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. The Section 34 flood area all exists over the San Mateo alluvial aquifer. Established background concentrations for the San Mateo alluvial aquifer are therefore the appropriate ground-water standards for this irrigation area. 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 San Mateo 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. Section 34 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)	ABOVE LSD (FT)	MP ELEV. (FT-MSL)	BASE OF ALLUVIUM (FT-LSD)	BASE OF ALLUVIUM (FT-MSL)		PERFORA TIONS (FT-LSD)	SATURATED THICKNESS
						Existing Alluvial Wells								
555	1538575	486249	80	5	8/15/2013	42.7	6514.3	2	6557	80	6477	A	60-80	37.3
556	1537722	485957	80	5	8/15/2013	50.1	6505.9	2	6556	78	6478	A	60-80	27.9
557	1537235	485729	70	5	8/15/2013	43.2	6512.8	2	6556	70	6486	A	50-70	26.8
844	1538376	487002	75	4	12/12/2013	36.23	6519.9	1.2	6556.13	70	6484.9	A	35-75	35.0
845	1537280	487833	65	4	12/12/2013	34.12	6522.93	1.7	6557.05	55	6500.4	A	45-65	22.5
846	1537219	484730	75	4	12/12/2013	44.84	6504.08	0.8	6548.92	65	6483.1	A	40-65	21.0

4.1.1 Sulfate Concentrations

The sulfate concentrations for 1999 (prior to irrigation) and 2013 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 2013 sulfate concentrations are listed adjacent to each of the monitoring wells. The 1000 contour exists in the area near to the eastern edge of Section 34 and extends into the western portion of Section 35.

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 slightly 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 both above 1,000 mg/l in 2013. An increasing trend starting in late 2011 through 2013 has been observed in wells 844 and 845 and in well 555 in 2012 and 2013. This abrupt change in concentrations is not reasonably caused by the Section 34 irrigation that started in 2000. Additional monitoring with time is needed prior to giving any significance to the abrupt change. 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 2013 are shown on the alluvial aquifer in Section 34 (see Figure 4-3). The red contour shows the TDS concentrations in 1999 and the blue contour shows the TDS concentrations in Section 34 in 2013. The width of the zone where the TDS concentrations exceed 2000 mg/l has increased from 1999 to 2013. A light green pattern is shown on Figure 4-3 where 2013 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 3480 and 3000 mg/l in late 2013. The TDS concentrations in wells 555, 844 and 845 show an increase in 2013 similar to the sulfate increase. 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 but the increase in the last three years could be from the irrigation. TDS concentrations in monitoring well 846 increased prior to irrigation and during the first five years of irrigation. They became fairly steady from 2004 through 2009 and increased at a higher rate the last four years. The irrigation in Section 34 is not thought to have affected the TDS in well 846 due to its distance from the irrigation area.

4.1.3 Chloride Concentrations

The chloride concentrations for 1999 and 2013 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 2013. The 2013 chloride concentrations in wells 555, 844, and 845 exceeded the site standard of 250 mg/l as shown by the light green pattern in Figure 4-5 adjacent to these two wells. 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 chloride contour in 2013 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 2013 for each of these wells. These chloride concentrations were similar to the freshwater injection concentration and were thought to be due to the freshwater injection that occurred to the east of this area. The chloride concentrations in monitoring wells 555, 844 and 845 had been relatively steady during the operation of the Section 34 flood irrigation, but increased in 2012 and 2013. The abrupt increase in chloride concentrations does not fit the expected concentration changes from the irrigation. Chloride concentrations increased from 2000 through 2010 in monitoring well 846, but have shown a slight decrease over the last four years. The 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 2013 uranium concentrations in the alluvial aquifer. This figure shows the concentrations are fairly similar in 1999 and 2013 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 555, 556, 557, 844, 845 and 846. This shows fairly small uranium concentrations changes with a slight increase in 2004 through 2011 in well 844 followed by a decrease in 2012 and 2013. This small increase could be due to higher levels moving into this area or it could be due to the Section 34 irrigation. Since 2011 the concentrations have shown a steady decline in this well. Uranium concentrations from the irrigation should move slower vertically than chloride concentrations. The fact that uranium concentrations in wells 845, 555, 556, and 557 have been relatively steady and smaller concentrations indicate the 844 results are from ground-water movement caused by the restoration program rather than contribution from the irrigation program.

4.1.5 Selenium Concentrations

The selenium concentrations for 1999 and 2013 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 with the exception of well 846. Figure 4-10 presents the selenium concentrations showing an increase in selenium concentrations in 2002 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 2013 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. An increase was observed in these two wells and well 555 in 2013. The nitrate concentrations in well 846 were on a significant increasing trend prior to irrigation and this trend had continued until an observed decline in 2013. 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 and in 2011 and 2012. Figure 4-15 shows the location of the 100 acre center pivot. The Section 28 irrigation area exists over the San Mateo alluvial aquifer which extends to the western portion of Section 28. The San Mateo alluvium joins the Rio San Jose alluvium in the western portion of Section 28. Therefore the background concentrations in the San Mateo alluvial aquifer are the appropriate ground-water standards for the Section 28 irrigation zone. Numerous monitoring wells exist in this area and have been used to define the water quality changes with time (see Table 4-2). Usage of San Andres well 951R for irrigation water replaced well 951 in 2012. The TDS, sulfate, and chloride concentrations in well 951R are naturally higher than the values in well 951.

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 (FT)	MP ELEV. (FT-MSL)	BASE OF ALLUVIUM (FT-LSD)	BASE OF ALLUVIUM (FT-MSL)		PERFORATIONS (FT-LSD)	SATURATED THICKNESS
							EXISTING ALLUVIAL WELLS							
633	1541467	479642	83	8	12/6/2011	32.4	6525.16	0	6557.56	95	6462.6	A	11-83	62.56
634	1541652	480362	103	4.5	12/12/2013	69	6491.07	2.8	6560.07	95	6462.3	A	80-100	28.77
654	1541994	478636	120	4.5	12/12/2013	71.55	6478.95	1.4	6550.5	106	6443.1	A	60-120	35.85
655	1541620	479830	96	8	4/15/2010	72.3	6485.88	---	6558.18	88	---	A	21-84	--
656	1542578	478333	88	8	4/30/2010	74.9	6479.17	---	6554.07	88	---	A	6-88	---
659	1541689	480772	101	4.5	12/12/2013	67.77	6492.4	2	6560.17	97	6461.2	A	61-101	31.2
680	1543850	478746	80	4.5	11/15/2011	86.89	6471.98	2	6558.87	75	6481.9	A	50-80	0
681	1540676	482734	117	6	3/18/2013	63.4	6497.12	2.1	6560.52	111	6447.4	A	67-117	49.72
684	1540273	478499	143	6	10/19/2012	85.95	6467.33	2	6553.28	118	6433.3	A	83-143	34.03
688	1541257	483955	105	5	12/12/2013	56.39	6506.23	2.9	6562.62	95	6464.7	A	65-105	41.53
881	1542034	481478	96	4.5	12/12/2013	70.63	6494.41	2.0	6565.04	103	6460	A	76-96	34.41
882	1541404	482396	110	4.5	8/8/2013	63.8	6497.36	2.0	6561.16	95	6461.2	A	70-110	36.16
883	1540097	483039	100	5	12/12/2013	59.25	6497.88	1.9	6557.13	96	6459.3	A	60-90	38.58
884	1542677	481498	90	5	8/8/2013	71.5	6494.6	1.0	6566.1	85	6480.2	A	58-88	14.4
885	1541919	483474	100	5	12/12/2013	59.94	6504.7	1.5	6564.64	95	6468.1	A	70-100	36.6
886	1542327	482487	90	5	12/12/2013	64.48	6500.07	1.5	6564.55	87	6476.1	A	60-90	23.97
887	1543063	482469	67	5	3/19/2013	56.64	6511.09	1.5	6567.73	60	6506.2	A	42-67	4.89
888	1542285	479335	105	5	12/12/2013	74.43	6482.9	1.1	6557.33	90	6466.2	A	75-105	16.7
889	1540047	480222	65	5	10/24/1996	63.31	6486.32	1.5	6549.63	60	6488.2	A	35-65	0
M16	1543252	485112	93.3	5	10/22/2012	62.43	6508.16	1.4	6570.59	100	6469.2	A	60-100	38.96
MO	1543620	485518	88	4.5	11/1/2013	48.24	6524.65	2	6572.89	80	6490.9	A	45-85	33.75
MR	1542609	483574	100	5	12/12/2013	60	6506.26	1.8	6566.26	100	6464.5	A	54-94	41.76
MS	1542607	485570	82	5	12/12/2013	54.83	6515.84	1.5	6570.67	89	6480.2	A	52-82	35.64
MT	1543221	483531	98	4.5	5/15/2013	58.21	6509.22	2.3	6567.43	87	6478.1	A	34-94	31.12
MV	1542618	484418	105	4.5	12/12/2013	58.31	6511.47	1.3	6569.78	95	6473.5	A	75-105	37.97

4.2.1 Sulfate Concentrations

Figure 4-15 shows the sulfate concentrations for 1999 and 2013. The 1000 mg/l contour exists along the central portion of Section 28 during 1999. In 2013, the 1000 sulfate contour extends only into the eastern portion of Section 28 pivot.

The sulfate concentration plots for wells 634, 881, 886, 888, 890, and 893 are shown on Figure 4-16. This figure shows that the sulfate concentrations were decreased significantly in monitoring well 888 in 2004 and 2005. This well is 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 through 2012. Sulfate concentrations declined in wells 881, 886, and 893 in 2013, but increased slightly in well 888.

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 to well 890 in 2013. The 2000 contours moved farther to the west and south in 2011 due to the lack of pumping in 2010. Figure 4-18 shows similar declines in TDS concentrations in wells 886 and 888 as those observed for sulfate concentrations. A small increase has been observed in wells 634, 881, 886 and 890 in Section 28 in 2010. Some of the increase in the last few years could be due to the irrigation but it also could be due to variations in the fresh water injection.

4.2.3 Chloride Concentrations

The chloride concentrations in Section 28 are presented in Figure 4-19 for 1999 and 2013. The chloride concentrations have been fairly similar between these two periods except for the declines that have occurred in wells 886 and 888 due to the freshwater injection in this area (see Figure 4-20) and the small increases in wells 634, 881, 886 and 890 in recent years. The chloride concentrations in the fresh water injection water increased from 60 to 150 mg/l in 2012 due to switching from well 951 to 951R.

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 2013. The 1999 0.1 mg/l contour extends further to the north and south of the area than in the more recent 2013 contour which reflects the eleven-year period of off-site operation in Section 28. Figure 4-22 shows the decrease in concentrations that have been observed in monitoring wells 634 and 881. Increases in uranium concentrations have been observed in wells 886, 888, and 890. These increases are thought to be due to ongoing ground-water migration but some of the increase could possibly be a function of the irrigation program.

4.2.5 Selenium Concentrations

Figure 4-23 presents the 1999 and 2013 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 the contour extends only to the eastern side of the west half of Section 27 in 2013.

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 881 and 886. Selenium concentrations in wells 890 and 893 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. Figure 4-26 shows that these molybdenum concentrations have been small in the past with a small increase in some of the irrigation supply wells. These small molybdenum concentrations in Section 28 are likely from the movement of alluvial water from Section 27 into this area. Figure 4-25 shows the molybdenum concentrations in 2013 exceeds 0.1 mg/l in only well MS with this contour extending only into the east side of the western half of Section 27. This higher molybdenum concentration in the eastern half of Section 27 likely caused the detectable molybdenum concentrations in the alluvial aquifer in the west half of Section 27. 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(see Figure 4-26 for molybdenum time plots).

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 do not exceed 10 mg/l into the eastern half of Section 27 in 2013. Figure 4-28 presents the nitrate concentrations with time and shows very small changes in nitrate concentrations except for the decrease in wells 881,886, and 893.

4.3 Section 33

Section 33 has the 150 acre center pivot and 24 acres of flood area. The Section 33 pivot existed over the Rio San Jose alluvium while the Section 33 flood area exists over both San Mateo and Rio San Jose alluvium. Neither of these two irrigation areas are proposed for future irrigation. 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 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. Section 33 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 (FT)	MP ELEV. (FT-MSL)	BASE OF ALLUVIUM (FT-LSD)	BASE OF ALLUVIUM (FT-MSL)		PERFORA TIONS (FT-LSD)	SATURATED THICKNESS
EXISTING ALLUVIAL WELLS														
541	1539831	477236	120	5	12/12/2013	88.33	6467.29	2	6555.62	—	—	A	78-118	—
551	1536280	4798001	130	5	12/12/2013	97.8	6449.5	2	6547.3	120	6433	A	90-130	16.5
553	1534840	480510	120	5	12/12/2013	103.45	6444.03	2	6547.48	110	6433	A	80-120	11.03
554	1534840	479110	140	5	12/12/2013	104.76	6442.41	2	6547.17	130	6411	A	100-140	31.41
647	1536623	478308	140	4.5	12/12/2013	102.72	6449.19	1.4	6551.91	132	6418.5	A	80-140	30.69
648	1534730	478343	120	4.5	3/6/2013	120	6427.79	2	6547.79	120	6425.8	A	80-120	1.99
649	1534730	479798	124	4.5	12/12/2013	101.71	6441.58	0.3	6543.29	115	6428	A	84-124	13.58
650	1536779	482135	109	4.5	12/11/2013	83.78	6463.33	2.2	6547.11	103	6441.9	A	89-109	21.43
657	1537497	478392	128	6	12/12/2013	97.13	6454.68	2.2	6551.81	120	6429.6	A	87-128	25.08
658	1535922	478436	130	6	12/12/2013	104.93	6445.25	0.4	6550.18	129	6420.8	A	89-130	24.45
685	1539098	478170	100	4.5	12/12/2013	93.7	6462.87	1.7	6556.57	116	6438.9	A	60-100	23.97
687	1539011	477276	102	6	12/12/2013	92.75	6463.21	2.2	6555.96	120	6433.8	A	62-102	29.41
996	1537621	477989	138	5	12/5/2011	49.6	6502.92	1.7	6552.52	136	6414.8	A	126-136	88.12

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 2013 alluvial sulfate concentrations in Section 33. The 1999 contour is presented in red while the blue contour presents the 2013 sulfate concentrations. Sulfate concentration data (2013) 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 similar in Sections 32 and 33 to the present 2013 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 groundwater 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, 650, and 658. Two additional samples were collected from the new alluvial wells 551, 553 and 554 in

2013. A small increase in concentration in alluvial well 658 was observed in 2009 followed by a small decrease in sulfate in 2010 and 2011 and a slight increase in values in 2012 and 2013. Sulfate concentration in alluvial well 649, which is on the south side of the center pivot, has gradually increased from 2006 through 2010 but were steady in 2011 and 2012. Sulfate concentrations prior to the irrigation in 2000 were slightly lower in well 649 than those observed in the last four years. These sulfate concentrations have been steady the last two years probably defining the very small increase in sulfate concentrations at well 649 due to the Section 33 pivot irrigation

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. The sulfate concentration in well 551 is slightly higher than most of the Section 33 monitoring wells and likely shows sulfate increase due to the Section 33 irrigation. 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. This small increase could possibly be due to the Section 33 flood irrigation.

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 2013. The data values adjacent to the wells are 2013 concentrations. The 1,000 mg/l contour for TDS in 2013 is generally 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 decreased, but there has been an overall increase in wells 647 and 649 over the last few 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 from 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. The slightly higher TDS values in well 551, 553, 554, 647 and 649 may be defining a small increase due to the irrigation. 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 2013. This plot shows that the 1999 chloride concentrations of >100 mg/l extended to the northwest side of the Section 33 center pivot. The 2013 chloride concentrations extend down to the southern edge of the center pivot. The movement of the 100 mg/l contour from 1999 to 2013 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 few years in wells 553, 554, 647, and 649. A small decrease was observed in 2010 and 2011 in well 658. Present chloride concentrations in well 647 are similar to 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 higher chloride concentrations in well 551 likely define the small increase due to the Section 33 center pivot irrigation. The chloride concentrations in alluvial well 650 could possibly be 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 concentration is an important parameter because it is the main hazardous constituent of concern in the irrigation water. Figure 4-35 presents the 1999 and 2013 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. In 2013, these concentrations extend down to just north of alluvial well 647 which is located approximately half of a mile north of well 648. A decrease in the area of significant uranium concentrations has occurred in the Section 33 center pivot irrigation area from 1999 to 2013.

Figure 4-36 presents the uranium concentrations versus time for the Section 33 alluvial wells. This plot shows that the uranium concentrations for the ten years during the operation of the Section 33 center pivot and three years after ceasing irrigation have been relatively steady. Uranium concentrations in well 647 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 2013 selenium concentrations for the alluvial aquifer in the Section 33 area. No iso-concentration contours are shown on this figure for the 1999 or 2013 concentrations because the selenium concentrations are all very low.

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 2013. This small decline in selenium concentrations is likely due to the off-site restoration efforts that have been occurring for the last thirteen years in this area. Selenium concentrations in the Section 33 monitoring wells have varied from 0.02 to 0.05 over this period of time with no consistent trends. 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 have been steady in well 650.

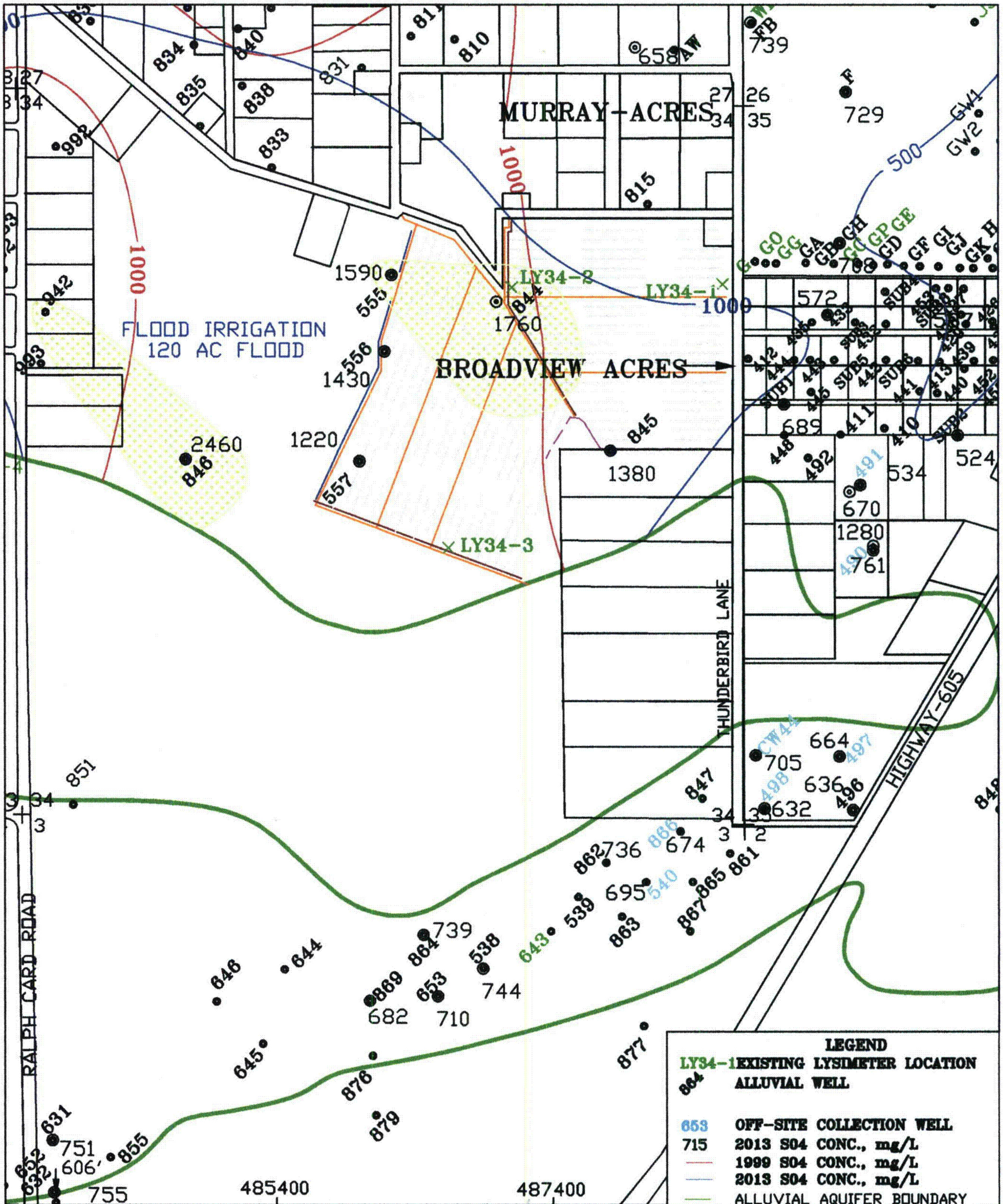
4.3.6 Molybdenum Concentrations

The molybdenum concentrations for 2013 are presented in Figure 4-39 with all of these concentrations less than the 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 2013 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 2013 in this area was 5.0 mg/l from well 650.

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'

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FIGURE 4-1. 1999 AND 2013 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY

GRANTS, NEW MEXICO

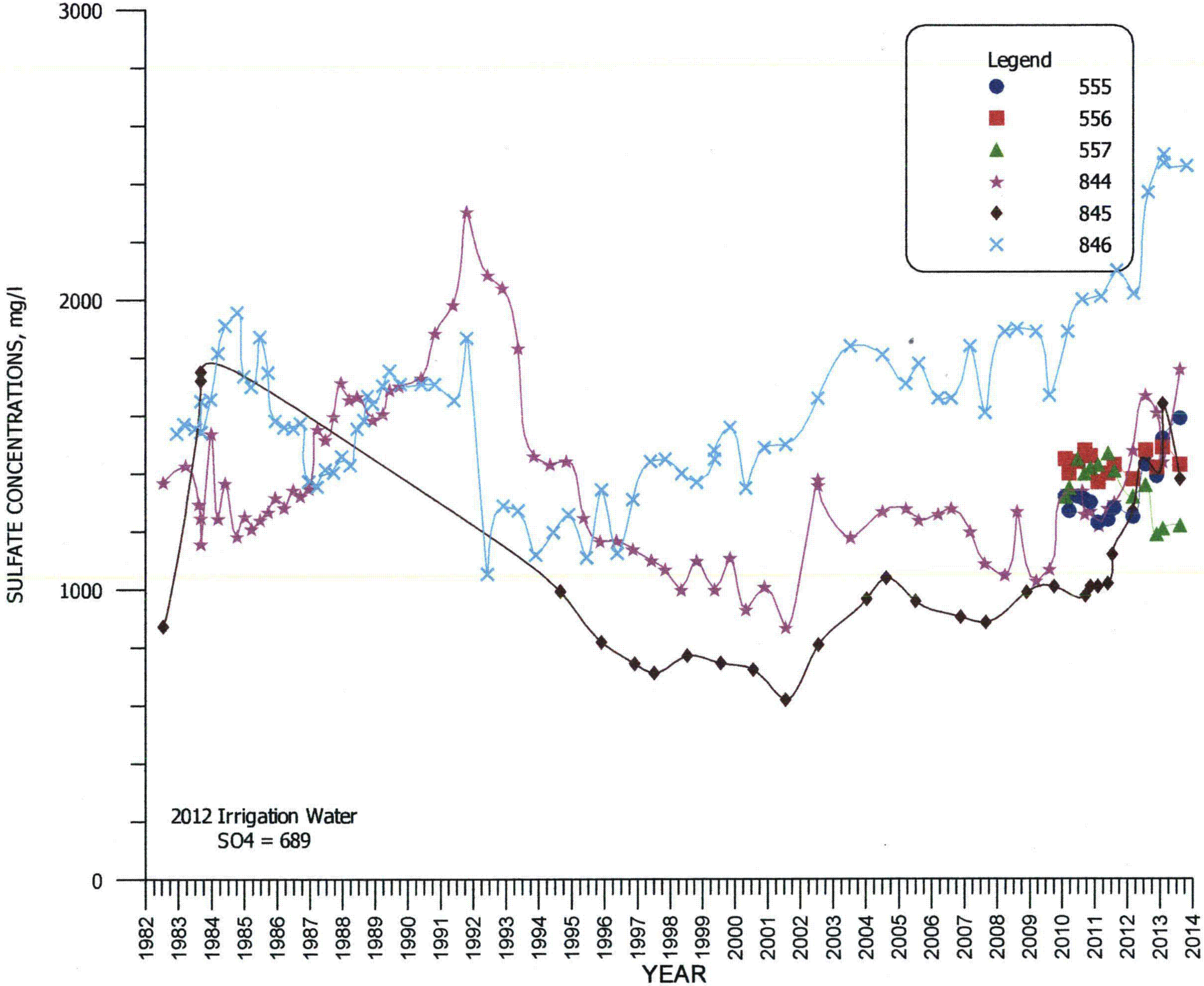
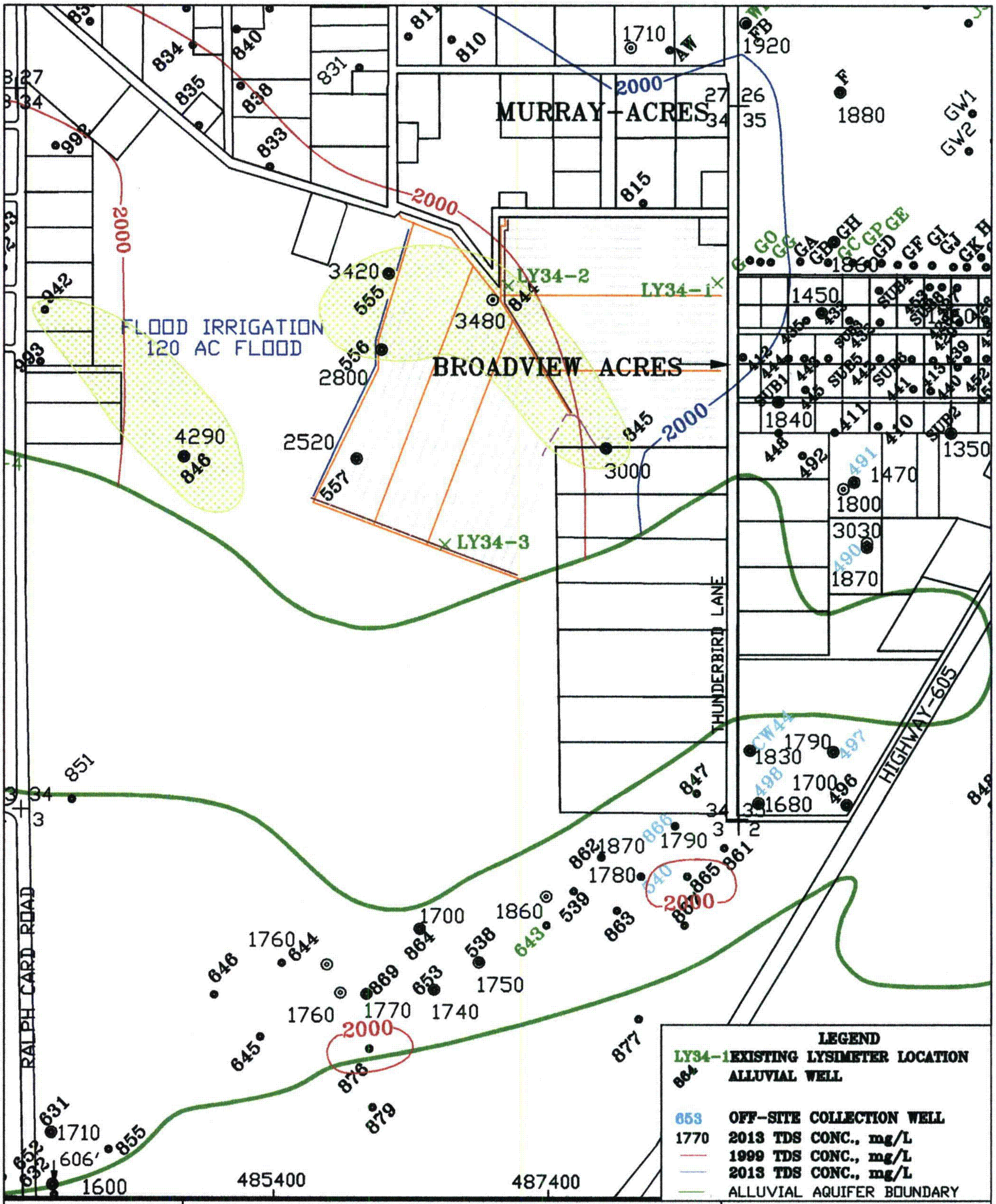


FIGURE 4-2. SULFATE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'	FIGURE 4-3. 1999 AND 2013 TDS ALLUVIAL CONCENTRATION IN SECTION 34, mg/L	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO
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DATE: 3/13/14		

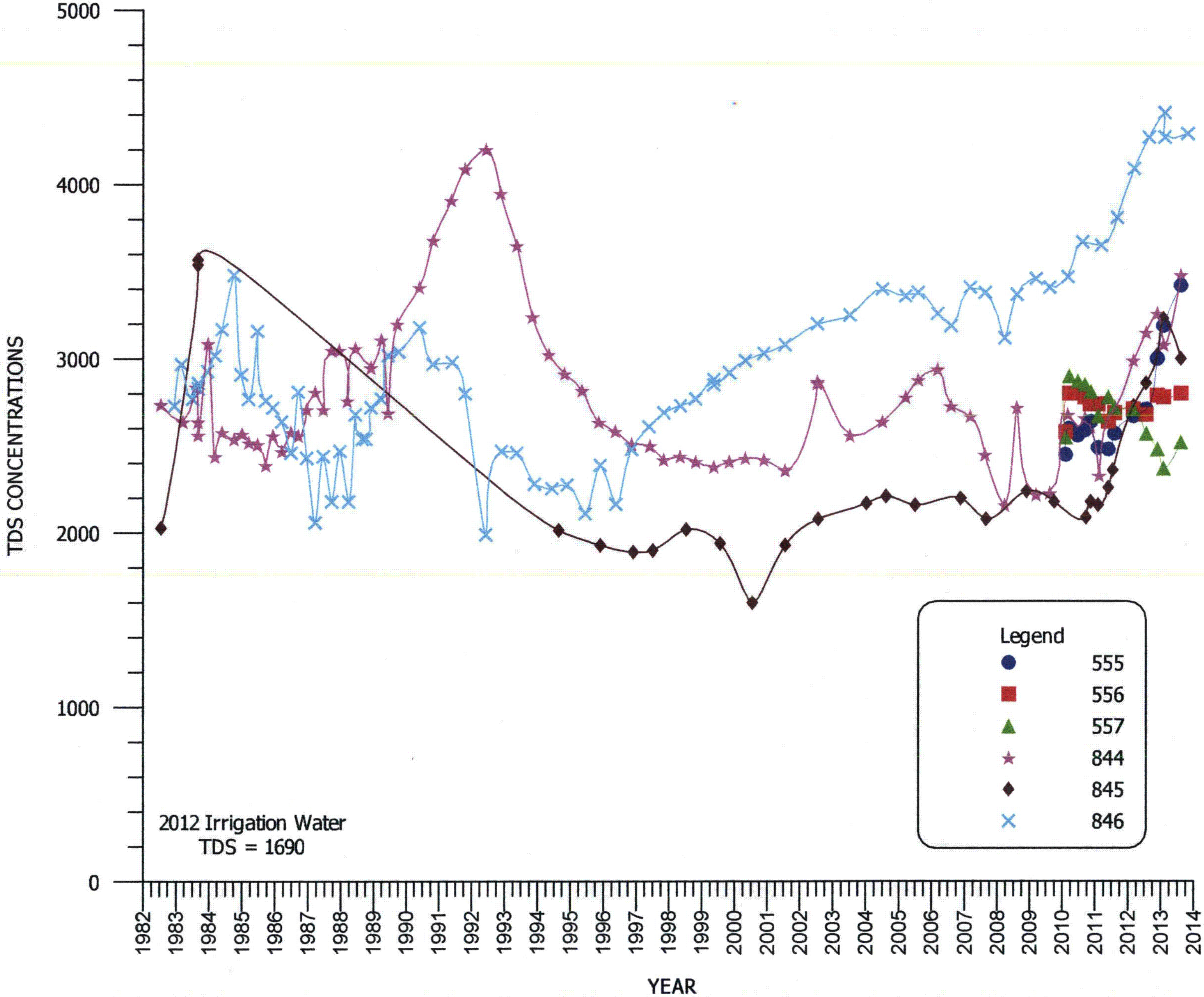
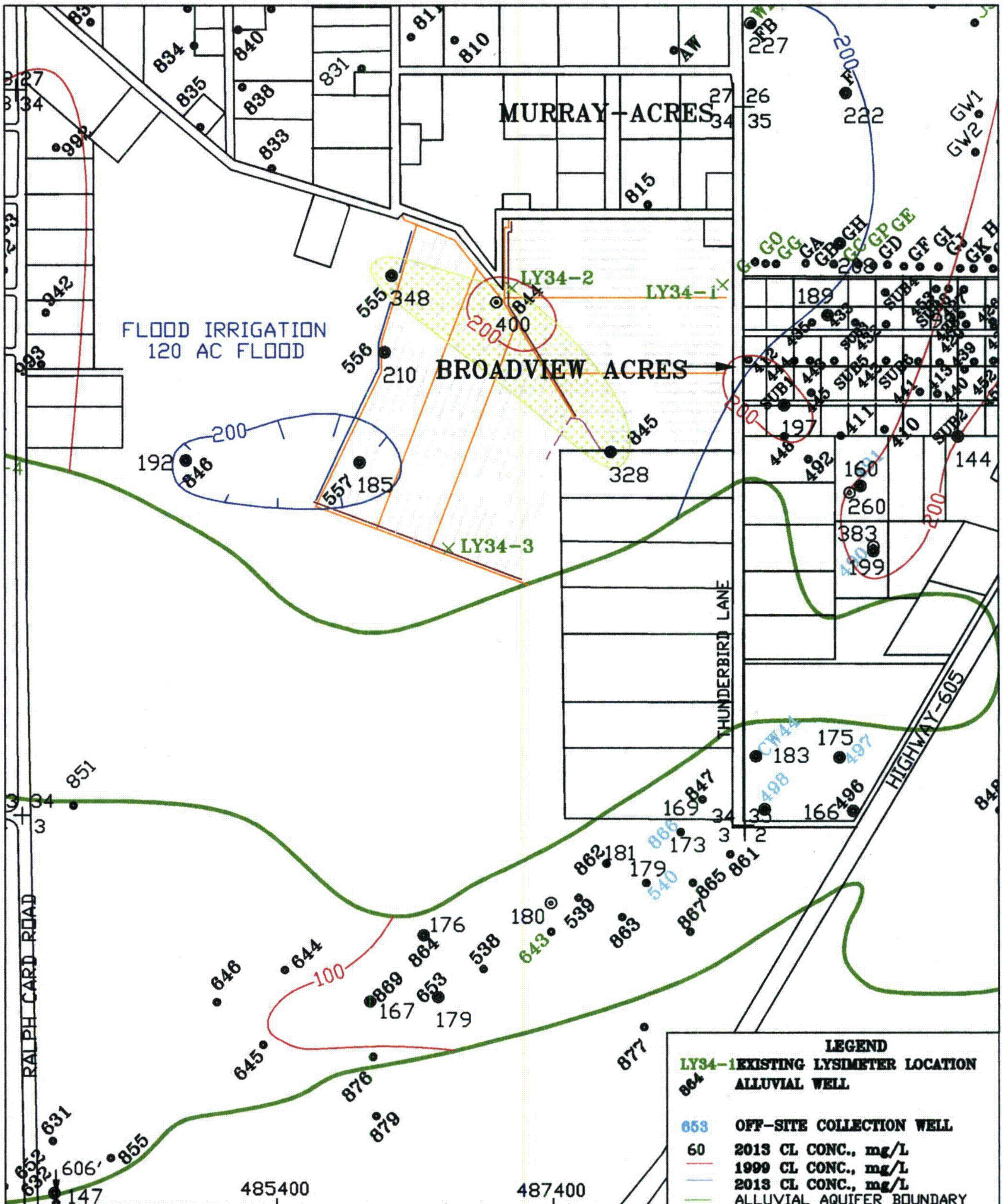


FIGURE 4-4. TDS CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000' C:\PROJECTS\2014-06\1600QAL13 DATE: 3/13/14	**FIGURE 4-5. 1999 AND 2013 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L**	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO

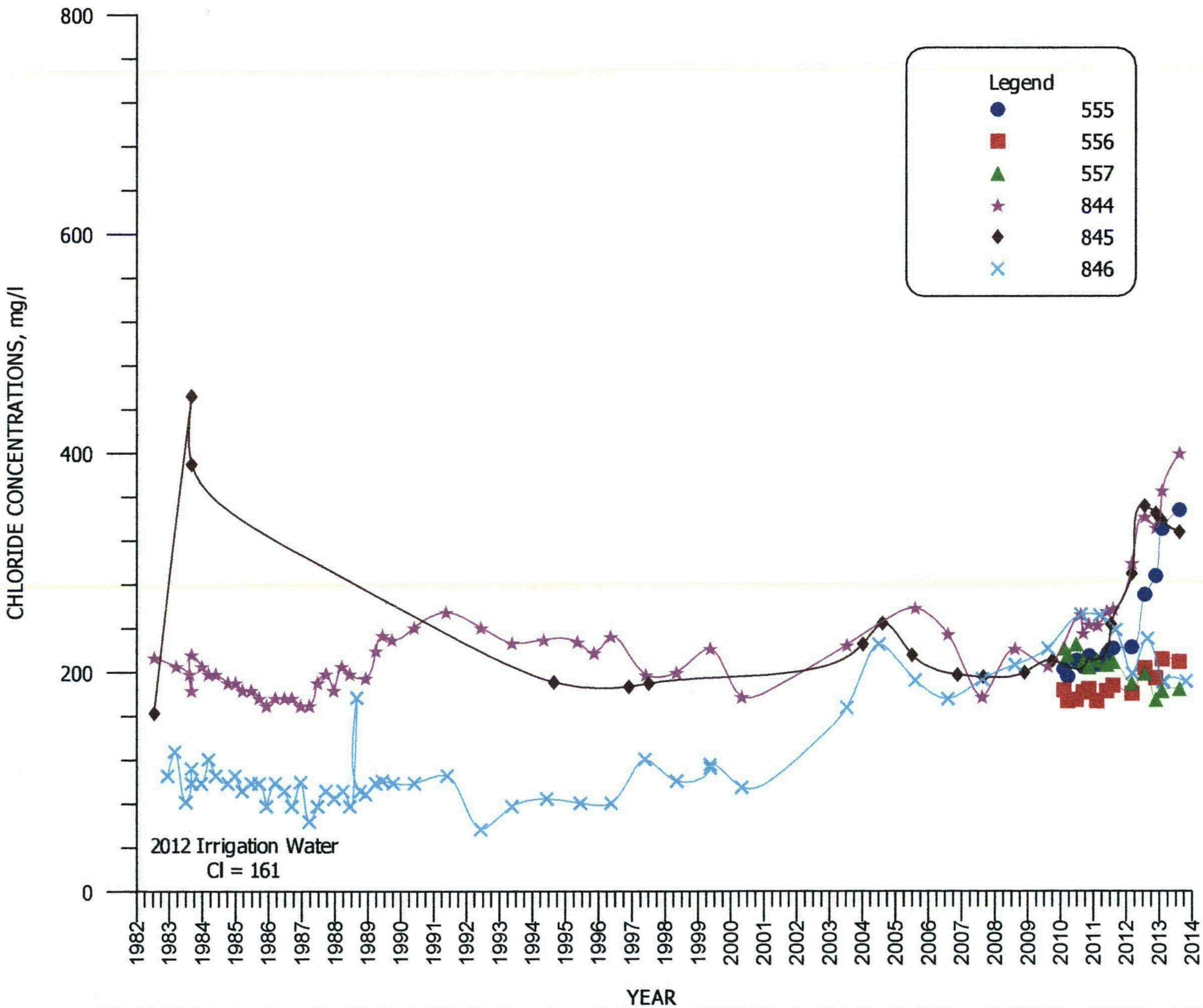
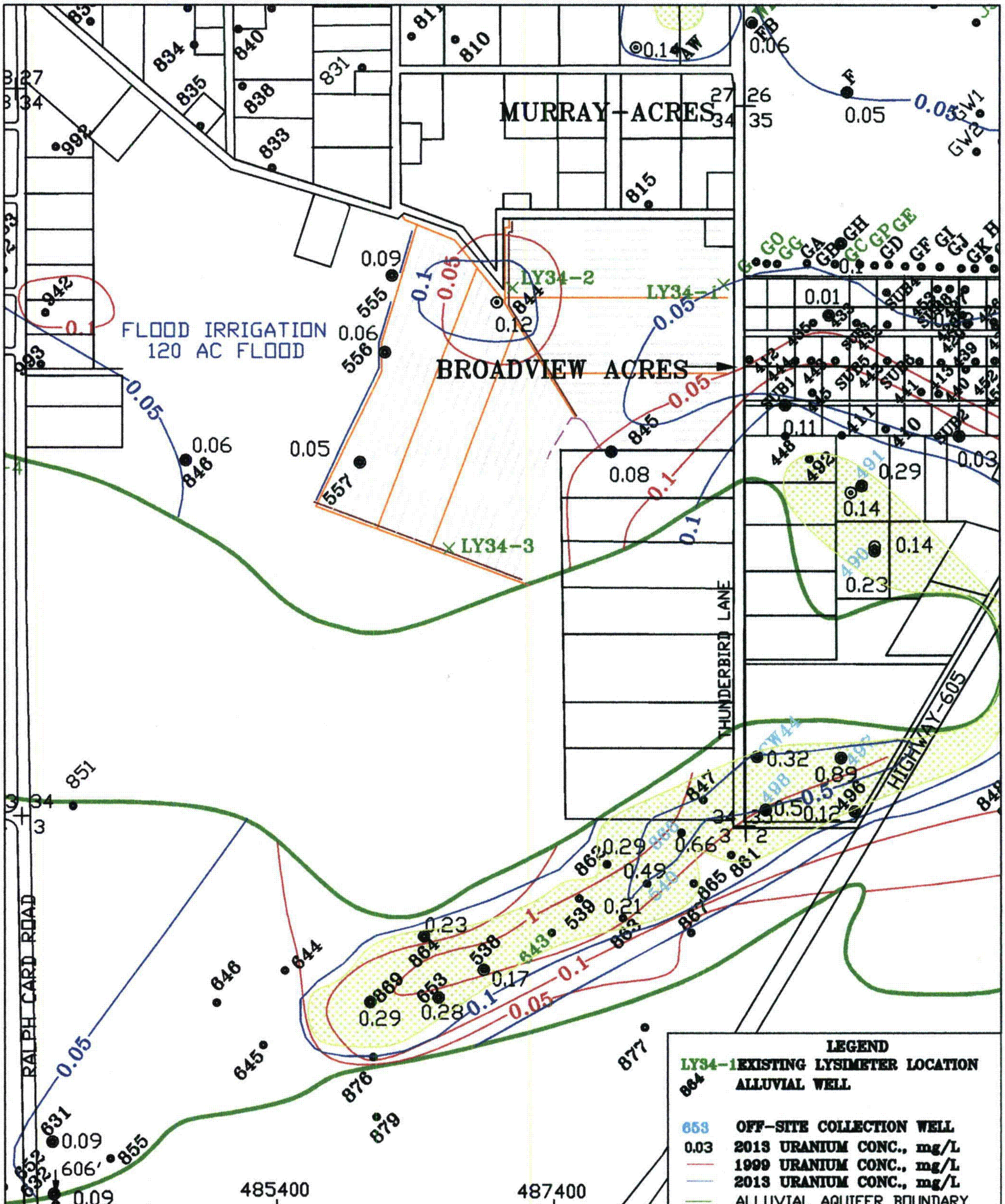


FIGURE 4-6. CHLORIDE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-7. 1999 AND 2013 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY

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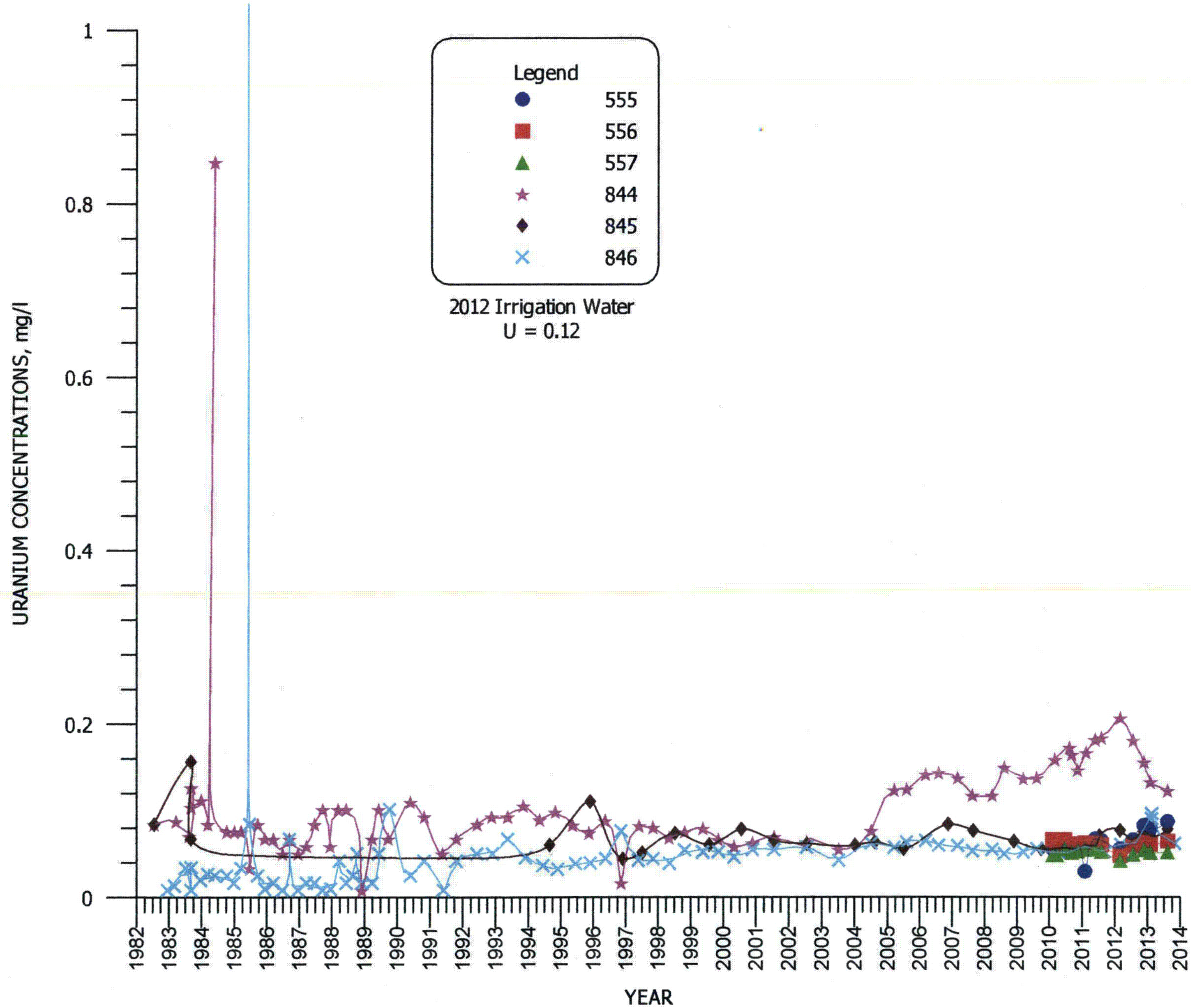
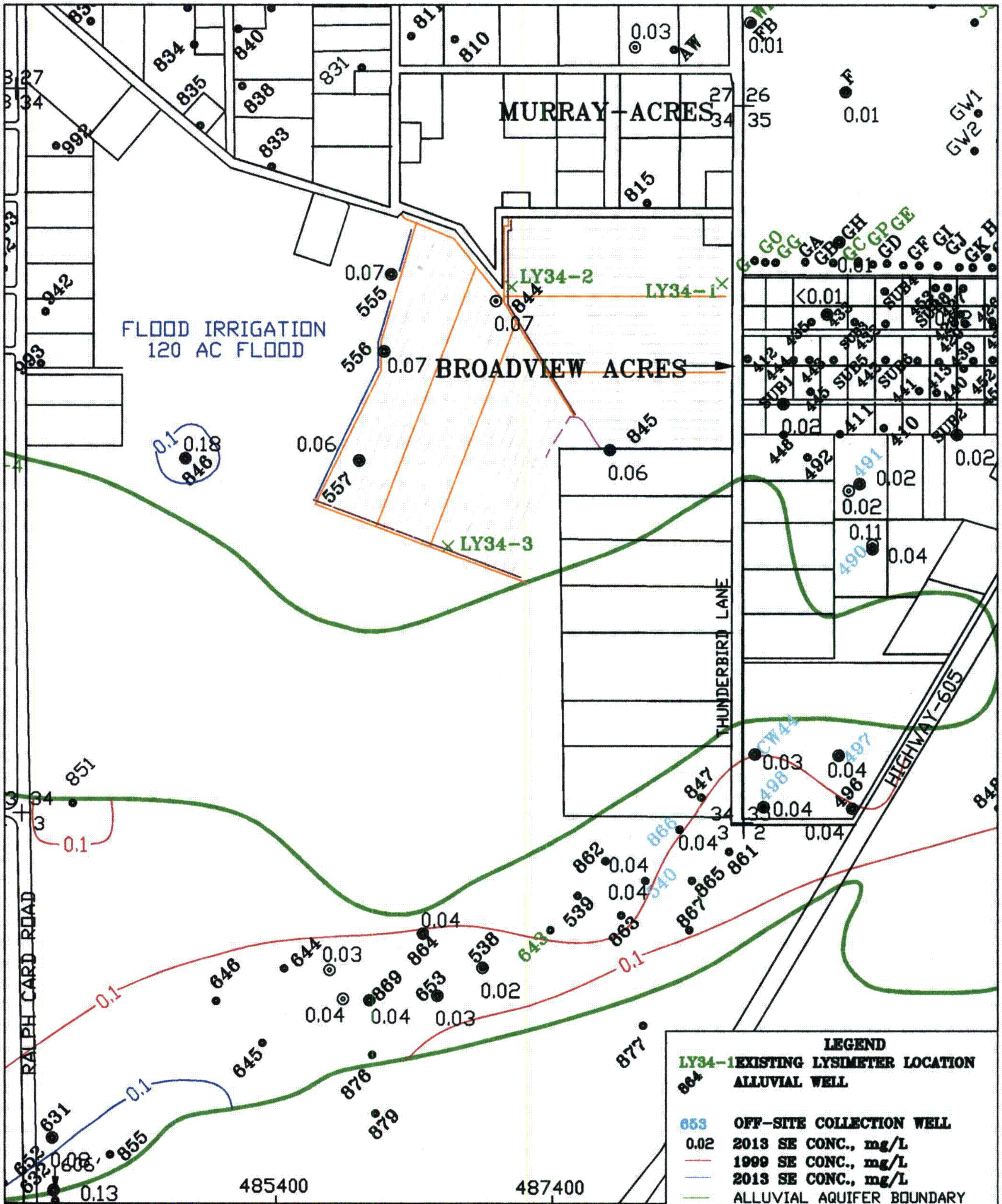


FIGURE 4-8. URANIUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'

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FIGURE 4-9. 2013 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L

HOMESTAKE MINING COMPANY
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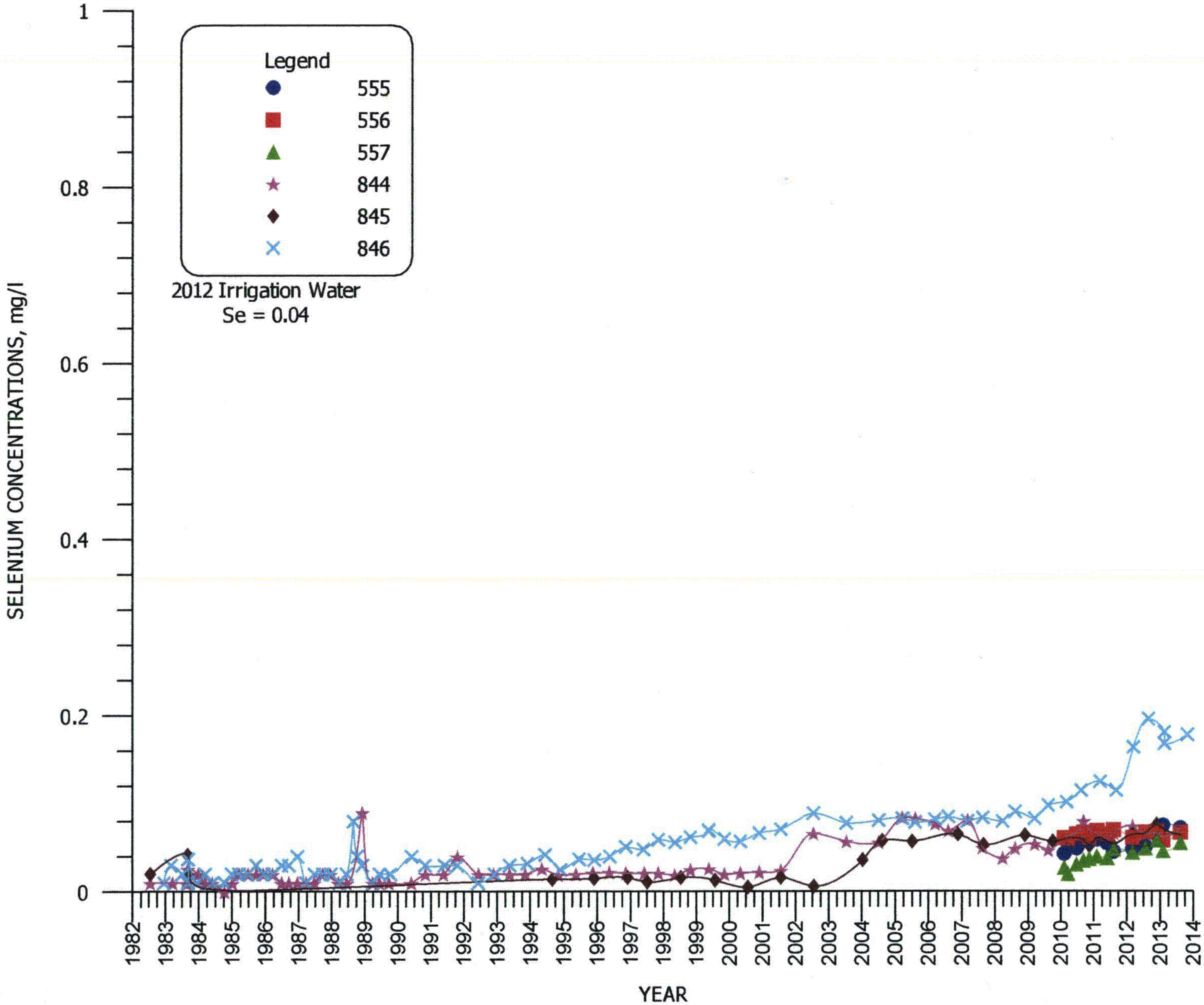
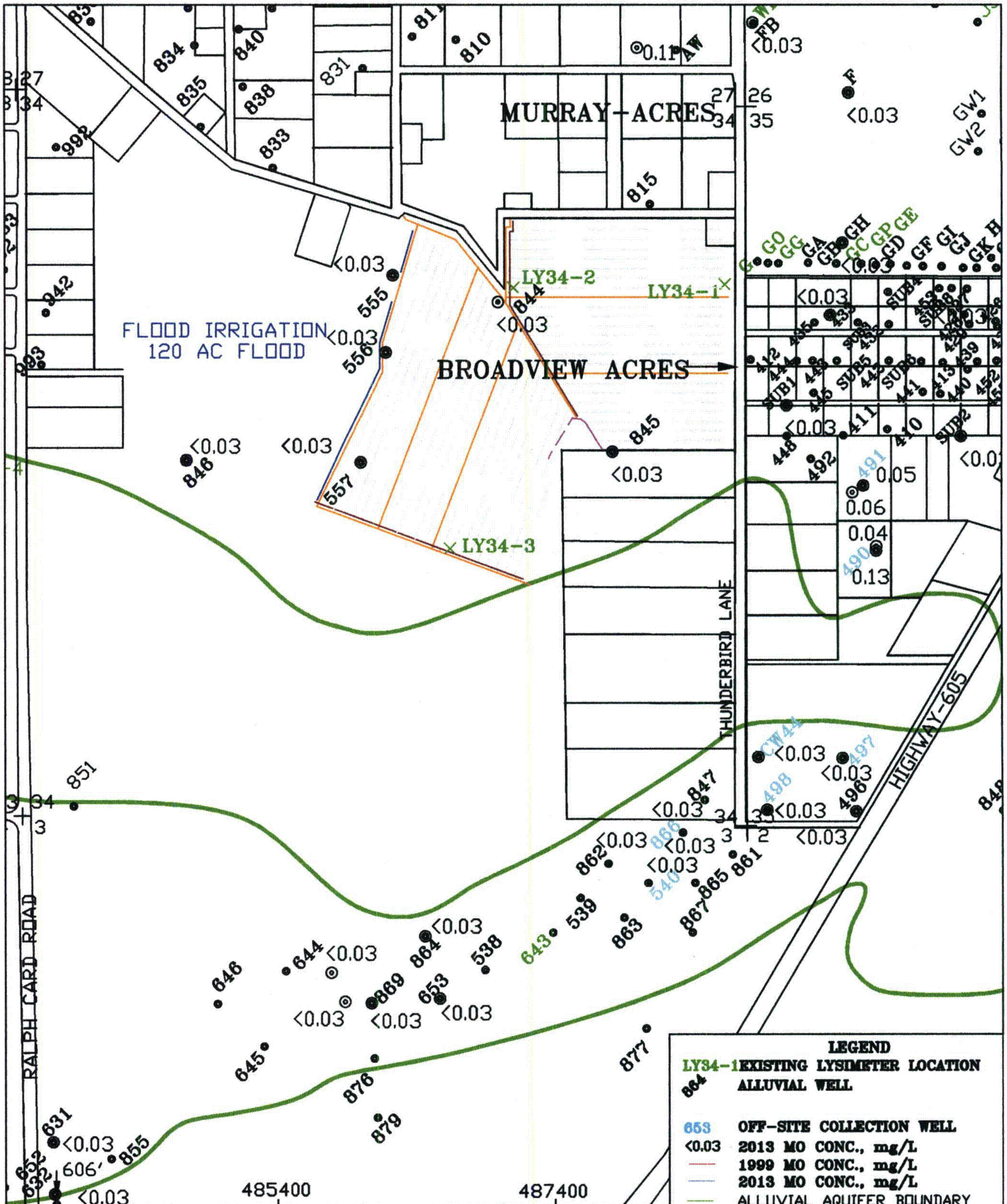


FIGURE 4-10. SELENIUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000'	FIGURE 4-11. 2013 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO
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DATE: 3/13/14		

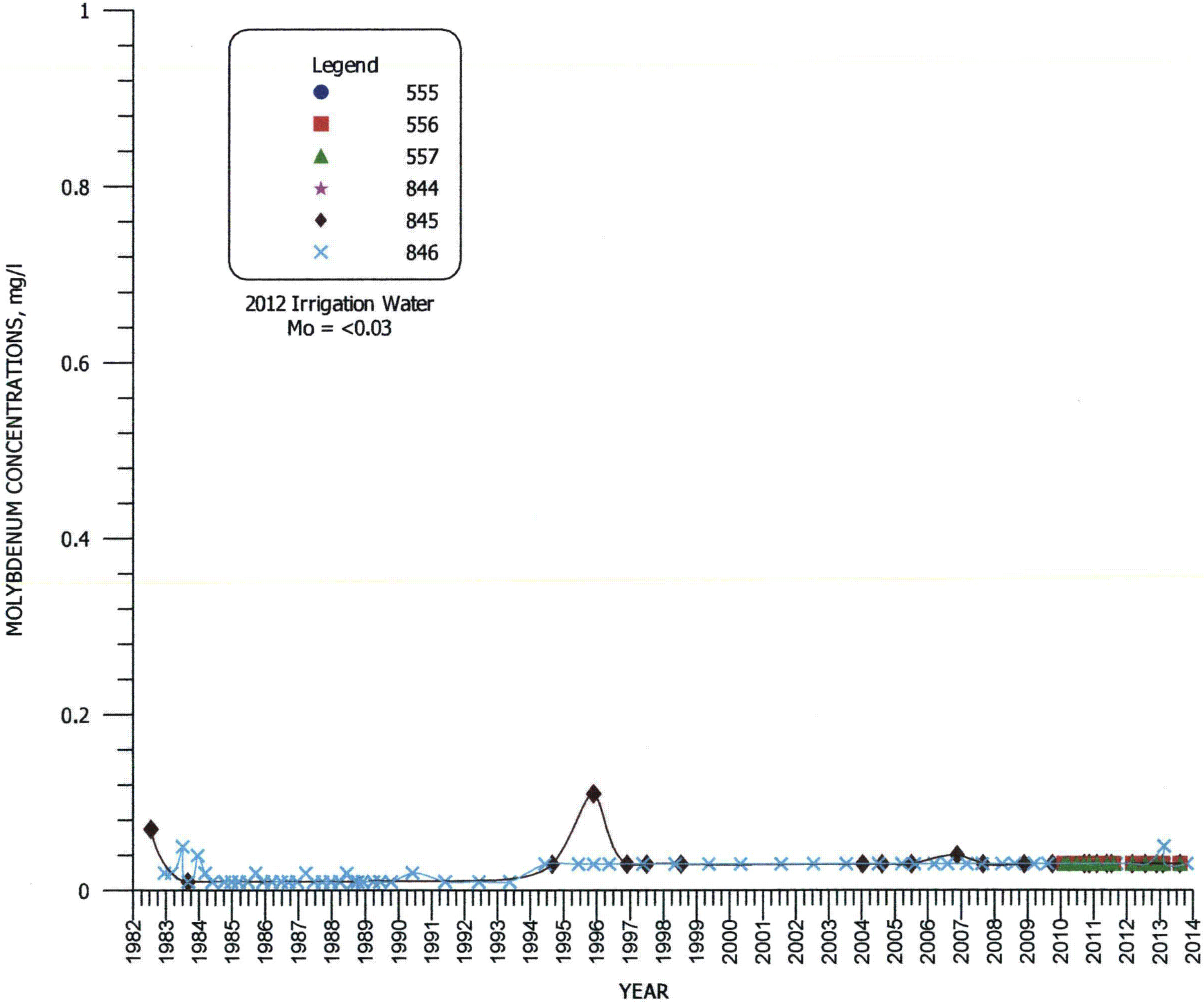
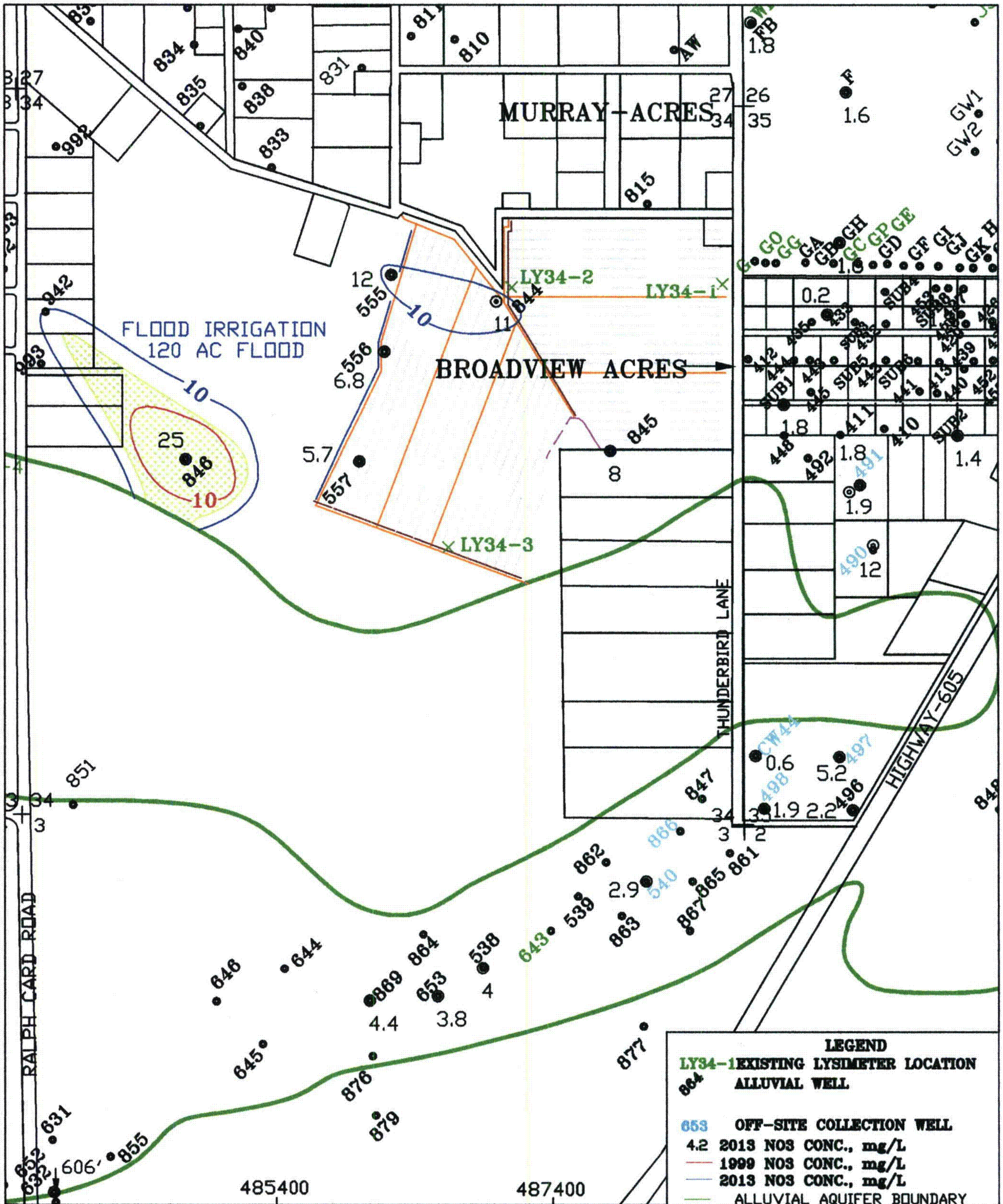


FIGURE 4-12. MOLYBDENUM CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 1000' C:\PROJECTS\2014-06\1600QAL13 DATE: 3/13/14	**FIGURE 4-13. 1999 AND 2013 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 34, mg/L**	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO

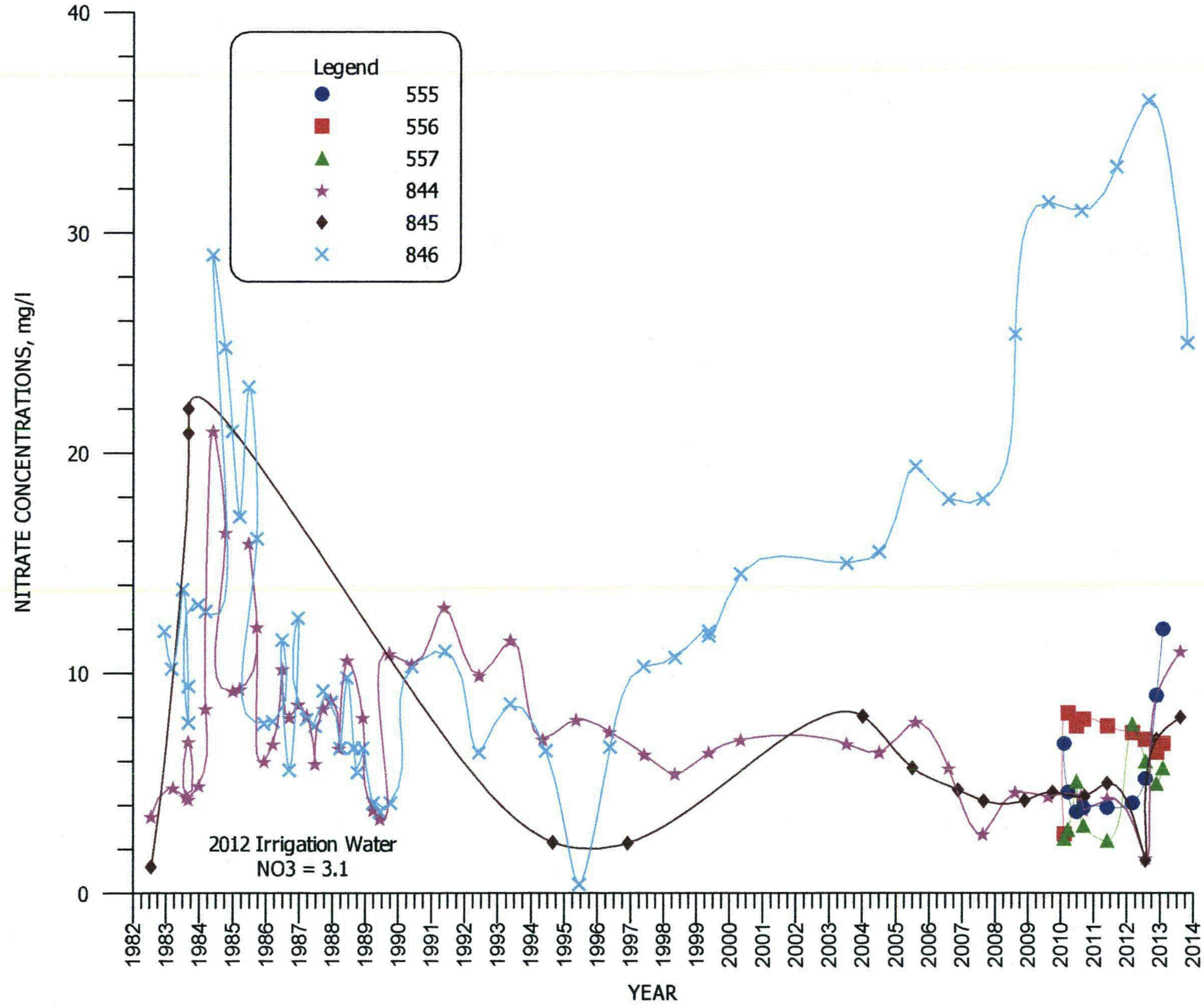
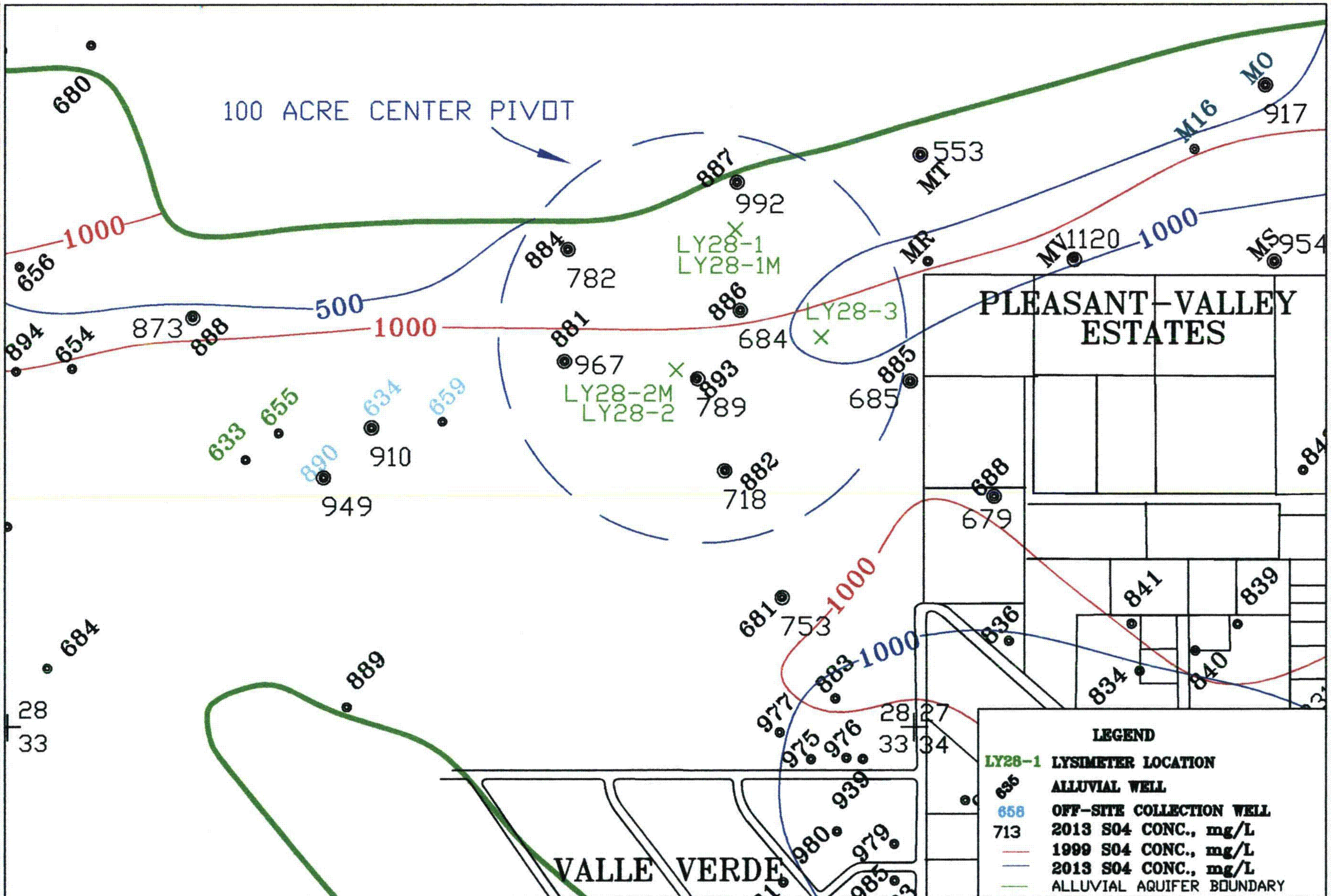


FIGURE 4-14. NITRATE CONCENTRATIONS FOR WELLS 555, 556, 557, 844, 845 AND 846.



SCALE: 1" = 800' C:\PROJECTS\2014-06\1600QAL13 DATE: 3/13/14	**FIGURE 4-15. 1999 AND 2013 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L**	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO

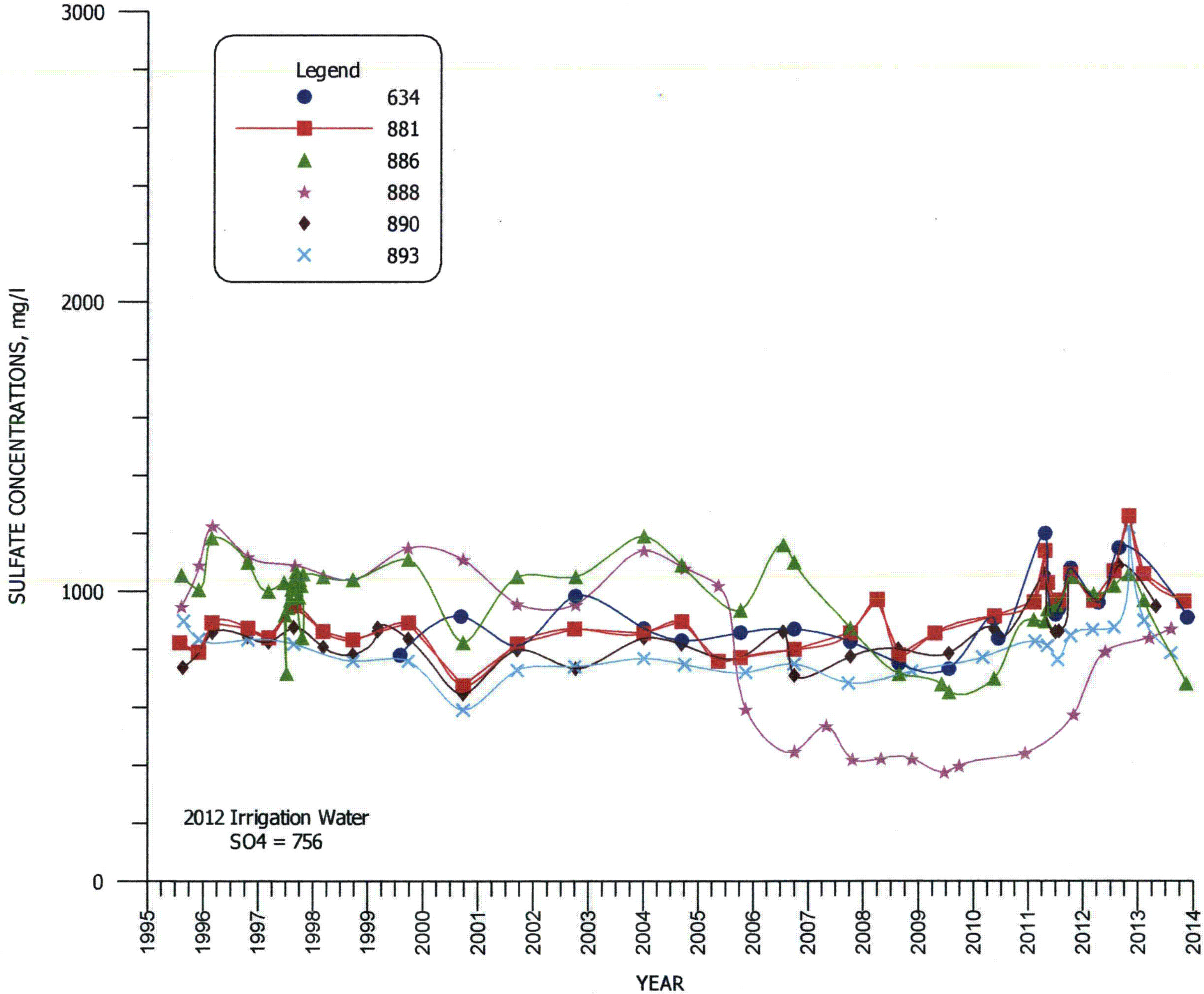
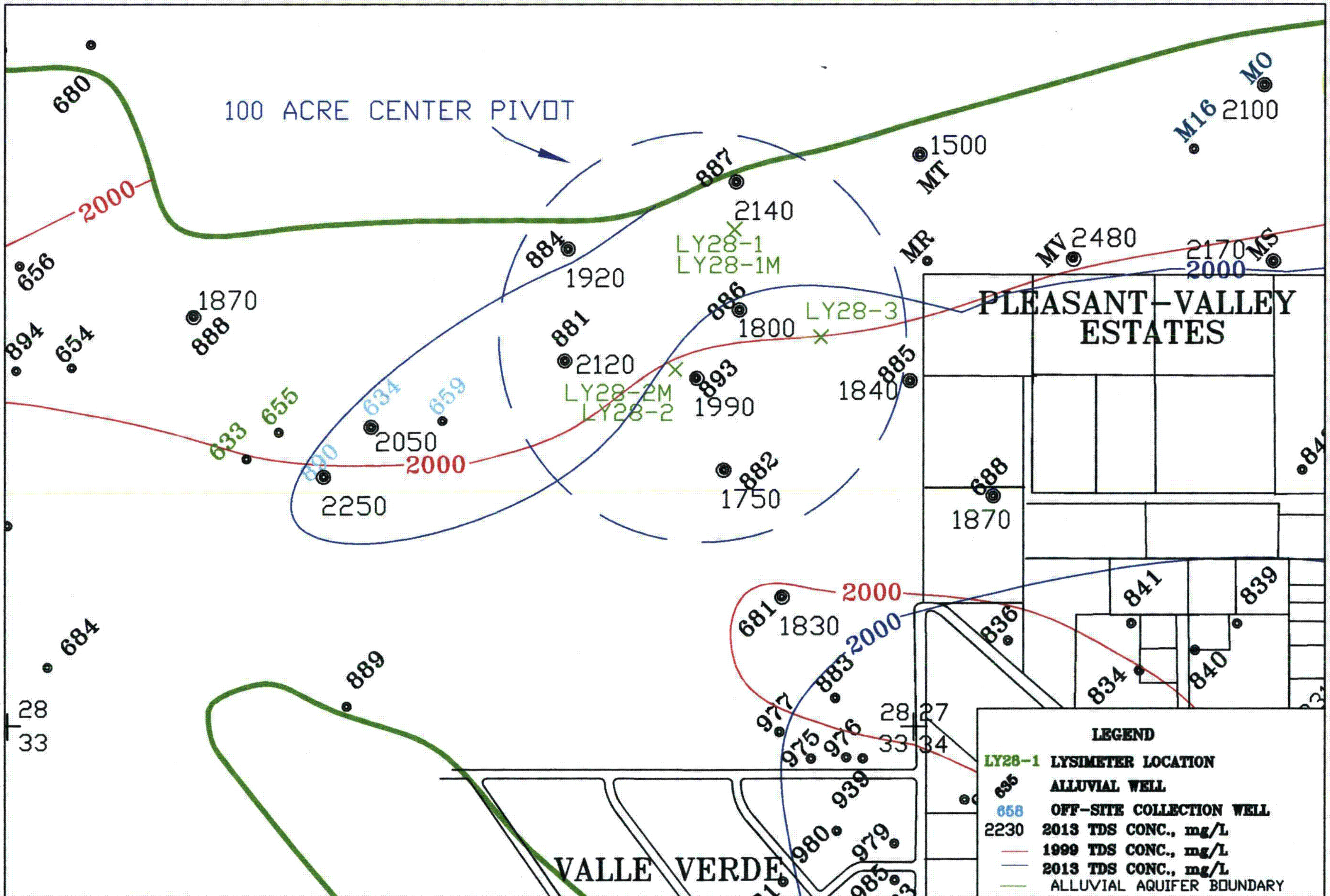


FIGURE 4-16. SULFATE CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890 AND 893.



SCALE: 1" = 800'

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FIGURE 4-17. 1999 AND 2013 TDS ALLUVIAL CONCENTRATION IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

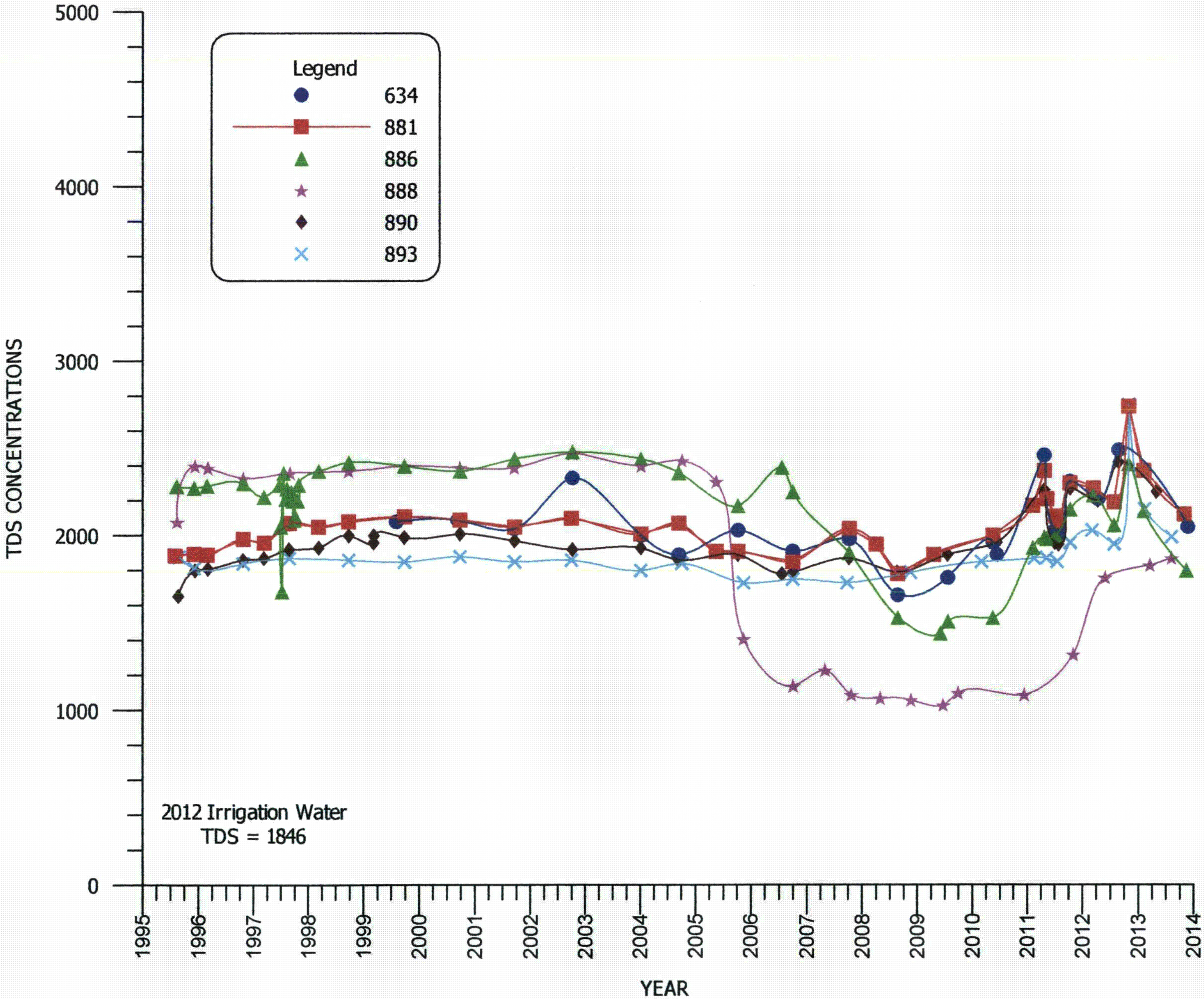
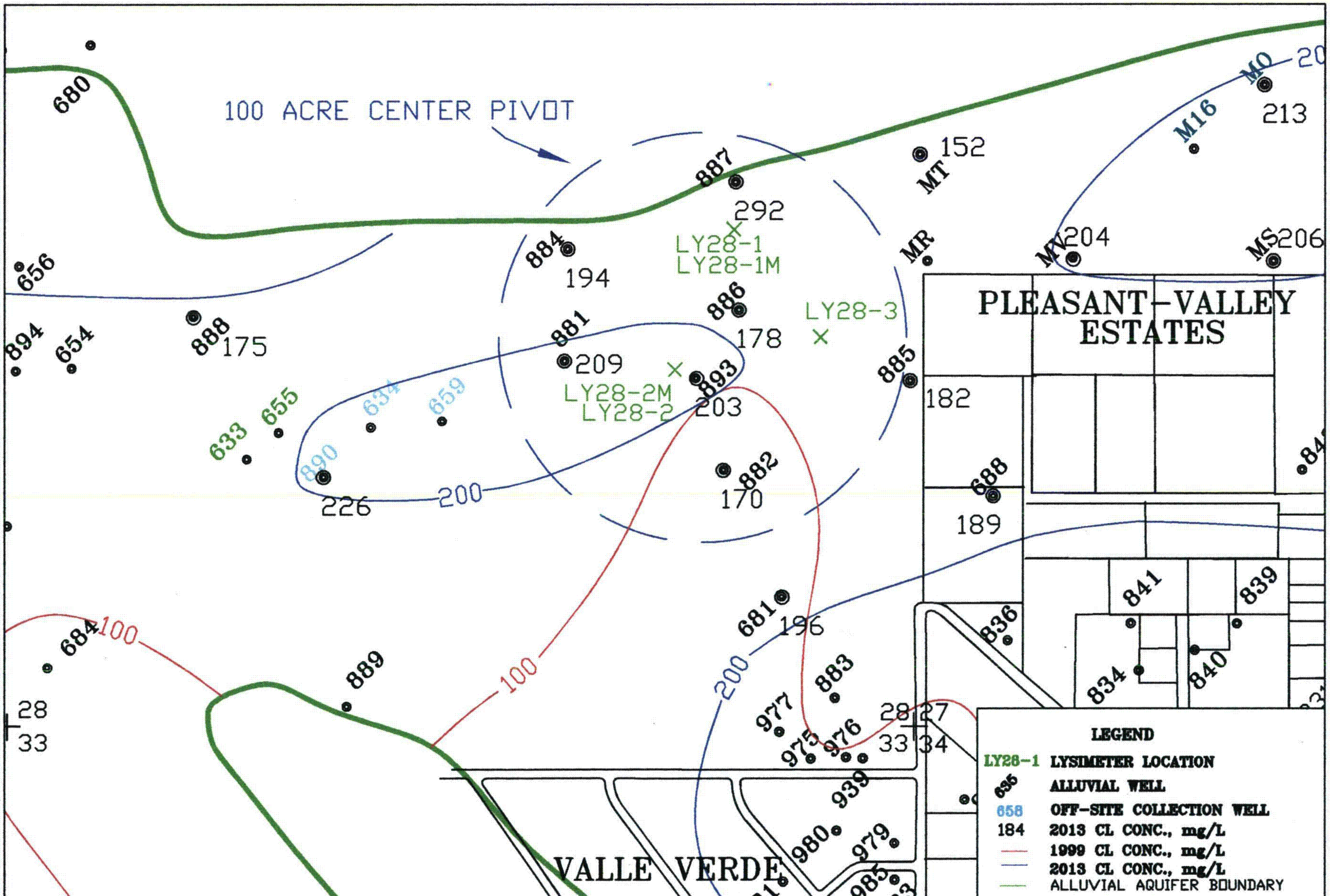


FIGURE 4-18. TDS CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 800'

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FIGURE 4-19. 1999 AND 2013 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

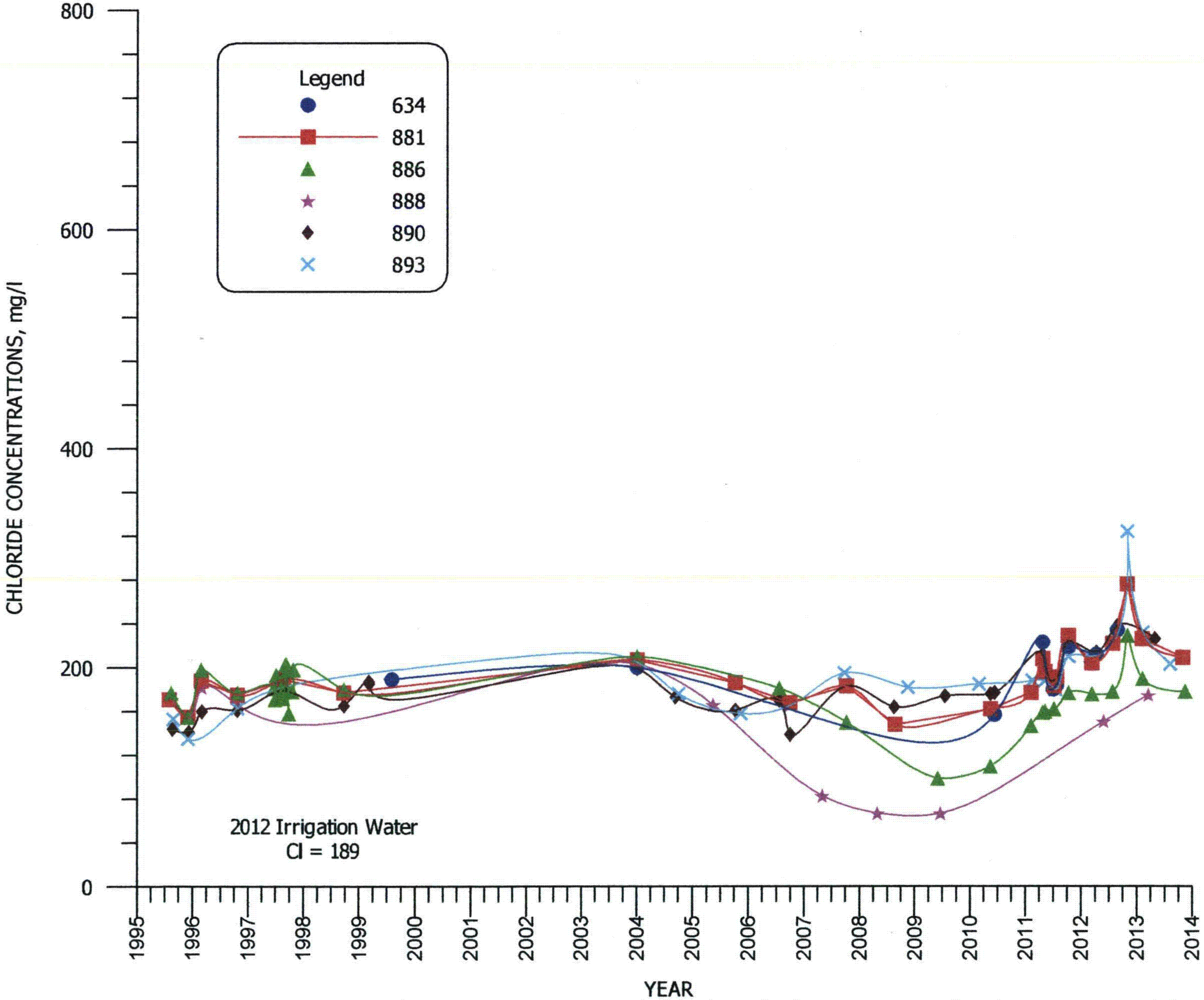
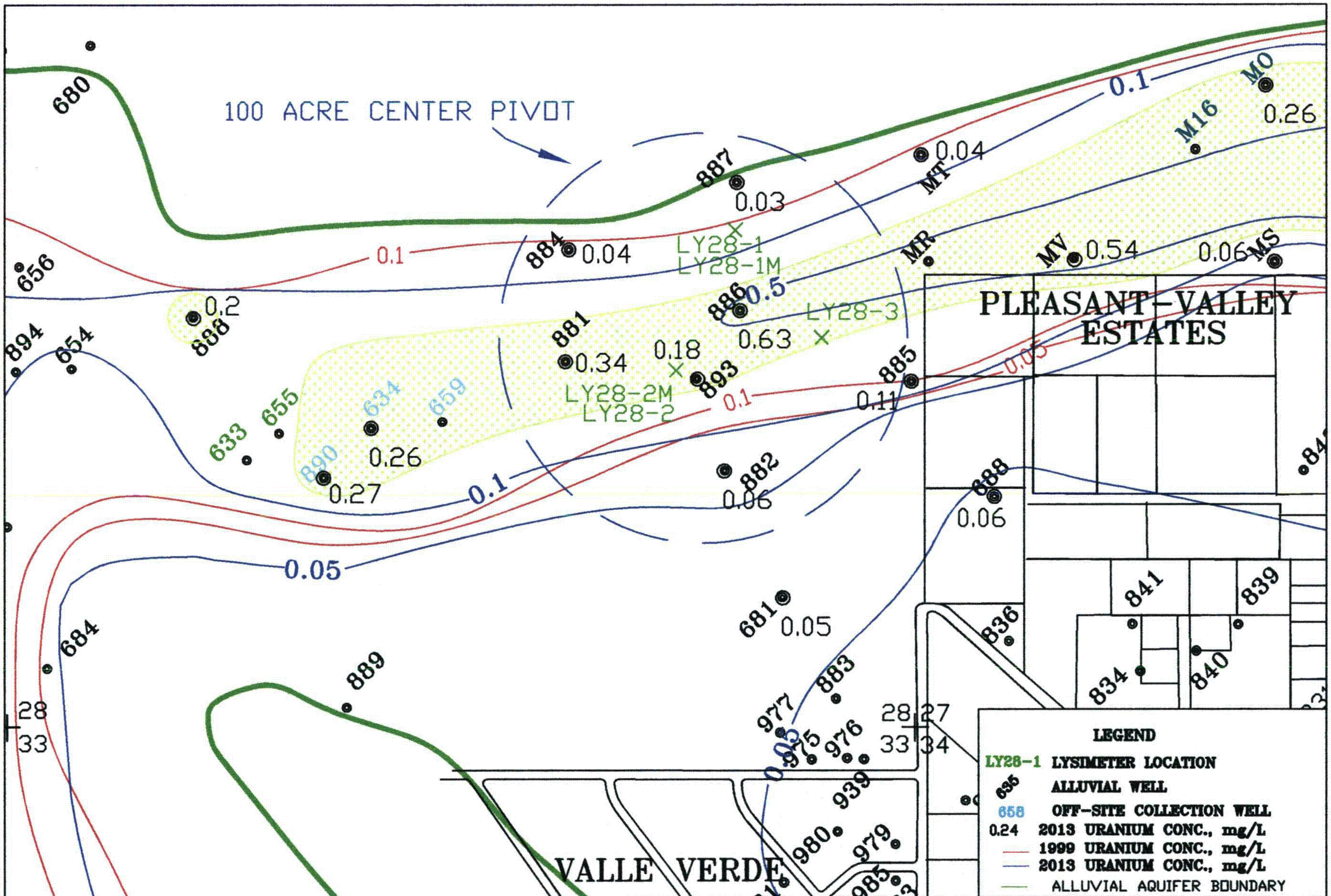


FIGURE 4-20. CHLORIDE CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 800'

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FIGURE 4-21. 1999 AND 2013 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
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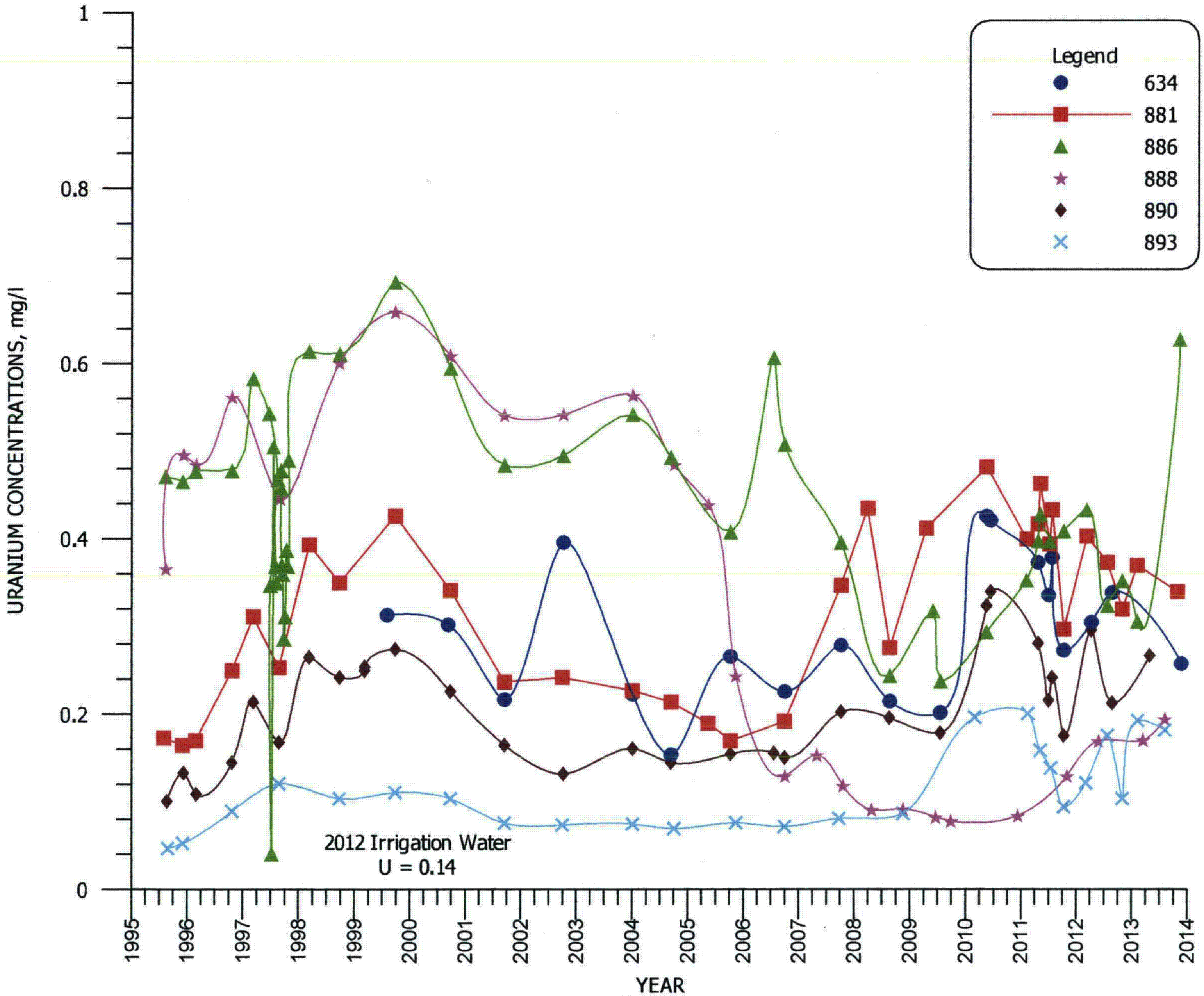
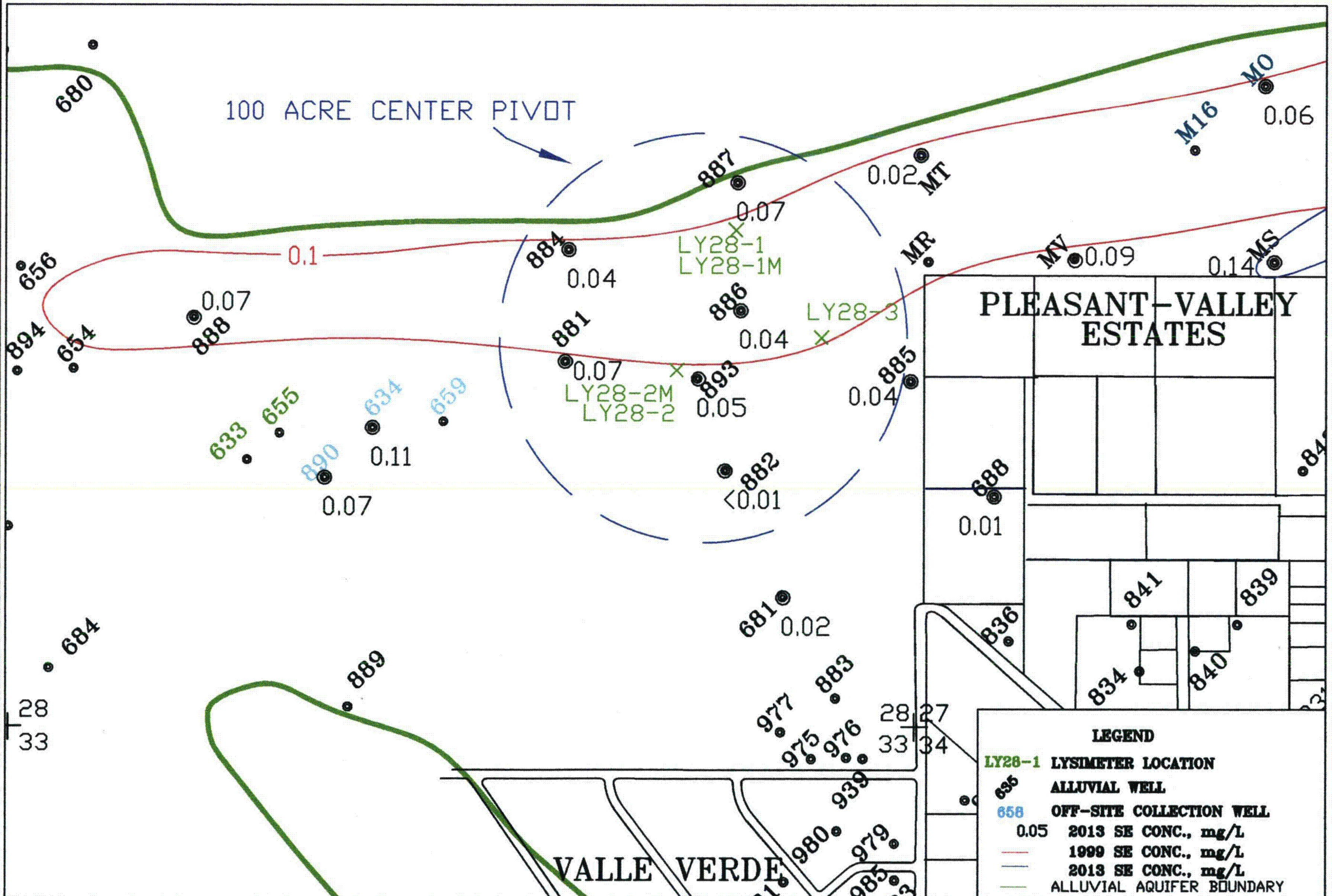


FIGURE 4-22. URANIUM CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 800'

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FIGURE 4-23. 1999 AND 2013 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

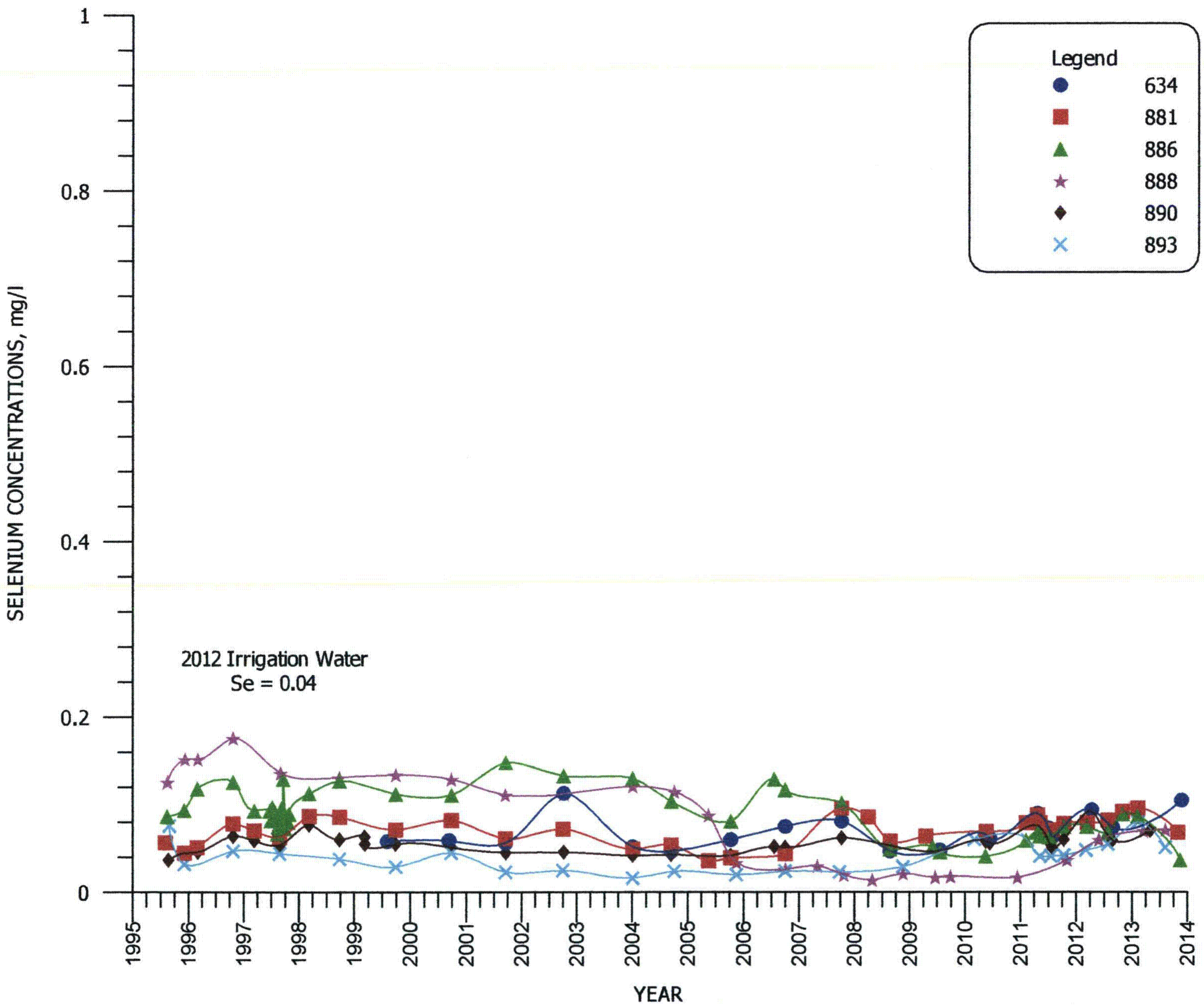
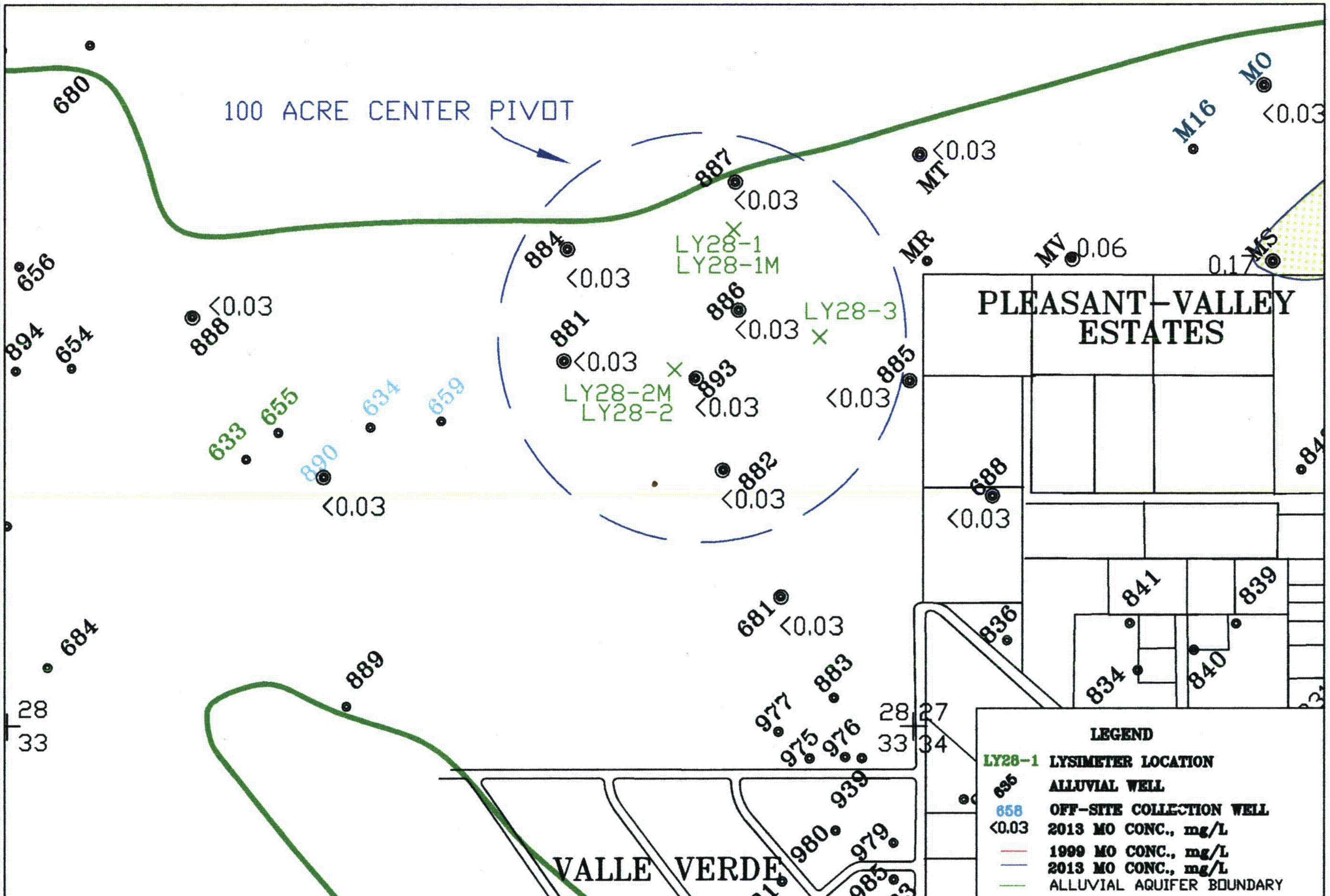


FIGURE 4-24. SELENIUM CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 800'

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FIGURE 4-25. 2013 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

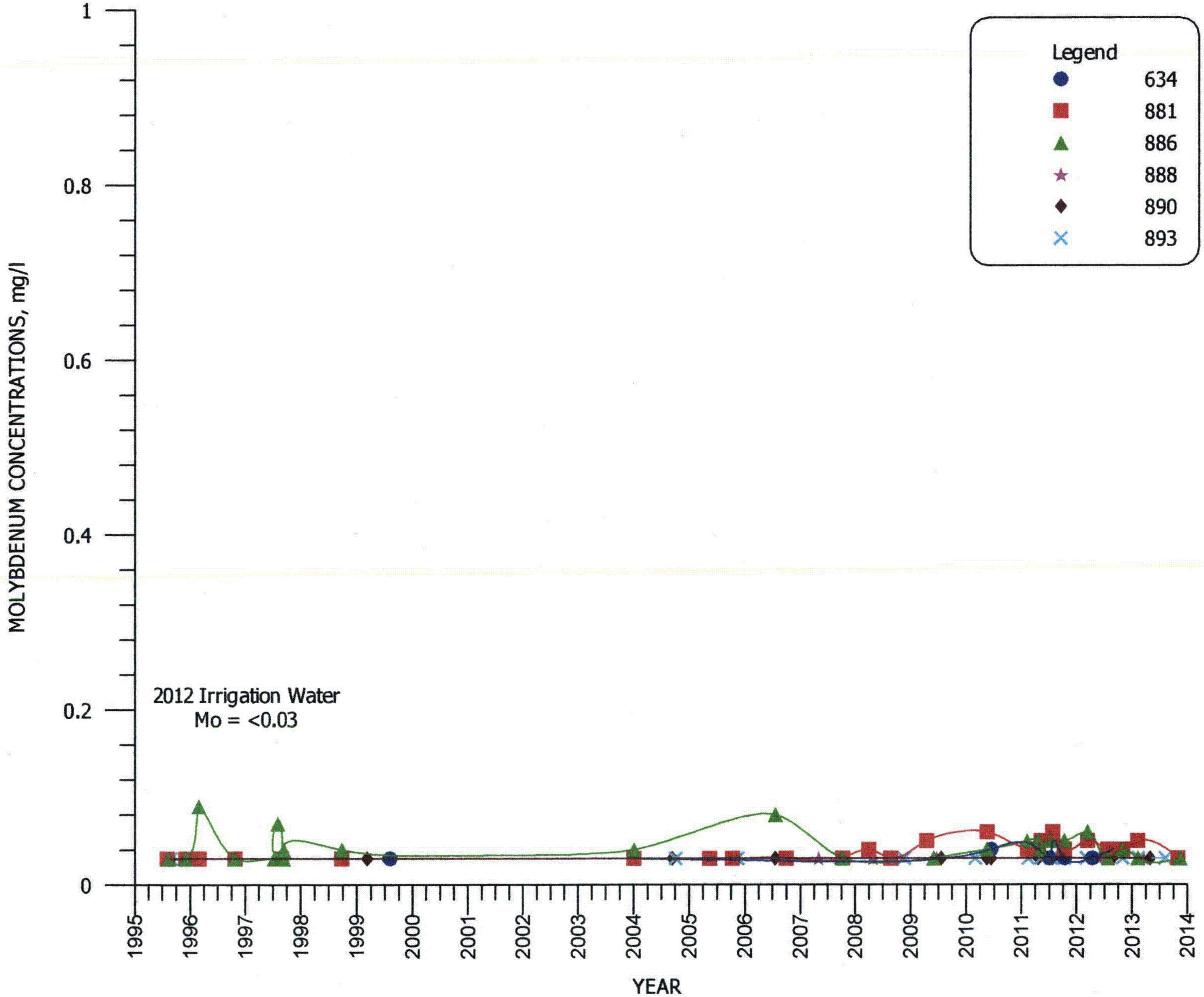
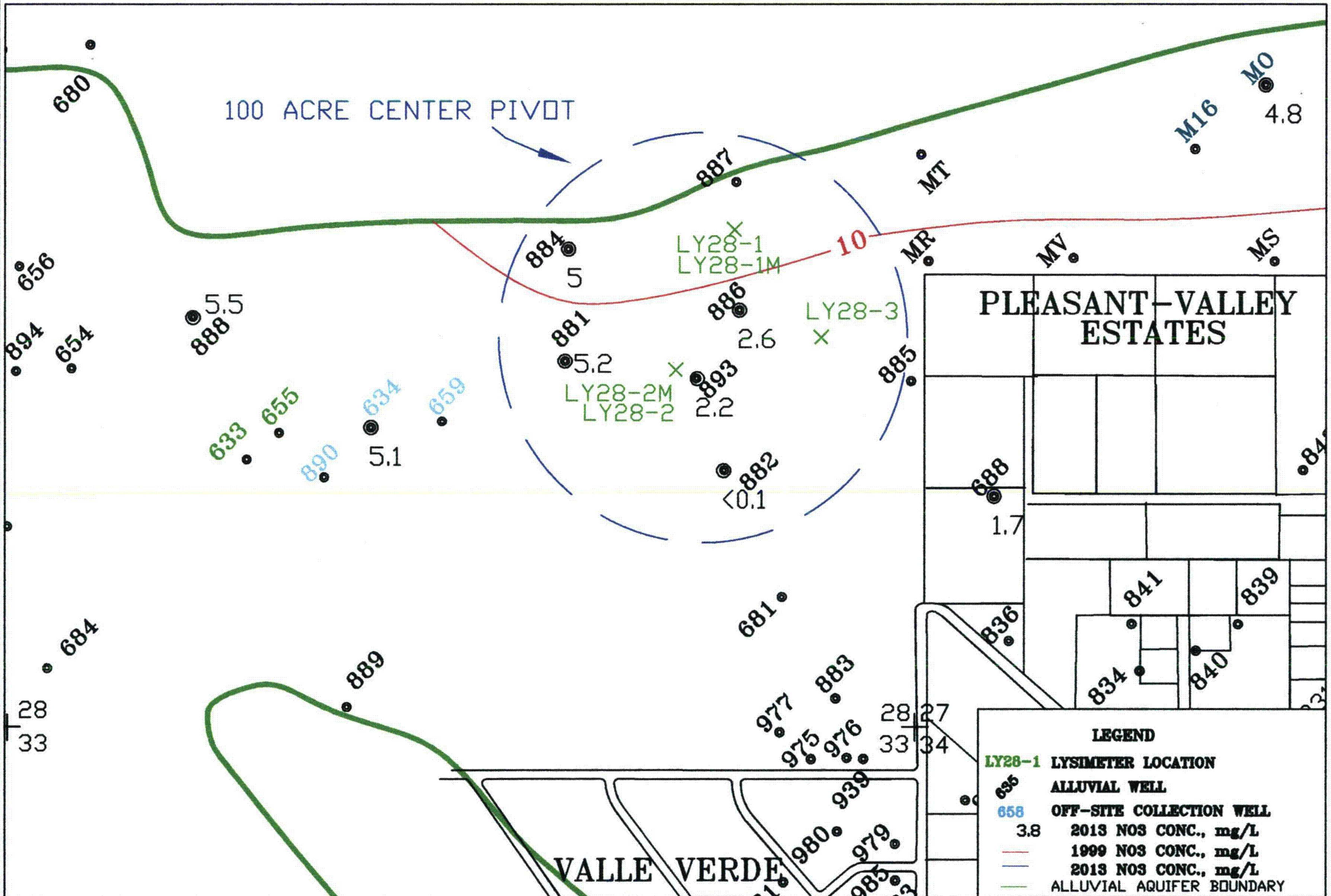


FIGURE 4-26. MOLYBDENUM CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 800'

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FIGURE 4-27. 1999 AND 2013 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 28, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

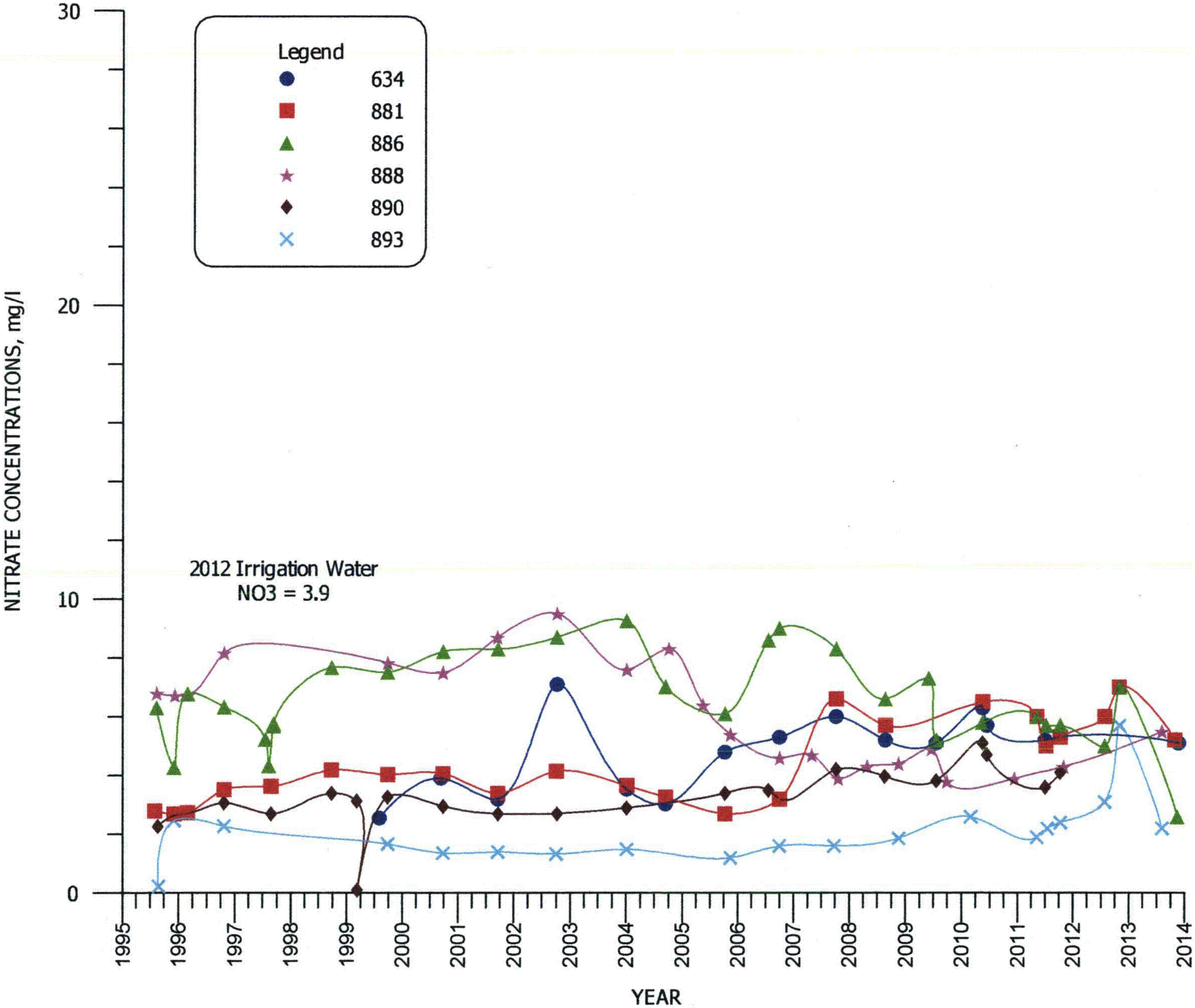
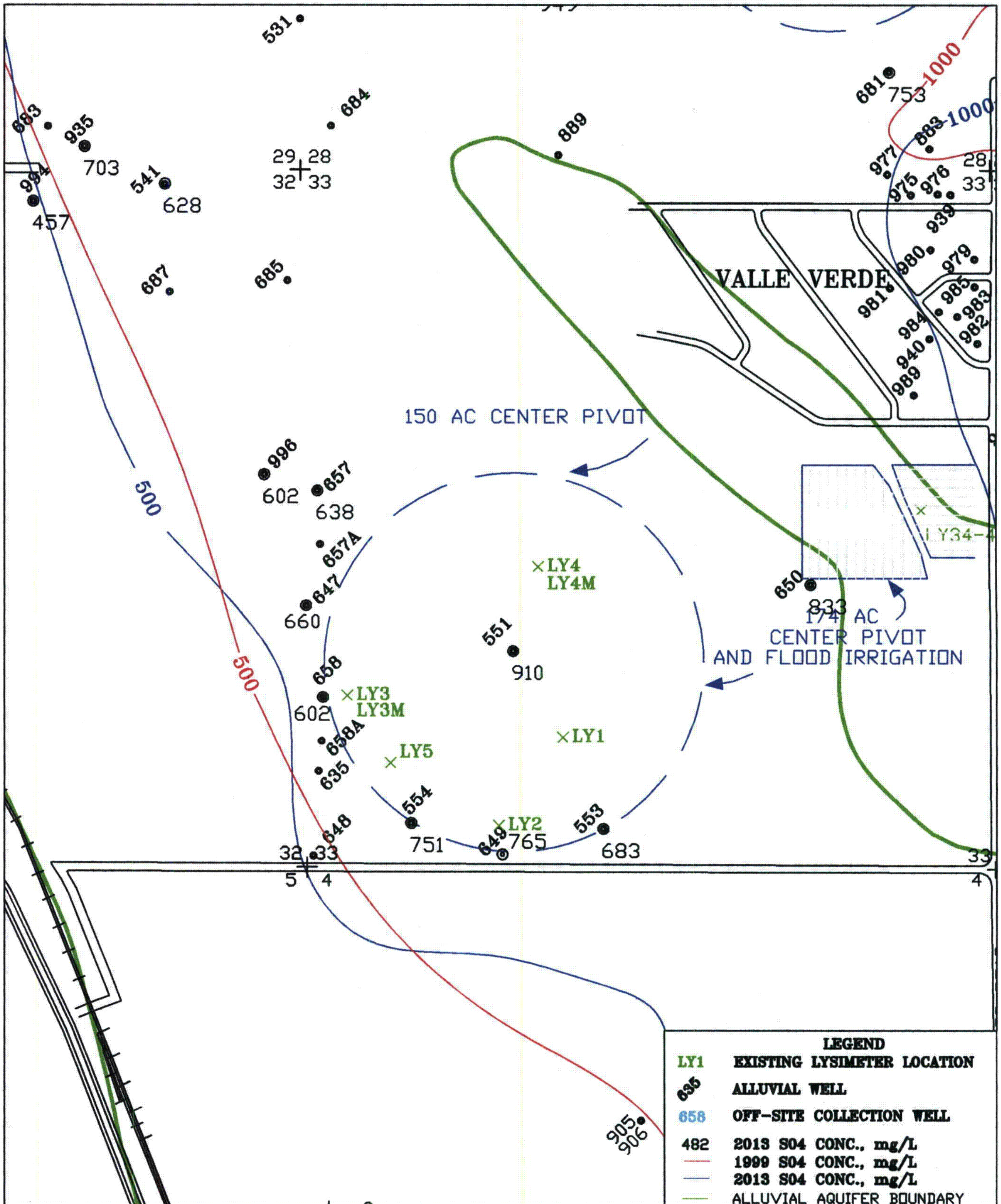


FIGURE 4-28. NITRATE CONCENTRATIONS FOR WELLS 634, 881, 886, 888, 890, AND 893.



SCALE: 1" = 1000'

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FIGURE 4-29. 1999 AND 2013 SULFATE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

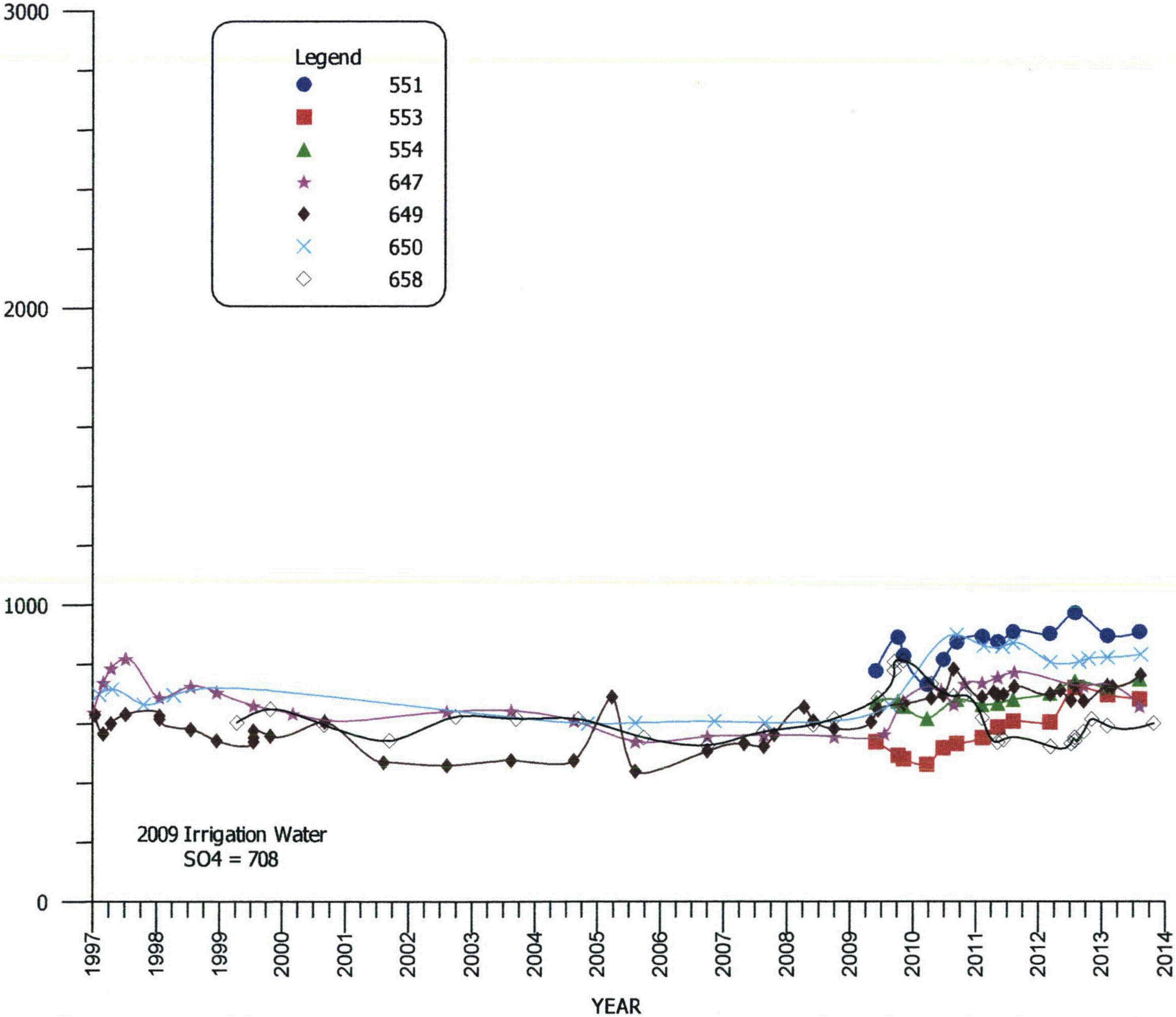
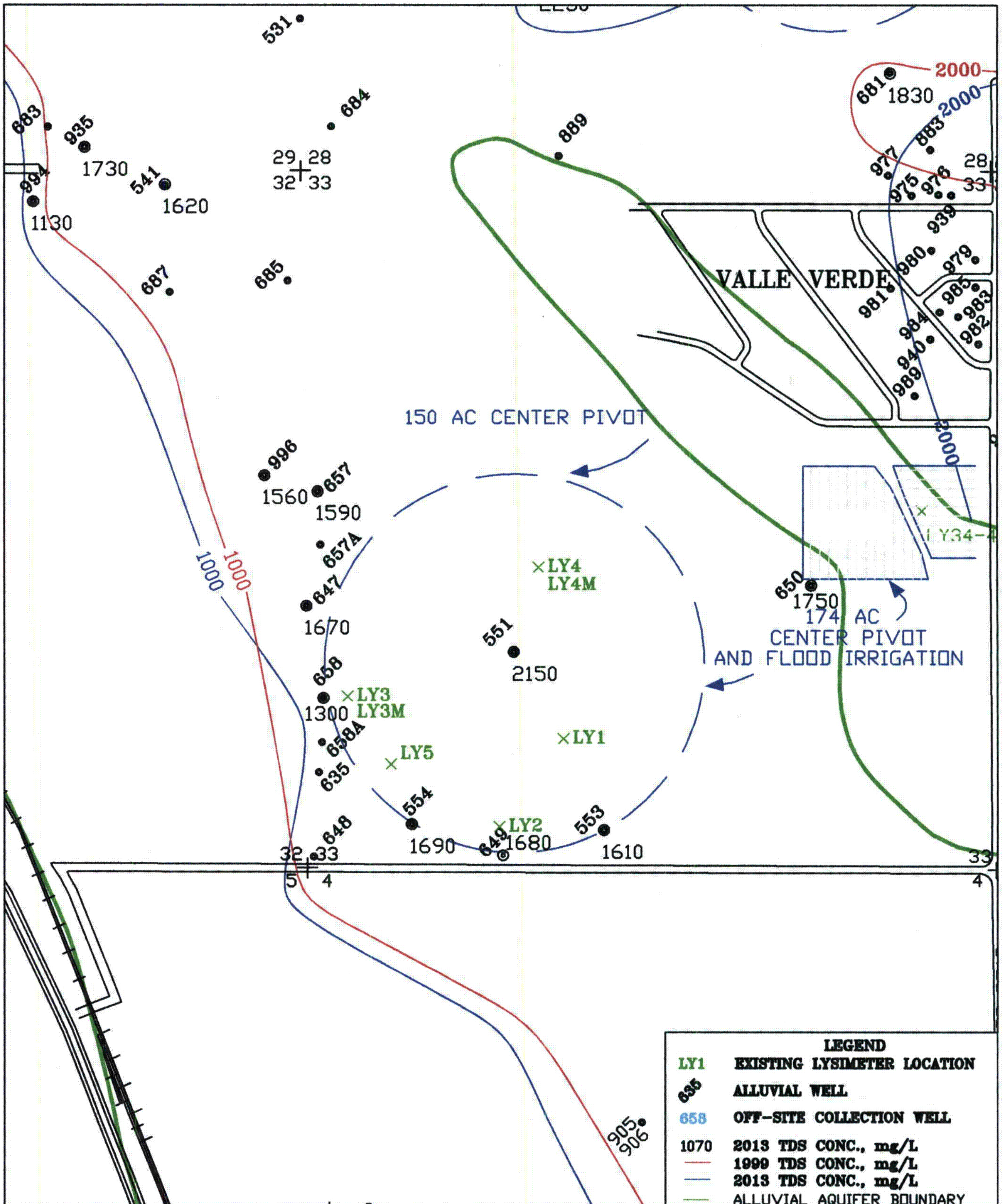


FIGURE 4-30. SULFATE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'

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FIGURE 4-31. 1999 AND 2013 TDS ALLUVIAL CONCENTRATION IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
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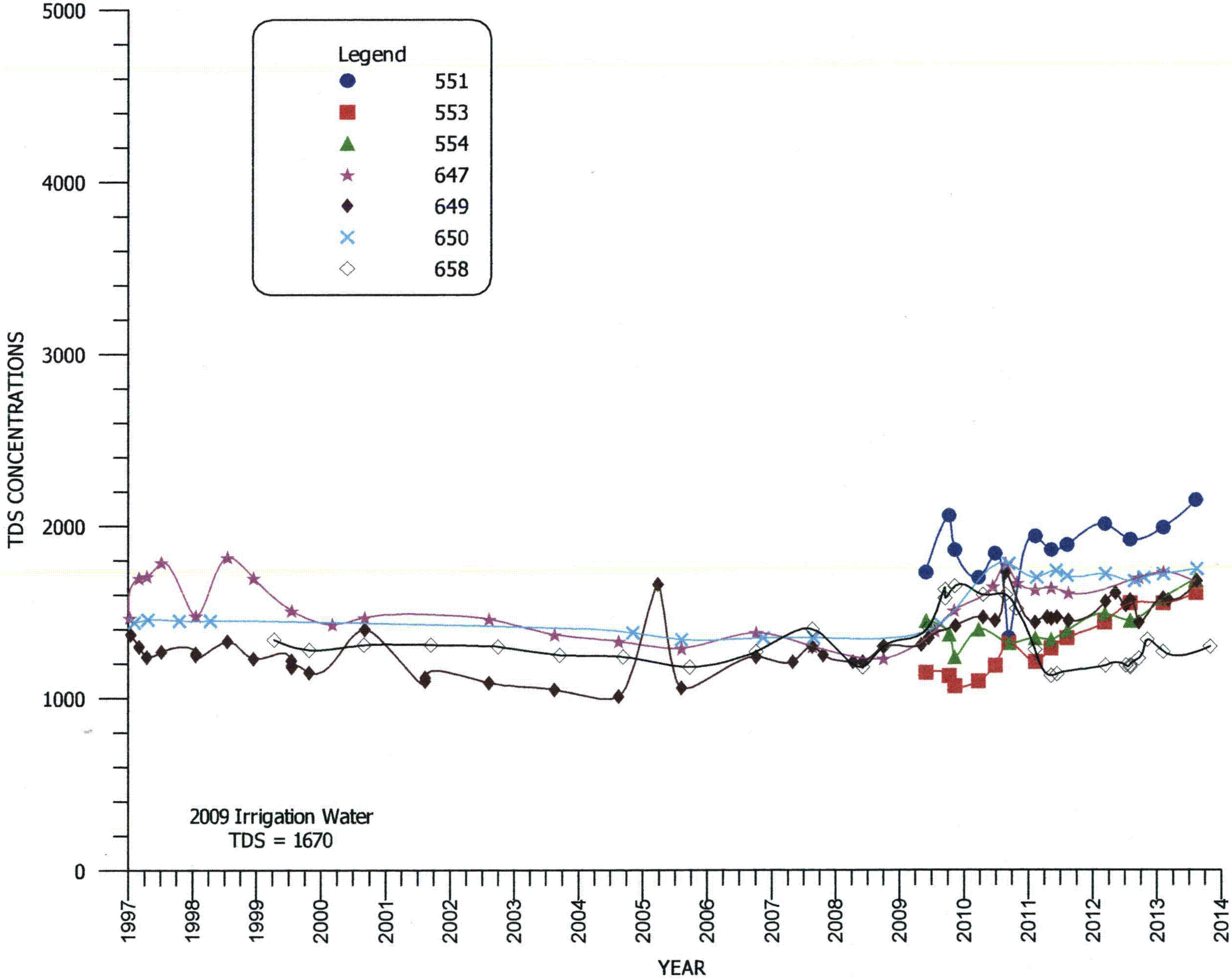
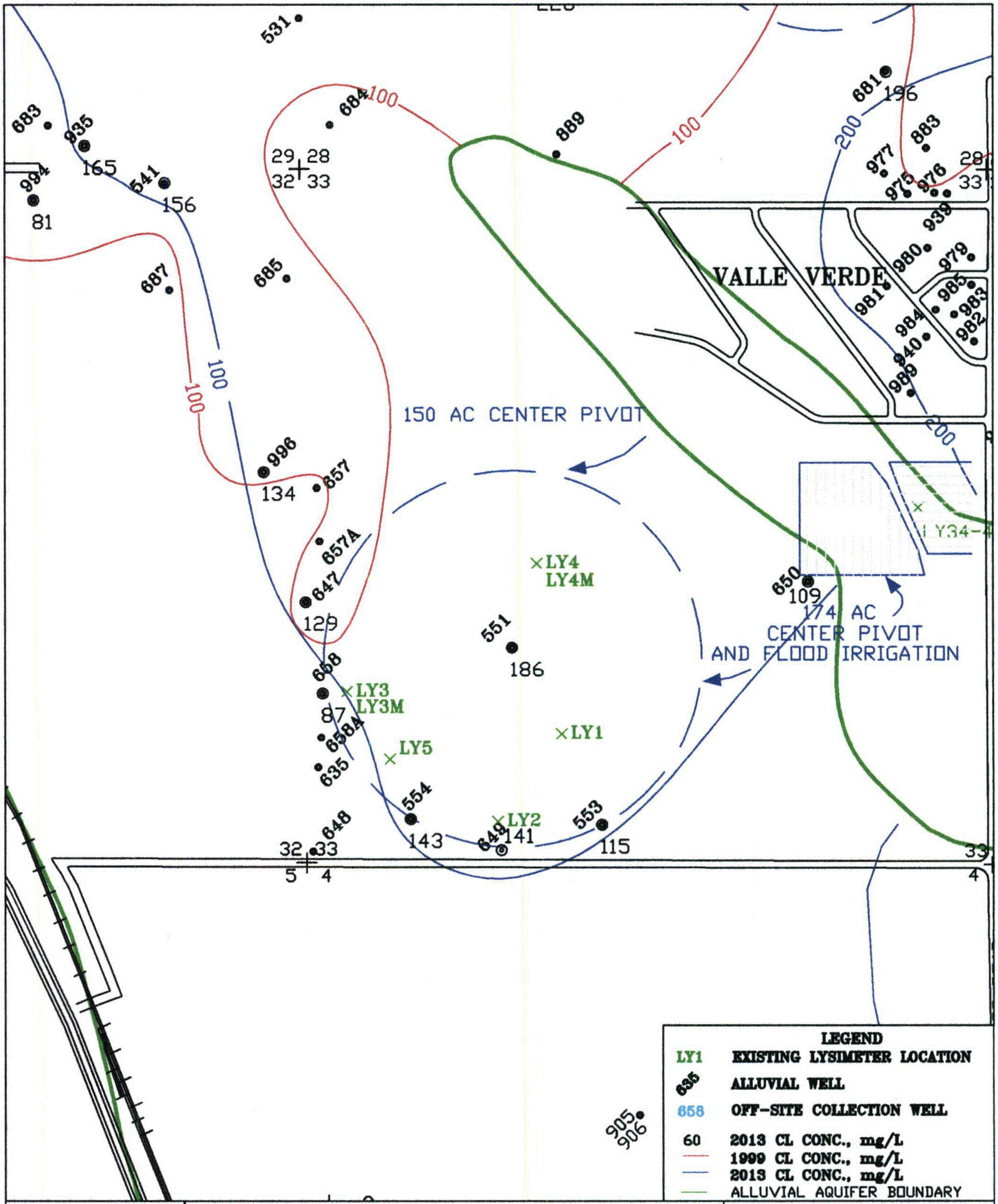


FIGURE 4-32. TDS CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'

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FIGURE 4-33. 1999 AND 2013 CHLORIDE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY

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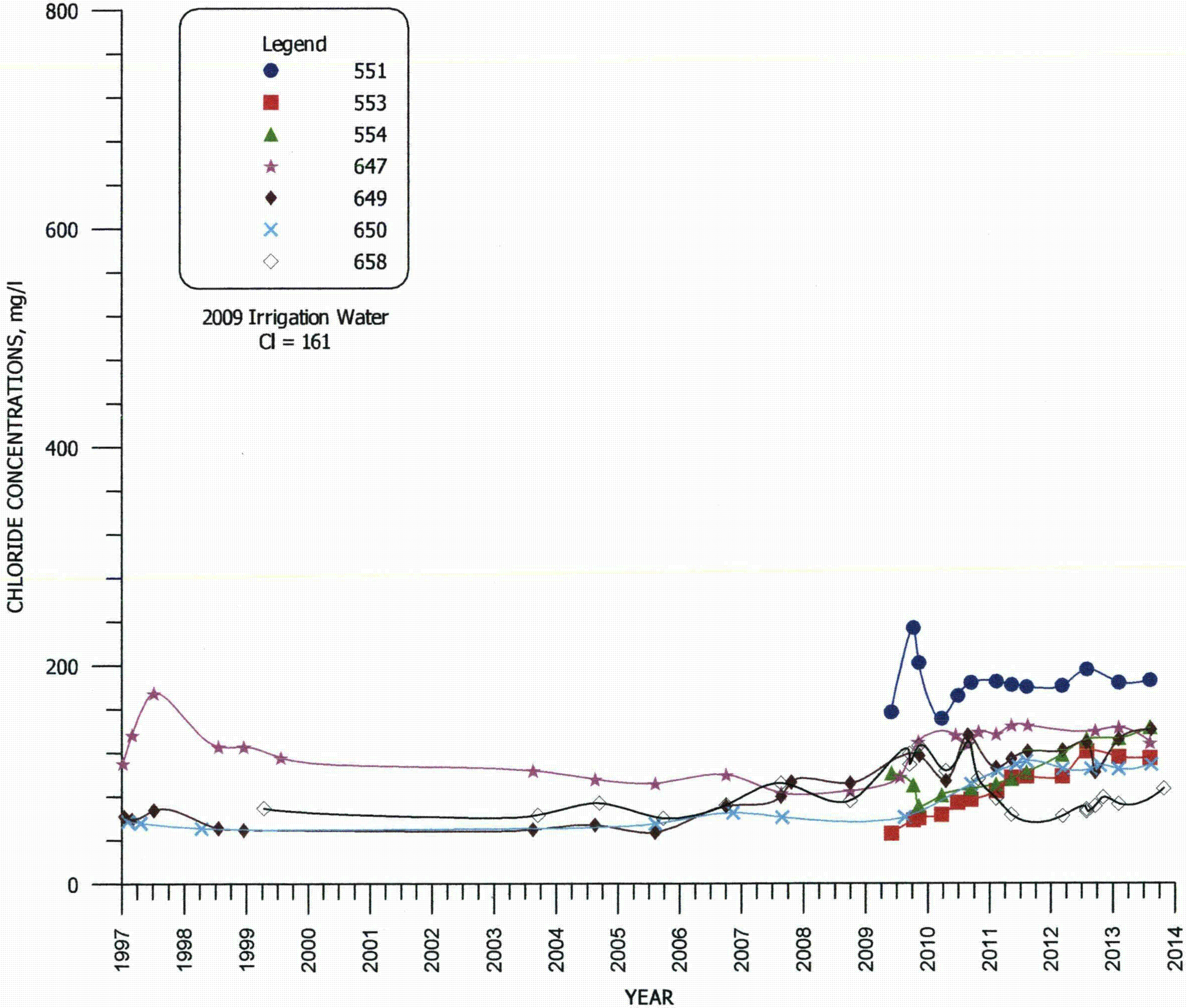
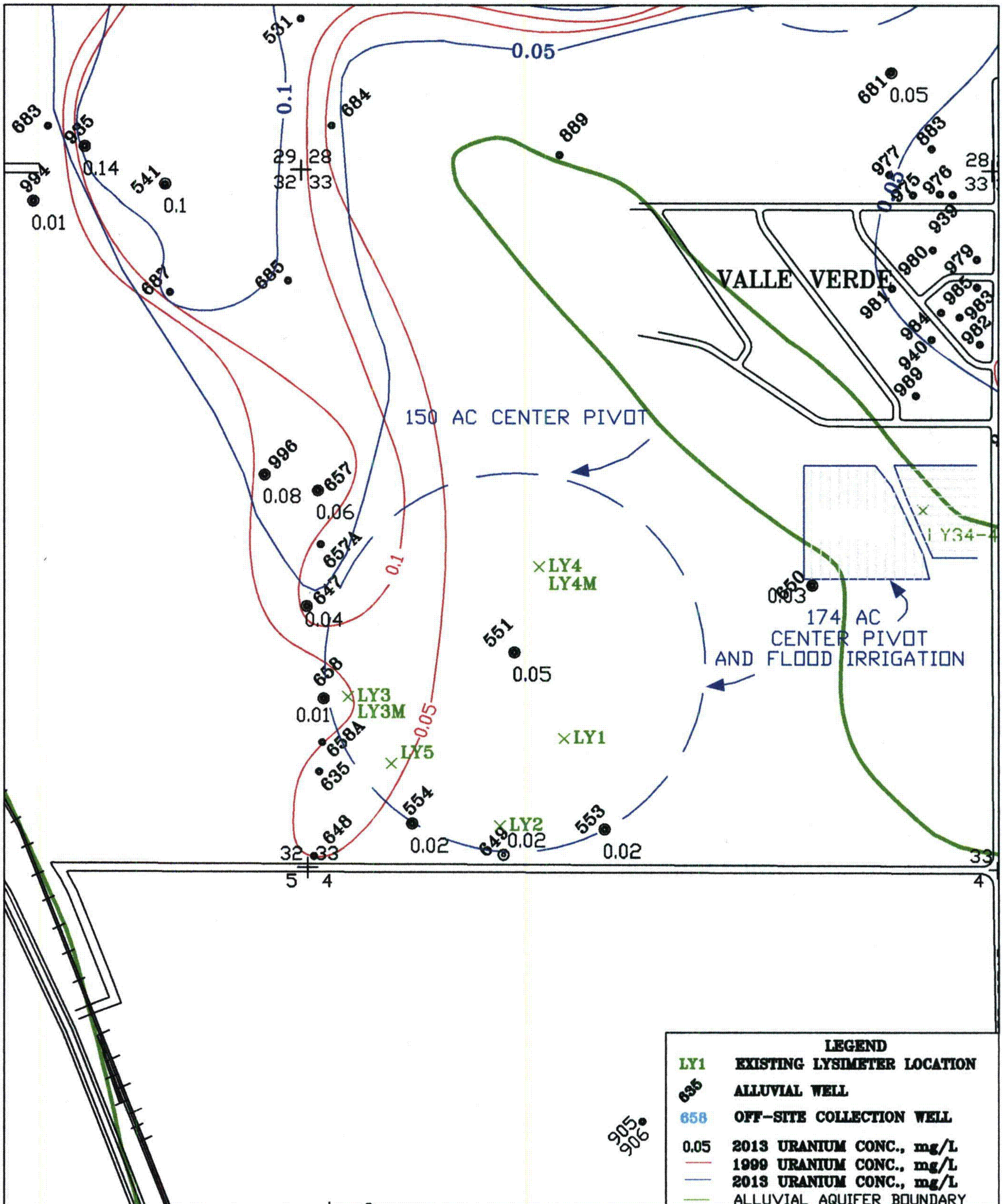


FIGURE 4-34. CHLORIDE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000'

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FIGURE 4-35. 1999 AND 2013 URANIUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

HOMESTAKE MINING COMPANY
GRANTS, NEW MEXICO

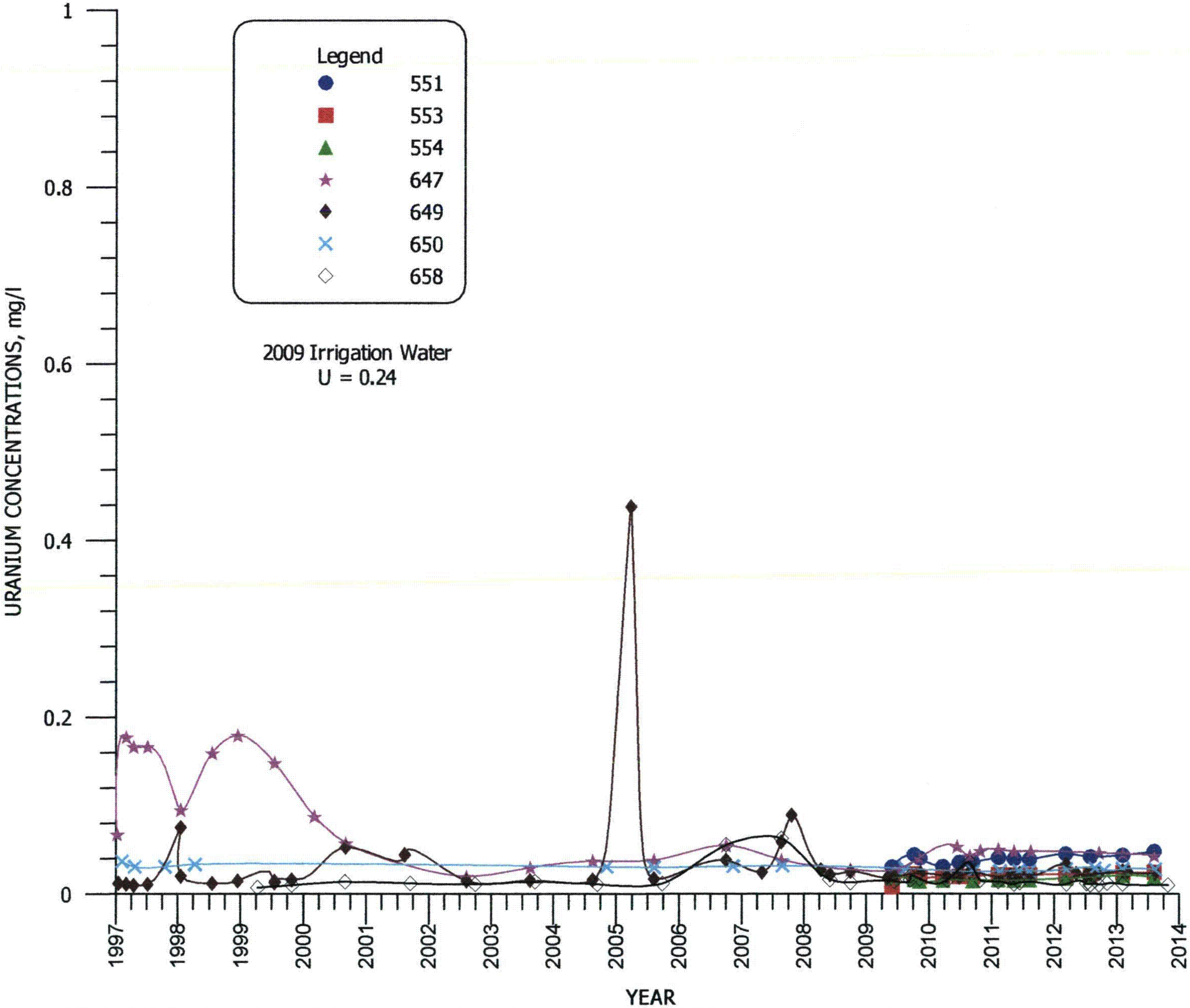
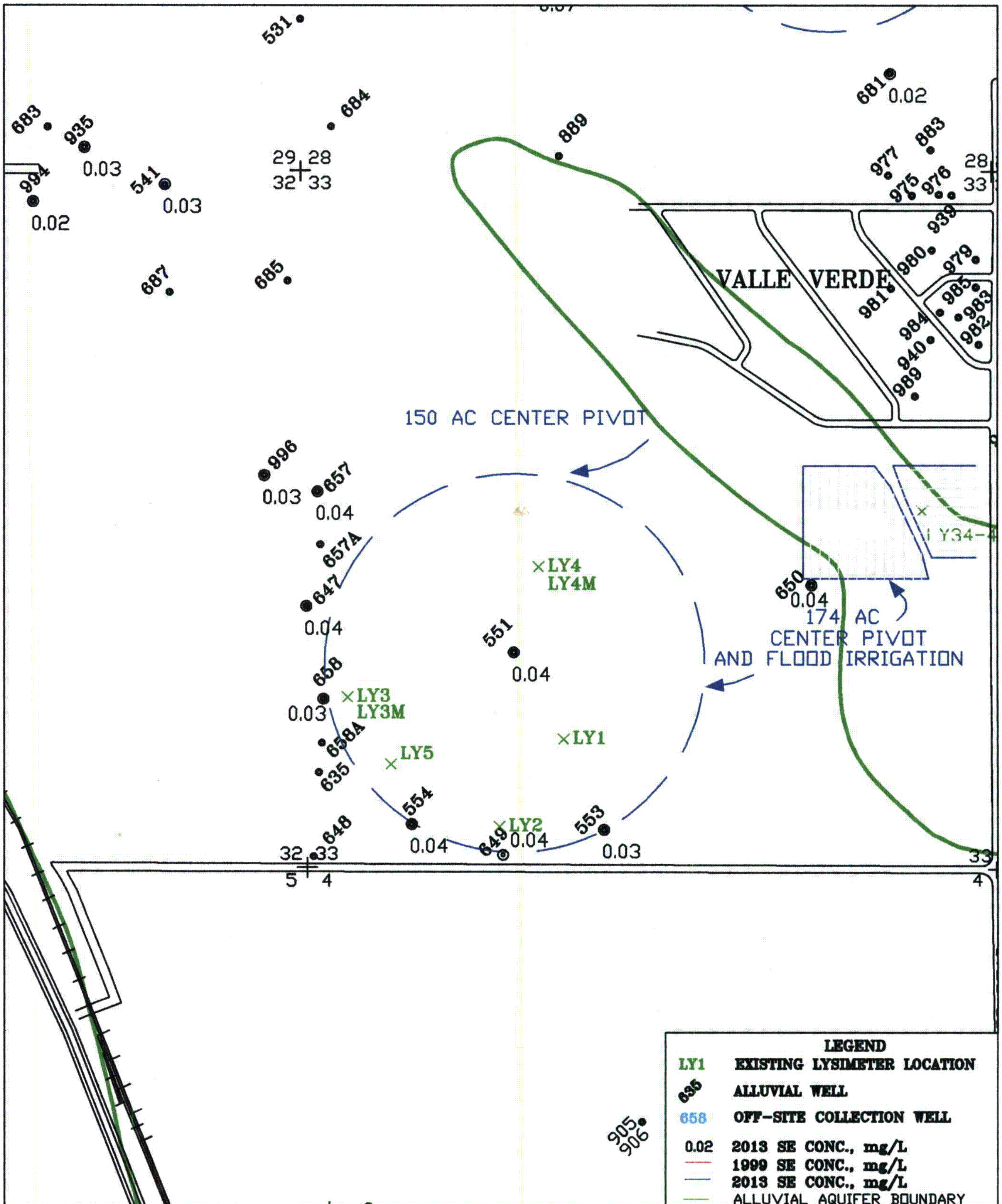


FIGURE 4-36. URANIUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.



SCALE: 1" = 1000' C:\PROJECTS\2014-06\1600QAL13 DATE: 3/13/14	**FIGURE 4-37. 2013 SELENIUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L**	HOMESTAKE MINING COMPANY GRANTS, NEW MEXICO

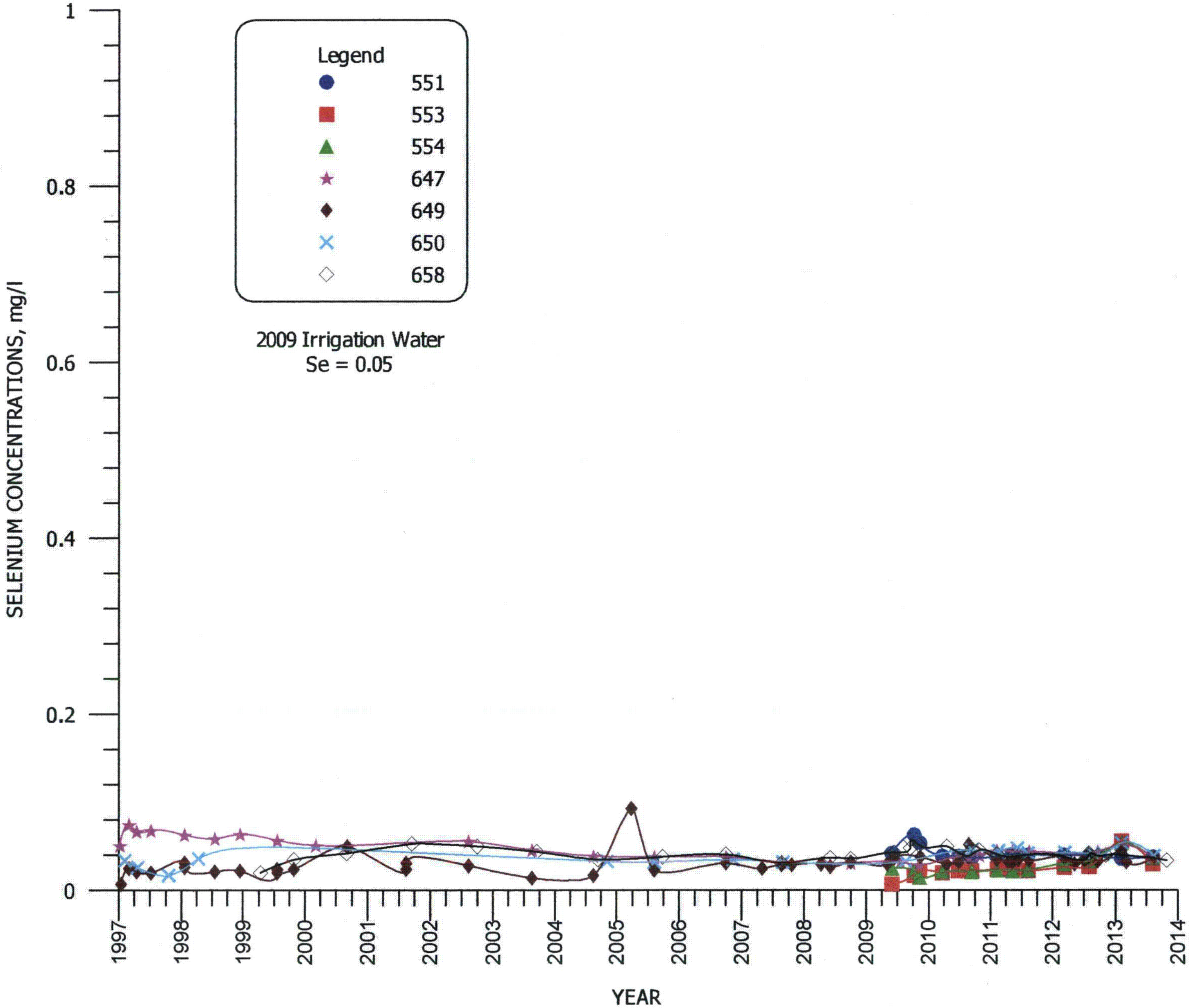


FIGURE 4-38. SELENIUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.

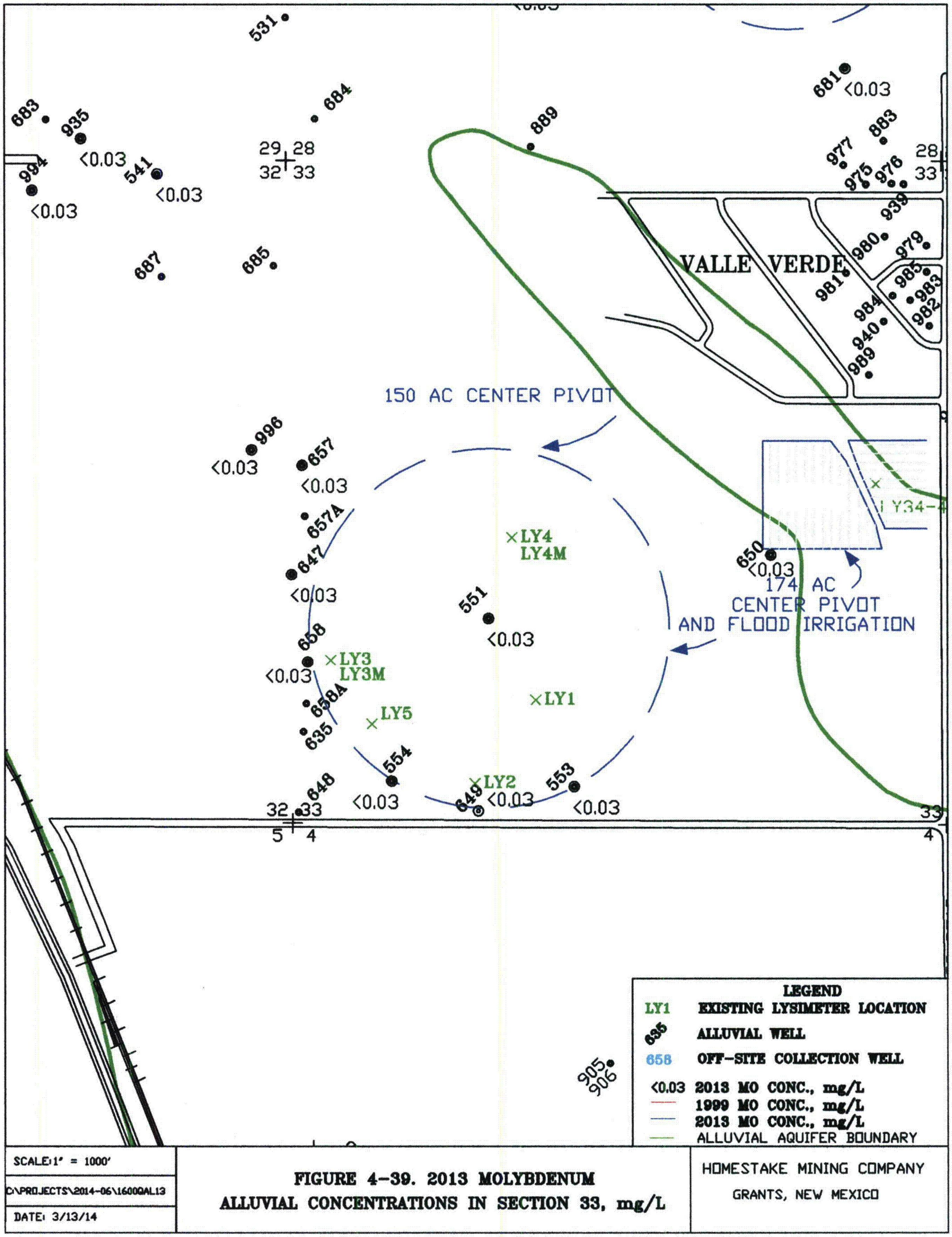


FIGURE 4-39. 2013 MOLYBDENUM ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

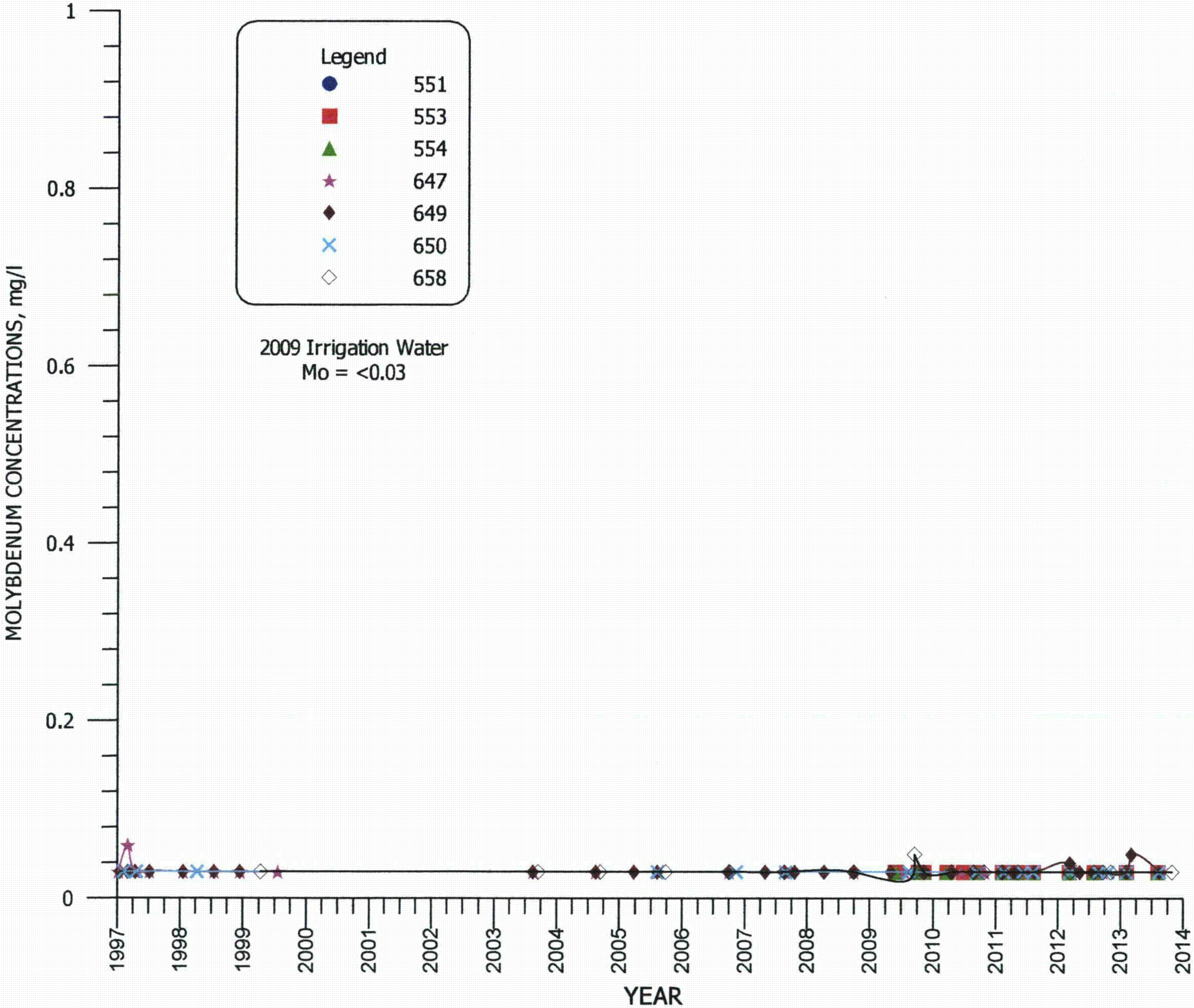


FIGURE 4-40. MOLYBDENUM CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.

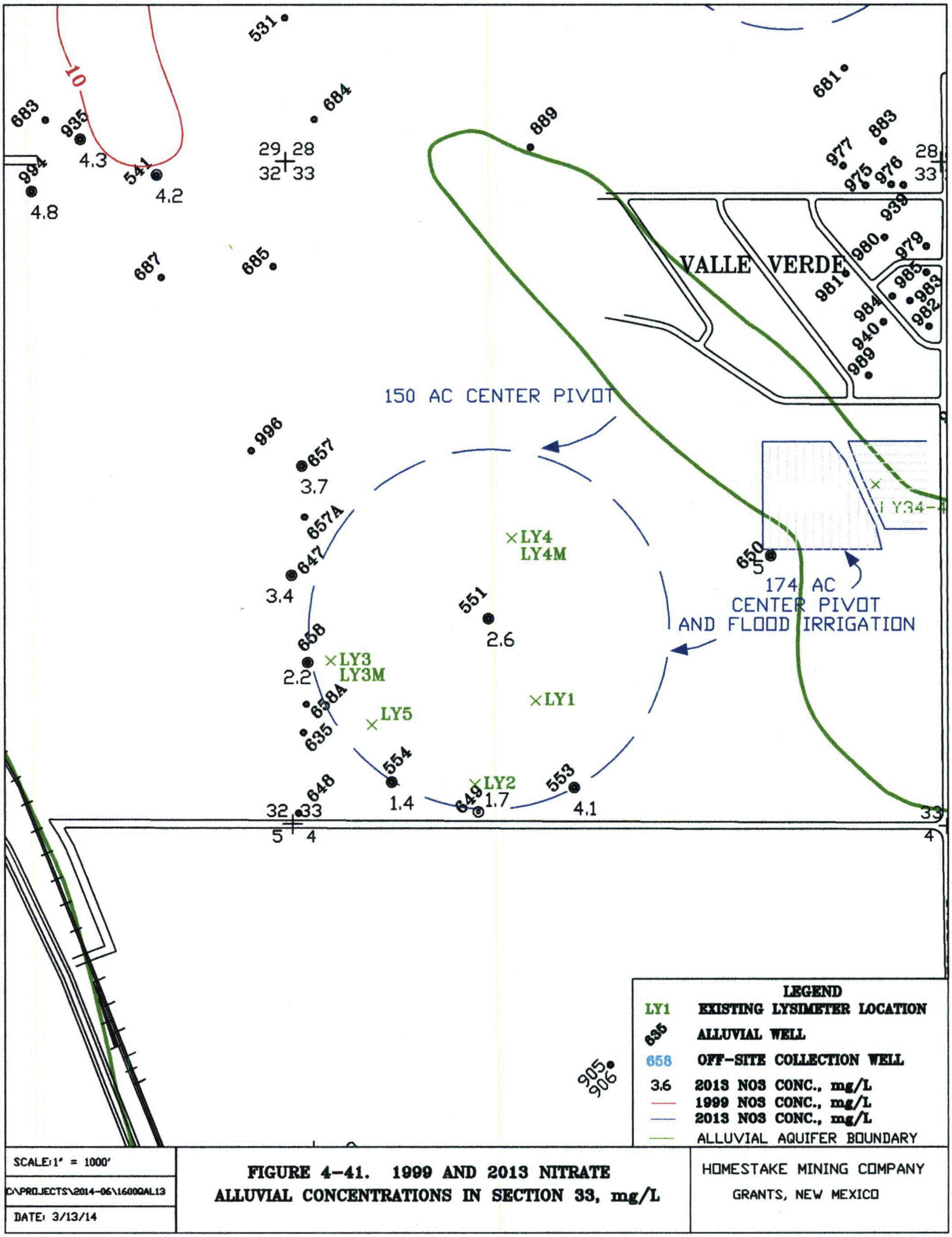


FIGURE 4-41. 1999 AND 2013 NITRATE ALLUVIAL CONCENTRATIONS IN SECTION 33, mg/L

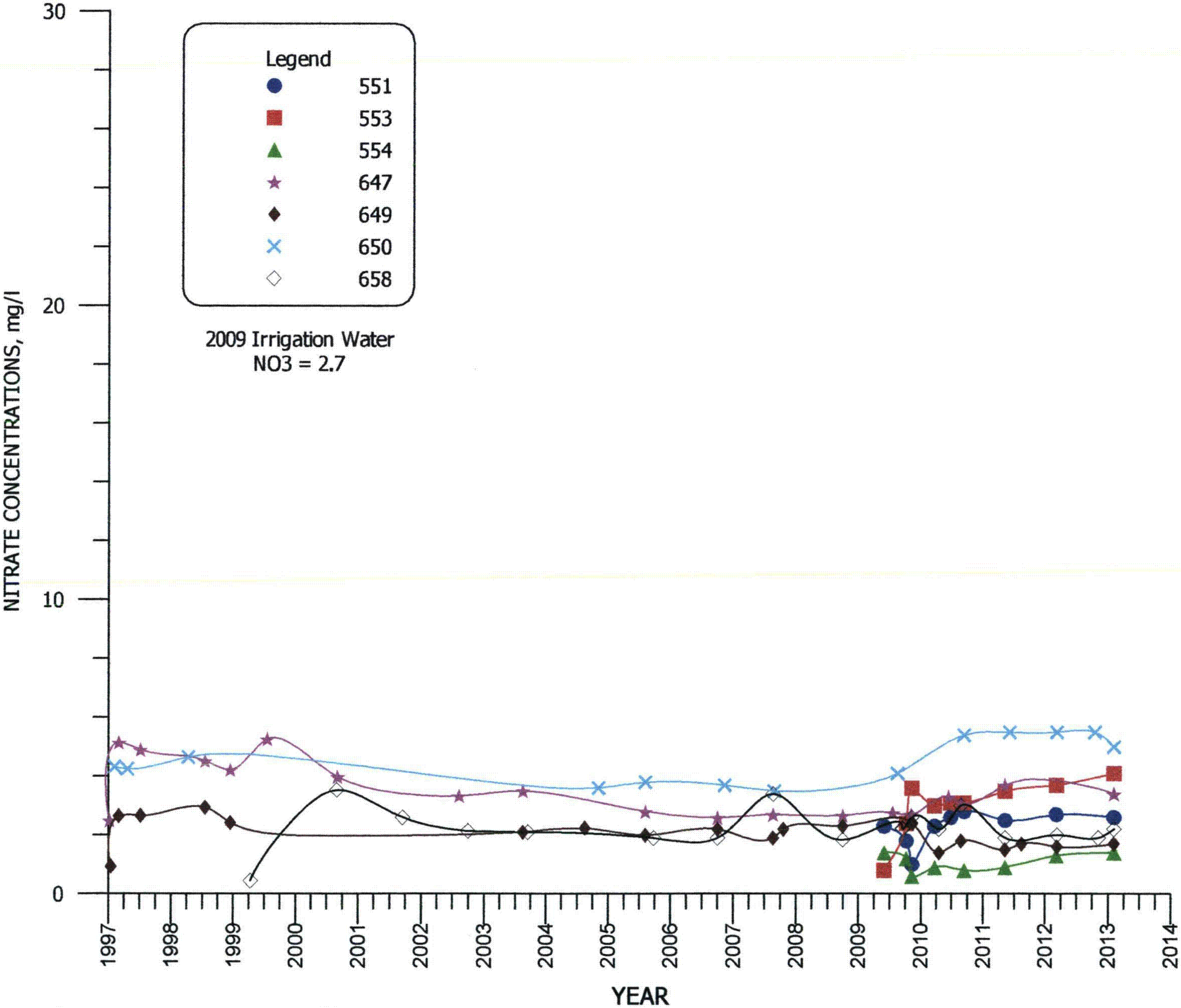


FIGURE 4-42. NITRATE CONCENTRATIONS FOR WELLS 551, 553, 554, 647, 649, 650 AND 658.

5.0 Predicted Ground-Water Concentrations

Predicted ground-water concentrations due to the irrigation restoration may be obtained by analysis of the mixing of the restored ground-water concentrations in the area with observed soil moisture concentrations and long-term recharge estimates. These mixing calculations were made for each of the two proposed future irrigation areas to estimate the potential change in the ground water quality. The measured lysimeter soil moisture concentrations are thought to be the best predictor of the average concentrations that could migrate in the soil moisture to the ground water from the irrigation. These measured concentrations are multiplied by the estimate of average recharge to obtain an estimate of the long-term mass constituent flux from irrigation. The average recharge rate is estimated by the long-term flux of soil moisture beyond the root zone under anticipated long-term soil and vegetation conditions. These calculations should yield an estimate of the potential long-term effect on the ground water from the irrigation when the soil moisture mixes with the restored ground water.

The restored ground-water concentrations are based on the restored concentrations to the east of the Section 34 flood area and the northern portion of the Section 28 pivot. The Section 28 restored area is smaller due to the larger concentrations that still exist in Section 28. The expected restored TDS concentration (see alluvial TDS map in Annual Performance Report) in Section 34 and Section 28 irrigation areas is 1800 mg/l, which is less than the mean San Mateo alluvial background TDS concentration of 1923 mg/l. The expected sulfate restored concentrations in Section 34 and Section 28 are 800 and 600 mg/l, respectively. The sulfate concentrations in these two restored areas should be less than the mean San Mateo alluvial background concentration of 1091 mg/l. Restored chloride concentrations in the Section 34 and Section 28 irrigation areas are expected to be 170 and 150 mg/l, respectively (see alluvial chloride concentration map in the Annual Performance Report). The uranium concentration map in the Annual Performance Report was used to estimate the restored uranium concentration for Sections 34 and 28 irrigation areas of 0.08 and 0.1 mg/l, respectively. A slightly higher restored concentration is expected in Section 28 due to the higher concentrations that have existed in this area. Restored selenium concentrations of 0.05 and 0.04 mg/l are expected for the Section 34 and Section 28 irrigation areas, respectively, based on the restored values near these areas. The restored molybdenum concentration in the Sections 28 and 34 irrigations areas is expected to be near 0.03 mg/l while the restored nitrate concentration is expected to be 7 mg/l.

The average long-term recharge rate for the irrigation areas is estimated from available water balance and recharge studies conducted by the USGS and other researchers. When the irrigation is discontinued, the irrigated areas in Section 34 and 28 will revert to a more natural vegetation type, cover and density that reflect the arid to semiarid climate at the site. There are no channels or streambeds in the irrigation area so the recharge will result only when precipitation exceeds evaporation and evapotranspiration. With an average annual precipitation of approximately 10.4 inches and typical annual lake evaporation of over 54 inches, evaporation and consumptive use by vegetation is expected to consume all but a very small fraction of the precipitation.

Estimated recharge in the southwestern United States was evaluated and reported by Stonestrom et al. (2007), in USGS Professional Paper 1703 (PP-1703). PP-1703 presented a compilation of several recharge studies for the southwestern U.S. and provided some regional estimates of potential ground-water recharge in terms of an excess water calculation. This excess water calculation was the sum of the average monthly precipitation above the corresponding monthly potential evapotranspiration. For the irrigation areas, the excess water is expected to be less than 10 mm/year. A study of the Abo Arroyo area of New Mexico reported in PP-1703 indicated that infiltration through streambeds was a large contributor to recharge while ground-water recharge in terrace areas was negligible.

A study and simulation of recharge was also conducted by Kearns and Hendrickx (1998). The simulation utilized an extensive precipitation record and a variety of soil types. The general findings of the study were that recharge was negligible for clay soils and ranged up to 1.57% of annual precipitation for vegetated sandy soil. This study also evaluated recharge for a barren soil surface with an attendant increase in recharge to 4.83% of annual precipitation for a sandy soil. However, vegetation will be present on the irrigation areas after the irrigation is terminated, so simulations that assume that no vegetation is present are a worst-case bounding estimate of recharge.

The results of the recharge studies lead to a moderately conservative estimated annual recharge rate of 2% of the average annual precipitation of 10.4 inches (265 mm). This equates to approximately 0.21 inches (5 mm) of annual recharge. As an additional measure of conservatism, an annual recharge rate of 0.35 inches (9 mm) or 3.3% of annual precipitation was considered in calculations of long-term recharge in the irrigation areas. The LEACHP simulations of the irrigation areas resulted in a similar estimate (approximately 9 mm) of recharge with the assumptions of relatively limited water consumption by vegetation.

5.1 Section 34

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. The upper ten feet of the ground-water flow would be approximately one-third of this rate or 12.5 gpm. A typical TDS concentration for the restored alluvial aquifer in the flood irrigation area is estimated at 1,800 mg/l. Sampling of the Section 34 lysimeters indicates an average TDS soil moisture concentration of 5,000 mg/l. The mixing of this ground water with the long-term conservatively high recharge rate of 9 mm/year at a TDS concentration of 5,000 mg/l in this soil moisture would result in an increase of TDS in the upper ten feet of ground water to 2,279 mg/l. Table C-3 in Appendix C gives the mixing calculations for the Section 34 area. This small increase in TDS is not expected to occur for many decades due to the very slow rate of movement of the soil moisture. As the ground water moves down gradient of the irrigation area, the soil moisture will mix with the entire saturated thickness which will result in an average concentration of 1,977 mg/l. This small increase above 1,800 mg/l will be difficult to detect considering the natural variations that exist in the alluvial aquifer. Both of these estimates are below the alluvial background concentration in the San Mateo alluvium of 2,734 mg/l.

The ground-water flow through the flood irrigation area in the alluvial aquifer as presented in the previous discussion is 37.5 gpm for the full aquifer thickness and 12.5 gpm for the upper ten feet of the aquifer. An average restored sulfate concentration in the flood irrigation area is estimated at 800 mg/l. The mixing of this ground water with the long term recharge rate of 9 mm/year at a sulfate concentration of 2,500 mg/l in this soil moisture would result in an increase of sulfate concentration in the ground water to 1,054 mg/l in the upper ten feet in the irrigation area and 894 mg/l down gradient of the irrigation area as it is mixed with the entire alluvial aquifer. This small increase in sulfate would be very difficult to detect and is not expected to occur for several decades based on the soil moisture predictions of sulfate movement. These predicted ground-water sulfate concentrations are below the San Mateo alluvial background concentration of 1,500 mg/l.

The mixture of the chloride soil moisture concentrations from the irrigation with the alluvial ground water in the Section 34 Flood irrigation area results in an alluvial chloride concentration of 234 mg/l in the upper ten feet and a value of 194 mg/l after the soil moisture completely mixes with the alluvial ground water. The measured chloride concentration of 600 mg/l from the Section 34 lysimeters was used with an alluvial restored chloride concentration of 170 mg/l for these calculations (see Table C-3 of Appendix C presents the chloride mixing concentrations for Section 34 Flood area). These mixing calculations indicate that the chloride concentration will remain below the site standard of 250 mg/l for the San Mateo alluvial ground water.

The potential minimal long-term effects of drainage of water can be estimated based on the average recharge rate of 9 mm/year and a ground-water flow of 12.5 gpm in the upper ten feet and full aquifer thickness flow of 37.5 gpm. The average uranium concentration in the restored ground water in the flood area is expected to be 0.08 mg/l. Sampling of the Section 34 lysimeters indicates an average uranium concentration of 0.4 mg/l in the soil moisture and this was used as the concentration reporting to the water table to evaluate potential effect on the ground water. The mixing of the ground-water flow rates of 12.5 and 37.5 gpm with the long-term recharge flux of 2.2 gpm results in a conservative estimate of uranium concentrations of 0.13 and 0.10 mg/l respectively for the mixing with the upper ten feet and the full aquifer thickness mixing. These calculations show that, even if the uranium made it to the water table, only a very small increase would occur in the uranium concentration in the ground water and the predicted concentrations would remain below the San Mateo alluvial background concentration of 0.16 mg/l.

An estimate of impacts of selenium on the ground water are made assuming that the selenium concentration of 0.1 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 12.5 and 2.2 gpm, respectively, with an average restored ground water selenium concentration of 0.05 mg/l and a soil moisture selenium concentration of 0.1 mg/l, produces a mixed concentration of 0.057 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial background concentration of 0.32 mg/l.

An estimate of impacts of molybdenum on the ground water are made assuming that the molybdenum concentration of 0.1 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 12.5 and 2.2 gpm, respectively, with an average restored ground water molybdenum concentration of 0.03 mg/l and a soil moisture molybdenum concentration of 0.1 mg/l, produces a mixed concentration of 0.04 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial site standard of 0.1 mg/l.

An estimate of impacts of nitrate on the ground water are made assuming that the nitrate concentration of 15 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 12.5 and 2.2 gpm, respectively, with an average restored ground water nitrate concentration of 7 mg/l and a soil moisture nitrate concentration of 15 mg/l, produces a mixed concentration of 8.2 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial background concentration of 12 mg/l.

5.2 Section 28

The ground-water flow through the Section 28 Pivot area in the alluvial aquifer is estimated to be at a rate of 206 gpm based on a transmissivity of 30,000 gal/day/ft, a width of 2,360 ft and a gradient of 0.0042 ft/ft. The upper ten feet of the ground-water flow would be approximately one-half of this rate or 103 gpm. A typical TDS concentration for the restored alluvial aquifer in the Section 28 irrigation area is estimated at 1,800 mg/l. Sampling of the Section 28 lysimeters indicates an average TDS soil moisture concentration of 6,000 mg/l. The mixing of this ground water with the long-term conservatively high recharge rate of 9 mm/year at a TDS concentration of 6,000 mg/l in this soil moisture would result in an increase of TDS in the upper ten feet of ground water to 1,873 mg/l. Table C-4 in Appendix C gives the mixing calculations for the Section 28 area. This small increase in TDS is expected to have already occurred through the sandy soils in Section 28 due to the faster rate of movement of the soil moisture. As the ground water moves down gradient of the irrigation area, the soil moisture will mix with the entire saturated thickness which will result in an average concentration of 1,837 mg/l. This small increase above 1,800 mg/l will be difficult to detect considering the natural variations that exist in the alluvial aquifer in Section 28. Both of these estimates are below the alluvial background concentration in the San Mateo alluvium of 2,734 mg/l.

An average restored sulfate concentration in the flood irrigation area is estimated at 600 mg/l. The mixing of this ground water with the long term recharge rate of 9 mm/year at a sulfate concentration of 3,000 mg/l in this soil moisture would result in an increase of sulfate concentration in the ground water to 642 mg/l in the upper ten feet in the irrigation area and 621 mg/l down gradient of the irrigation area as it is mixed with the entire alluvial aquifer. This small increase in sulfate would be very difficult to detect and is already exist based on the soil moisture predictions of sulfate movement. These predicted ground-water sulfate concentrations are below the San Mateo alluvial background concentration of 1,500 mg/l.

The mixture of the chloride soil moisture concentrations from the irrigation with the alluvial ground water in the Section 28 irrigation area results in an alluvial chloride concentration of 158 mg/l in the upper ten feet and a value of 154 mg/l after the soil moisture completely mixes with the alluvial ground water. The measured chloride concentration of 600 mg/l from the Section 28 lysimeters was used with an alluvial restored chloride concentration of 150 mg/l for these calculations (see Table C-4 of Appendix C presents the chloride mixing concentrations for Section 28 area). These mixing calculations indicate that the chloride concentration will remain below the site standard of 250 mg/l for the San Mateo alluvial ground water.

The potential minimal long-term effects of drainage of water can be estimated based on the average recharge rate of 9 mm/year and a ground-water flow of 103 gpm in the upper ten feet and full aquifer thickness flow of 206 gpm. The average uranium concentration in the restored ground water in the Section 28 area is expected to be 0.10 mg/l. Sampling of the Section 28 lysimeters indicates an average uranium concentration of 0.6 mg/l in the soil moisture and this was used as the concentration reporting to the water table to evaluate potential effect on the ground water. The mixing of the ground-water flow rates of 103 and 206 gpm with the long-term recharge flux of 1.83 gpm results in a conservative estimate of uranium concentrations of 0.11 and 0.10 mg/l respectively for the mixing with the upper ten feet and the full aquifer thickness mixing. These calculations show that, even if the uranium makes it to the water table, only a very small increase would occur in the uranium concentration in the ground water and the predicted concentrations would remain below the San Mateo alluvial background concentration of 0.16 mg/l.

An estimate of impacts of selenium on the ground water are made assuming that the selenium concentration of 0.1 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 103 and 1.83 gpm, respectively, with an average restored ground water selenium concentration of 0.05 mg/l and a soil moisture selenium concentration of 0.1 mg/l, produces a mixed concentration of 0.057 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial background concentration of 0.32 mg/l.

An estimate of impacts of molybdenum on the ground water are made assuming that the molybdenum concentration of 0.1 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 103 and 1.83 gpm, respectively, with an average restored ground water molybdenum concentration of 0.03 mg/l and a soil moisture molybdenum concentration of 0.1 mg/l, produces a mixed concentration of 0.03 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial site standard 0.1 mg/l.

An estimate of impacts of nitrate on the ground water are made assuming that the nitrate concentration of 30 mg/l (based on the lysimeter data) makes it to the water table with the long-term recharge soil moisture flux. The mixing of the previously discussed ground water and long-term recharge rates of 103 and 1.83 gpm, respectively, with an average restored ground water nitrate concentration of 7 mg/l and a soil moisture nitrate concentration of 30 mg/l, produces a mixed concentration of 7.4 mg/l for the upper ten feet of ground water. A smaller concentration would be expected as this water moves down gradient of the irrigation area and fully mixes through the aquifer. This small increase in concentration would not be detectable in the ground water and is below the San Mateo alluvial background concentration of 12 mg/l.

5.3 Section 33

No future irrigation is proposed for the Section 33 Pivot area. Therefore no mixing calculations of soil moisture flux and the ground water were made. Future ground-water monitoring will be the most important information developed on the affects from the Section 33 Pivot irrigation.

5.4 Section 33 Flood

Future irrigation is also not proposed for the Section 33 Flood area. Therefore no mixing calculations of ground water and soil moisture were made. Ground-water monitoring in Section 33 will be important to define if any affects from the limited Section 33 Flood irrigation occur.

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. Section 28 was planted in sorghum/sudan and permanent grass in 2011 and was baled at the end of the growing season. Only Section 34 was grazed with cattle to limit the damage to new permanent pasture grass. No baling of the vegetation was done in 2012 after the limited irrigation and was only used for grazing. No vegetation samples were collected in 2012. Due to the lack of irrigation, no hay was baled in 2013 and no vegetation samples were collected.

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 if grazing occurred during the year. The samples are collected from a distribution similar to the soil sample site distribution. The vegetation samples were analyzed by an offsite vendor laboratory. No vegetation samples were analyzed in 2012 or 2013.

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 and 2011. 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 and 2011 average uranium and selenium concentrations were less than most prior values. 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 values from the permanent grass sampled in 2010 and 2011 were less than the hay values of previous years. A smaller Section 33 vegetation selenium concentration was measured in 2011. 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	----	----
2011	0.20	----	----	0.83	----	----	----	0.66	----	----
2012	----	----	----	----	----	----	----	----	----	----
2013	----	----	----	----	----	----	----	----	----	----
	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	----	----
2011	<0.5	----	----	<0.5	----	----	----	<0.5	----	----
2012	----	----	----	----	----	----	----	----	----	----
2013	----	----	----	----	----	----	----	----	----	----

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 2011. No trends are apparent for uranium or selenium during 2003 to 2011 except generally some decline in the last couple of years. 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 2011 vegetation cuttings ranged from 0.20 to 0.83 mg/kg.

In 2011, the average selenium concentrations in vegetation were less than 0.50 mg/kg. 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
2011	1.2	3.06	0.75	0.2	0.83	0.66
				Average:	0.81	

The calculated uranium transfer coefficients have a mean of 0.66 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
2011	0.17	0.27	0.88
	Mean	0.66	
	SDV	0.52	

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 except 2010, 2012, and 2013 when the irrigated areas were only grazed. 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, 2012, and 2013 and therefore no hay was produced. Only the sorghum/sudan grass in Section 28 was baled in 2011.

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
2011	#52
2012	0
2013	0

Table 6-4. Homestake Irrigation Hay Production and Fertilization (continued)

FERTILIZER APPLIED TO IRRIGATED FIELDS

IRRIGATED AREA	APPLICATION DATE	FERTILIZER TYPE (N-P-K)	FERTILIZER 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 grazed.
#= Only the sorghum/sudan grass was baled in Section 28 in 2011

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 groundwater extracted from a contaminated aquifer, as part of a groundwater 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 2011 (Table 6-2 average concentration 0.81 mg/kg = 548 pCi/kg). The uranim concentration in hay was not measured in 2012 or 2013. Consequently the average uranium concentration from 2000 through 2011 was used in this evaluation. 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 report and therefore over estimates the potential impact to humans from the groundwater restoration activities.

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:

C_{bi}	=	Uranium concentration in beef (pCi/kg)
Q	=	assumed feed ingestion rate, 27kg(wet weight)/d, NUREG/CR-5512

F_{bi} = Transfer coefficient from vegetation to livestock, 2.0E-4 kg^{-1}, 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) = 548 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

Using the above equation, the estimated uranium concentration in beef is 1.5 pCi/kg.

7.1.2 Beef to Human Uptake

The human ingestion of uranium 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 of uranium (pCi/y)

U_{bk} = ingestion rate of beef for an adult (58.4 kg/y)
C_{bi} = concentration in meat (1.5 pCi/kg)

Based on this equation, the estimated annual intake rate of uranium from beef grazing on irrigated fields (I_i) is 88 pCi/y.

The CEDE from uranium due to ingestion is calculated from the following equation:

$$D_{(ing)} = I_i DCF_{(ing)} * 1x10^{-6}$$

Where:

$D_{(ing)}$ = CEDE from ingestion, millirem per year (mrem/y)

= (250mrem/ μCi, derived from 10 CFR 20 Appendix B)

1×10^{-6} = factor to convert pCitoμCi

Using this equations, the estimated CEDE from ingesting uranium in beef is 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 partially fed by 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 0.66) is approximately 40 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.

No known limit for uranium in animal feed exists. Animals have been grazing on or near uranium mining and processing facilities for many decades without any observed adverse effects. Therefore studies have not been conducted on which to base an animal feed standard for uranium. 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 2012 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 2.67 mg/kg, or 1.81 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 potential 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 highest concentration of natural uranium in samples collected from the 0-1 foot interval in treated areas (in this case, Section 34) was 4.67 mg/kg. The net concentration of natural uranium at 0-1 foot was 2.67 mg/kg, or 1.81(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 0.89 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:

$$\left[{}^{226}Ra\right]_{soil} = I_{Ra} x \, {}^{1}\!/_{\rho_{soil}} \, x \, {}^{1}\!/_{0.4} \, x 1 x 10^{-3} \; \textit{(Equation 1)}$$

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

Sections 28 and 34 were irrigated in 2012. The irrigation rate in Section 28 and 34 was 1.6 feet/yr (0.49 meters/yr) and 1.2 feet/yr (0.37 meters/yr) as shown in Table 3-7. The highest irrigation rate (0.49 meters/yr) was selected as well as 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 increase 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 radium-226 from the decay of thorium-230 via the water-dependent pathways (e.g. plant and meat consumption) and direct exposure.

The predicted dose rate for the first few hundred years is approximately 0.4 millirem per year for thirty years with a maximum of 5.0 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 0.4 mrem/year received by the resident farmer in the first thirty years of exposure is comparable to estimates of the average radiation dose to the public from cooking with natural gas.

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 (HMC, 2010). The results of the risk analysis concluded that risk to existing residents from potential exposure to radon released from irrigation activities was 1.1×10^{-10}, or at negligible levels. The potential radon concentrations have not changed over the years. Thus parameters for calendar year 2012 are similar to the 2009 parameters and the conclusion of negligible risk in 2012 is supported. Another detailed risk evaluation for 2012 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. High spring winds in the area are known to create periods of dusty conditions, which may occur for several days during the months of March, April, and May. Given the measured natural uranium concentration in surface soil of 1.81 pCi/g in surface soils in the irrigation area, these soils if suspended in the air as dust would give rise to an additional radiation dose equal to 1.0 mrem/year for each mg/m^3 of dust in the air, assuming continuous exposure (10 CFR 20 Appendix B, Table 2).

In the 2010 Irrigation Report (HMC, 2011), it was conservatively estimated using site specific meteorological data collected for the 2009-2010 period that significant airborne dust from the site would be generated 4.25 percent of the year.

In order to protect workers from lung diseases such as silicosis, OSHA doesn't allow unprotected workers in areas where the average dust concentration exceeds 15 mg/m^3. At these levels, the dust is visible and certainly high enough that a person would not choose to live in the area if the levels persisted for a large portion of the year. If we assume that for 4.25 percent of the year the dust concentration arising from the previously irrigated fields is 15 mg/m^3, the average annual dust concentration would be approximately 0.64 mg/m^3. Exposures to these levels of dust containing uranium concentrations equivalent to those currently measured in surface soils at the irrigation fields would result in an additional radiation dose of 0.64mrem per year (0.64 mg/m^3 x 1.0 mrem/y /1 mg/m^3). This additional radiation dose is insignificant compared to the more than 600 mrem/y that the average U.S. resident receives from medical, man-made, and background sources.

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. The recent selenium vegetation concentrations are less than one half of the previous values.

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

1. No ground water impacts should result 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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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	8.48	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	68.60	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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Appendix B

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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.

Soil Textures

Texture	% 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 Modeling Discussion,
LeachP Model Input and Results
And
Soil Moisture and Ground-Water
Mixing Calculation Sheets

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C.1 LEACHP Modeling Discussion

The partially saturated numerical model LEACHP model was used to predict the movement of constituents in soil moisture below the irrigation areas with time. The LEACHP model was also used to predict future soil moisture concentrations of constituents of concern for the Section 28 pivot and Section 34 flood irrigated areas.

An irrigation application depth of 2.5 feet/year is planned for the Section 34 and Section 28 irrigation areas from 2013 and 2014. Irrigation was not done in 2013 and likely will not be used in 2014, but may be used for two years in the future. The 2013 and 2014 irrigation application in the modeling should adequately account for two years of future irrigation. Actual applied irrigation depths were used in the modeling prior to 2013. The simulations were conducted from year 2000 to 2100 in two sequential runs. The irrigations were applied in the precipitation records input for the LEACHP model. Eight irrigation events were used for the Section 34 irrigation modeling and 12 irrigation events were used in simulating the sprinkler irrigation in Section 28. The precipitation inputs also included 15 precipitation events each year distributed according to the monthly average precipitation for the typical annual precipitation of 10.4 inches.

Vegetation was assumed to be present with the density and expected consumptive water use by vegetation proportional to the depth of applied irrigation waters. The potential evaporation is input on weekly basis and was estimated as 75% of the typical pan evaporation for the site. The total root zone for irrigation areas was assumed to be six feet with 92% of the root mass within the top three feet.

The vegetation density and expected water use pan factors were increased during periods of irrigation. After irrigation is ended, the vegetation was assumed to revert to a more natural condition with perennial vegetation at relatively low density and limited expected water use.

The baseline soil properties for the 35 foot depth simulated flood irrigation area (Section 34) are presented in Table C-1. The baseline soil properties for the 68 foot thick simulated profile in the Section 28 pivot irrigation are presented in Table C-2.

A summary of model results for the irrigation areas is presented in Tables C-1 and C-2. The predicted drainage or flux from the profile is presented as the interval drainage (mm) occurring over the one year interval. During periods of significant irrigation application prior to 2010, there was significant flux through the profile. After irrigation is ended, the flux through the profile gradually drops to a relatively small fraction of the total precipitation.

The LEACHP model simulates transport of up to four constituents through the profile. The irrigation application depths may vary due to the combination of restoration programs actually used. The mixing calculations are presented in Tables C-3 and C-4 and discussed in Section 5. The continuing use of the irrigation program after a selected alternative restoration program is implemented will aid in controlling the restoration zone on its downgradient side.

C.1.1 Section 34

A preliminary sensitivity analysis was performed for the Section 34 flood irrigation modeling. The baseline simulation reported in this appendix used a typical soil profile with permeability ranging from 40 to 160 mm/day (4.6E-05 to 1.85E-04 cm/sec). The vegetation density and potential evapotranspiration were established at moderate levels. The predicted long-term annual drainage rate with the baseline simulation is approximately 9 mm. A simulation was also conducted with a five-fold increase in soil profile permeability and an increased potential evapotranspiration rate. The predicted long-term annual drainage rate with increased permeability and evapotranspiration is approximately 3 mm. A third simulation was conducted with the baseline permeability reduced by a factor of two and an increased potential evoptranspiration. The predicted long-term annual drainage rate with decreased permeability and increased evapotranspiration is approximately 1 mm. The sensitivity simulations indicate the predicted long-term drainage rate is consistent with expectations and the rate for the baseline simulation may be conservatively large. The results of the baseline simulation are presented in tabular and graphical form in the remainder of this section.

Figure C-1 presents the model prediction for TDS concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture TDS concentrations are also shown on Figure C-1 for lysimeters LY34-1, LY34-2 and LY34-3 for 2011 and 2012. The measured TDS concentrations in lysimeters are slightly smaller than those predicted by LEACHP. Modeling of the Section 33 pivot and flood area was not done due to no additional planned irrigation in these two areas.

Figure C-2 presents the model prediction for sulfate concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture sulfate concentrations are also shown on Figure C-2 for lysimeters LY34-1, LY34-2 and LY34-3 for 2012 and 2013. The measured sulfate concentrations in lysimeters are slightly smaller than those predicted by LEACHP.

Figure C-3 presents the model prediction for chloride concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture chloride concentrations are also shown on Figure C-3 for lysimeters LY34-1, LY34-2 and LY34-3 for 2012 and 2013. With the exception of the LY34-2 sample for 2011, the measured chloride concentrations in lysimeters are slightly smaller than those predicted by LEACHP.

Figure C-4 presents the model prediction for uranium concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture uranium concentrations are also shown on Figure C-4 for lysimeters LY34-1, LY34-2 and LY34-3 for 2012 and 2013. The measured uranium concentrations in lysimeters are very similar to or slightly smaller than those predicted by LEACHP.

Figure C-5 presents the model prediction for selenium concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture selenium concentrations are also shown on Figure C-5 for lysimeters LY34-1, LY34-2 and LY34-3 for 2012 and 2013. The measured selenium concentrations in lysimeters are very similar to or slightly smaller than those predicted by LEACHP.

Figure C-6 presents the model prediction for molybdenum concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture molybdenum concentrations are also shown on Figure C-6 for lysimeters LY34-1, LY34-2 and LY34-3 for 2012 and 2013. The measured molybdenum concentrations in lysimeters are very similar to or slightly smaller than those predicted by LEACHP except for the LY34-2 results which are higher than the model predictions in 2012.

Figure C-7 presents the model prediction for nitrate concentrations in soil moisture for the Section 34 flood irrigation. The observed soil moisture nitrate concentrations are also shown on Figure C-7 for lysimeters LY34-1, LY34-2 and LY34-3 for 2010 and 2013. The measured nitrate concentrations in lysimeters are larger than those predicted by LEACHP.

The 2013 and 2014 simulations are essentially the same for each constituent showing that two years of additional irrigation will not change the concentrations moving through the soil profile. The Section 34 flood irrigation for two years should not change the soil moisture concentrations below the seven foot depth.

C.1.2 Section 28

Figure C-8 presents the model prediction for TDS concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture TDS concentrations are also shown on Figure C-8 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. The measured TDS concentrations in lysimeters are slightly smaller than those predicted by LEACHP. The 2012 lysimeter soil moisture concentrations fit the observed LEACHP TDS predictions very well except for the observed value in LY28-1 being too small.

Figure C-9 presents the model prediction for sulfate concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture sulfate concentrations are also shown on Figure C-9 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. The measured sulfate concentrations in lysimeters are slightly smaller or very similar to those predicted by LEACHP.

Figure C-10 presents the model prediction for chloride concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture chloride concentrations are also shown on Figure C-10 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. With the exception of the LY28-2M samples, the measured chloride concentrations in lysimeters are slightly smaller than those predicted by LEACHP.

Figure C-11 presents the model prediction for uranium concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture uranium concentrations are also shown on Figure C-11 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. All of the the measured uranium concentrations in lysimeters are smaller than or equal to those predicted by LEACHP.

Figure C-12 presents the model prediction for selenium concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture selenium concentrations are also shown on Figure C-12 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. With the exception of the LY28-2M sample for 2011 and 2012, the measured selenium concentrations in lysimeters are slightly smaller than those predicted by LEACHP.

Figure C-13 presents the model prediction for molybdenum concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture molybdenum concentrations are also shown on Figure C-13 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2012 and 2013. With the exception of the LY28-2M sample for 2011 and 2012, the measured molybdenum concentrations in lysimeters are smaller than those predicted by LEACHP.

Figure C-14 presents the model prediction for nitrate concentrations in soil moisture for the Section 28 center pivot irrigation. The observed soil moisture nitrate concentrations are also shown on Figure C-14 for lysimeters LY28-1, LY28-2, LY28-2M and LY28-3 for 2010 and 2013. The 2013 measured nitrate concentrations in lysimeters are generally higher than those predicted by LEACHP.

A small difference exists between the 2013 and 2014 predicted concentrations for the Section 28 area. These two predictions indicate that two years of additional irrigation will cause a small difference in the soil moisture concentrations in the upper portion of the soil profile

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

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evap (mm)	Plant Uptake (mm)
1999	3005.4	0	0	0	0
2000	3154.2	1160	6	246	760
2001	3154.5	1115	89	250	776
2002	3228.7	1196	95	254	774
2003	3242.2	1205	163	254	775
2004	3227.3	1184	172	252	776
2005	3207.6	1164	155	254	774
2006	3098.3	1051	138	245	777
2007	2863.2	563	58	135	605
2008	3010.7	1076	29	226	673
2009	2852	731	14	172	704
2010	2863.1	874	14	191	658
2011	2760.4	265	6	90	272
2012	2776.1	753	1	156	580
2013	2907.4	1025	-2	221	675
2014	2942.7	1021	-4	235	755
2015	2941.7	265	-2	181	88
2016	2946.2	265	4	165	91
2017	2947.9	265	8	164	91
2018	2949.1	265	9	164	91
2019	2950.4	265	10	163	91
2020	2948.1	265	10	167	91
2021	2947.8	265	10	165	91
2022	2947.8	265	10	164	91
2023	2948.1	265	10	164	91
2024	2949.3	265	10	163	91
2025	2951.2	265	10	162	91
2026	2953.2	265	10	162	91
2027	2951	265	10	167	91
2028	2951.3	265	10	164	91
2029	2951.5	265	10	163	91
2030	2952	265	10	163	91
2031	2948.4	265	10	168	91
2032	2947.8	265	10	164	91
2033	2947.9	265	10	164	91
2034	2948.2	265	10	164	91
2035	2949	265	10	163	91
2036	2950.8	265	10	162	91
2037	2953.2	265	10	162	91
2038	2951	265	9	167	91
2039	2950.7	265	10	164	91
2040	2951.3	265	10	163	91
2041	2952.1	265	10	163	91
2042	2948.6	265	10	168	91
2043	2947.2	265	10	165	91
2044	2947.3	265	10	164	91
2045	2947.3	265	10	164	91
2046	2948.4	265	10	163	91
2047	2950.2	265	9	163	91
2048	2952.7	265	9	162	91
2049	2950.3	265	9	167	91
2050	2951.5	265	10	174	80
2051	2946.1	264.9	10.2	171.8	88.4
2052	2943.4	264.9	10.3	166.2	91
2053	2940.9	265	10.4	165.9	91.1
2054	2939.7	264.9	10	165	91.2
2055	2939	264.9	9.5	165	91.1
2056	2939.4	264.9	8.9	164.3	91.2
2057	2936.5	264.9	8.7	168.2	91
2058	2936	264.9	8.6	165.7	91.1
2059	2935.8	265	8.7	165.3	91.2
2060	2940.9	264.9	8.6	159.9	91.4

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
2061	2940	264.9	8.3	166.6	91
2062	2941	264.9	8	164.2	91.1
2063	2943	264.9	8.4	164	91.2
2064	2945	264.9	8.5	162.9	91.3
2065	2947	264.9	8.6	162.9	91.3
2066	2950	264.9	8.7	162.5	91.3
2067	2952	265	8.8	162	91.4
2068	2951	264.9	9	166.3	91
2069	2951	264.9	9.5	164.4	91.2
2070	2952	264.9	9.8	163.1	91.2
2071	2952	264.9	9.9	163.4	91.3
2072	2949	264.9	9.8	167.6	90.9
2073	2947	264.9	9.9	165.4	91
2074	2947	264.9	10.1	163.9	91.3
2075	2947	264.9	9.8	163.7	91.2
2076	2948	264.9	9.4	163.4	91.3
2077	2949	264.9	9.3	163	91.2
2078	2952	264.9	9.2	162	91.4
2079	2949	264.9	9.1	167	91
2080	2949	264.9	9.4	164.7	91.2
2081	2950	264.9	9.8	163.2	91.3
2082	2951	264.9	9.8	162.9	91.3
2083	2952	264.8	9.6	162.7	91.3
2084	2950	264.9	9.5	166.7	91
2085	2949	264.9	9.6	164.7	91.2
2086	2949	264.8	9.9	163.9	91.3
2087	2945	264.9	9.8	168	90.9
2088	2944	264.9	9.8	165	91.1
2089	2944	264.9	9.8	164.9	91.1
2090	2943	264.8	9.5	164.4	91.2
2091	2945	264.9	9.3	163.5	91.2
2092	2942	264.9	8.9	168	91
2093	2941	264.9	8.9	165.2	91.1
2094	2942	264.8	9.2	164.4	91.1
2095	2942	264.9	9	164.1	91.2
2096	2943	264.9	8.9	163.6	91.1
2097	2940	264.9	8.7	168.4	91
2098	2940	264.8	8.8	165.2	91.1
2099	2942	264.9	9.1	175.4	78.7

Table C-2. LEACHP Section 28 Center Pivot Irrigation Inputs 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	2003.8	265	43	220	0
2001	2012.8	265	12	244	0
2002	2170.7	936	8	173	597
2003	2433.4	1049	7	182	597
2004	2834.9	1191	6	184	600
2005	2738.8	991	317	178	592
2006	2714.3	975	228	178	593
2007	2738.9	1003	204	180	594
2008	2838.8	1106	227	182	597
2009	2583.8	829	323	172	589
2010	2296.2	265	133	125	294
2011	2475.2	905	90	152	484
2012	2525.5	752	62	154	486
2013	2848.7	1027	59	158	488
2014	2899.6	1027	329	158	489
2015	2518.3	265	378	189	79
2016	2395.5	265	134	171	83
2017	2333.6	265	75	168	83
2018	2296.8	265	52	167	83
2019	2272.7	265	39	167	83
2020	2253	265	32	170	83
2021	2239.9	265	27	168	83
2022	2230.4	265	24	167	83
2023	2224	265	22	167	83
2024	2220.2	265	20	166	83
2025	2217.5	265	19	166	83
2026	2216.4	265	18	165	83
2027	2212.1	265	17	170	83
2028	2210.4	265	16	167	83
2029	2209.7	265	16	167	83
2030	2209.8	265	16	166	83
2031	2206.2	265	15	170	83
2032	2204.8	265	15	168	83
2033	2204.2	265	15	167	83
2034	2203.9	265	15	167	83
2035	2204.1	265	15	166	83
2036	2205.3	265	15	165	83
2037	2206.7	265	15	166	83
2038	2204.6	265	15	169	83
2039	2204.4	265	15	167	83
2040	2205.1	265	15	167	83
2041	2206.3	265	15	166	83
2042	2203.5	265	15	170	83
2043	2202.3	265	15	169	83
2044	2202.4	265	15	167	83
2045	2202.8	265	15	167	83
2046	2203.3	265	15	166	83
2047	2204.1	265	15	166	83
2048	2205.9	265	15	165	83
2049	2203.6	265	15	170	83
2050	2203.2	265	15	178	73
2051	2197.1	264.9	14.6	176.1	80.5
2052	2193.4	264.9	14.6	171.1	83
2053	2190.5	265	14.5	170.2	83
2054	2188.6	264.9	14.6	169	83.2
2055	2186.9	264.9	14.5	168.8	83.1
2056	2185.8	264.9	14.6	168.3	83.2
2057	2180.9	264.9	14.3	172.5	82.9
2058	2178.9	264.9	14	170	83
2059	2177.2	265	13.6	169.8	83.1
2060	2180.9	264.9	13.4	164.4	83.4

Elapsed Time Years	Profile Water (mm)	Interval Rain (mm)	Interval Drainage (mm)	Interval Evaporation (mm)	Plant Uptake (mm)
2061	2180	264.9	13.2	169.6	83.1
2062	2180	264.9	13	168.5	83.1
2063	2181	264.9	12.8	168	83.3
2064	2184	264.9	12.6	166.6	83.2
2065	2186	264.9	12.5	166.8	83.3
2066	2189	264.9	12.4	166.6	83.2
2067	2191	265	12.5	166.4	83.3
2068	2191	264.9	12.5	169.8	83.1
2069	2192	264.9	12.5	168.2	83.2
2070	2193	264.9	12.8	167.5	83.3
2071	2195	264.9	12.9	167	83.2
2072	2193	264.9	13.1	171	83
2073	2192	264.9	13.3	169.3	83.1
2074	2192	264.9	13.5	167.9	83.2
2075	2192	264.9	13.5	167.8	83.2
2076	2193	264.9	13.7	167.4	83.3
2077	2194	264.9	13.8	166.9	83.3
2078	2196	264.9	13.8	165.8	83.3
2079	2194	264.9	13.6	170.4	83.1
2080	2193	264.9	13.5	168.8	83.1
2081	2195	264.9	13.5	167.1	83.2
2082	2196	264.9	13.6	166.9	83.3
2083	2197	264.8	13.5	166.6	83.2
2084	2196	264.9	13.5	170	83
2085	2195	264.9	13.5	168.5	83.2
2086	2196	264.8	13.7	167.9	83.2
2087	2192	264.9	13.7	171.7	82.9
2088	2191	264.9	13.8	169.2	83.1
2089	2190	264.9	13.8	168.9	83.2
2090	2190	264.8	13.7	168.1	83.1
2091	2190	264.9	13.8	167.4	83.3
2092	2187	264.9	13.8	171.2	82.9
2093	2185	264.9	13.7	170	83.1
2094	2185	264.8	13.6	168.6	83.2
2095	2185	264.9	13.5	168.1	83.1
2096	2186	264.9	13.3	167.7	83.2
2097	2183	264.9	13.3	171.7	83
2098	2182	264.8	13.2	169.6	83.1
2099	2183	264.9	13.1	179.1	71.7

TABLE C-3. SECTION 34 FLOOD MIXING CALCULATIONS

Upper 10 Ft. Mixing

Ground-Water Flow Estimate (GWF)

T = 3,000 gpd/ft Width (L) = 3,000 ft Gradient (i) = 0.006 ft/ft

GWF= Q = 1/3*TiL = 12.5 gpm

Soil Moisture Long-Term Model Flux (SMF): = 9 mm/yr

= 2.20 gpm for 120 Ac

TDS: GW TDS average after restoration = 1,800 mg/l

SM TDS = 5,000 mg/l

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

$$Mixture\ TDS = \frac{1800\ \ (12.5) + 5000\ \ (2.2)}{14.7}$$

Mixture TDS = 2279 mg/l

SO4: GW SO4 average after restoration = 800 mg/l

SM SO4 = 2,500 mg/l

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

$$\text{Mixture SO4} = \frac{800\ \ (12.5) + 2500\ \ (2.2)}{14.7}$$

Mixture SO4 = 1054 mg/l

Cl: GW Cl average after restoration= 170 mg/l

SM Cl = 600 mg/l

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

$$Mixture\ Cl = \frac{170\ \ (12.5) + 600\ \ (2.2)}{14.7}$$

Mixture Cl = 234 mg/l

U: GW U average after restoration= 0.08 mg/l

SM U = 0.4 mg/l

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

$$Mixture\ U = \frac{0.08\ \ (12.5) + 0.4\ \ (2.2)}{14.7}$$

Mixture U = 0.13 mg/l

Se: GW Se average after restoration = 0.05 mg/l

SM Se = 0.1 mg/l

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

$$Mixture\ Se = \frac{0.05\ \ (12.5) + 0.1\ \ (2.2)}{14.7}$$

Mixture Se = 0.057 mg/l

TABLE C-3. SECTION 34 FLOOD MIXING CALCULATIONS, cont.

Upper 10 Ft. Mixing (cont.)

Mo: GW Mo average after restoration= 0.03 mg/l
SM Mo = 0.1 mg/l

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

$$Mixture\ Mo = \frac{0.03\ (12.5) + 0.1\ (2.2)}{14.7}$$

$$Mixture\ Mo = 0.04\ mg/l$$

NO3: GW NO3 average after restoration = 7 mg/l
SM NO3 = 15 mg/l

$$Mixture\ NO3 = \frac{GW\ NO3(GWF) + SM\ NO3(SMF)}{GWF + SMF}$$

$$Mixture\ NO3 = \frac{7\ (12.5) + 15\ (2.2)}{14.7}$$

$$Mixture\ NO3 = 8.2\ mg/l$$

Full Mixing

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

Soil Moisture Long-Term Model Flux (SMF): = 9 mm/yr
= 2.20 gpm for 120 Ac

TDS: GW TDS average after restoration = 1,800 mg/l
SM TDS = 5,000 mg/l

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

$$Mixture\ TDS = \frac{1800\ (37.5) + 5000\ (2.2)}{39.7}$$

$$Mixture\ TDS = 1977\ mg/l$$

SO4: GW SO4 average after restoration = 800 mg/l
SM SO4 = 2,500 mg/l

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

$$Mixture\ SO4 = \frac{1800\ (37.5) + 5000\ (2.2)}{39.7}$$

$$Mixture\ SO4 = 894\ mg/l$$

TABLE C-3. SECTION 34 FLOOD MIXING CALCULATIONS, cont.

Full Mixing (cont.)

Cl: GW Cl average after restoration= 170 mg/l
SM Cl = 600 mg/l

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

$$Mixture\ Cl = \frac{170\ (37.5) + 600\ (2.2)}{39.7}$$

$$Mixture\ Cl = 194\ mg/l$$

U: GW U average after restoration= 0.08 mg/l
SM U = 0.4 mg/l

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

$$Mixture\ U = \frac{0.08\ (37.5) + 0.4\ (2.2)}{39.7}$$

$$Mixture\ U = 0.10\ mg/l$$

Se: GW Se average after restoration = 0.05 mg/l
SM Se = 0.1 mg/l

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

$$Mixture\ Se = \frac{0.05\ (37.5) + 0.1\ (2.2)}{39.7}$$

$$Mixture\ Se = 0.053\ mg$$

Mo: GW Mo average after restoration= 0.03 mg/l
SM Mo = 0.1 mg/l

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

$$Mixture\ Mo = \frac{0.03\ (37.5) + 0.1\ (2.2)}{39.7}$$

$$Mixture\ Mo = 0.03\ mg/l$$

NO3: GW NO3 average after restoration = 7 mg/l
SM NO3 = 15 mg/l

$$Mixture\ NO3 = \frac{GW\ NO3(GWF) + SM\ NO3(SMF)}{GWF + SMF}$$

$$Mixture\ NO3 = \frac{7\ (37.5) + 15\ (2.2)}{39.7}$$

$$Mixture\ NO3 = 7.4\ mg/l$$

TABLE C-4. SECTION 28 PIVOT MIXING CALCULATIONS

Upper 10 Ft. Mixing

Ground-Water Flow Estimate (GWF)

T = 30,000 gpd/ft
Gradient (i) = 0.0042 ft/ft

Width (L) = 2,360 ft
Q = ½ TiL = 103 gpm

Soil Moisture Long-Term Model Flux (SMF): = 9 mm/yr
= 1.83 gpm for 100 Ac

TDS: GW TDS average after restoration = 1,800 mg/l
SM TDS = 6,000 mg/l

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

$$Mixture\ TDS = \frac{1800\ (103) + 6000\ (1.83)}{104.83}$$

Mixture TDS = 1873 mg/l

SO4: GW SO4 average after restoration = 600 mg/l
SM SO4 = 3,000 mg/l

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

$$Mixture\ SO4 = \frac{600\ (103) + 3{,}000\ (1.83)}{104.83}$$

Mixture SO4 = 642 mg/l

CL: GW CL average after restoration = 150 mg/l
SM CL = 600 mg/l

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

$$Mixture\ CL = \frac{150\ (103) + 600\ (1.83)}{104.83}$$

Mixture CL = 158 mg/l

U: GW U average after restoration = 0.1 mg/l
SM U = 0.6 mg/l

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

$$Mixture\ U = \frac{0.1\ (103) + 0.6\ (1.83)}{104.83}$$

Mixture U = 0.11 mg/l

Se: GW Se average after restoration = 0.04 mg/l
SM Se = 0.1 mg/l

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

$$Mixture\ Se = \frac{0.04\ (103) + 0.1\ (1.83)}{104.83}$$

Mixture Se = 0.041 mg/l

Upper 10 Ft. Mixing (cont.)

Mo: GW Mo = average after restoration = 0.03 mg/l
SM Mo = 0.1 mg/l

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

$$Mixture\ Mo = \frac{0.03\ (103) + 0.1\ (1.83)}{104.83}$$

Mixture Mo = 0.03 mg/l

NO3: GW NO3 average after restoration = 7 mg/l
SM NO3 = 30 mg/l

$$Mixture\ NO3 = \frac{GW\ NO3(GWF) + SM\ NO3(SMF)}{GWF + SMF}$$

$$Mixture\ NO3 = \frac{7\ (103) + 30\ (1.83)}{104.83}$$

Mixture NO3 = 7.4 mg/l

Full Mixing

Ground-Water Flow Estimate (GWF)

T = 30,000 gpd/ft
Gradient (i) = 0.0042 ft/ft

Width (L) = 2,360 ft
Q = ½ TiL = 206 gpm

Soil Moisture Long-Term Model Flux (SMF): = 9 mm/yr
= 1.83 gpm for 100 Ac

TDS: GW TDS average after restoration = 1,800 mg/l
SM TDS = 6,000 mg/l

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

$$Mixture\ TDS = \frac{1800\ (206) + 6000\ (1.83)}{207.83}$$

Mixture TDS = 1837 mg/l

SO4: GW SO4 average after restoration = 600 mg/l
SM SO4 = 3,000 mg/l

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

$$Mixture\ SO4 = \frac{600\ (206) + 3{,}000\ (1.83)}{207.83}$$

Mixture SO4 = 621 mg/l

CL: GW CL average after restoration = 150 mg/l
SM CL = 600 mg/l

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

$$Mixture\ CL = \frac{150\ (206) + 600\ (1.83)}{207.83}$$

Mixture CL = 154 mg/l

TABLE C-4. SECTION 28 PIVOT MIXING CALCULATIONS, cont.

Full Mixing (cont.)

U: GW U average after restoration = 0.1 mg/l
SM U = 0.6 mg/l

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

$$Mixture\ U = \frac{0.1\ (206) + 0.6\ (1.83)}{207.83}$$

Mixture U = 0.10 mg/l

Se: GW Se average after restoration = 0.04 mg/l
SM Se = 0.1 mg/l

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

$$Mixture\ Se = \frac{0.04\ (206) + 0.1\ (1.83)}{207.83}$$

Mixture Se = 0.041 mg/l

Mo: GW Mo average after restoration = 0.03 mg/l
SM Mo = 0.1 mg/l

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

$$Mixture\ Mo = \frac{0.03\ (206) + 0.1\ (1.83)}{207.83}$$

Mixture Mo = 0.03 mg/l

NO3: GW NO3 average after restoration = 7 mg/l
SM NO3 = 30 mg/l

$$Mixture\ NO3 = \frac{GW\ NO3(GWF) + SM\ NO3(SMF)}{GWF + SMF}$$

$$Mixture\ NO3 = \frac{7\ (206) + 30\ (1.83)}{207.83}$$

Mixture NO3 = 7.2 mg/l

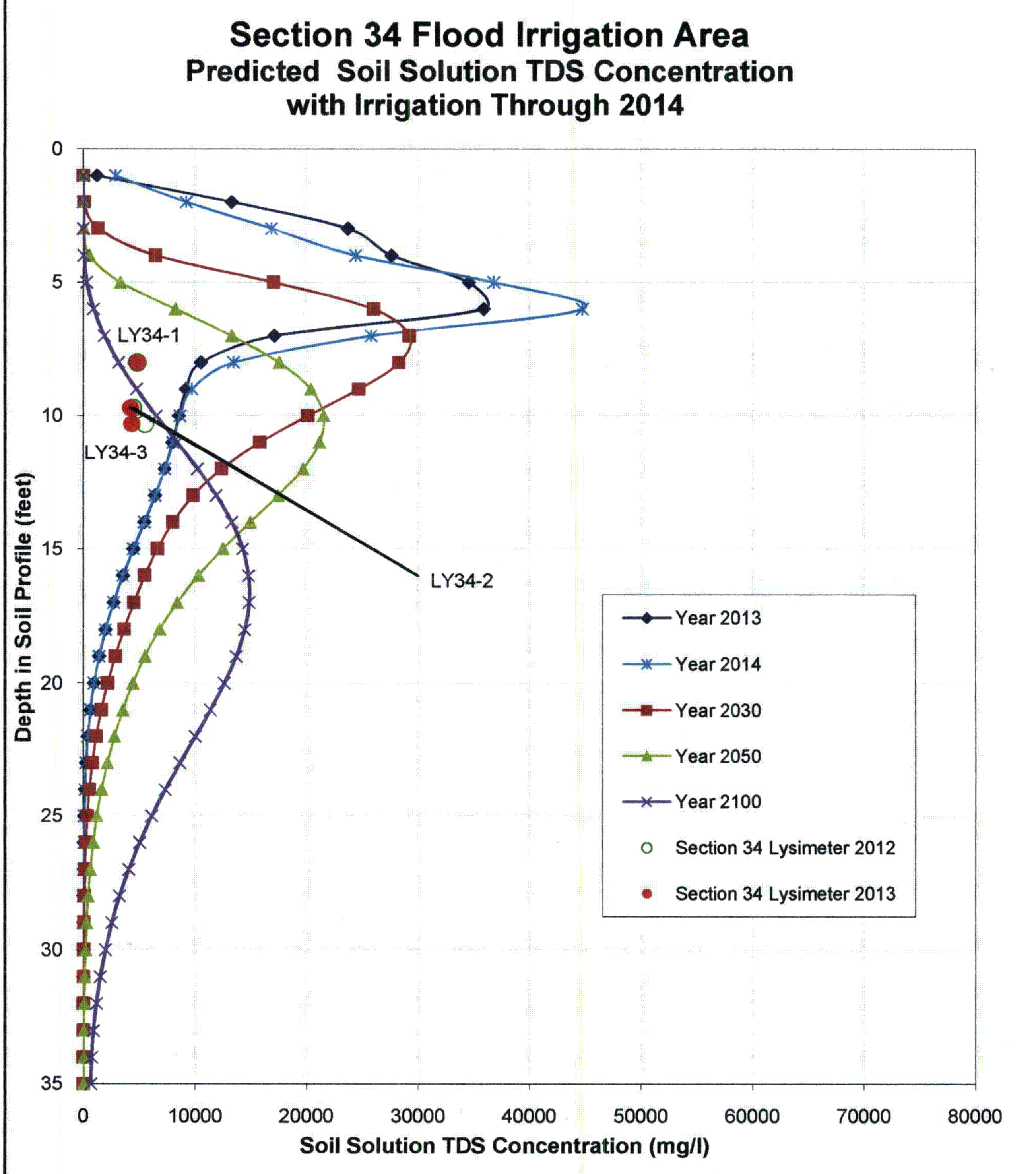

Figure C-1. Predicted and Observed Soil Solution TDS Concentration, (mg/l), for the Section 34 Flood Irrigation

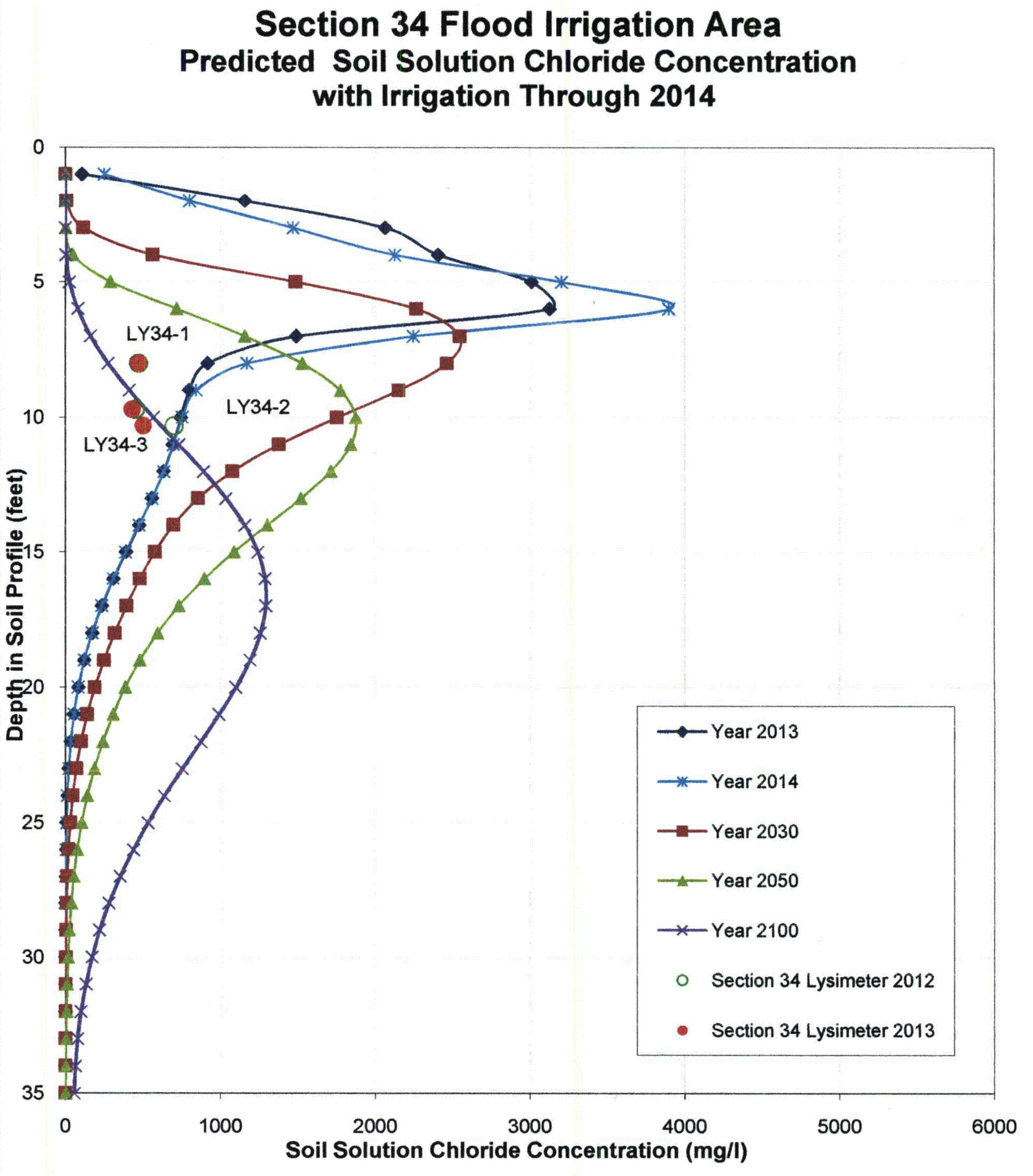

Figure C-3. Predicted and Observed Soil Solution Chloride Concentration, (mg/l), for the Section 34 Flood Irrigation

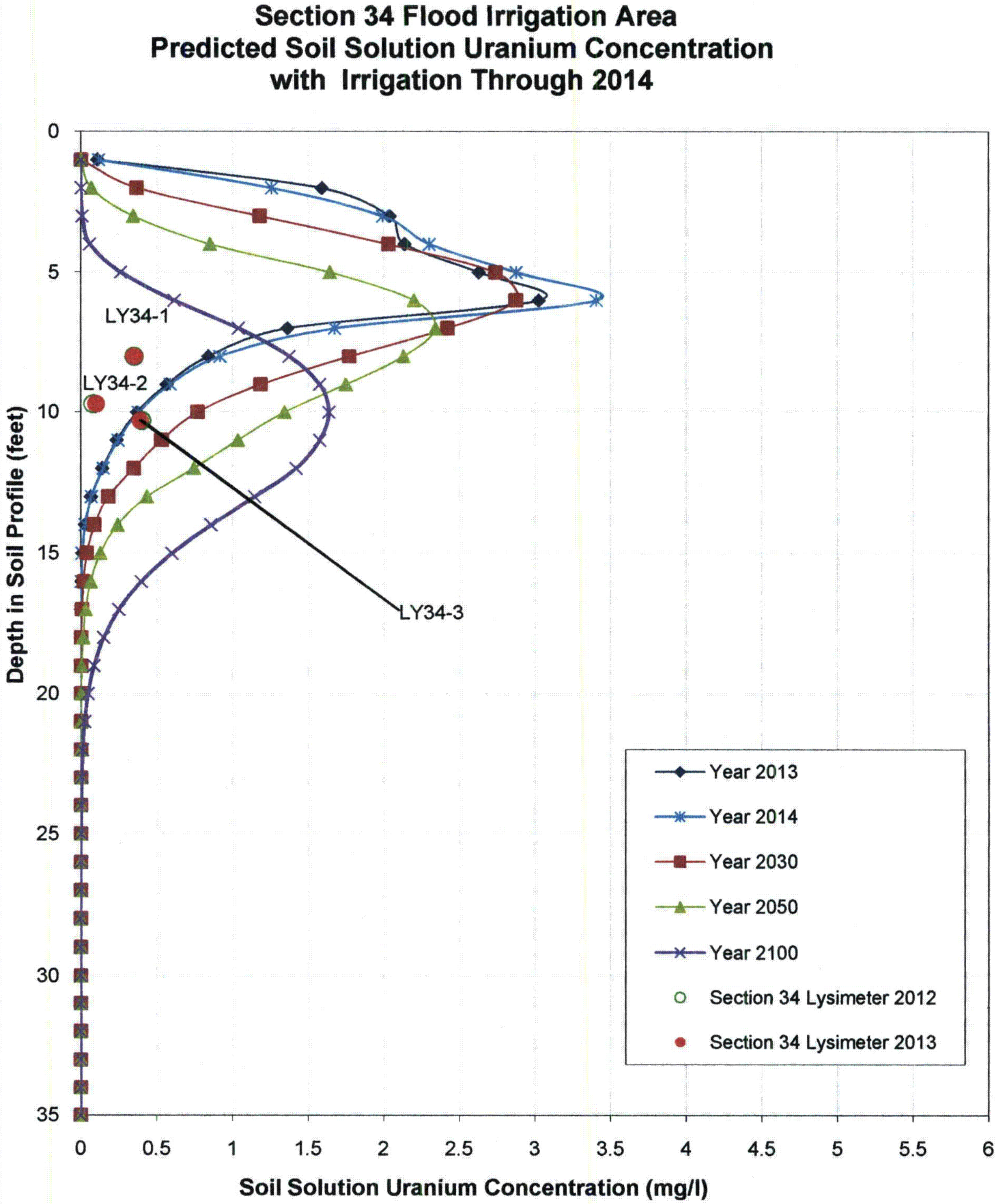

Figure C-4. Predicted and Observed Soil Solution Uranium Concentration, (mg/l), for the Section 34 Flood Irrigation

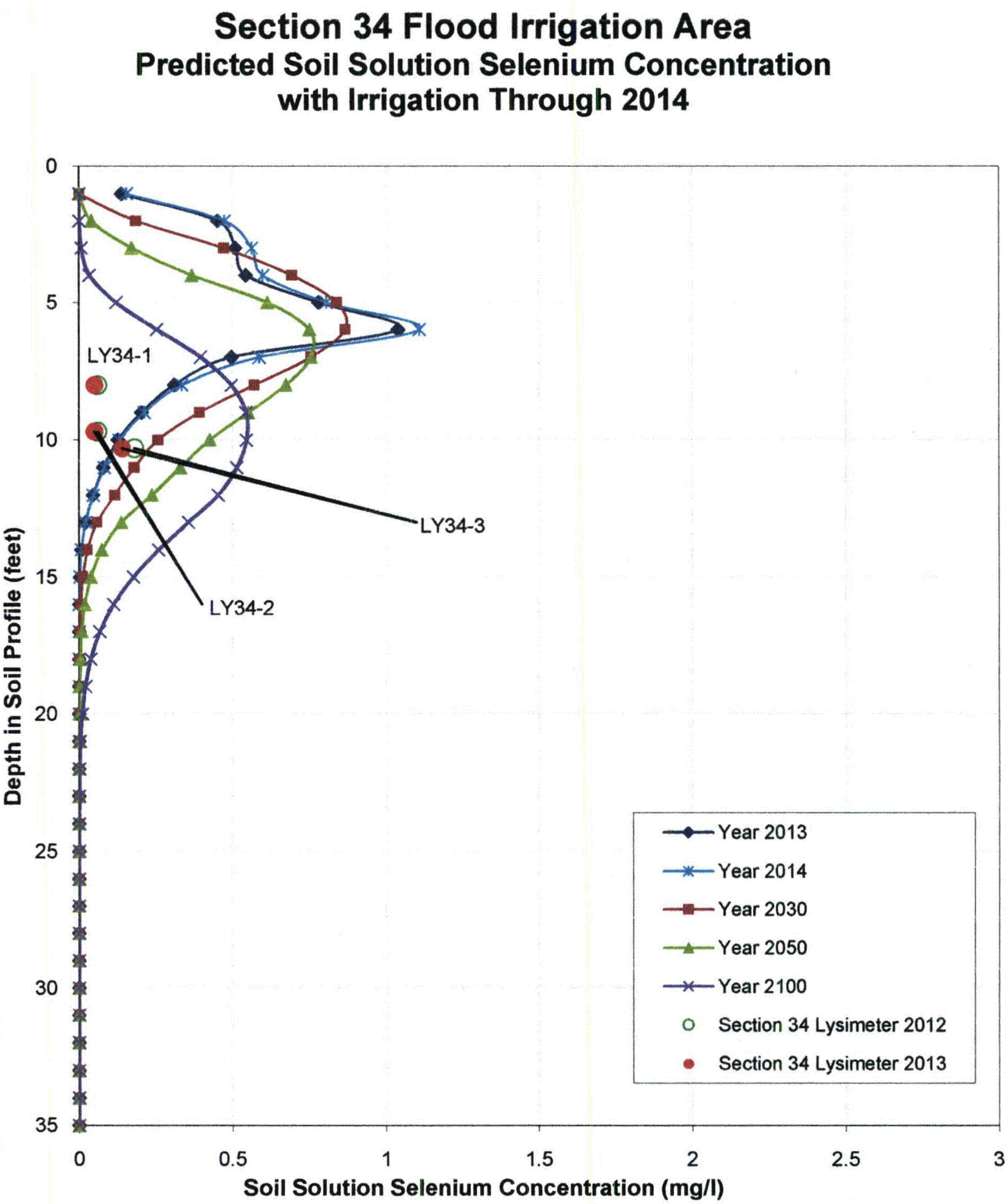

Figure C-5. Predicted and Observed Soil Solution Selenium Concentration, (mg/l), for the Section 34 Flood Irrigation

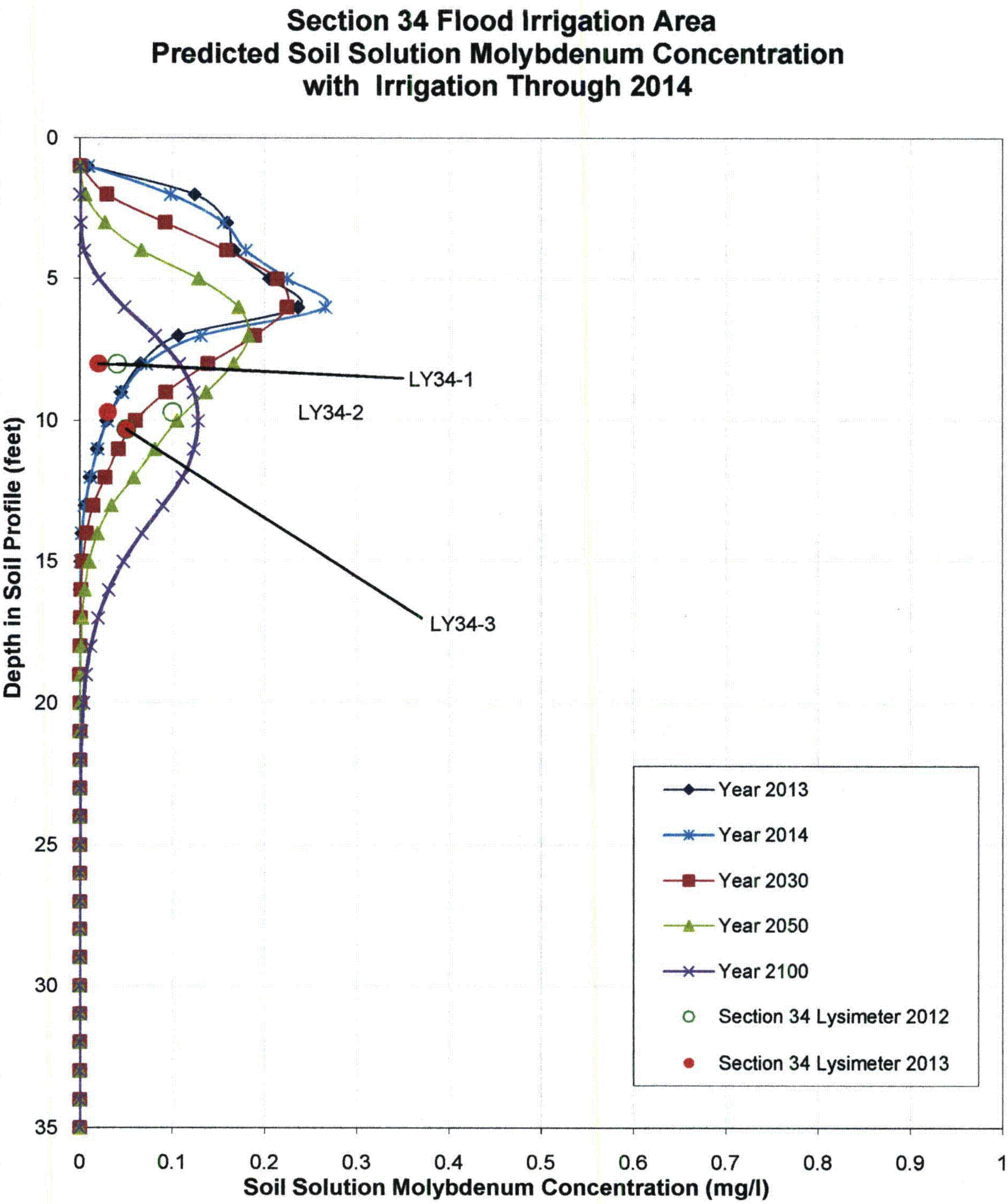

Figure C-6. Predicted and Observed Soil Solution Molybdenum Concentration, (mg/l), for the Section 34 Flood Irrigation

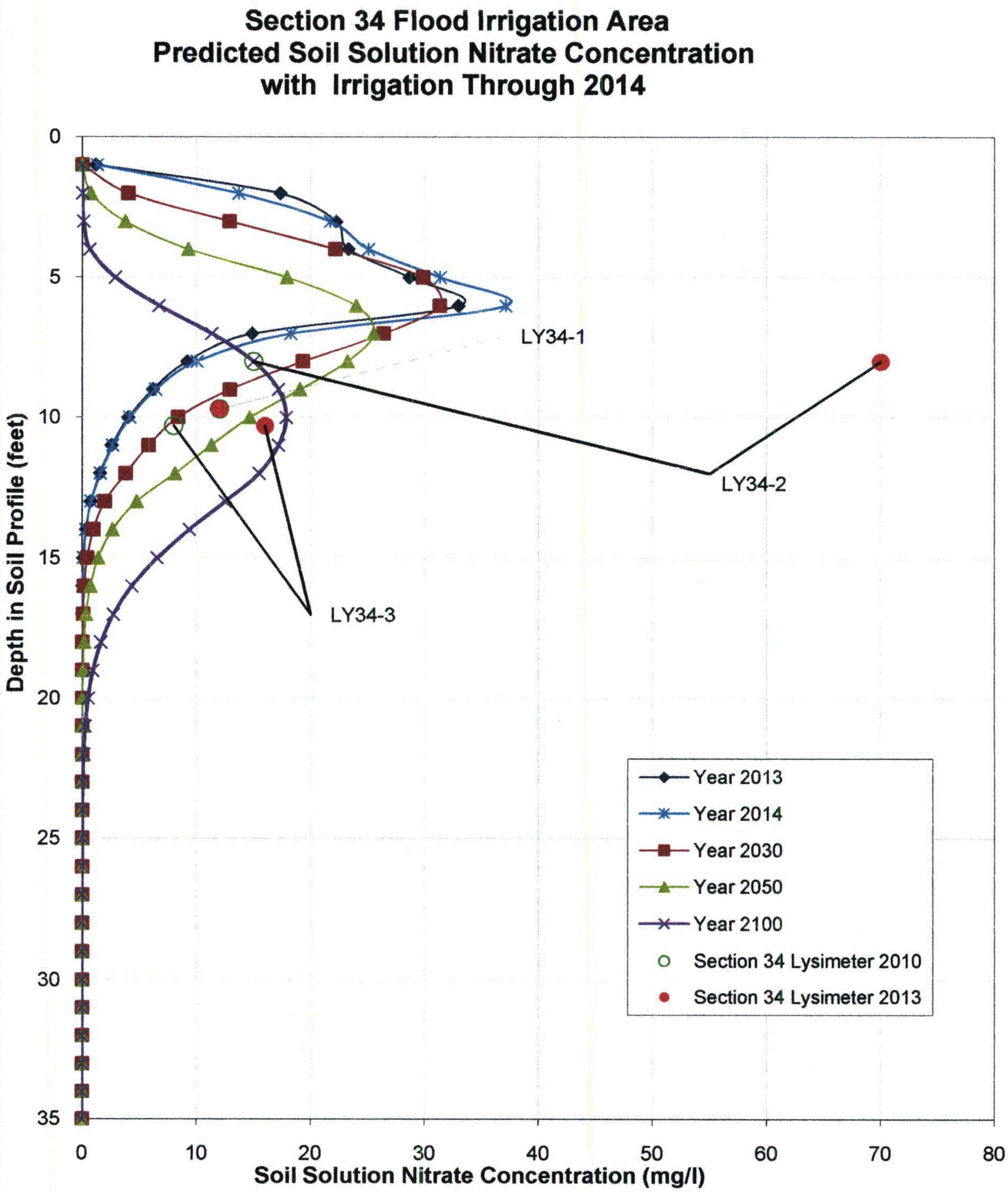

Figure C-7. Predicted and Observed Soil Solution Nitrate Concentration, (mg/l), for the Section 34 Flood Irrigation

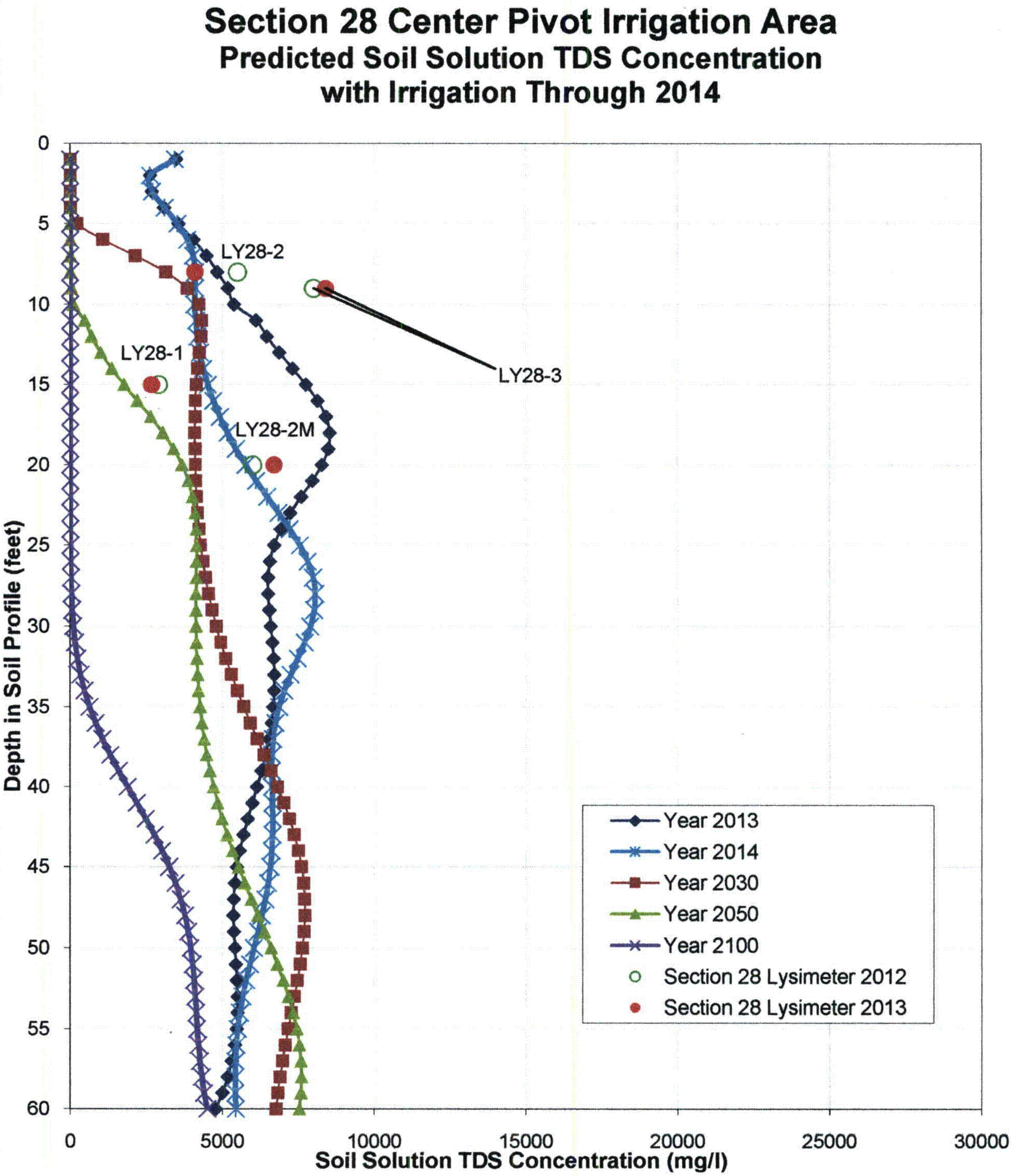

Figure C-8. Predicted and Observed Soil Solution TDS Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

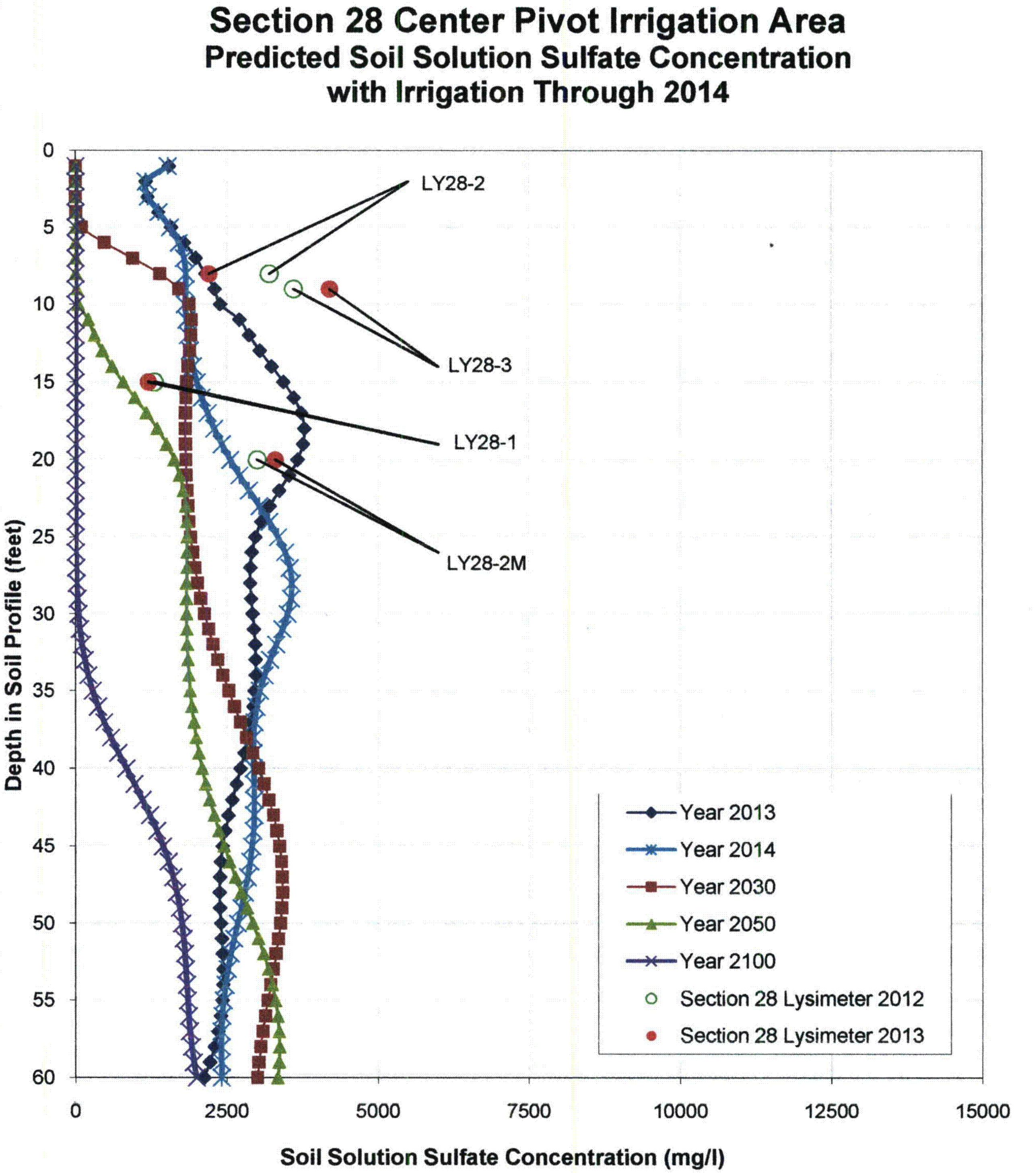

Figure C-9. Predicted and Observed Soil Solution Sulfate Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

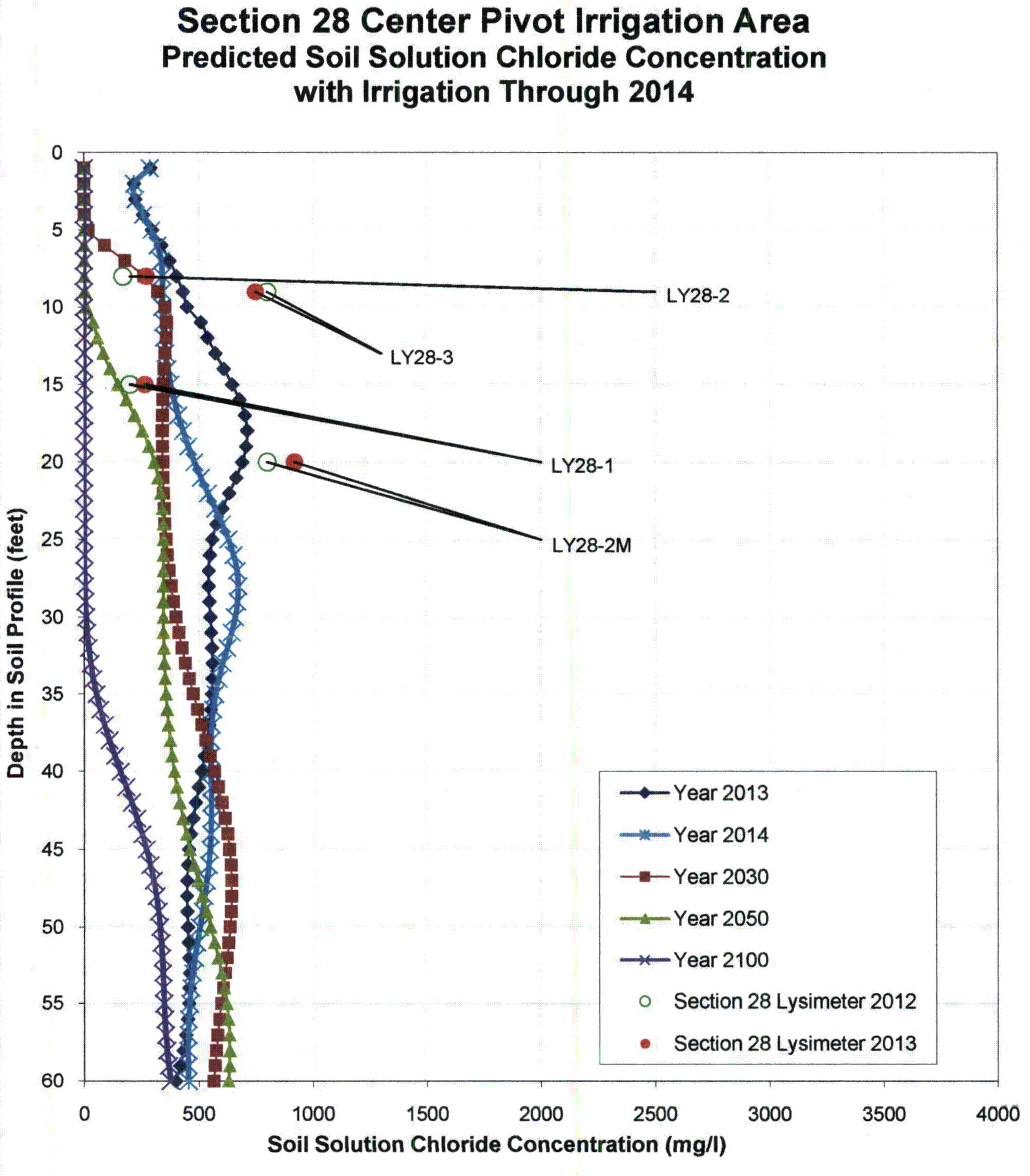

Figure C-10. Predicted and Observed Soil Solution Chloride Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

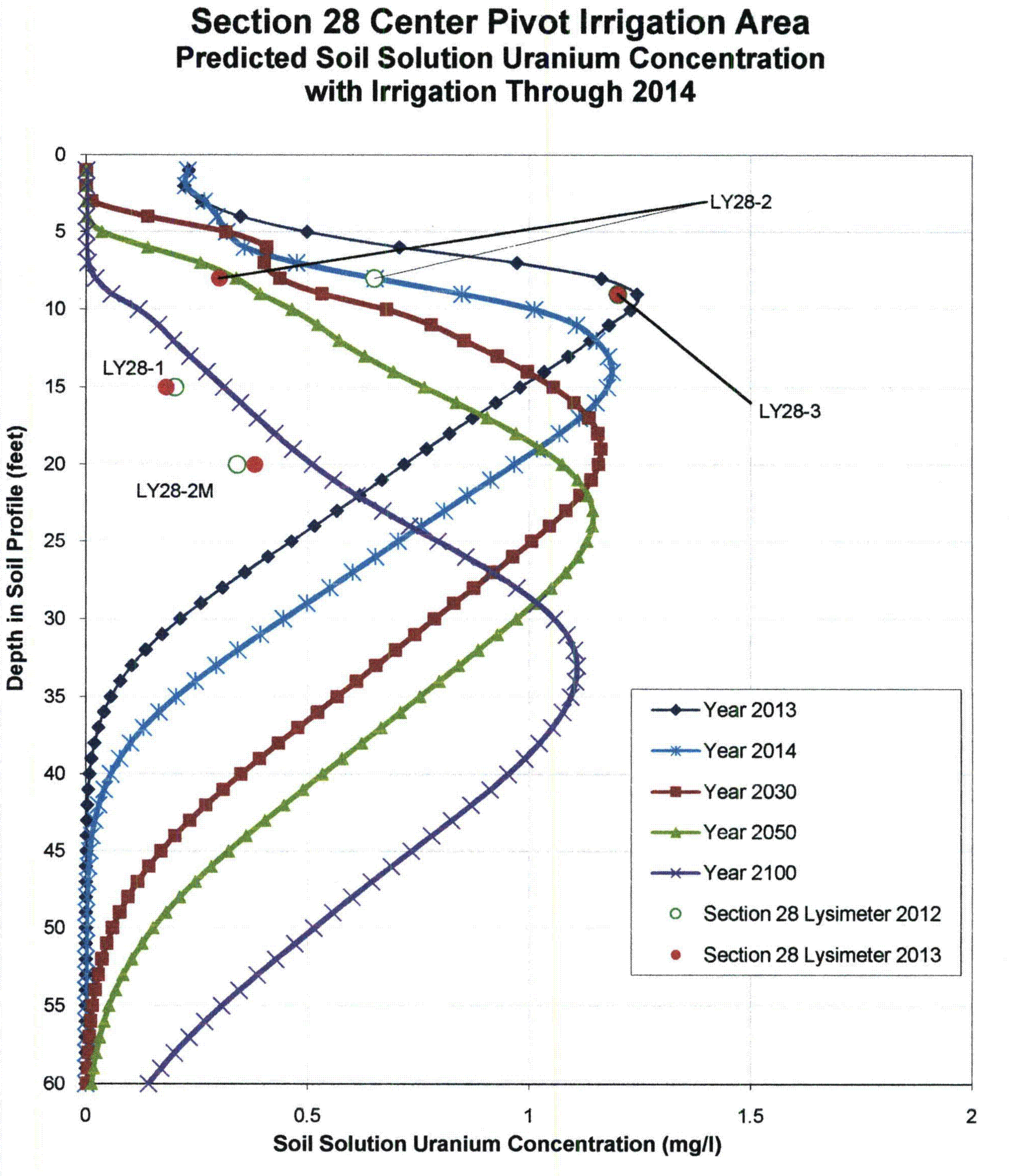

Figure C-11. Predicted and Observed Soil Solution Uranium Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

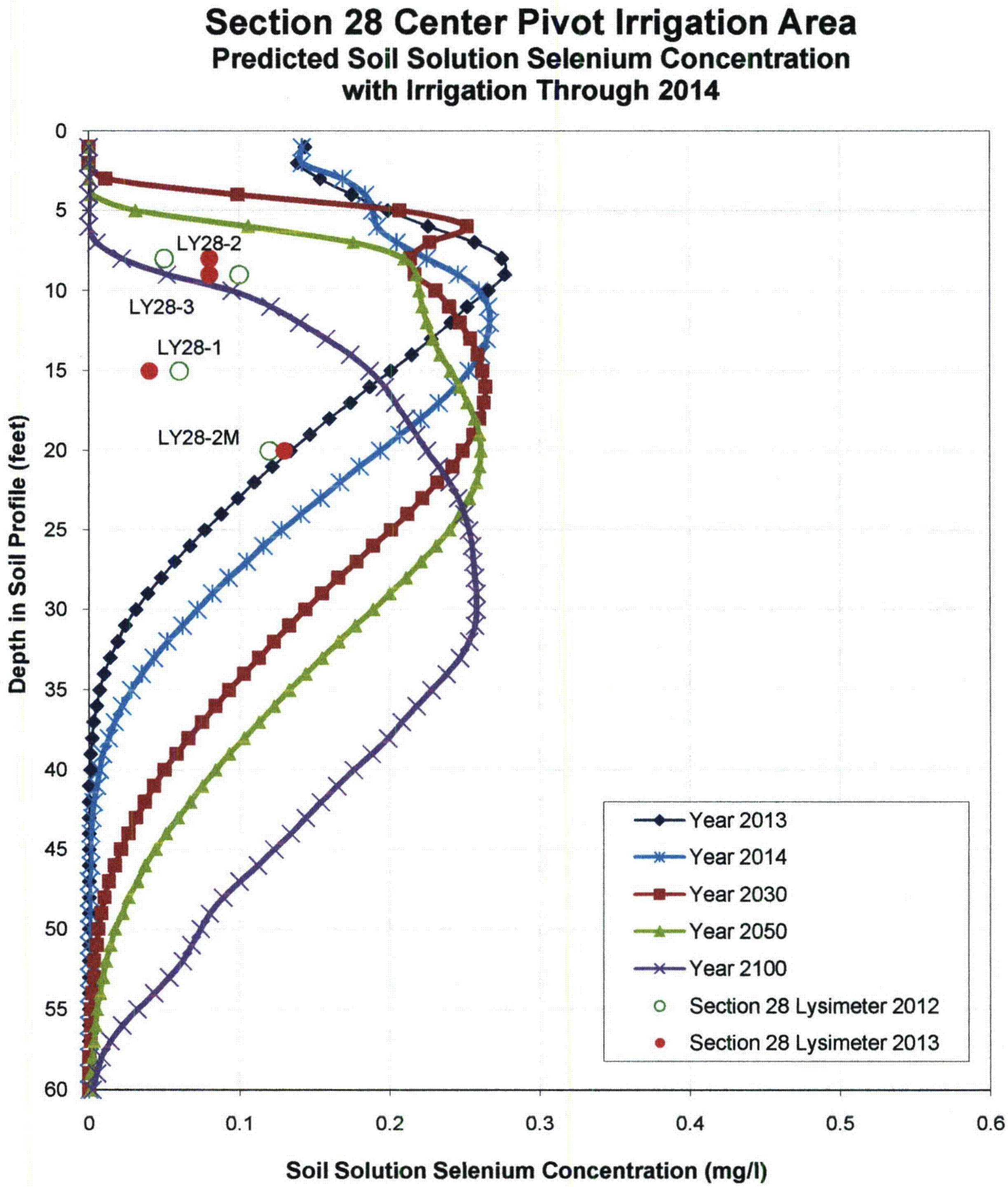

Figure C-12. Predicted and Observed Soil Solution Selenium Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

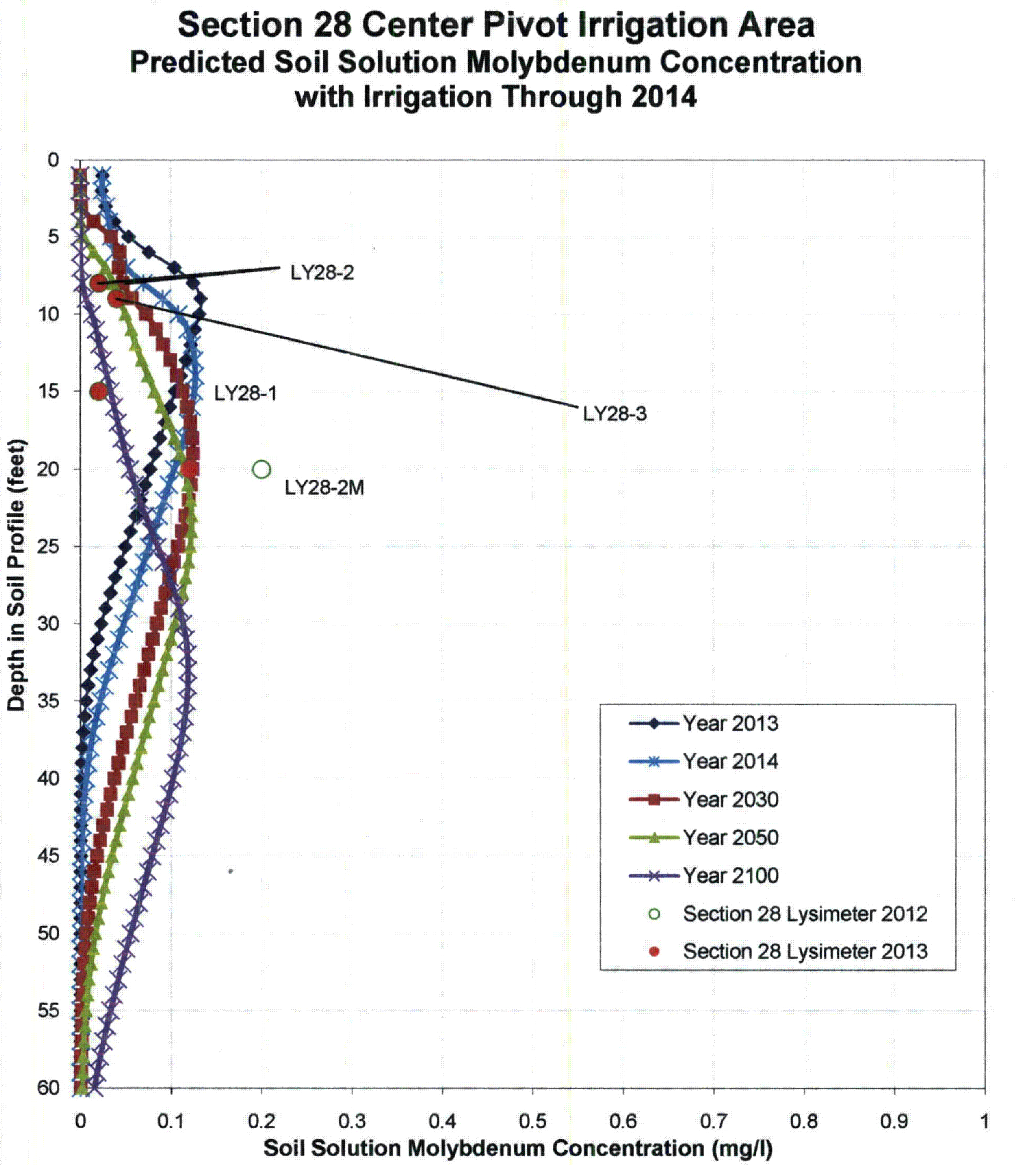

Figure C-13. Predicted and Observed Soil Solution Molybdenum Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

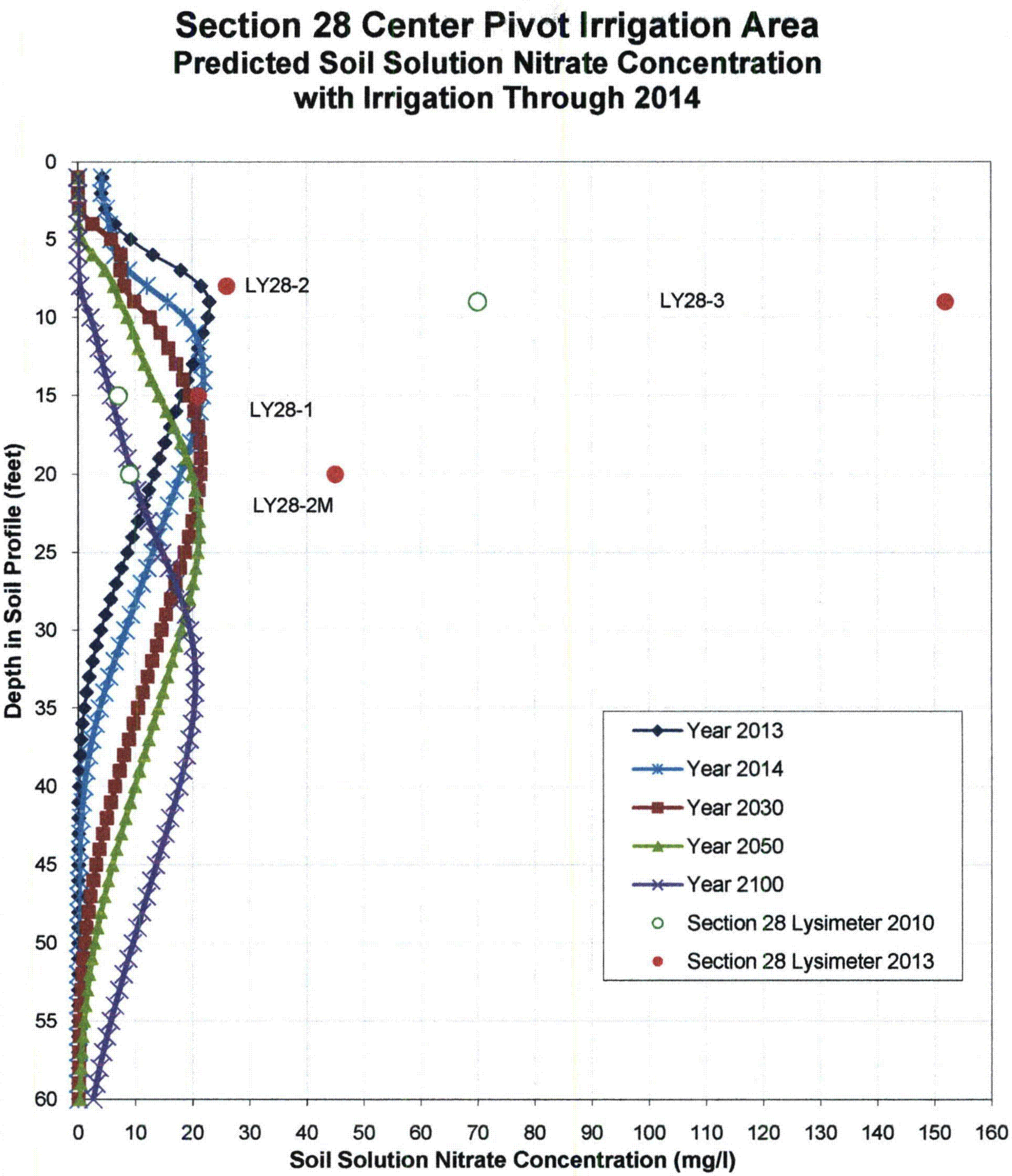

Figure C-14. Predicted and Observed Soil Solution Nitrate Concentration, (mg/l), for the Section 28 Center Pivot Irrigation

APPENDIX D

Vegetation Analyses

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D.1 2008 through 2011 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. Section 28 was planted in sorghum/sudan grass and permanent grass in 2011. Table D-4 presents the vegetation analyses of the 2011 samples.

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	#1	0.460	0.950	0.89	1.40	0.58	2.25	6.90	1.60
- 1st Cut	#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	#1	0.700	1.500	0.17	0.68	0.67	1.56	0.60	0.80
- 2nd Cut	#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	#1 Pivot	0.252	0.990	0.54	1.36	0.49	1.05	0.71	1.10
- 3rd Cut	#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 - 1st Cut	#1	0.5	0.3	----	----	----	----
	#2	0.3	<0.20	----	----	----	----
	Average	*0.40*	*<0.25*	----	----	----	----
Section 34 - Flood - 1st Cut	#1	2.0	1.8	0.7	0.9	1.3	2.4
	#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 - 2nd Cut	#1	0.7	0.7	1.3	1.1	----	----
	#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.)

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 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 2011 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)	2011 Uranium (mg/kg)	2011 Selenium (mg/kg)
Section 33 - Pivot - 1st Cut	#1	0.3	1.3	0.7	1.0	0.2	0.9	0.3	<0.5
	#2	0.8	1.3	<0.5	1.1	0.2	0.9	0.1	<0.5
	#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*	*0.20*	*#DIV/0!*
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 2011 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)	2011 Uranium (mg/kg)	2011 Selenium (mg/kg)
Section 33 - Flood	#1	----	----	----	----	0.3	0.5	0.4	<0.5
- 1st Cut	#2	----	----	----	----	0.1	0.5	0.4	<0.5
	Average	----	----	----	----	*0.2*	*0.5*	*0.39*	*#DIV/0!*
Section 34 - Flood	#1	----	----	0.5	<0.5	1.2	2.0	0.7	<0.5
- 1st Cut	#2	----	----	0.9	<0.5	0.2	0.5	1.9	<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*	*1.27*	*#DIV/0!*
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 2011 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)	2011 Uranium (mg/kg)	2011 Selenium (mg/kg)
Section 28 - Pivot - 1st Cut	#1	1.6	1.4	0.6	2.5	0.1	0.7	0.7	0.5
	#2	1.5	1.4	0.9	2.4	0.2	1.1	0.7	<0.5
	#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*	*0.66*	*0.5*
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

1RESRAD, Version 6.5 T½ Limit = 180 days 03/14/2014 15:53 Page 2
Summary : RESRAD Default Parameters
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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-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(1)
A-1	Ac-228 (Source: FGR 12)	5.978E+00	5.978E+00	DCF1(2)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(3)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(4)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(5)
A-1	Bi-212 (Source: FGR 12)	1.171E+00	1.171E+00	DCF1(6)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(7)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(8)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(9)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(10)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(11)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(12)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(13)
A-1	Pb-212 (Source: FGR 12)	7.043E-01	7.043E-01	DCF1(14)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(15)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(16)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(17)
A-1	Po-212 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(18)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(19)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(20)
A-1	Po-216 (Source: FGR 12)	1.042E-04	1.042E-04	DCF1(21)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(22)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(23)
A-1	Ra-224 (Source: FGR 12)	5.119E-02	5.119E-02	DCF1(24)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(25)
A-1	Ra-228 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(27)
A-1	Rn-220 (Source: FGR 12)	2.298E-03	2.298E-03	DCF1(28)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(29)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(30)
A-1	Th-228 (Source: FGR 12)	7.940E-03	7.940E-03	DCF1(31)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(32)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(33)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(34)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(35)
A-1	Tl-208 (Source: FGR 12)	2.298E+01	2.298E+01	DCF1(36)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(37)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(38)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(39)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(40)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.724E+00	6.700E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(3)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(4)
B-1	Ra-228+D	5.078E-03	4.770E-03	DCF2(5)
B-1	Th-228+D	3.454E-01	3.420E-01	DCF2(6)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(7)

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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
B-1	U-234	1.320E-01	1.320E-01	DCF2(8)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(9)
B-1	U-238	1.180E-01	1.180E-01	DCF2(10)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(11)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.410E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(3)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(4)
D-1	Ra-228+D	1.442E-03	1.440E-03	DCF3(5)
D-1	Th-228+D	8.086E-04	3.960E-04	DCF3(6)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(7)
D-1	U-234	2.830E-04	2.830E-04	DCF3(8)
D-1	U-235+D	2.673E-04	2.660E-04	DCF3(9)
D-1	U-238	2.550E-04	2.550E-04	DCF3(10)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(11)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Ra-228+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(5,1)
D-34	Ra-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Ra-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,3)
D-34				
D-34	Th-228+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Th-228+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Th-228+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(7,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(7,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(7,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)

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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-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(10,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(11,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Ra-228+D , fish	5.000E+01	5.000E+01	BIOFAC(5,1)
D-5	Ra-228+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(5,2)
D-5				
D-5	Th-228+D , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Th-228+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(6,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(7,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(7,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)

#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.

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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): Pb-210	3.300E-04	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	3.300E-04	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Ra-228	1.670E-03	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): Th-230	8.900E-01	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-234	8.900E-01	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): U-235	4.000E-02	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): U-238	8.900E-01	0.000E+00	---	S1(10)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Ra-228	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(10)
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)	4.900E-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

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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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
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 Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.174E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.676E-03	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Ra-228				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.676E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.961E-06	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

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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 U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.344E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(9,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.344E-03	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.344E-03	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.823E-03	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.344E-03	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Th-228				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.961E-06	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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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)
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

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0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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
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

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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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      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ----------------------------            ----------------------------------
        Area: 485640.00 square meters                Pb-210     3.300E-04
   Thickness:      2.00 meters                       Ra-226     3.300E-04
 Cover Depth:      0.00 meters                       Ra-228     1.670E-03
                                                     Th-230     8.900E-01
                                                     U-234      8.900E-01
                                                     U-235      4.000E-02
                                                     U-238      8.900E-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):  3.782E-01  3.828E-01  3.902E-01  4.136E-01  5.067E-01  8.926E-01  1.791E+00  5.021E+00
M(t):  1.513E-02  1.531E-02  1.561E-02  1.654E-02  2.027E-02  3.571E-02  7.163E-02  2.008E-01
0Maximum TDOSE(t):  5.021E+00 mrem/yr    at t = 1.000E+03 years
```

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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 = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

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.
Pb-210	1.185E-06	0.0000	7.104E-07	0.0000	0.000E+00	0.0000	2.056E-03	0.0054	1.406E-04	0.0004	6.851E-05	0.0002	6.468E-05	0.0002
Ra-226	2.190E-03	0.0058	2.783E-07	0.0000	0.000E+00	0.0000	1.553E-03	0.0041	9.187E-05	0.0002	1.097E-04	0.0003	1.293E-05	0.0000
Ra-228	7.148E-03	0.0189	9.160E-06	0.0000	0.000E+00	0.0000	7.955E-03	0.0210	4.658E-04	0.0012	5.637E-04	0.0015	6.777E-05	0.0002
Th-230	1.923E-03	0.0051	2.736E-02	0.0724	0.000E+00	0.0000	4.336E-02	0.1146	1.786E-03	0.0047	1.776E-04	0.0005	1.336E-02	0.0353
U-234	2.139E-04	0.0006	1.107E-02	0.0293	0.000E+00	0.0000	5.476E-02	0.1448	3.614E-03	0.0096	8.859E-03	0.0234	6.887E-03	0.0182
U-235	1.808E-02	0.0478	4.635E-04	0.0012	0.000E+00	0.0000	2.329E-03	0.0062	1.548E-04	0.0004	3.761E-04	0.0010	2.925E-04	0.0008
U-238	8.034E-02	0.2124	9.896E-03	0.0262	0.000E+00	0.0000	5.199E-02	0.1375	3.431E-03	0.0091	8.411E-03	0.0222	6.539E-03	0.0173
Total	1.099E-01	0.2906	4.880E-02	0.1290	0.000E+00	0.0000	1.640E-01	0.4337	9.684E-03	0.0256	1.857E-02	0.0491	2.722E-02	0.0720

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

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.
Pb-210	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	2.332E-03	0.0062
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	0.0105
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	0.0429
Th-230	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	8.797E-02	0.2326
U-234	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	8.540E-02	0.2258
U-235	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	2.170E-02	0.0574
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	1.606E-01	0.4247
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	3.782E-01	1.0000

0*Sum of all water independent and dependent pathways.

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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)

Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Pb-210	1.147E-06	0.0000	6.878E-07	0.0000	0.000E+00	0.0000	1.991E-03	0.0052	1.361E-04	0.0004	6.633E-05	0.0002	6.263E-05	0.0002
Ra-226	2.185E-03	0.0057	2.994E-07	0.0000	0.000E+00	0.0000	1.614E-03	0.0042	9.619E-05	0.0003	1.116E-04	0.0003	1.488E-05	0.0000
Ra-228	8.742E-03	0.0228	2.111E-05	0.0001	0.000E+00	0.0000	7.075E-03	0.0185	4.142E-04	0.0011	4.990E-04	0.0013	6.882E-05	0.0002
Th-230	4.479E-03	0.0117	2.736E-02	0.0715	0.000E+00	0.0000	4.520E-02	0.1181	1.894E-03	0.0049	3.050E-04	0.0008	1.337E-02	0.0349
U-234	2.134E-04	0.0006	1.104E-02	0.0288	0.000E+00	0.0000	5.463E-02	0.1427	3.605E-03	0.0094	8.838E-03	0.0231	6.871E-03	0.0179
U-235	1.804E-02	0.0471	4.626E-04	0.0012	0.000E+00	0.0000	2.331E-03	0.0061	1.577E-04	0.0004	3.753E-04	0.0010	2.921E-04	0.0008
U-238	8.015E-02	0.2094	9.873E-03	0.0258	0.000E+00	0.0000	5.187E-02	0.1355	3.423E-03	0.0089	8.392E-03	0.0219	6.524E-03	0.0170
Total	1.138E-01	0.2973	4.876E-02	0.1274	0.000E+00	0.0000	1.647E-01	0.4303	9.727E-03	0.0254	1.859E-02	0.0486	2.721E-02	0.0711

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

Radio-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Pb-210	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	2.258E-03	0.0059
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	0.0105
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	0.0439
Th-230	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	9.261E-02	0.2419
U-234	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	8.520E-02	0.2226
U-235	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	2.166E-02	0.0566
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	1.602E-01	0.4186
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	3.828E-01	1.0000

0*Sum of all water independent and dependent pathways.

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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 = 3.000E+00 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Pb-210	1.076E-06	0.0000	6.449E-07	0.0000	0.000E+00	0.0000	1.867E-03	0.0048	1.276E-04	0.0003	6.219E-05	0.0002	5.872E-05	0.0002
Ra-226	2.176E-03	0.0056	3.395E-07	0.0000	0.000E+00	0.0000	1.727E-03	0.0044	1.040E-04	0.0003	1.151E-04	0.0003	1.858E-05	0.0000
Ra-228	9.506E-03	0.0244	3.085E-05	0.0001	0.000E+00	0.0000	5.572E-03	0.0143	3.257E-04	0.0008	3.908E-04	0.0010	6.362E-05	0.0002
Th-230	9.575E-03	0.0245	2.736E-02	0.0701	0.000E+00	0.0000	4.910E-02	0.1258	2.128E-03	0.0055	5.699E-04	0.0015	1.341E-02	0.0344
U-234	2.125E-04	0.0005	1.099E-02	0.0282	0.000E+00	0.0000	5.438E-02	0.1394	3.589E-03	0.0092	8.797E-03	0.0225	6.839E-03	0.0175
U-235	1.795E-02	0.0460	4.607E-04	0.0012	0.000E+00	0.0000	2.336E-03	0.0060	1.636E-04	0.0004	3.735E-04	0.0010	2.913E-04	0.0007
U-238	7.978E-02	0.2045	9.827E-03	0.0252	0.000E+00	0.0000	5.163E-02	0.1323	3.407E-03	0.0087	8.353E-03	0.0214	6.493E-03	0.0166
Total	1.192E-01	0.3055	4.867E-02	0.1247	0.000E+00	0.0000	1.666E-01	0.4270	9.844E-03	0.0252	1.866E-02	0.0478	2.718E-02	0.0697

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-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Pb-210	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	2.117E-03	0.0054
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	4.141E-03	0.0106
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	0.0407
Th-230	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	1.022E-01	0.2618
U-234	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	8.480E-02	0.2174
U-235	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	2.158E-02	0.0553
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	1.595E-01	0.4088
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	3.902E-01	1.0000

0*Sum of all water independent and dependent pathways.

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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+01 years

0

Water Independent Pathways (Inhalation excludes radon)

0 Radio- Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil	
Pb-210	8.584E-07	0.0000	5.145E-07	0.0000	0.000E+00	0.0000	1.489E-03	0.0036	1.018E-04	0.0002	4.962E-05	0.0001	4.685E-05	0.0001
Ra-226	2.144E-03	0.0052	4.591E-07	0.0000	0.000E+00	0.0000	2.062E-03	0.0050	1.271E-04	0.0003	1.254E-04	0.0003	2.966E-05	0.0001
Ra-228	5.533E-03	0.0134	2.114E-05	0.0001	0.000E+00	0.0000	2.386E-03	0.0058	1.391E-04	0.0003	1.662E-04	0.0004	3.250E-05	0.0001
Th-230	2.724E-02	0.0659	2.736E-02	0.0662	0.000E+00	0.0000	6.465E-02	0.1563	3.076E-03	0.0074	1.555E-03	0.0038	1.361E-02	0.0329
U-234	2.102E-04	0.0005	1.081E-02	0.0261	0.000E+00	0.0000	5.350E-02	0.1293	3.530E-03	0.0085	8.654E-03	0.0209	6.728E-03	0.0163
U-235	1.766E-02	0.0427	4.546E-04	0.0011	0.000E+00	0.0000	2.355E-03	0.0057	1.838E-04	0.0004	3.675E-04	0.0009	2.887E-04	0.0007
U-238	7.848E-02	0.1897	9.667E-03	0.0234	0.000E+00	0.0000	5.079E-02	0.1228	3.352E-03	0.0081	8.217E-03	0.0199	6.388E-03	0.0154
Total	1.313E-01	0.3174	4.832E-02	0.1168	0.000E+00	0.0000	1.772E-01	0.4285	1.051E-02	0.0254	1.913E-02	0.0463	2.713E-02	0.0656

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- Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways*	
Pb-210	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	1.689E-03	0.0041
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	4.489E-03	0.0109
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	8.277E-03	0.0200
Th-230	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	1.375E-01	0.3325
U-234	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	8.343E-02	0.2017
U-235	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	2.131E-02	0.0515
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	1.569E-01	0.3793
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	4.136E-01	1.0000

0*Sum of all water independent and dependent pathways.

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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 = 3.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Pb-210	4.503E-07	0.0000	2.699E-07	0.0000	0.000E+00	0.0000	7.812E-04	0.0015	5.342E-05	0.0001	2.603E-05	0.0001	2.458E-05	0.0000
Ra-226	2.056E-03	0.0041	6.705E-07	0.0000	0.000E+00	0.0000	2.644E-03	0.0052	1.674E-04	0.0003	1.425E-04	0.0003	4.940E-05	0.0001
Ra-228	5.095E-04	0.0010	1.993E-06	0.0000	0.000E+00	0.0000	2.074E-04	0.0004	1.209E-05	0.0000	1.442E-05	0.0000	2.928E-06	0.0000
Th-230	7.630E-02	0.1506	2.737E-02	0.0540	0.000E+00	0.0000	1.205E-01	0.2378	6.578E-03	0.0130	4.715E-03	0.0093	1.456E-02	0.0287
U-234	2.097E-04	0.0004	1.032E-02	0.0204	0.000E+00	0.0000	5.106E-02	0.1008	3.369E-03	0.0066	8.257E-03	0.0163	6.422E-03	0.0127
U-235	1.687E-02	0.0333	4.402E-04	0.0009	0.000E+00	0.0000	2.416E-03	0.0048	2.377E-04	0.0005	3.509E-04	0.0007	2.829E-04	0.0006
U-238	7.488E-02	0.1478	9.225E-03	0.0182	0.000E+00	0.0000	4.847E-02	0.0957	3.199E-03	0.0063	7.841E-03	0.0155	6.096E-03	0.0120
Total	1.708E-01	0.3371	4.736E-02	0.0935	0.000E+00	0.0000	2.261E-01	0.4462	1.362E-02	0.0269	2.135E-02	0.0421	2.744E-02	0.0542

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-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Pb-210	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	8.860E-04	0.0017
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	5.060E-03	0.0100
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	7.483E-04	0.0015
Th-230	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	2.500E-01	0.4935
U-234	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	7.964E-02	0.1572
U-235	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	2.059E-02	0.0406
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	1.497E-01	0.2955
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	5.067E-01	1.0000

0*Sum of all water independent and dependent pathways.

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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+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Pb-210	4.708E-08	0.0000	2.822E-08	0.0000	0.000E+00	0.0000	8.169E-05	0.0001	5.586E-06	0.0000	2.722E-06	0.0000	2.570E-06	0.0000
Ra-226	1.774E-03	0.0020	7.894E-07	0.0000	0.000E+00	0.0000	2.891E-03	0.0032	1.862E-04	0.0002	1.433E-04	0.0002	6.183E-05	0.0001
Ra-228	9.810E-08	0.0000	3.838E-10	0.0000	0.000E+00	0.0000	3.991E-08	0.0000	2.326E-09	0.0000	2.775E-09	0.0000	5.636E-10	0.0000
Th-230	2.325E-01	0.2605	2.741E-02	0.0307	0.000E+00	0.0000	3.565E-01	0.3993	2.170E-02	0.0243	1.671E-02	0.0187	1.941E-02	0.0217
U-234	2.701E-04	0.0003	8.774E-03	0.0098	0.000E+00	0.0000	4.347E-02	0.0487	2.867E-03	0.0032	7.013E-03	0.0079	5.459E-03	0.0061
U-235	1.436E-02	0.0161	4.026E-04	0.0005	0.000E+00	0.0000	2.601E-03	0.0029	3.870E-04	0.0004	2.987E-04	0.0003	2.686E-04	0.0003
U-238	6.355E-02	0.0712	7.831E-03	0.0088	0.000E+00	0.0000	4.114E-02	0.0461	2.715E-03	0.0030	6.656E-03	0.0075	5.174E-03	0.0058
Total	3.125E-01	0.3501	4.442E-02	0.0498	0.000E+00	0.0000	4.466E-01	0.5004	2.786E-02	0.0312	3.082E-02	0.0345	3.038E-02	0.0340

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-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Pb-210	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	9.264E-05	0.0001
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	5.058E-03	0.0057
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	1.441E-07	0.0000
Th-230	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	6.742E-01	0.7553
U-234	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	6.785E-02	0.0760
U-235	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	1.832E-02	0.0205
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	1.271E-01	0.1424
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	8.926E-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 = 3.000E+02 years
0                                          Water Independent Pathways (Inhalation excludes radon)
0            Ground           Inhalation           Radon              Plant              Meat               Milk               Soil
 Radio-  --------------------------------------------------------------------------------------------------------------------
Nuclide  mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 Pb-210  7.431E-11 0.0000  4.454E-11 0.0000  0.000E+00 0.0000  1.289E-07 0.0000  8.816E-09 0.0000  4.296E-09 0.0000  4.056E-09 0.0000
 Ra-226  1.164E-03 0.0006  5.368E-07 0.0000  0.000E+00 0.0000  1.951E-03 0.0011  1.259E-04 0.0001  9.579E-05 0.0001  4.228E-05 0.0000
 Ra-228  2.374E-18 0.0000  9.288E-21 0.0000  0.000E+00 0.0000  9.658E-19 0.0000  5.630E-20 0.0000  6.716E-20 0.0000  1.364E-20 0.0000
 Th-230  5.699E-01 0.3182  2.751E-02 0.0154  0.000E+00 0.0000  9.193E-01 0.5133  5.800E-02 0.0324  4.439E-02 0.0248  3.155E-02 0.0176
 U-234   7.813E-04 0.0004  5.527E-03 0.0031  0.000E+00 0.0000  2.816E-02 0.0157  1.854E-03 0.0010  4.433E-03 0.0025  3.453E-03 0.0019
 U-235   9.088E-03 0.0051  3.095E-04 0.0002  0.000E+00 0.0000  2.639E-03 0.0015  5.725E-04 0.0003  1.886E-04 0.0001  2.226E-04 0.0001
 U-238   3.977E-02 0.0222  4.904E-03 0.0027  0.000E+00 0.0000  2.576E-02 0.0144  1.700E-03 0.0009  4.168E-03 0.0023  3.240E-03 0.0018
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 Total   6.207E-01 0.3466  3.825E-02 0.0214  0.000E+00 0.0000  9.778E-01 0.5460  6.226E-02 0.0348  5.327E-02 0.0297  3.851E-02 0.0215
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             Water             Fish              Radon              Plant              Meat               Milk          All Pathways*
 Radio-  --------------------------------------------------------------------------------------------------------------------
Nuclide  mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.   mrem/yr fract.
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 Pb-210  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  1.462E-07 0.0000
 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  3.380E-03 0.0019
 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  3.486E-18 0.0000
 Th-230  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  1.651E+00 0.9217
 U-234   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  4.421E-02 0.0247
 U-235   5.543E-05 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.043E-05 0.0000  4.773E-08 0.0000  8.047E-08 0.0000  1.309E-02 0.0073
 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  7.955E-02 0.0444
 ------- --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------  --------- ------
 Total   5.543E-05 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.043E-05 0.0000  4.773E-08 0.0000  8.047E-08 0.0000  1.791E+00 1.0000
0*Sum of all water independent and dependent pathways.
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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+03 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Pb-210	1.161E-20	0.0000	6.957E-21	0.0000	0.000E+00	0.0000	2.014E-17	0.0000	1.377E-18	0.0000	6.709E-19	0.0000	6.335E-19	0.0000
Ra-226	2.658E-04	0.0001	1.226E-07	0.0000	0.000E+00	0.0000	4.458E-04	0.0001	2.876E-05	0.0000	2.188E-05	0.0000	9.661E-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
Th-230	1.061E+00	0.2112	2.753E-02	0.0055	0.000E+00	0.0000	1.742E+00	0.3470	1.111E-01	0.0221	8.479E-02	0.0169	4.930E-02	0.0098
U-234	3.042E-03	0.0006	1.155E-03	0.0002	0.000E+00	0.0000	1.018E-02	0.0020	6.603E-04	0.0001	1.088E-03	0.0002	8.065E-04	0.0002
U-235	1.829E-03	0.0004	9.882E-05	0.0000	0.000E+00	0.0000	1.192E-03	0.0002	3.331E-04	0.0001	3.774E-05	0.0000	7.989E-05	0.0000
U-238	7.714E-03	0.0015	9.529E-04	0.0002	0.000E+00	0.0000	5.009E-03	0.0010	3.306E-04	0.0001	8.100E-04	0.0002	6.296E-04	0.0001
Total	1.073E+00	0.2138	2.973E-02	0.0059	0.000E+00	0.0000	1.759E+00	0.3504	1.125E-01	0.0224	8.675E-02	0.0173	5.082E-02	0.0101

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	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Pb-210	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	2.284E-17	0.0000
Ra-226	1.287E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.435E-04	0.0000	4.723E-05	0.0000	4.190E-05	0.0000	2.392E-03	0.0005
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
Th-230	2.010E-01	0.0400	0.000E+00	0.0000	0.000E+00	0.0000	3.802E-02	0.0076	7.383E-03	0.0015	6.611E-03	0.0013	3.329E+00	0.6629
U-234	6.180E-01	0.1231	0.000E+00	0.0000	0.000E+00	0.0000	1.165E-01	0.0232	9.247E-03	0.0018	2.700E-02	0.0054	7.877E-01	0.1569
U-235	1.234E-01	0.0246	0.000E+00	0.0000	0.000E+00	0.0000	2.326E-02	0.0046	5.180E-03	0.0010	1.261E-03	0.0003	1.567E-01	0.0312
U-238	5.856E-01	0.1166	0.000E+00	0.0000	0.000E+00	0.0000	1.104E-01	0.0220	8.662E-03	0.0017	2.563E-02	0.0051	7.458E-01	0.1485
Total	1.529E+00	0.3046	0.000E+00	0.0000	0.000E+00	0.0000	2.884E-01	0.0574	3.052E-02	0.0061	6.055E-02	0.0121	5.021E+00	1.0000

0*Sum of all water independent and dependent pathways.

Summary : RESRAD Default Parameters
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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
Pb-210+D	Pb-210+D	1.000E+00	7.066E+00	6.842E+00	6.414E+00	5.118E+00	2.685E+00	2.807E-01	4.431E-04	6.920E-14
0Ra-226+D	Ra-226+D	1.000E+00	1.186E+01	1.184E+01	1.179E+01	1.161E+01	1.113E+01	9.605E+00	6.299E+00	2.501E+00
Ra-226+D	Pb-210+D	1.000E+00	1.333E-01	3.529E-01	7.624E-01	1.991E+00	4.199E+00	5.722E+00	3.942E+00	4.747E+00
Ra-226+D	-DSR(j)		1.199E+01	1.219E+01	1.255E+01	1.360E+01	1.533E+01	1.533E+01	1.024E+01	7.248E+00
0Ra-228+D	Ra-228+D	1.000E+00	8.720E+00	7.717E+00	6.043E+00	2.569E+00	2.229E-01	4.290E-05	1.038E-15	0.000E+00
Ra-228+D	Th-228+D	1.000E+00	9.864E-01	2.356E+00	3.471E+00	2.388E+00	2.252E-01	4.337E-05	1.049E-15	0.000E+00
Ra-228+D	-DSR(j)		9.706E+00	1.007E+01	9.514E+00	4.957E+00	4.481E-01	8.626E-05	2.088E-15	0.000E+00
0Th-230	Th-230	1.000E+00	9.633E-02	9.633E-02	9.633E-02	9.632E-02	9.630E-02	9.623E-02	9.602E-02	9.528E-02
Th-230	Ra-226+D	1.000E+00	2.484E-03	7.601E-03	1.783E-02	5.331E-02	1.518E-01	4.654E-01	1.143E+00	2.191E+00
Th-230	Pb-210+D	1.000E+00	2.094E-05	1.274E-04	6.126E-04	4.863E-03	3.283E-02	1.959E-01	6.160E-01	1.454E+00
Th-230	-DSR(j)		9.884E-02	1.041E-01	1.148E-01	1.545E-01	2.809E-01	7.576E-01	1.855E+00	3.740E+00
0U-234	U-234	1.000E+00	9.596E-02	9.573E-02	9.528E-02	9.373E-02	8.943E-02	7.589E-02	4.746E-02	8.684E-01
U-234	Th-230	1.000E+00	4.560E-07	1.325E-06	3.049E-06	9.020E-06	2.555E-05	7.762E-05	1.867E-04	3.353E-04
U-234	Ra-226+D	1.000E+00	7.294E-09	5.256E-08	2.809E-07	2.505E-06	2.056E-05	2.015E-04	1.353E-03	7.617E-03
U-234	Pb-210+D	1.000E+00	5.000E-11	6.469E-10	6.762E-09	1.587E-07	3.207E-06	6.854E-05	6.692E-04	8.710E-03
U-234	-DSR(j)		9.596E-02	9.573E-02	9.529E-02	9.374E-02	8.948E-02	7.624E-02	4.967E-02	8.851E-01
0U-235+D	U-235+D	1.000E+00	5.423E-01	5.410E-01	5.385E-01	5.297E-01	5.055E-01	4.290E-01	2.685E-01	8.660E-01
U-235+D	Pa-231	1.000E+00	1.327E-04	4.192E-04	9.920E-04	2.955E-03	8.214E-03	2.298E-02	4.292E-02	7.901E-01
U-235+D	Ac-227+D	1.000E+00	7.964E-07	4.838E-06	2.318E-05	1.810E-04	1.165E-03	6.070E-03	1.577E-02	2.261E+00
U-235+D	-DSR(j)		5.424E-01	5.414E-01	5.395E-01	5.329E-01	5.148E-01	4.580E-01	3.272E-01	3.917E+00
0U-238	U-238	5.400E-05	4.656E-06	4.645E-06	4.623E-06	4.548E-06	4.340E-06	3.683E-06	2.305E-06	4.237E-05
0U-238+D	U-238+D	9.999E-01	1.805E-01	1.800E-01	1.792E-01	1.763E-01	1.682E-01	1.428E-01	8.934E-02	8.354E-01
U-238+D	U-234	9.999E-01	1.360E-07	4.070E-07	9.453E-07	2.790E-06	7.733E-06	2.162E-05	4.045E-05	2.466E-03
U-238+D	Th-230	9.999E-01	4.449E-13	2.972E-12	1.534E-11	1.342E-10	1.092E-09	1.063E-08	7.030E-08	3.106E-07
U-238+D	Ra-226+D	9.999E-01	5.081E-15	7.895E-14	9.358E-13	2.479E-11	5.883E-10	1.872E-08	3.590E-07	6.786E-06
U-238+D	Pb-210+D	9.999E-01	2.971E-17	7.908E-16	1.764E-14	1.213E-12	7.224E-11	5.363E-09	1.634E-07	1.016E-05
U-238+D	-DSR(j)		1.805E-01	1.800E-01	1.792E-01	1.763E-01	1.682E-01	1.428E-01	8.938E-02	8.379E-01

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

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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
Pb-210	3.538E+00	3.654E+00	3.897E+00	4.885E+00	9.312E+00	8.905E+01	5.642E+04	*7.634E+13
Ra-226	2.084E+00	2.051E+00	1.992E+00	1.838E+00	1.631E+00	1.631E+00	2.441E+00	3.449E+00
Ra-228	2.576E+00	2.482E+00	2.628E+00	5.044E+00	5.580E+01	2.898E+05	*2.726E+14	*2.726E+14
Th-230	2.529E+02	2.402E+02	2.178E+02	1.618E+02	8.899E+01	3.300E+01	1.348E+01	6.684E+00
U-234	2.605E+02	2.611E+02	2.624E+02	2.667E+02	2.794E+02	3.279E+02	5.033E+02	2.825E+01
U-235	4.609E+01	4.617E+01	4.634E+01	4.692E+01	4.856E+01	5.458E+01	7.642E+01	6.382E+00
U-238	1.385E+02	1.389E+02	1.395E+02	1.418E+02	1.486E+02	1.751E+02	2.797E+02	2.984E+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)
Pb-210	3.300E-04	0.000E+00	7.066E+00	3.538E+00	6.920E-14	*7.634E+13
Ra-226	3.300E-04	58.2 ñ 0.1	1.594E+01	1.568E+00	7.248E+00	3.449E+00
Ra-228	1.670E-03	1.164 ñ 0.002	1.008E+01	2.481E+00	0.000E+00	*2.726E+14
Th-230	8.900E-01	1.000E+03	3.740E+00	6.684E+00	3.740E+00	6.684E+00
U-234	8.900E-01	1.000E+03	8.851E-01	2.825E+01	8.851E-01	2.825E+01
U-235	4.000E-02	1.000E+03	3.917E+00	6.382E+00	3.917E+00	6.382E+00
U-238	8.900E-01	1.000E+03	8.379E-01	2.984E+01	8.379E-01	2.984E+01

*At specific activity limit

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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
Pb-210	Pb-210	1.000E+00	2.332E-03	2.258E-03	2.117E-03	1.689E-03	8.860E-04	9.264E-05	1.462E-07	2.284E-17
Pb-210	Ra-226	1.000E+00	4.400E-05	1.164E-04	2.516E-04	6.570E-04	1.386E-03	1.888E-03	1.301E-03	1.566E-03
Pb-210	Th-230	1.000E+00	1.864E-05	1.134E-04	5.452E-04	4.328E-03	2.922E-02	1.743E-01	5.482E-01	1.294E+00
Pb-210	U-234	1.000E+00	4.450E-11	5.757E-10	6.018E-09	1.413E-07	2.855E-06	6.100E-05	5.956E-04	7.752E-03
Pb-210	U-238	9.999E-01	2.644E-17	7.038E-16	1.570E-14	1.080E-12	6.430E-11	4.773E-09	1.454E-07	9.044E-06
Pb-210	-DOSE(j)		2.394E-03	2.488E-03	2.914E-03	6.674E-03	3.149E-02	1.764E-01	5.501E-01	1.303E+00
0Ra-226	Ra-226	1.000E+00	3.914E-03	3.906E-03	3.889E-03	3.832E-03	3.674E-03	3.170E-03	2.079E-03	8.253E-04
Ra-226	Th-230	1.000E+00	2.210E-03	6.765E-03	1.587E-02	4.745E-02	1.351E-01	4.143E-01	1.017E+00	1.950E+00
Ra-226	U-234	1.000E+00	6.492E-09	4.678E-08	2.500E-07	2.230E-06	1.830E-05	1.794E-04	1.205E-03	6.779E-03
Ra-226	U-238	9.999E-01	4.522E-15	7.027E-14	8.329E-13	2.207E-11	5.236E-10	1.666E-08	3.195E-07	6.039E-06
Ra-226	-DOSE(j)		6.124E-03	1.067E-02	1.976E-02	5.128E-02	1.388E-01	4.176E-01	1.020E+00	1.958E+00
0Ra-228	Ra-228	1.000E+00	1.456E-02	1.289E-02	1.009E-02	4.290E-03	3.722E-04	7.164E-08	1.734E-18	0.000E+00
0Th-228	Ra-228	1.000E+00	1.647E-03	3.934E-03	5.797E-03	3.988E-03	3.761E-04	7.242E-08	1.753E-18	0.000E+00
0Th-230	Th-230	1.000E+00	8.574E-02	8.574E-02	8.573E-02	8.573E-02	8.571E-02	8.564E-02	8.545E-02	8.480E-02
Th-230	U-234	1.000E+00	4.058E-07	1.179E-06	2.714E-06	8.027E-06	2.274E-05	6.908E-05	1.661E-04	2.984E-04
Th-230	U-238	9.999E-01	3.960E-13	2.645E-12	1.365E-11	1.194E-10	9.723E-10	9.459E-09	6.257E-08	2.765E-07
Th-230	-DOSE(j)		8.574E-02	8.574E-02	8.574E-02	8.573E-02	8.573E-02	8.571E-02	8.562E-02	8.510E-02
0U-234	U-234	1.000E+00	8.540E-02	8.520E-02	8.480E-02	8.342E-02	7.960E-02	6.754E-02	4.224E-02	7.729E-01
U-234	U-238	9.999E-01	1.210E-07	3.622E-07	8.413E-07	2.483E-06	6.882E-06	1.924E-05	3.600E-05	2.195E-03
U-234	-DOSE(j)		8.540E-02	8.520E-02	8.480E-02	8.342E-02	7.960E-02	6.756E-02	4.228E-02	7.751E-01
0U-235	U-235	1.000E+00	2.169E-02	2.164E-02	2.154E-02	2.119E-02	2.022E-02	1.716E-02	1.074E-02	3.464E-02
0Pa-231	U-235	1.000E+00	5.309E-06	1.677E-05	3.968E-05	1.182E-04	3.285E-04	9.191E-04	1.717E-03	3.160E-02
0Ac-227	U-235	1.000E+00	3.186E-08	1.935E-07	9.273E-07	7.239E-06	4.661E-05	2.428E-04	6.308E-04	9.044E-02
0U-238	U-238	5.400E-05	4.144E-06	4.134E-06	4.115E-06	4.048E-06	3.862E-06	3.278E-06	2.051E-06	3.771E-05
U-238	U-238	9.999E-01	1.606E-01	1.602E-01	1.595E-01	1.569E-01	1.497E-01	1.271E-01	7.951E-02	7.435E-01
U-238	-DOSE(j)		1.606E-01	1.602E-01	1.595E-01	1.569E-01	1.497E-01	1.271E-01	7.951E-02	7.435E-01

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

1RESRAD, Version 6.5   T« Limit = 180 days   03/14/2014 15:53 Page 23
Summary : RESRAD Default Parameters
File   : X:\PROJECT_DATA\HMC\IRRIGATION REPORTS\2013 IRRIGATION REPORT\IR 2013.RAD

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
Pb-210	Pb-210	1.000E+00	3.300E-04	3.195E-04	2.996E-04	2.390E-04	1.254E-04	1.311E-05	2.069E-08	3.232E-18
Pb-210	Ra-226	1.000E+00	0.000E+00	1.008E-05	2.924E-05	8.671E-05	1.901E-04	2.620E-04	1.807E-04	4.128E-05
Pb-210	Th-230	1.000E+00	0.000E+00	5.924E-06	5.212E-05	5.358E-04	3.915E-03	2.399E-02	7.592E-02	1.522E-01
Pb-210	U-234	1.000E+00	0.000E+00	1.782E-11	4.724E-10	1.643E-08	3.743E-07	8.340E-06	8.232E-05	4.261E-04
Pb-210	U-238	9.999E-01	0.000E+00	1.264E-17	1.008E-15	1.180E-13	8.253E-12	6.483E-10	2.005E-08	3.055E-07
Pb-210	-S(j):		3.300E-04	3.355E-04	3.809E-04	8.615E-04	4.230E-03	2.428E-02	7.619E-02	1.527E-01
0Ra-226	Ra-226	1.000E+00	3.300E-04	3.293E-04	3.279E-04	3.231E-04	3.098E-04	2.672E-04	1.753E-04	4.004E-05
Ra-226	Th-230	1.000E+00	0.000E+00	3.852E-04	1.153E-03	3.815E-03	1.121E-02	3.474E-02	8.556E-02	1.595E-01
Ra-226	U-234	1.000E+00	0.000E+00	1.733E-09	1.555E-08	1.710E-07	1.494E-06	1.497E-05	1.012E-04	4.541E-04
Ra-226	U-238	9.999E-01	0.000E+00	1.637E-15	4.405E-14	1.612E-12	4.207E-11	1.384E-09	2.681E-08	3.328E-07
Ra-226	-S(j):		3.300E-04	7.145E-04	1.481E-03	4.138E-03	1.152E-02	3.502E-02	8.583E-02	1.600E-01
0Ra-228	Ra-228	1.000E+00	1.670E-03	1.478E-03	1.157E-03	4.919E-04	4.269E-05	8.215E-09	1.988E-19	0.000E+00
0Th-228	Ra-228	1.000E+00	0.000E+00	4.760E-04	8.966E-04	6.751E-04	6.437E-05	1.240E-08	3.000E-19	0.000E+00
0Th-230	Th-230	1.000E+00	8.900E-01	8.900E-01	8.900E-01	8.899E-01	8.897E-01	8.890E-01	8.871E-01	8.803E-01
Th-230	U-234	1.000E+00	0.000E+00	8.002E-06	2.395E-05	7.918E-05	2.320E-04	7.137E-04	1.722E-03	3.065E-03
Th-230	U-238	9.999E-01	0.000E+00	1.134E-11	1.017E-10	1.118E-09	9.752E-09	9.724E-08	6.477E-07	2.791E-06
Th-230	-S(j):		8.900E-01	8.900E-01	8.900E-01	8.900E-01	8.899E-01	8.897E-01	8.888E-01	8.834E-01
0U-234	U-234	1.000E+00	8.900E-01	8.879E-01	8.838E-01	8.694E-01	8.295E-01	7.039E-01	4.402E-01	8.519E-02
U-234	U-238	9.999E-01	0.000E+00	2.517E-06	7.516E-06	2.465E-05	7.055E-05	1.996E-04	3.746E-04	2.418E-04
U-234	-S(j):		8.900E-01	8.879E-01	8.838E-01	8.694E-01	8.296E-01	7.041E-01	4.406E-01	8.543E-02
0U-235	U-235	1.000E+00	4.000E-02	3.991E-02	3.972E-02	3.907E-02	3.728E-02	3.164E-02	1.980E-02	3.839E-03
0Pa-231	U-235	1.000E+00	0.000E+00	8.443E-07	2.521E-06	8.266E-06	2.366E-05	6.688E-05	1.253E-04	8.038E-05
0Ac-227	U-235	1.000E+00	0.000E+00	1.328E-08	1.163E-07	1.174E-06	8.176E-06	4.373E-05	1.023E-04	7.043E-05
0U-238	U-238	5.400E-05	4.806E-05	4.795E-05	4.772E-05	4.695E-05	4.480E-05	3.802E-05	2.379E-05	4.613E-06
U-238	U-238	9.999E-01	8.900E-01	8.879E-01	8.837E-01	8.693E-01	8.295E-01	7.040E-01	4.406E-01	8.542E-02
U-238	-S(j):		8.900E-01	8.879E-01	8.838E-01	8.694E-01	8.296E-01	7.041E-01	4.406E-01	8.543E-02

THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =   1.94 seconds

APPENDIX F

2013 Water Quality Laboratory Analytical Sheets

See Attached CD