soil Moisture Model Flux Long Term (SMF): = 4 mm/yr
= 0.81 gpm for 100 Ac

TDS: GW TDS = 1,762 mg/l
SM TDS = 5,000 mg/l

$$Mixture\ TDS\ During\ Irrigation = \frac{GW\ TDS(GWF) + SM\ TDS(SMFI)}{GWF + SMFI}$$

$$Mixture\ TDS = \frac{1762(206) + 5000(24)}{230}$$

$$Mixture\ TDS = 2100\ mg/l$$

$$Mixture\ TDS\ Long\ Term = \frac{GW\ TDS(GWF) + SM\ TDS(SMF)}{GWF + SMF}$$

$$Mixture\ TDS = \frac{1762(206) + 5000(0.81)}{206.81}$$

$$Mixture\ TDS = 1775\ mg/l$$

SO4: GW SO4 = 797 mg/l
SM SO4 =2200 mg/l

$$Mixture\ SO4\ During\ Irrigation = \frac{GW\ SO4(GWF) + SM\ SO4(SMFI)}{GWF + SMFI}$$

$$Mixture\ SO4\ During\ Irrigation = \frac{797(206) + 2200(24)}{230}$$

$$Mixing\ SO4 = 943\ mg/l$$

$$Mixture\ SO4\ Long Term = \frac{GW\ SO4(GWF) + SM\ SO4(SMF)}{GWF + SMF}$$

$$Mixture\ SO4\ Long\ Term = \frac{797(206) + 2200(0.81)}{206.81}$$

$$Mixture\ SO4 = 802\ mg/l$$

U: GW U = 0.1 mg/l average after restoration
SM U = 0.5 mg/l (model does not indicate)

$$Mixture\ U = \frac{GW\ U(GWF) + SM\ U(SMF)}{GWF + SMF}$$

$$Mixture\ U = \frac{0.1(206) + 0.5(0.81)}{206.81}$$

$$Mixture\ U = 0.102\ mg/l$$

Se: GW Se = 0.04 mg/l average after restoration
SM Se = 0.2 mg/l (model does not indicate)

$$Mixture\ Se = \frac{GW\ Se(GWF) + SM\ Se(SMF)}{GWF + SMF}$$

$$Mixture\ Se = \frac{0.04(206) + 0.2(0.81)}{206.81}$$

$$Mixture\ Se = 0.0406\ mg/l$$

TABLE C-7. MIXING CALCULATION SHEET

SECTION 33 PIVOT

Ground-Water Flow Estimate (GWF)
T = 10,000 gpd/ft   Width (L) = 2,885 ft   Gradient (i) = 0.005 ft/ft
Q = TiL =100 gpm

Soil Moisture Model Flux During Irrigation (SMFI): = 40 mm/yr
= 12 gpm for 150 Ac

Soil Moisture Model Flux Long Term (SMF): = 4 mm/yr
= 1.2 gpm for 150 Ac

TDS: GW TDS = 1,540 mg/l
SM TDS = 3,400 mg/l

$$Mixture\ TDS\ During\ Irrigation = \frac{GW\ TDS(GWF) + SM\ TDS(SMFI)}{GWF + SMFI}$$

$$Mixture\ TDS = \frac{1540(100) + 3400(12)}{112}$$

$$Mixture\ TDS = 1740\ mg/l$$

$$Mixture\ TDS\ Long\ Term = \frac{GW\ TDS(GWF) + SM\ TDS(SMF)}{GWF + SMF}$$

$$Mixture\ TDS = \frac{1540(100) + 3400(1.2)}{101.2}$$

$$Mixture\ TDS = 1562\ mg/l$$

SO4: GW SO4 = 718 mg/l
SM SO4 =1500 mg/l

$$Mixture\ SO4\ During\ Irrigation = \frac{GW\ SO4(GWF) + SM\ SO4(SMFI)}{GWF + SMFI}$$

$$Mixture\ SO4\ During\ Irrigation = \frac{718(100) + 1500(12)}{112}$$

$$Mixing\ SO4 = 802\ mg/l$$

$$Mixture\ SO4\ Long Term = \frac{GW\ SO4(GWF) + SM\ SO4(SMF)}{GWF + SMF}$$

$$Mixture\ SO4\ Long\ Term = \frac{718(100) + 1500(1.2)}{101.2}$$

$$Mixture\ SO4 = 727\ mg/l$$

U: GW U = 0.02 mg/l
SM U = 0.5 mg/l (model does not indicate)

$$Mixture\ U = \frac{GW\ U(GWF) + SM\ U(SMF)}{GWF + SMF}$$

$$Mixture\ U = \frac{0.02(100) + 0.5(1.2)}{101.2}$$

$$Mixture\ U = 0.026\ mg/l$$

Se: GW Se = 0.034 mg/l average after restoration
SM Se = 0.2 mg/l (model does not indicate)

$$Mixture\ Se = \frac{GW\ Se(GWF) + SM\ Se(SMF)}{GWF + SMF}$$

$$Mixture\ Se = \frac{0.034(100) + 0.2(1.2)}{101.2}$$

$$Mixture\ Se = 0.036\ mg/l$$

APPENDIX D

Vegetation Analyses

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Tables

D.1 2008 and 2010 Vegetation Analyses

The western 120 acres of the Section 34 flood was tilled and replanted in 2008 with triticale. Triticale was also seeded with the alfalfa in the eastern 55 acres of the Section 34 flood area, but this area was not tilled prior to adding the triticale. Vegetation samples 7-12 of Section 34 flood area in the first cutting are from the west side and therefore are from triticale. Samples 1, 2, 5 and 6 of the second cutting are from the east side and were mostly triticale with some alfalfa. Samples 3 and 4 were from the east side were mostly alfalfa with some triticale.

In the south pivot (Section 33) there was 25 acres of canola seeded into the alfalfa in the southeast quarter. Camelina was also seeded into 25 acres of the western half of the south pivot. The 12 samples collected from the south pivot during the first cutting were alfalfa. The 12 samples collected during the second cut of the south pivot were from alfalfa except for sample number 11.

The 24 acres of flood irrigated area in Section 33 were retilled during 2008. Triticale was planted in the eastern portion of this flood area in 2008, but a crop was not obtained from this area due to the later season planting.

The Section 34 flood area was planted in sorghum/sudan grass in 2009 and 2010 after tilling while no additional planting was done in the Section 33 flood area. After tilling in the Section 33 center pivot was planted in permanent grass and a test crop of canola was planted in the Section 28 center pivot. While wheat was planted in all of Section 28 and only half of Section 33 in 2010. Table D-3 and D-4 presents the vegetation analyses from the cutting of the Section 34 crop, the Section 33 grass and the clippings from the Section 28 canola.

Table D-1. 2000 Hay Analyses

Sample	Uranium (mg/Kg)	Selenium (mg/Kg)	Moisture Content (%)	Percent Solids (%)
Homestake Hay				
Section 33 - 1st Cut	1.12	1.1	2.8	93.9
Section 34 - 1st Cut	0.73	0.5	2.9	95.1
Section 33 - 2nd Cut - Unwashed	0.62	1.4	4.6	95.7
Section 33 - 2nd Cut - Washed	0.58	1.5	33.4	95.9
Other Hay				
Carver	0.19	0.2	13.1	96.4
Elkin	0.05	0.1	7.4	95.7

Table D-2. 2001, 2002, 2003 and 2004 Hay Analyses

Irrigation Area	Sample	2001 Uranium (mg/kg)	2001 Selenium (mg/kg)	2002 Uranium (mg/kg)	2002 Selenium (mg/kg)	2003 Uranium (mg/kg)	2003 Selenium (mg/kg)	2004 Uranium (mg/kg)	2004 Selenium (mg/kg)
Section 33 - 1st Cut	#1	0.460	0.950	0.89	1.40	0.58	2.25	6.90	1.60
	#2	0.650	1.500	1.60	2.17	0.62	1.73	2.40	1.50
	#3	0.700	1.450	1.51	1.39	0.87	2.08	1.90	1.30
	#4	0.550	1.650	0.99	1.89	0.70	1.56	1.70	1.50
	#5	0.690	1.400	1.10	1.40	0.87	2.01	1.50	1.30
	#6	0.490	1.850	1.45	1.83	0.80	1.16	0.70	1.20
	#7	0.500	0.950	1.21	1.93	0.95	1.52	0.90	0.90
	#8	0.600	1.550	1.81	2.36	0.83	1.59	0.70	1.00
	#9	-----	-----	-----	-----	0.68	0.90	0.70	0.70
	#10	-----	-----	-----	-----	0.63	2.15	0.80	0.90
	#11	-----	-----	-----	-----	0.59	1.02	0.80	1.70
	#12	-----	-----	-----	-----	0.64	2.48	0.50	1.30
	Average	*0.580*	*1.413*	*1.32*	*1.80*	*0.73*	*1.70*	*1.63*	*1.24*
Section 33 - 2nd Cut	#1	0.700	1.500	0.17	0.68	0.67	1.56	0.60	0.80
	#2	0.680	1.000	0.31	0.90	0.77	1.75	0.40	0.80
	#3	0.500	1.650	0.32	1.27	0.81	1.44	0.40	1.40
	#4	1.050	1.250	0.38	1.48	0.76	1.26	0.50	1.60
	#5	0.500	0.750	0.51	1.12	0.81	1.68	0.70	0.20
	#6	0.400	0.950	0.33	1.14	0.69	1.98	0.40	<0.2
	#7	0.350	0.550	0.35	1.57	0.57	1.67	0.40	0.60
	#8	0.350	0.750	0.59	1.23	0.39	0.60	0.40	0.70
	#9	-----	-----	-----	-----	0.68	0.99	0.90	0.90
	#10	-----	-----	-----	-----	0.89	2.07	0.50	0.40
	#11	-----	-----	-----	-----	0.82	1.36	0.40	0.50
	#12	-----	-----	-----	-----	0.54	1.22	0.50	0.30
	Average	*0.566*	*1.050*	*0.37*	*1.17*	*0.70*	*1.47*	*0.51*	*0.69*
Section 33 - 3rd Cut	#1 Pivot	0.252	0.990	0.54	1.36	0.49	1.05	0.71	1.10
	#2 Pivot	0.286	0.930	0.93	1.68	0.73	1.43	0.73	1.20
	#3 Pivot	0.322	1.260	1.10	1.64	0.90	2.00	0.46	1.10
	#4 Pivot	0.202	1.450	0.96	1.82	0.46	1.15	0.55	0.90
	#5 Pivot	0.289	1.090	0.78	2.12	0.43	1.36	0.67	1.40
	#6 Pivot	0.250	0.820	0.61	2.13	0.58	1.60	0.60	1.00
	#7 Pivot	0.312	0.620	0.69	1.66	0.57	1.59	1.20	1.60
	#8 Pivot	0.479	1.110	0.59	2.07	0.81	0.83	1.31	1.00
	#9 Pivot	0.177	0.510	-----	-----	0.45	1.39	1.39	1.30
	#10 Pivot	0.195	0.680	-----	-----	1.97	3.59	1.09	1.50
	#11 Pivot	0.205	0.680	-----	-----	0.60	1.20	0.92	1.40
	#12 Pivot	0.182	0.660	-----	-----	0.78	1.35	1.18	1.40
	#13 Pivot	0.703	1.080	-----	-----	-----	-----	-----	-----
	#14 Pivot	0.522	0.930	-----	-----	-----	-----	-----	-----
	#15 Pivot	0.263	0.620	-----	-----	-----	-----	-----	-----
	#16 Pivot	0.104	0.460	-----	-----	-----	-----	-----	-----
	Average	*0.296*	*0.868*	*0.78*	*1.81*	*0.73*	*1.55*	*0.90*	*1.24*

Table D-2. 2001, 2002, 2003 and 2004 Hay Analyses (cont.)

Irrigation Area	Sample	2001 Uranium (mg/kg)	2001 Selenium (mg/kg)	2002 Uranium (mg/kg)	2002 Selenium (mg/kg)	2003 Uranium (mg/kg)	2003 Selenium (mg/kg)	2004 Uranium (mg/kg)	2004 Selenium (mg/kg)
Section 34 - 1st Cut	#1	0.600	0.950	0.73	0.82	0.74	2.02	1.30	1.70
	#2	0.750	1.250	0.94	1.38	1.40	1.86	1.20	1.50
	#3	0.550	0.950	0.84	0.82	0.61	1.40	0.90	0.90
	#4	0.650	0.600	0.75	0.74	0.92	1.67	1.10	1.30
	#5	0.450	0.750	0.59	0.41	0.92	1.12	1.50	1.30
	#6	0.500	0.800	1.62	0.83	1.06	2.08	0.70	1.20
	#7	0.550	1.950	-----	-----	0.61	1.52	0.90	0.80
	#8	0.400	1.050	-----	-----	0.66	1.68	0.70	0.90
	#9	0.450	1.200	-----	-----	0.49	1.44	1.40	1.50
	#10	0.600	1.000	-----	-----	0.39	1.67	1.00	1.00
	#11	-----	-----	-----	-----	0.97	1.45	1.00	0.90
	#12	-----	-----	-----	-----	1.87	1.53	0.60	1.30
	Average	*0.550*	*1.050*	*0.91*	*0.83*	*0.89*	*1.62*	*1.03*	*1.19*
Section 34 - 2nd Cut	#1 Flood	0.203	0.900	1.63	0.95	0.69	1.18	0.80	<0.2
	#2 Flood	0.420	1.420	0.84	1.05	0.47	0.56	1.00	0.30
	#3 Flood	0.318	0.440	3.51	1.48	0.59	1.09	0.80	<0.2
	#4 Flood	0.402	1.050	0.89	0.96	0.44	0.50	0.90	0.30
	#5 Flood	0.358	0.530	0.53	1.28	0.71	0.92	0.70	0.50
	#6 Flood	0.195	0.330	1.72	1.14	0.58	0.54	1.10	0.20
	#7 Flood	0.450	1.120	-----	-----	0.41	0.79	-----	-----
	#8 Flood	0.514	0.660	-----	-----	-----	-----	-----	-----
	#9 Flood	0.408	1.160	-----	-----	-----	-----	-----	-----
	#10 Flood	0.535	0.610	-----	-----	-----	-----	-----	-----
	Average	*0.380*	*0.822*	*1.52*	*1.14*	*0.56*	*0.80*	*0.88*	*0.25*
Section 34 - 3rd Cut	#1 Flood	1.040	1.110	0.81	1.20	1.56	2.32	-----	-----
	#2 Flood	0.672	0.712	0.44	1.59	1.36	1.19	-----	-----
	#3 Flood	0.538	0.817	0.32	0.62	1.28	1.40	-----	-----
	#4 Flood	0.489	0.630	0.48	1.00	0.87	0.75	-----	-----
	#5 Flood	0.612	0.530	0.65	1.03	1.18	1.60	-----	-----
	#6 Flood	0.823	0.710	0.53	0.94	1.00	1.19	-----	-----
	#7 Flood	0.586	0.782	-----	-----	1.32	0.62	-----	-----
	#8 Flood	0.948	0.980	-----	-----	1.59	0.74	-----	-----
	#9 Flood	-----	-----	-----	-----	0.80	1.18	-----	-----
	#10 Flood	-----	-----	-----	-----	0.91	0.44	-----	-----
	#11 Flood	-----	-----	-----	-----	1.16	0.92	-----	-----
	#12 Flood	-----	-----	-----	-----	0.74	0.93	-----	-----
	Average	*0.714*	*0.784*	*0.54*	*1.06*	*1.15*	*1.11*	-----	-----
Section 34 - 4th Cut	#1 Flood	-----	-----	0.80	1.65	-----	-----	-----	-----
	#2 Flood	-----	-----	0.97	1.09	-----	-----	-----	-----
	#3 Flood	-----	-----	1.29	1.21	-----	-----	-----	-----
	#4 Flood	-----	-----	0.58	0.50	-----	-----	-----	-----
	#5 Flood	-----	-----	0.84	1.48	-----	-----	-----	-----
	#6 Flood	-----	-----	0.83	1.11	-----	-----	-----	-----
	Average	-----	-----	*0.89*	*1.17*	-----	-----	-----	-----

Table D-2. 2001, 2002, 2003 and 2004 Hay Analyses (cont.)

Irrigation Area	Sample	2001 Uranium (mg/kg)	2001 Selenium (mg/kg)	2002 Uranium (mg/kg)	2002 Selenium (mg/kg)	2003 Uranium (mg/kg)	2003 Selenium (mg/kg)	2004 Uranium (mg/kg)	2004 Selenium (mg/kg)
Section 28 - 1st Cut	#1 Pivot 2	-----	-----	0.40	0.81	0.68	1.30	1.16	1.00
	#2 Pivot 2	-----	-----	0.27	0.74	1.50	1.52	1.25	1.00
	#3 Pivot 2	-----	-----	0.28	0.65	1.74	1.18	1.79	1.10
	#4 Pivot 2	-----	-----	0.33	0.86	0.81	1.82	1.07	1.00
	#5 Pivot 2	-----	-----	0.23	0.99	0.86	1.70	1.57	1.40
	#6 Pivot 2	-----	-----	0.25	0.70	0.98	1.82	1.08	1.20
	#7 Pivot 2	-----	-----	-----	-----	0.61	1.54	0.94	1.10
	#8 Pivot 2	-----	-----	-----	-----	0.93	1.89	0.85	0.90
	#9 Pivot 2	-----	-----	-----	-----	1.28	1.53	0.67	0.70
	#10 Pivot 2	-----	-----	-----	-----	0.81	1.70	1.18	1.00
	#11 Pivot 2	-----	-----	-----	-----	0.83	1.87	0.68	1.00
	#12 Pivot 2	-----	-----	-----	-----	0.84	1.52	0.80	1.00
	Average	-----	-----	*0.29*	*0.79*	*0.99*	*1.62*	*1.09*	*1.03*
Section 28 - 2nd Cut	#1 Pivot 2	-----	-----	-----	-----	1.26	1.36	0.80	<0.2
	#2 Pivot 2	-----	-----	-----	-----	0.72	1.45	0.80	0.30
	#3 Pivot 2	-----	-----	-----	-----	0.77	1.14	0.70	0.40
	#4 Pivot 2	-----	-----	-----	-----	0.82	1.37	1.10	1.60
	#5 Pivot 2	-----	-----	-----	-----	1.21	1.31	1.30	1.20
	#6 Pivot 2	-----	-----	-----	-----	0.97	1.80	1.50	1.40
	#7 Pivot 2	-----	-----	-----	-----	0.66	1.15	1.20	1.80
	#8 Pivot 2	-----	-----	-----	-----	0.91	1.41	0.90	1.00
	#9 Pivot 2	-----	-----	-----	-----	0.88	0.84	1.50	1.30
	#10 Pivot 2	-----	-----	-----	-----	1.16	1.28	0.90	1.40
	#11 Pivot 2	-----	-----	-----	-----	0.94	1.08	1.90	1.20
	#12 Pivot 2	-----	-----	-----	-----	1.44	1.18	1.40	1.20
	Average	-----	-----	-----	-----	*0.98*	*1.28*	*1.17*	*1.08*
Section 28 - 3rd Cut	#1 Pivot 2	-----	-----	-----	-----	1.54	1.57	0.73	1.50
	#2 Pivot 2	-----	-----	-----	-----	0.79	0.86	1.12	1.60
	#3 Pivot 2	-----	-----	-----	-----	0.78	1.14	0.96	1.20
	#4 Pivot 2	-----	-----	-----	-----	1.33	1.29	1.12	1.80
	#5 Pivot 2	-----	-----	-----	-----	1.40	0.58	0.63	0.80
	#6 Pivot 2	-----	-----	-----	-----	1.14	1.41	0.79	1.10
	#7 Pivot 2	-----	-----	-----	-----	0.94	0.49	0.91	1.00
	#8 Pivot 2	-----	-----	-----	-----	1.44	0.96	0.49	0.40
	#9 Pivot 2	-----	-----	-----	-----	1.00	0.81	0.83	1.30
	#10 Pivot 2	-----	-----	-----	-----	0.81	0.37	1.20	0.60
	#11 Pivot 2	-----	-----	-----	-----	1.14	1.02	0.58	0.20
	#12 Pivot 2	-----	-----	-----	-----	1.35	1.46	0.84	0.80
	Average	-----	-----	-----	-----	*1.14*	*1.00*	*0.85*	*1.03*

Table D-3. 2005 through 2007 Hay Analyses

Irrigation Area	Sample	2005 Uranium (mg/kg)	2005 Selenium (mg/kg)	2006 Uranium (mg/kg)	2006 Selenium (mg/kg)	2007 Uranium (mg/kg)	2007 Selenium (mg/kg)
Section 33 - Pivot - 1st Cut	#1	0.9	1.5	0.7	1.2	0.7	0.7
	#2	0.8	1.5	1.2	1.4	0.9	1.2
	#3	0.8	0.8	0.1	1.2	1.3	1.6
	#4	1.1	0.8	1.1	1.3	0.7	0.7
	#5	0.7	1.2	0.7	1.5	0.9	1.3
	#6	0.9	1.2	0.9	1.2	1.2	1.5
	#7	0.8	1.5	0.8	1.2	0.8	1.0
	#8	0.8	1.5	0.9	1.1	1.0	1.3
	#9	0.6	1.0	0.6	1.1	1.6	1.8
	#10	1.0	1.1	1.0	1.4	1.1	1.4
	#11	0.9	1.6	0.9	1.2	1.3	1.7
	#12	0.8	1.3	0.7	1.2	1.0	1.1
	Average	*0.84*	*1.3*	*0.80*	*1.3*	*1.04*	*1.3*
Section 33 - Pivot - 2nd Cut	#1	0.6	1.3	0.6	1.4	1.7	1.2
	#2	0.5	1.3	0.7	1.5	0.8	0.6
	#3	0.7	1.4	0.7	1.0	0.9	1.5
	#4	1.3	1.4	0.6	1.8	1.1	1.5
	#5	0.6	1.2	0.5	0.5	1.2	0.7
	#6	0.8	1.1	0.6	2.1	1.2	1.6
	#7	0.6	1.6	0.7	1.1	1.3	1.1
	#8	0.5	1.4	0.5	0.7	0.9	1.6
	#9	0.6	1.0	0.7	1.0	0.8	1.0
	#10	0.6	1.6	0.4	1.6	2.1	2.0
	#11	0.5	1.0	0.7	1.4	0.9	1.6
	#12	0.4	1.2	0.7	1.4	1.2	1.8
	Average	*0.64*	*1.3*	*0.62*	*1.3*	*1.18*	*1.4*
Section 33 - Pivot - 3rd Cut	#1	0.7	1.1	0.5	1.6	1.7	1.2
	#2	0.7	1.3	0.5	1.0	2.0	1.2
	#3	0.4	0.8	0.6	1.0	1.8	1.2
	#4	0.5	0.9	0.4	0.9	1.5	1.9
	#5	0.9	1.2	0.6	0.9	1.5	1.9
	#6	0.8	1.6	0.4	0.8	0.9	1.6
	#7	0.8	1.3	0.3	0.9	1.7	1.7
	#8	0.6	1.2	0.4	1.0	1.5	1.9
	#9	1.0	2.6	0.5	1.2	2.0	1.3
	#10	0.6	1.2	0.3	0.7	1.4	1.5
	#11	0.7	0.9	0.5	1.1	1.3	1.1
	#12	0.8	1.1	0.4	0.9	1.9	1.0
	Average	*0.71*	*1.3*	*0.45*	*1.0*	*1.60*	*1.5*

Table D-3. 2005 through 2007 Hay Analyses (cont.)

Irrigation Area	Sample	2005 Uranium (mg/kg)	2005 Selenium (mg/kg)	2006 Uranium (mg/kg)	2006 Selenium (mg/kg)	2007 Uranium (mg/kg)	2007 Selenium (mg/kg)
Section 33 - Flood	#1	0.5	0.3	----	----	----	----
- 1st Cut	#2	0.3	<0.20	----	----	----	----
	Average	*0.40*	*<0.25*	----	----	----	----
Section 34 - Flood	#1	2.0	1.8	0.7	0.9	1.3	2.4
- 1st Cut	#2	1.8	1.7	1.1	0.9	0.7	1.3
	#3	1.4	2.0	1.2	0.6	0.9	1.0
	#4	0.6	1.7	0.8	0.6	1.2	1.6
	#5	2.4	2.0	0.8	0.7	0.8	1.4
	#6	2.1	1.7	0.7	1.0	1.2	0.9
	#7	1.6	2.5	0.8	0.8	----	----
	#8	3.0	2.7	0.6	0.7	----	----
	#9	2.2	1.7	0.6	0.9	----	----
	#10	2.4	1.5	0.6	0.4	----	----
	#11	1.0	1.9	----	----	----	----
	#12	1.3	1.6	----	----	----	----
	Average	*1.8*	*1.9*	*0.79*	*0.75*	*1.02*	*1.43*
Section 34 - Flood	#1	0.7	0.7	1.3	1.1	----	----
- 2nd Cut	#2	0.7	1.0	0.9	1.3	----	----
	#3	1.0	1.1	0.8	0.9	----	----
	#4	0.9	0.8	0.5	2.5	----	----
	#5	0.8	0.6	0.6	1.9	----	----
	#6	1.2	0.6	0.6	0.7	----	----
	#7	----	----	----	----	----	----
	#8	----	----	----	----	----	----
	#9	----	----	----	----	----	----
	#10	----	----	----	----	----	----
	#11	----	----	----	----	----	----
	#12	----	----	----	----	----	----
	Average	*0.9*	*0.8*	*0.78*	*1.40*	----	----

Table D-3. 2005 through 2007 Hay Analyses (cont.)

		2005		2006		2007	
Irrigation Area	Sample	Uranium (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Selenium (mg/kg)	Uranium (mg/kg)	Selenium (mg/kg)
Section 28 - Pivot - 1st Cut	#1	1.6	1.4	1.0	0.6	0.7	1.0
	#2	1.6	1.7	1.2	1.1	1.1	1.2
	#3	2.1	1.7	1.0	0.8	0.9	1.2
	#4	1.8	1.8	1.5	1.3	0.9	0.9
	#5	1.8	1.1	1.5	1.3	0.6	0.6
	#6	1.5	1.5	1.3	1.7	0.6	0.7
	#7	1.5	1.6	0.7	1.1	0.6	0.7
	#8	1.9	0.9	1.3	1.5	1.0	0.7
	#9	3.3	1.5	1.3	1.1	1.3	1.0
	#10	1.9	1.5	1.4	1.4	0.7	1.1
	#11	1.7	2.4	1.3	1.2	0.9	1.0
	#12	1.3	0.9	1.0	0.9	0.9	0.9
	Average	*1.8*	*1.5*	*1.2*	*1.2*	*0.9*	*0.9*
Section 28 - Pivot - 2nd Cut	#1	0.8	1.3	0.5	1.5	1.3	1.4
	#2	0.9	1.4	0.9	1.2	0.7	1.0
	#3	1.0	1.4	1.3	1.5	0.8	0.8
	#4	0.8	1.1	0.7	1.7	1.0	1.0
	#5	1.0	1.3	0.6	1.3	0.9	1.0
	#6	0.9	1.3	0.6	1.5	1.5	1.3
	#7	1.1	0.9	0.8	1.0	2.4	1.1
	#8	0.6	1.2	1.0	1.3	1.8	1.6
	#9	0.9	1.3	0.7	0.8	1.3	1.1
	#10	0.9	1.0	0.6	1.2	1.7	1.3
	#11	1.5	1.1	0.7	1.1	2.2	1.1
	#12	0.9	1.6	0.8	1.1	3.5	1.2
	Average	*0.9*	*1.2*	*0.8*	*1.3*	*1.6*	*1.2*
Section 28 - Pivot - 3rd Cut	#1	1.2	1.6	0.8	0.9	1.6	1.8
	#2	1.2	1.8	0.7	0.7	1.1	1.3
	#3	1.0	1.9	0.7	0.7	0.9	1.5
	#4	1.7	1.4	0.9	1.0	0.6	1.0
	#5	1.5	1.4	0.7	1.1	0.8	1.4
	#6	1.5	1.2	0.8	1.1	1.7	1.6
	#7	1.4	1.2	0.9	1.0	1.1	1.3
	#8	1.2	1.3	0.2	1.1	1.2	1.2
	#9	1.8	1.3	0.5	1.0	1.4	1.2
	#10	1.4	1.5	0.3	1.0	1.5	1.3
	#11	1.8	1.2	0.4	0.8	1.2	1.4
	#12	1.4	1.9	0.5	1.0	0.9	1.0
	Average	*1.4*	*1.5*	*0.62*	*0.95*	*1.17*	*1.33*

Table D-4. 2008 through 2010 Hay Analyses

Irrigation Area	Sample	2008 Uranium (mg/kg)	2008 Selenium (mg/kg)	2009 Uranium (mg/kg)	2009 Selenium (mg/kg)	2010 Uranium (mg/kg)	2010 Selenium (mg/kg)
Section 33 - Pivot - 1st Cut	#1	0.3	1.3	0.7	1.0	0.2	0.9
	#2	0.8	1.3	<0.5	1.1	0.2	0.9
	#3	0.8	1.4	<0.5	0.7	----	----
	#4	0.4	1.4	0.7	0.7	----	----
	#5	0.7	1.5	<0.5	0.6	----	----
	#6	0.3	0.8	<0.5	0.6	----	----
	#7	0.5	1.1	<0.5	1.0	----	----
	#8	0.4	0.7	<0.5	1.0	----	----
	#9	0.6	1.0	<0.5	1.3	----	----
	#10	0.2	1.3	<0.5	0.7	----	----
	#11	0.2	0.8	<0.5	1.2	----	----
	#12	0.4	1.1	0.8	0.8	----	----
	Average	*0.47*	*1.1*	*0.73*	*0.9*	*0.21*	*0.9*
Section 33 - Pivot - 2nd Cut	#1	1.7	3.1	----	----	----	----
	#2	1.2	1.1	----	----	----	----
	#3	1.3	1.6	----	----	----	----
	#4	0.8	1.3	----	----	----	----
	#5	0.6	0.7	----	----	----	----
	#6	0.6	0.6	----	----	----	----
	#7	0.4	1.2	----	----	----	----
	#8	0.5	1.2	----	----	----	----
	#9	0.3	0.9	----	----	----	----
	#10	0.7	1.4	----	----	----	----
	#11	0.7	1.3	----	----	----	----
	#12	1.2	1.2	----	----	----	----
	Average	*0.83*	*1.3*	----	----	----	----
Section 33 - Pivot - 3rd Cut	#1	----	----	----	----	----	----
	#2	----	----	----	----	----	----
	#3	----	----	----	----	----	----
	#4	----	----	----	----	----	----
	#5	----	----	----	----	----	----
	#6	----	----	----	----	----	----
	#7	----	----	----	----	----	----
	#8	----	----	----	----	----	----
	#9	----	----	----	----	----	----
	#10	----	----	----	----	----	----
	#11	----	----	----	----	----	----
	#12	----	----	----	----	----	----
	Average	----	----	----	----	----	----

Table D-4. 2008 through 2010 Hay Analyses (cont.)

Irrigation Area	Sample	2008 Uranium (mg/kg)	2008 Selenium (mg/kg)	2009 Uranium (mg/kg)	2009 Selenium (mg/kg)	2010 Uranium (mg/kg)	2010 Selenium (mg/kg)
Section 33 - Flood	#1	----	----	----	----	0.3	0.5
- 1st Cut	#2	----	----	----	----	0.1	0.5
	Average	----	----	----	----	*0.2*	*0.5*
Section 34 - Flood	#1	----	----	0.5	<0.5	1.2	2.0
- 1st Cut	#2	----	----	0.9	<0.5	0.2	0.5
	#3	----	----	0.5	<0.5	----	----
	#4	----	----	0.9	0.8	----	----
	#5	----	----	0.7	0.8	----	----
	#6	----	----	<0.5	<0.5	----	----
	#7	0.3	2.0	1.2	0.6	----	----
	#8	0.2	1.8	<0.5	0.5	----	----
	#9	0.2	1.1	0.8	<0.5	----	----
	#10	1.2	2.2	1.2	0.6	----	----
	#11	0.8	1.8	1.0	<0.5	----	----
	#12	0.2	1.9	1.0	<0.5	----	----
	Average	*0.49*	*1.8*	*0.87*	*0.7*	*0.67*	*1.3*
Section 34 - Flood	#1	0.3	1.2	----	----	----	----
- 2nd Cut	#2	0.2	1.1	----	----	----	----
	#3	0.6	0.6	----	----	----	----
	#4	0.6	1.4	----	----	----	----
	#5	0.2	0.7	----	----	----	----
	#6	0.3	0.7	----	----	----	----
	#7	0.4	0.7	----	----	----	----
	#8	0.5	2.5	----	----	----	----
	#9	0.4	1.3	----	----	----	----
	#10	0.7	1.2	----	----	----	----
	#11	0.3	0.7	----	----	----	----
	#12	0.2	0.9	----	----	----	----
	Average	*0.43*	*1.3*	----	----	----	----

Table D-4. 2008 through 2010 Hay Analyses (cont.)

Irrigation Area	Sample	2008 Uranium (mg/kg)	2008 Selenium (mg/kg)	2009 Uranium (mg/kg)	2009 Selenium (mg/kg)	2010 Uranium (mg/kg)	2010 Selenium (mg/kg)
Section 28 - Pivot - 1st Cut	#1	1.6	1.4	0.6	2.5	0.1	0.7
	#2	1.5	1.4	0.9	2.4	0.2	1.1
	#3	2.3	1.6	1.0	1.3	----	----
	#4	2.2	1.8	0.7	3.2	----	----
	#5	1.5	1.7	1.0	1.8	----	----
	#6	1.3	1.3	0.7	1.1	----	----
	#7	1.3	1.4	0.7	1.0	----	----
	#8	2.3	1.6	0.9	2.7	----	----
	#9	1.2	1.6	0.8	0.8	----	----
	#10	2.0	1.5	<0.5	2.2	----	----
	#11	1.4	1.6	1.4	1.1	----	----
	#12	1.6	1.4	1.4	1.4	----	----
	Average	*1.68*	*1.5*	*0.92*	*1.8*	*0.14*	*0.9*
Section 28 - Pivot - 2nd Cut	#1	----	----	----	----	----	----
	#2	----	----	----	----	----	----
	#3	----	----	----	----	----	----
	#4	----	----	----	----	----	----
	#5	----	----	----	----	----	----
	#6	----	----	----	----	----	----
	#7	----	----	----	----	----	----
	#8	----	----	----	----	----	----
	#9	----	----	----	----	----	----
	#10	----	----	----	----	----	----
	#11	----	----	----	----	----	----
	#12	----	----	----	----	----	----
	Average	----	----	----	----	----	----
Section 28 - Pivot - 3rd Cut	#1	----	----	----	----	----	----
	#2	----	----	----	----	----	----
	#3	----	----	----	----	----	----
	#4	----	----	----	----	----	----
	#5	----	----	----	----	----	----
	#6	----	----	----	----	----	----
	#7	----	----	----	----	----	----
	#8	----	----	----	----	----	----
	#9	----	----	----	----	----	----
	#10	----	----	----	----	----	----
	#11	----	----	----	----	----	----
	#12	----	----	----	----	----	----
	Average	----	----	----	----	----	----

APPENDIX E

Resident Farmer on Section 34 Irrigated Areas RESRAD Results

Summary : RESRAD Default Parameters
File   : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

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Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(1)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(4)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(5)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(6)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(7)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(8)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(9)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(10)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(11)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(12)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(13)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(14)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(15)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(16)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(17)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(18)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(19)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(20)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(21)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(22)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(23)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(24)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(25)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(26)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(27)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(1)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(2)
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(3)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	U-234	1.320E-01	1.320E-01	DCF2(6)
B-1	U-238	1.180E-01	1.180E-01	DCF2(7)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(8)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(1)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(2)
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(3)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	U-234	2.830E-04	2.830E-04	DCF3(6)
D-1	U-238	2.550E-04	2.550E-04	DCF3(7)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(8)

Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(2,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(2,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(3,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(3,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				

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Summary : RESRAD Default Parameters
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Dose Conversion Factor (and Related) Parameter Summary (continued)
Dose Library: FGR 12 & FGR 11

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

1RESRAD, Version 6.5   T½ Limit = 180 days   01/10/2011 12:17 Page 5
Summary : RESRAD Default Parameters
File   : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.856E+05	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	2.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ra-226	3.300E-04	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Ra-228	1.670E-03	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): U-238	8.800E-01	0.000E+00	---	S1(7)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(7)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	5.300E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	2.700E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	5.100E-01	2.000E-01	---	RI
R013	Irrigation mode	ditch	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.723E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.723E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.410E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.207E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.017E-06	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.017E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.410E-03	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	5.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R018	Fruits, vegetables and grain consumption (kg/yr)	1.600E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	9.200E+01	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	6.300E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	5.100E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.100E+01	FMEAT
R018	Contamination fraction of milk	-1	-1	0.100E+01	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	active
4 -- meat ingestion	active
5 -- milk ingestion	active
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	suppressed

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 Summary : RESRAD Default Parameters
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

     Contaminated Zone Dimensions           Initial Soil Concentrations, pCi/g

       Area: 485640.00 square meters                 Ra-226     3.300E-04
  Thickness:      2.00 meters                        Ra-228     1.670E-03
 Cover Depth:     0.00 meters                        U-238      8.800E-01
0
                                    Total Dose TDOSE(t), mrem/yr
                              Basic Radiation Dose Limit = 2.500E+01 mrem/yr
              Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

    t (years):  0.000E+00  1.000E+00  3.000E+00  1.000E+01  3.000E+01  1.000E+02  3.000E+02  1.000E+03
     TDOSE(t):  1.790E-01  1.793E-01  1.777E-01  1.678E-01  1.535E-01  1.298E-01  8.044E-02  7.663E-01
         M(t):  7.159E-03  7.170E-03  7.107E-03  6.711E-03  6.141E-03  5.194E-03  3.217E-03  3.065E-02
0Maximum TDOSE(t):  7.663E-01 mrem/yr   at t = 1.000E+03 years
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1RESRAD, Version 6.5   T½ Limit = 180 days   01/10/2011 12:17 Page 12
Summary : RESRAD Default Parameters
File   : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.190E-03	0.0122	2.783E-07	0.0000	0.000E+00	0.0000	1.553E-03	0.0087	9.186E-05	0.0005	1.097E-04	0.0006	1.293E-05	0.0001
Ra-228	7.148E-03	0.0399	9.160E-06	0.0001	0.000E+00	0.0000	7.955E-03	0.0444	4.658E-04	0.0026	5.637E-04	0.0031	6.777E-05	0.0004
U-238	7.943E-02	0.4438	9.784E-03	0.0547	0.000E+00	0.0000	5.141E-02	0.2873	3.393E-03	0.0190	8.317E-03	0.0465	6.465E-03	0.0361
Total	8.877E-02	0.4960	9.794E-03	0.0547	0.000E+00	0.0000	6.092E-02	0.3404	3.950E-03	0.0221	8.990E-03	0.0502	6.546E-03	0.0366

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.958E-03	0.0221
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.621E-02	0.0906
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.588E-01	0.8873
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.790E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : RESRAD Default Parameters
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Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.185E-03	0.0122	2.994E-07	0.0000	0.000E+00	0.0000	1.614E-03	0.0090	9.619E-05	0.0005	1.116E-04	0.0006	1.488E-05	0.0001
Ra-228	8.742E-03	0.0488	2.111E-05	0.0001	0.000E+00	0.0000	7.075E-03	0.0395	4.142E-04	0.0023	4.989E-04	0.0028	6.881E-05	0.0004
U-238	7.924E-02	0.4420	9.761E-03	0.0544	0.000E+00	0.0000	5.129E-02	0.2861	3.384E-03	0.0189	8.297E-03	0.0463	6.450E-03	0.0360
Total	9.017E-02	0.5030	9.782E-03	0.0546	0.000E+00	0.0000	5.997E-02	0.3346	3.895E-03	0.0217	8.907E-03	0.0497	6.533E-03	0.0364

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0 Water Dependent Pathways

0 Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.022E-03	0.0224
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.682E-02	0.0938
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.584E-01	0.8837
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.793E-01	1.0000

0*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.176E-03	0.0122	3.394E-07	0.0000	0.000E+00	0.0000	1.727E-03	0.0097	1.040E-04	0.0006	1.151E-04	0.0006	1.858E-05	0.0001
Ra-228	9.505E-03	0.0535	3.084E-05	0.0002	0.000E+00	0.0000	5.571E-03	0.0314	3.256E-04	0.0018	3.908E-04	0.0022	6.361E-05	0.0004
U-238	7.886E-02	0.4438	9.714E-03	0.0547	0.000E+00	0.0000	5.104E-02	0.2872	3.368E-03	0.0190	8.257E-03	0.0465	6.419E-03	0.0361
Total	9.054E-02	0.5096	9.745E-03	0.0548	0.000E+00	0.0000	5.834E-02	0.3283	3.798E-03	0.0214	8.763E-03	0.0493	6.501E-03	0.0366

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0
Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.140E-03	0.0233
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.589E-02	0.0894
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.577E-01	0.8873
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.777E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.143E-03	0.0128	4.589E-07	0.0000	0.000E+00	0.0000	2.061E-03	0.0123	1.271E-04	0.0008	1.254E-04	0.0007	2.964E-05	0.0002
Ra-228	5.531E-03	0.0330	2.114E-05	0.0001	0.000E+00	0.0000	2.385E-03	0.0142	1.391E-04	0.0008	1.661E-04	0.0010	3.249E-05	0.0002
U-238	7.754E-02	0.4622	9.552E-03	0.0569	0.000E+00	0.0000	5.019E-02	0.2991	3.312E-03	0.0197	8.119E-03	0.0484	6.312E-03	0.0376
Total	8.522E-02	0.5079	9.573E-03	0.0571	0.000E+00	0.0000	5.463E-02	0.3256	3.578E-03	0.0213	8.410E-03	0.0501	6.374E-03	0.0380

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.487E-03	0.0267
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.274E-03	0.0493
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.550E-01	0.9239
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.678E-01	1.0000

0*Sum of all water independent and dependent pathways.

1RESRAD, Version 6.5 T½ Limit = 180 days 01/10/2011 12:17 Page 16
Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	2.053E-03	0.0134	6.696E-07	0.0000	0.000E+00	0.0000	2.640E-03	0.0172	1.672E-04	0.0011	1.423E-04	0.0009	4.934E-05	0.0003
Ra-228	5.088E-04	0.0033	1.990E-06	0.0000	0.000E+00	0.0000	2.071E-04	0.0013	1.207E-05	0.0001	1.440E-05	0.0001	2.924E-06	0.0000
U-238	7.389E-02	0.4813	9.103E-03	0.0593	0.000E+00	0.0000	4.783E-02	0.3115	3.156E-03	0.0206	7.737E-03	0.0504	6.015E-03	0.0392
Total	7.646E-02	0.4980	9.105E-03	0.0593	0.000E+00	0.0000	5.068E-02	0.3301	3.336E-03	0.0217	7.894E-03	0.0514	6.067E-03	0.0395

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.053E-03	0.0329
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.473E-04	0.0049
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.477E-01	0.9622
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.535E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)
0

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	1.766E-03	0.0136	7.859E-07	0.0000	0.000E+00	0.0000	2.878E-03	0.0222	1.854E-04	0.0014	1.426E-04	0.0011	6.156E-05	0.0005
Ra-228	9.765E-08	0.0000	3.820E-10	0.0000	0.000E+00	0.0000	3.972E-08	0.0000	2.315E-09	0.0000	2.762E-09	0.0000	5.610E-10	0.0000
U-238	6.242E-02	0.4807	7.691E-03	0.0592	0.000E+00	0.0000	4.041E-02	0.3112	2.667E-03	0.0205	6.538E-03	0.0503	5.082E-03	0.0391
Total	6.419E-02	0.4943	7.692E-03	0.0592	0.000E+00	0.0000	4.329E-02	0.3334	2.852E-03	0.0220	6.680E-03	0.0514	5.144E-03	0.0396

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways
0

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.035E-03	0.0388
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.434E-07	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.248E-01	0.9612
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.298E-01	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ra-226	1.147E-03	0.0143	5.294E-07	0.0000	0.000E+00	0.0000	1.924E-03	0.0239	1.242E-04	0.0015	9.445E-05	0.0012	4.170E-05	0.0005
Ra-228	2.341E-18	0.0000	9.158E-21	0.0000	0.000E+00	0.0000	9.521E-19	0.0000	5.550E-20	0.0000	6.621E-20	0.0000	1.345E-20	0.0000
U-238	3.855E-02	0.4793	4.753E-03	0.0591	0.000E+00	0.0000	2.497E-02	0.3105	1.648E-03	0.0205	4.040E-03	0.0502	3.140E-03	0.0390
Total	3.970E-02	0.4935	4.753E-03	0.0591	0.000E+00	0.0000	2.690E-02	0.3344	1.772E-03	0.0220	4.134E-03	0.0514	3.182E-03	0.0396

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.332E-03	0.0414
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.437E-18	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.710E-02	0.9586
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.044E-02	1.0000

0*Sum of all water independent and dependent pathways.

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Ra-226	2.535E-04	0.0003	1.170E-07	0.0000	0.000E+00	0.0000	4.253E-04	0.0006	2.744E-05	0.0000	2.087E-05	0.0000	9.217E-06	0.0000
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	7.137E-03	0.0093	8.817E-04	0.0012	0.000E+00	0.0000	4.635E-03	0.0060	3.059E-04	0.0004	7.494E-04	0.0010	5.826E-04	0.0008
Total	7.391E-03	0.0096	8.818E-04	0.0012	0.000E+00	0.0000	5.060E-03	0.0066	3.333E-04	0.0004	7.703E-04	0.0010	5.918E-04	0.0008

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0 Water Dependent Pathways

0 Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Ra-226	1.396E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	2.749E-04	0.0004	5.303E-05	0.0001	4.654E-05	0.0001	2.507E-03	0.0033
Ra-228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	5.966E-01	0.7785	0.000E+00	0.0000	0.000E+00	0.0000	1.170E-01	0.1527	9.133E-03	0.0119	2.676E-02	0.0349	7.638E-01	0.9967
Total	5.980E-01	0.7804	0.000E+00	0.0000	0.000E+00	0.0000	1.173E-01	0.1531	9.186E-03	0.0120	2.680E-02	0.0350	7.663E-01	1.0000

0*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226+D	Ra-226+D	1.000E+00	1.186E+01	1.183E+01	1.178E+01	1.161E+01	1.112E+01	9.559E+00	6.210E+00	2.531E+00
Ra-226+D	Pb-210+D	1.000E+00	1.333E-01	3.529E-01	7.623E-01	1.990E+00	4.194E+00	5.697E+00	3.888E+00	5.066E+00
Ra-226+D	ΣDSR(j)		1.199E+01	1.219E+01	1.255E+01	1.360E+01	1.531E+01	1.526E+01	1.010E+01	7.597E+00
0Ra-228+D	Ra-228+D	1.000E+00	8.720E+00	7.716E+00	6.042E+00	2.567E+00	2.226E-01	4.269E-05	1.023E-15	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	9.864E-01	2.356E+00	3.471E+00	2.387E+00	2.249E-01	4.317E-05	1.035E-15	0.000E+00
Ra-228+D	ΣDSR(j)		9.706E+00	1.007E+01	9.513E+00	4.954E+00	4.475E-01	8.586E-05	2.058E-15	0.000E+00
0U-238	U-238	5.400E-05	4.656E-06	4.644E-06	4.622E-06	4.545E-06	4.331E-06	3.659E-06	2.259E-06	4.393E-05
0U-238+D	U-238+D	9.999E-01	1.805E-01	1.800E-01	1.792E-01	1.762E-01	1.679E-01	1.418E-01	8.757E-02	8.653E-01
U-238+D	U-234	9.999E-01	1.359E-07	4.070E-07	9.451E-07	2.788E-06	7.717E-06	2.148E-05	3.965E-05	2.557E-03
U-238+D	Th-230	9.999E-01	4.449E-13	2.972E-12	1.533E-11	1.341E-10	1.091E-09	1.058E-08	6.943E-08	3.009E-07
U-238+D	Ra-226+D	9.999E-01	5.081E-15	7.895E-14	9.357E-13	2.478E-11	5.875E-10	1.864E-08	3.544E-07	6.809E-06
U-238+D	Pb-210+D	9.999E-01	2.971E-17	7.907E-16	1.764E-14	1.213E-12	7.215E-11	5.340E-09	1.613E-07	1.071E-05
U-238+D	ΣDSR(j)		1.805E-01	1.800E-01	1.792E-01	1.762E-01	1.679E-01	1.418E-01	8.761E-02	8.679E-01

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

0Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	2.084E+00	2.051E+00	1.993E+00	1.839E+00	1.633E+00	1.639E+00	2.476E+00	3.291E+00
Ra-228	2.576E+00	2.482E+00	2.628E+00	5.046E+00	5.587E+01	2.912E+05	*2.726E+14	*2.726E+14
U-238	1.385E+02	1.389E+02	1.395E+02	1.419E+02	1.489E+02	1.763E+02	2.853E+02	2.880E+01

*At specific activity limit
0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 1.000E+03 years

0Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ra-226	3.300E-04	57.5 ± 0.1	1.590E+01	1.572E+00	7.597E+00	3.291E+00
Ra-228	1.670E-03	1.164 ± 0.002	1.008E+01	2.481E+00	0.000E+00	*2.726E+14
U-238	8.800E-01	1.000E+03	8.679E-01	2.880E+01	8.679E-01	2.880E+01

*At specific activity limit

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Summary : RESRAD Default Parameters
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\HMCIRR10.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	Ra-226	1.000E+00	3.914E-03	3.905E-03	3.889E-03	3.830E-03	3.669E-03	3.155E-03	2.049E-03	8.353E-04
Ra-226	U-238	9.999E-01	4.471E-15	6.947E-14	8.234E-13	2.181E-11	5.170E-10	1.640E-08	3.119E-07	5.992E-06
Ra-226	ΣDOSE(j)		3.914E-03	3.905E-03	3.889E-03	3.830E-03	3.669E-03	3.155E-03	2.050E-03	8.413E-04
0Pb-210	Ra-226	1.000E+00	4.400E-05	1.164E-04	2.516E-04	6.568E-04	1.384E-03	1.880E-03	1.283E-03	1.672E-03
Pb-210	U-238	9.999E-01	2.614E-17	6.958E-16	1.553E-14	1.067E-12	6.349E-11	4.699E-09	1.419E-07	9.421E-06
Pb-210	ΣDOSE(j)		4.400E-05	1.164E-04	2.516E-04	6.568E-04	1.384E-03	1.880E-03	1.283E-03	1.681E-03
0Ra-228	Ra-228	1.000E+00	1.456E-02	1.289E-02	1.009E-02	4.287E-03	3.717E-04	7.130E-08	1.709E-18	0.000E+00
0Th-228	Ra-228	1.000E+00	1.647E-03	3.934E-03	5.796E-03	3.986E-03	3.756E-04	7.209E-08	1.728E-18	0.000E+00
0U-238	U-238	5.400E-05	4.097E-06	4.087E-06	4.067E-06	3.999E-06	3.811E-06	3.220E-06	1.988E-06	3.866E-05
U-238	U-238	9.999E-01	1.588E-01	1.584E-01	1.577E-01	1.550E-01	1.477E-01	1.248E-01	7.707E-02	7.615E-01
U-238	ΣDOSE(j)		1.588E-01	1.584E-01	1.577E-01	1.550E-01	1.477E-01	1.248E-01	7.707E-02	7.615E-01
0U-234	U-238	9.999E-01	1.196E-07	3.581E-07	8.317E-07	2.453E-06	6.791E-06	1.890E-05	3.489E-05	2.250E-03
0Th-230	U-238	9.999E-01	3.915E-13	2.615E-12	1.349E-11	1.180E-10	9.601E-10	9.312E-09	6.110E-08	2.648E-07

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

0Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	Ra-226	1.000E+00	3.300E-04	3.293E-04	3.279E-04	3.230E-04	3.093E-04	2.660E-04	1.728E-04	3.819E-05
Ra-226	U-238	9.999E-01	0.000E+00	1.619E-15	4.355E-14	1.593E-12	4.155E-11	1.363E-09	2.616E-08	3.166E-07
Ra-226	ΣS(j):		3.300E-04	3.293E-04	3.279E-04	3.230E-04	3.093E-04	2.660E-04	1.728E-04	3.850E-05
0Pb-210	Ra-226	1.000E+00	0.000E+00	1.008E-05	2.923E-05	8.667E-05	1.899E-04	2.609E-04	1.782E-04	3.939E-05
Pb-210	U-238	9.999E-01	0.000E+00	1.250E-17	9.969E-16	1.166E-13	8.149E-12	6.382E-10	1.958E-08	2.905E-07
Pb-210	ΣS(j):		0.000E+00	1.008E-05	2.923E-05	8.667E-05	1.899E-04	2.609E-04	1.782E-04	3.968E-05
0Ra-228	Ra-228	1.000E+00	1.670E-03	1.478E-03	1.157E-03	4.917E-04	4.263E-05	8.176E-09	1.960E-19	0.000E+00
0Th-228	Ra-228	1.000E+00	0.000E+00	4.760E-04	8.966E-04	6.749E-04	6.429E-05	1.234E-08	2.958E-19	0.000E+00
0U-238	U-238	5.400E-05	4.752E-05	4.741E-05	4.718E-05	4.639E-05	4.421E-05	3.734E-05	2.306E-05	4.268E-06
U-238	U-238	9.999E-01	8.800E-01	8.778E-01	8.736E-01	8.590E-01	8.186E-01	6.915E-01	4.270E-01	7.904E-02
U-238	ΣS(j):		8.800E-01	8.779E-01	8.737E-01	8.590E-01	8.186E-01	6.915E-01	4.271E-01	7.904E-02
0U-234	U-238	9.999E-01	0.000E+00	2.489E-06	7.430E-06	2.435E-05	6.962E-05	1.960E-04	3.630E-04	2.238E-04
0Th-230	U-238	9.999E-01	0.000E+00	1.121E-11	1.006E-10	1.105E-09	9.630E-09	9.573E-08	6.325E-07	2.666E-06

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time = 4.82 seconds