GRANTS RECLAMATION PROJECT

# 2011 ANNUAL MONITORING REPORT / PERFORMANCE REVIEW FOR HOMESTAKE'S GRANTS PROJECT PURSUANT TO NRC LICENSE SUA-1471 AND DISCHARGE PLAN DP-200

*Prepared for:*
**U.S. Nuclear Regulatory Commission**
11545 Rockville Pike
Rockville, MD 20852-2736

&

**New Mexico Environment Department**
1190 St. Francis Drive, N4050
Sante Fe, NM 87502


*Prepared by:*
**Homestake Mining Company**
P.O. Box 98 – San Mateo Road
Grants, NM 87020

&

**Hydro-Engineering, LLC**
4685 East Magnolia Street
Casper, Wyoming 82604


**March 2012**

HOMESTAKE
Grants Office

**Alan D. Cox**
*Project Manager*

30 March 2012

Via UPS Overnight

Mr. John Buckley, Site Manager
c/o Document Control Desk
Fuel Cycle Facilities Branch (Mailstop T8-A33)
Division of Fuel Cycle Safety and Safeguards
Office of Nuclear Materials Safety and Safeguards
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Two White Flint North
Rockville, MD 20852-2738

RE: **Grants Reclamation Project**
**Docket No. 40-8903**
**License No. SUA-1471**
**2011 Annual Monitoring Report / Performance Review**

Dear Mr. Buckley:

Pursuant to NRC License SUA-1 471, Docket 40-8903, License Condition 35(E), Homestake Mining Company of California (HMC) hereby submits two (2) copies of our 2011 Annual Monitoring Report / Performance Review for the Grants Reclamation Project. This report is an updated performance review of the groundwater corrective action program for the Grants site. Included in each report copy is a CD containing an electronic PDF file version of the report.

HMC noted in the past that monitoring conditions on the site are subject to change and may require periodic judgment decisions relative to the ability to supply certain data to meet the Table 2 - Groundwater Monitoring Program (8-99) requirements, as modified by NRC License provisions. With respect to the well monitoring requirements outlined in Table 2, monitoring wells 446 and 492 were not sampled in 2011; the wells are either obstructed or supply inadequate water for sampling. We are recommending, as part of the Corrective Action Plan (CAP) update review, that these wells be replaced by alternate wells for monitoring in this area.

Thank you for your time and attention on this matter. If you have any questions or require additional information, please contact me in our Grants office at (505) 287-4456 Ext. 25 or via cell phone at (505) 400-2794.

Sincerely yours,

*HOMESTAKE MINING COMPANY*
*OF CALIFORNIA*
Alan D. Cox
Project Manager / RSO

Enclosures (2 copies 2011 Annual Performance Review report)

xc: B. Spitzberg, NRC Arlington, TX (w/encl.)
J. Schoeppner, NMED (encl. – *2 copies)*
S. Appaji, Region VI EPA, (w/encl.)
T. Plessinger, DOE Grand Jct (w/encl.)
Grants Superfund Repository (CD only)
R. Chase, SLC, ( electronic copy.)
P. Malone, SLC (electronic copy)
B. Ferdinand, SLC, (electronic copy)
G. Hoffman, Casper (w/o encl)



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# 2011 ANNUAL MONITORING REPORT / PERFORMANCE REVIEW FOR HOMESTAKE'S GRANTS PROJECT PURSUANT TO NRC LICENSE SUA-1471 AND DISCHARGE PLAN DP-200

**FOR:**

**U.S. NUCLEAR REGULATORY COMMISSION**
**AND**
**NEW MEXICO ENVIRONMENT DEPARTMENT**

**BY:**


**HOMESTAKE MINING COMPANY OF CALIFORNIA**
**GRANTS, NEW MEXICO**

**AND**

**HYDRO-ENGINEERING, LLC**
**CASPER, WYOMING**


**MARCH, 2012**


**ADAM ARGUELLO, E.I.T**
**Hydro-Engineering, LLC**

**GEORGE L. HOFFMAN, P.E.**
**5831 N.M. HYDROLOGIST**
3/26/2012

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## GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT



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**GROUND WATER MONITORING**
**FOR HOMESTAKE'S GRANTS PROJECT**



**FIGURES**

## 1.0 EXECUTIVE SUMMARY AND INTRODUCTION

### 1.1 EXECUTIVE SUMMARY

Homestake Mining Company of California manages a ground water restoration program as defined by Nuclear Regulatory Commission (NRC) License SUA-1471, and New Mexico Environment Department (NMED), DP-200 permit. The restoration program is a dynamic on-going strategy based on a restoration plan, which began in 1977.

Homestake's long-term goal is to restore the ground water aquifer to levels as close as practicable to the up-gradient site background levels. A ground water collection area (see yellow shaded area on Figure 2.1-1, Page 2.1-13) has been established and is bounded by a down-gradient perimeter of injection/infiltration wells and trenches. Alluvial ground water that flows beneath the tailings enters this collection area. All ground water in the alluvial aquifer that is within the collection area is eventually captured by the collection well system. Once ground water quality restoration within the zone is complete and approved by the agencies, the site is to be transferred to the U.S. Department of Energy, which will have the responsibility for long-term site care and maintenance.

The data reported within this document represent the results of the monitoring program during 2011. This is a yearly reporting requirement. A similar report has been submitted to the agencies each year since 1983 (see footnote list in Section 1.2 and report Section 9.0).

The restoration program is designed to remove target contaminants from the ground water by flushing the alluvial aquifer with deep-well supplied fresh water or water produced from the reverse osmosis (R.O.) plant. A series of collection wells is used to collect the contaminated water, which is pumped to the R.O. plant for treatment or, alternatively, reported to the evaporation ponds.

Historically, the contaminants are found in two different aquifer systems. The aquifer system of primary concern is the alluvial system, which averages approximately 100 feet in depth, and extends generally north to south encompassing the San Mateo alluvial aquifer. In addition, a second aquifer system is found within the Chinle formation underlying the San Mateo alluvium. It is comprised of three separate aquifers designated as the Upper, Middle and Lower Chinle aquifers. The Hydro-Engineering 2003b report should be reviewed for details of the geologic setting and aquifer conditions on the site. The Upper and Middle Chinle aquifers subcrop beneath the alluvial system near the project site. Slight to moderately elevated concentrations of constituents of concern have been observed in the Upper, Middle and Lower Chinle aquifers near their subcrops with the overlying alluvial system.

The restoration program, as described above, is made up of injection and collection well systems. R.O. product water, or fresh water pumped from deep wells, is injected in a series of wells or infiltration trenches arranged to form a continuous injection line across the site. The injection line creates a hydraulic barrier that results in containment of the contaminants within the collection area. The contaminated ground water is pumped and collected from a series of wells within the collection area. The collected aquifer water is pumped to the R.O. plant or to three large lined evaporation ponds for passive and forced (spray) evaporation.

In the years from 1977 to the present, the combination of injection wells and the up-gradient collection system has gradually continued the withdrawal of the contaminated ground water plume up-gradient of the current hydraulic barrier which assists in aquifer restoration of ground water concentrations to or below site background levels.

An average of 581 gallons per minute (gpm) was pumped into the on-site alluvial fresh-water injection systems in 2011. An additional 55 gpm of fresh water was injected into the Upper and Middle Chinle aquifer systems. An average rate of 170 gpm of R.O. product water was injected into the alluvial aquifer in 2011, in addition to the fresh-water injection program. Production of significant quantities of R.O. product water started in July of 1999 with consistent operation during 2000 through 2011 except during equipment repair periods.

In 2011, the average collection rate for the alluvial aquifer was maintained at 257 gpm. An additional 25 gpm was pumped from the alluvial aquifer and re-injected within the collection area. The Upper Chinle aquifer collection program consisted of pumping wells CE2, CE5, CE6, CE7, CE11 and CE12 at an average rate of 88 gpm in 2011. The up-gradient alluvial aquifer collection system was estimated at 67 gpm in 2011, while average rates of 27 and 104 gpm were pumped from the Large Tailings Pile toe drains and in situ tailings pile dewatering, respectively.

The continuing evaluation of the performance of the Grants restoration system, including the 2011 results, shows that sulfate, TDS, chloride, uranium, selenium and molybdenum are still the key constituents of interest at this site. Successful restoration of ground water quality with respect to these key constituents will also accomplish restoration for other constituents. The monitoring program has shown that any low levels of nitrate, radium-226, radium-228, vanadium and thorium-230 are also reduced when the key constituents are restored in a particular area.

Data relating to key constituents currently being restored at the site have been reviewed and statistically evaluated to determine upgradient site background water quality. These background water quality levels have been accepted by NRC, EPA and NMED; the NRC has set site standards based on the background water quality and accordingly amended the Radioactive Material license to reflect those standards. It should be noted that these site standards are utilized throughout this report for comparison purposes in discussing restoration progress.

Observed alluvial aquifer concentrations of key constituents at the Grants site were similar to those in previous years. The only areas where sulfate, TDS and chloride concentrations exceed the alluvial site standard are small localized areas east of Valle Verde plus the large area in close proximity to the Large and Small Tailings Piles in the Grants Project area.

Uranium concentrations exceed the alluvial site standard of 0.16 mg/l within the collection area near the tailings. There are also six wells in Felice Acres and one well in Murray Acres subdivision that contain concentrations of uranium exceeding the site standard. Ground water withdrawal for irrigation is being used to further reduce uranium levels that exceed the standard in an area southwest of Felice Acres in Section 3 and in the western half of Section 27 and Section 28. Collection of water from one well in Murray Acres is being used to reduce uranium concentrations in that area.

Selenium concentrations also exceed the relevant site standard in the collection area near the Large Tailings Pile and southeast of the Small Tailings Pile. None of the sampled subdivision wells contained selenium concentrations above the site standard.

None of the subdivision wells contain molybdenum concentrations above the site standard of 0.1 mg/l. The wells exhibiting elevated molybdenum concentrations are all located near the Large and Small Tailings Piles, to the southeast of the Small Tailings Pile, and in an area in central Section 27. Migration of this constituent has been limited due to natural retardation within the alluvial aquifer.

Nitrate concentrations are compared to the alluvial site standard of 12 mg/l. Areas to the west of the Large Tailings Pile contain higher nitrate concentrations above the site standard, but these levels are likely natural given their location. Nitrate concentrations in the area of the Large and Small

Tailings Piles and to the east are likely caused by tailings seepage. A small area southeast of Valle Verde area exceeds the nitrate alluvial site standard. Water quality with respect to this constituent should easily be remediated through the ongoing restoration program.

All radium values in the alluvial aquifer outside of the tailings perimeter were less than the site standard. This demonstrates that radium is only a constituent of concern under the Large Tailings Pile.

None of the vanadium concentrations measured in 2011 exceeded the alluvial site standard. Concentrations of this constituent have been adequately restored to below the site standard except for levels immediately under the Large Tailings Pile.

Thorium levels observed in 2011 were less than the site standard except levels in the alluvium immediately under the Large Tailings Pile. The mobility of this constituent has been very limited and is found in close proximity to the tailings. However, the analytical results for this constituent vary significantly at the low observed levels as they are approaching laboratory detection limits. Slightly higher values should not be given any significance until they are supported by additional monitoring. The monitoring records for thorium indicate that it is a minor constituent of concern at the Grants site.

Fresh-water injection into Upper Chinle well CW13 and 944, (See Figure 5.1-2), east of the East Fault, continued in 2011. This injection has maintained higher water levels in the Upper Chinle aquifer east of the East Fault which in turn has allowed continued operation of the nearby Upper Chinle collection wells.

Fresh-water injection continued in 2011 in Upper Chinle well CW5 just north of Broadview Acres and also in Upper Chinle wells CW4R and CW25. This injection has resulted in gradient reversal within the Upper Chinle, thereby forcing ground water from this area back to the north toward the tailings piles. Collection from Upper Chinle well CE2 was initiated in 1999 and continued through 2011. Collection in Upper Chinle wells CE5, CE6, CE11 and CE12 was started in 2006. Collection from Upper Chinle well CE7 started in late 2010. This collection is used in conjunction with injection wells CW4R, CW5 and CW25 to restore ground water quality in this area. Injection into well CW25 was started in 2000 and continued through 2011.

All sulfate, chloride and TDS concentrations in the Upper Chinle aquifer are below the site standards except for samples from wells CE7 and CE13. Therefore, the Upper Chinle aquifer only requires restoration with respect to TDS, chloride and sulfate in a localized area near the Large Tailings Pile.

Uranium concentrations in eleven Upper Chinle wells exceeded the Upper Chinle site standard in 2011. Restoration of these elevated values should result from CE2, CE5, CE6, CE7, CE11 and CE12 well collection and the CW4R, CW5 and CW25 well injection efforts.

Selenium concentrations in the Upper Chinle aquifer exceed the site standard in five wells in the mixing zone. The site standards for selenium for the Upper Chinle mixing zone and the Upper Chinle non-mixing zone are 0.14 and 0.06 mg/l, respectively.

The concentrations of molybdenum exceeded the site standard in two wells near the tailings in the Upper Chinle aquifer and six more to the south of the Collection Ponds during 2011. Restoration for these locations should occur from continued CE2, CE5, CE6, CE7, CE11 and CE12 well collection and CW4R, CW5 and CW25 well injection activities.

All nitrate concentrations observed in 2011 for the Upper Chinle mixing zone were less than the nitrate site standard. This indicates that nitrate is not a constituent of concern in this aquifer.

None of the Upper Chinle wells contain a radium-226 plus radium-228 value above 5 pCi/l. Two Upper Chinle well near the Large Tailings Pile exceeded the site standard for vanadium concentrations from the 2011 sampling. The highest measured thorium-230 concentration near the Large Tailings Pile in the Upper Chinle aquifer wells during 2011 was less than 0.4 pCi/l at wells CE7 and CE13. This is consistent with the low observed concentrations in the overlying alluvial aquifer.

The direction and rate of ground water flow in the Middle Chinle aquifer in 2011 is very similar to that of past years. Fresh-water injection into well CW14 started in December of 1997. Fresh-water injection into wells CW30 and CW46 started in 2004. The fresh water is building up a mound of ground water in this area, which will result in a reversal of the flow of Middle Chinle water back toward the alluvial subcrop. Well CW28 was added as a supply well for fresh-water injection in 2002 but was not used during 2011.

Water quality in the Middle Chinle aquifer is generally good. All sulfate concentrations are less than the site standards except for exceedance in the mixing zone area at wells CW24 and WR25. All TDS concentrations in the Middle Chinle aquifer are less than the standards except for four TDS values in Broadview and Felice and two in Murray Acres that are slightly above the non-mixing zone background value and one TDS value in a well west of the West Fault. Only the chloride concentrations in well ACW exceed the Middle Chinle site standard. This chloride concentration is above recent values and is not supported by similar percent increase in sulfate and TDS. Additional monitoring is needed before giving this value any significance. Uranium concentrations in the western portion of Felice Acres are above mixing zone site standards due to the alluvial recharge to the Middle Chinle aquifer just south of Felice Acres. Uranium concentrations in the non-mixing zone in the western portion of Broadview Acres are also above site standards. Continued irrigation use of this water by Homestake will reduce these elevated concentrations in western Felice Acres and Broadview Acres. The uranium background is also exceeded in well CW1 north of the LTP and wells CW17, CW35 and WR25 west of the West Fault. The non-mixing zone selenium site standard is slightly exceeded in well CW28 which is located east of the East Fault and also well 493 in Felice Acres (See Figure 6.3-14). The mixing zone selenium site standard is exceeded in well CW17. Molybdenum concentration in well CW17 is the only Middle Chinle value above the mixing zone standard of 0.10 mg/l, while well 482 exceeded the standard in the non-mixing zone.

Nitrate, radium, vanadium and thorium-230 concentrations in the Middle Chinle aquifer are at less than significant levels for each of the constituents. Hence, uranium and selenium are considered the important constituents relative to restoration needs for the Middle Chinle aquifer system.

Concentrations of major constituents in the Lower Chinle aquifer generally increase in the down-gradient direction due to the slow movement of water in the fractured shale. All sulfate, TDS and chloride concentrations are less than the site standards except in far-down-gradient areas, where natural concentrations exceed the non-mixing zone site standard. These exceedances are a result of the limited background data for the far-down-gradient areas of the Lower Chinle aquifer, and there is a naturally occurring deterioration of Lower Chinle water quality in the down-gradient direction. The uranium site standards in the Lower Chinle aquifer are exceeded in three wells. The two wells where concentrations exceed the mixing zone site standard of 0.18 mg/l are located near the subcrop of the Lower Chinle aquifer with the alluvial aquifer. Concentrations in one non-mixing zone well exceed the site standard of 0.03 mg/l.

Concentrations of selenium do not exceed the standards in the two zones for the Lower Chinle aquifer. All molybdenum concentrations in the Lower Chinle aquifer are less than the site standard. None of the Lower Chinle nitrate concentrations exist at a significant level. All radium, vanadium and thorium-230 concentrations in the Lower Chinle aquifer in 2011 were at low levels for these constituents.

## 1.2 INTRODUCTION

This report, as required by the New Mexico Environment Department (NMED) discharge plan DP-200 and the Nuclear Regulatory Commission (NRC) License SUA-1471, presents results of the 2011 annual ground water monitoring program at Homestake's Grants Project. Homestake Mining Company (HMC) conducted uranium milling operations five miles northeast of Milan, New Mexico from 1958 to 1990 (see Figure 1.2-1). Referred to as the Grants Project or Grants site, HMC deposited uranium tailings from the alkaline leach (high pH) Grants mills into two unlined piles (Large and Small Tailings Piles) that overlie San Mateo alluvium. The San Mateo alluvium is simply referred to as the alluvium or alluvial aquifer in this report. In 1977, due to initial concerns about ground water selenium levels, HMC installed a system of wells and pumps in order to inject fresh water into the alluvium at the property boundary and to withdraw contaminated water from the alluvium near the tailings.

Previous monitoring reports have been published in quarterly, semi-annual and annual reports[1], which were presented to the NMED and the NRC.

Four subdivisions, Broadview Acres, Murray Acres, Felice Acres and Pleasant Valley Estates, are adjacent to the HMC site. These subdivisions are shown on many of the various report figures found in this report.

Monitoring data for ground water west of the project site is included in the 1995 through 2011 reports (see Appendix A for water levels and Appendix B for water quality). This area has been designated the "West Area" and was so labeled on the figures in the annual reports prior to 2003. The 2003 through 2011 annual reports combine the project site and West Area figures on one 11 x 17 inch set of figures.

The annual ALARA audit, required as an NRC license condition, is presented in Appendix C. Additionally, a report of an annual inspection of the tailings piles and pond dikes must be submitted per license condition and is presented in Appendix D. Appendix E provides an annual land-use survey discussion for the immediate Grants site area; this was an added license condition beginning in 2002. The annual radon flux survey report for the Large and Small Tailings Piles is

1 See Hydro-Engineering 1983b, 1983c, 1984a, 1984b, 1984c, 1985a, 1985b, 1985c, 1985d, 1986a, 1986b, 1986c, 1987a, 1987b, 1988a, 1988b,, 1990, 1991, 1992, 1993a, 1994, 1995, 1996, 1997, 1998, 1999, 2000a, 2001a, 2002, 2003a, 2004, 2005, 2006, 2007, 2008, 2009, 2010 and 2011.

presented in **Appendix F** of this report.

A detailed table of contents is included at the front of each report section including a list of associated section figures and tables.

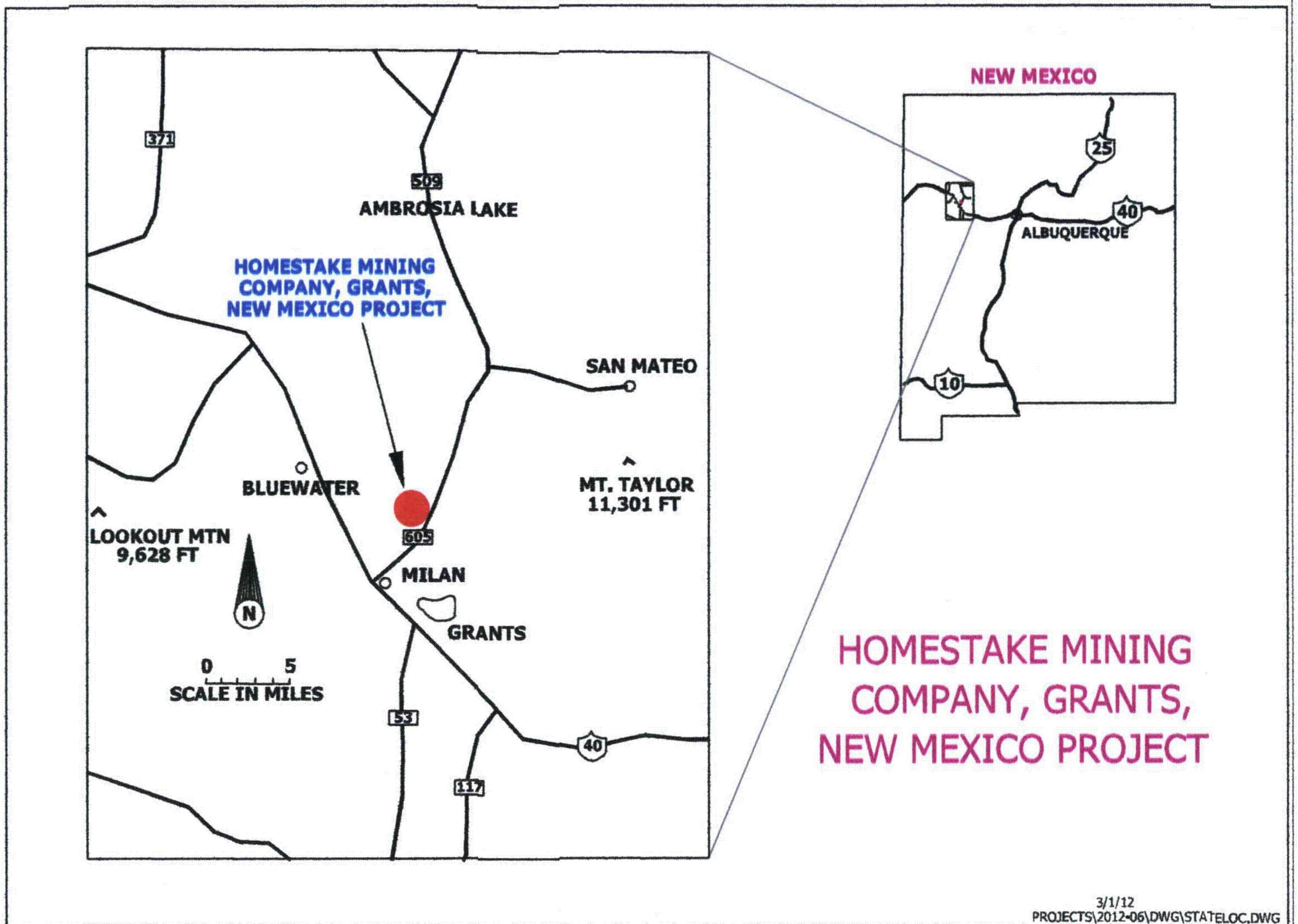


FIGURE 1.2-1. LOCATION OF THE GRANTS PROJECT

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## GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT

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## FIGURES

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## GROUND WATER MONITORING FOR HOMESTAKE'S GRANTS PROJECT
**(continued)**

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### FIGURES
**(continued)**



### TABLES

## 2.0 OPERATIONS

### 2.1 CURRENT OPERATIONS SUMMARY

The annual precipitation of 7.6 inches at the Grants Project site in 2011 is below the normal precipitation for Grants, New Mexico. This below normal condition would be expected to cause water levels at the Grants site to decline.

The Grants Project ground water remediation system consists of collection of contaminated ground water near the tailings piles and down-gradient injection of fresh water and R.O. product water. These collection and injection systems continued to operate in 2011, along with the reverse osmosis (R.O.) plant, which is used to treat and manage the majority of collected ground water. The R.O. plant produces product water that is of much better quality than the natural alluvial water, and it is used as injection water in some areas of the Grants Project restoration program. Figure 2.1-1 on page 2.1-13 shows the location of the present (end of 2011) injection and collection systems along with their starting dates of operation. Water collected from the site is pumped to the R.O. plant or discharged into lined collection ponds or one of three lined evaporation ponds (light blue areas).

The area where ground water flow is controlled by the fresh-water injection and collection systems is called the "Collection Area" and is shown by the yellow cross-hatched pattern on Figure 2.1-1. All of the alluvial ground water within the collection area converges to the collection wells.

#### 2.1.1 R.O. PLANT

The R.O. plant utilizes a lime/caustic pre-treatment and clarification unit. Blowdown (sludge) from the pre-treatment unit discharges to the West Collection Pond with the treated water feeding the two 300 gpm low-pressure R.O. units. The brine from the No. 1 low-pressure unit feeds a 75-gpm high-pressure R.O. unit. The No. 2 R.O. unit is a single stage, low pressure 300 gpm system. The R.O. product water from the two units is discharged to a series of injection wells. The brine from the R.O. plant is discharged to the evaporation ponds. Other miscellaneous flows and blowdown from the R.O. plant are pumped to the West Collection Pond for recycle to the R.O. plant.

The R.O. plant inputs and output of R.O. product water for injection are listed in the following tabulation:

| R.O. Plant Performance (GPM)<br>(2000-2011) | | | | |
|---|---|---|---|---|
| Year | Input | | Output | |
| | Collection Wells | Tailings Collection | R.O. Injection | Brine |
| 2000 | 274 | 0 | 204 | 70 |
| 2001 | 276 | 5 | 222 | 59 |
| 2002 | 383 | 5 | 288 | 100 |
| 2003 | 338 | 4 | 266 | 76 |
| 2004 | 293 | 12.2 | 249 | 64 |
| 2005 | 250 | 6.4 | 198 | 49 |
| 2006 | 257 | 2.1 | 184 | 48 |
| *2007* | *262* | *0.0* | *204* | *55* |
| 2008 | 264 | 3.1 | 194 | 60 |
| 2009 | 251 | 0.3 | 171 | 60 |
| 2010 | 240 | 0.0 | 166 | 59 |
| 2011 | 257 | 1.4 | 170 | 58 |

Aquifer restoration results continue to show that the R.O. product water injection is much more effective than the fresh water in reducing the uranium and molybdenum concentrations within the alluvial aquifer.

### 2.1.2 COLLECTION

The 2011 alluvial aquifer collection rate was slightly greater than the 2010 rate. In general, the R.O. plant was operated on a single unit 300 gpm basis during 2011; each of the two R.O. units were operated alternatively to allow single unit operation while the other unit was on a backwash cleaning cycle.

Up-gradient alluvial aquifer collection continues north of County Road 63. Wells P2, P3 and P4 were used to collect upgradient alluvial aquifer water (brown triangle symbol on Figure 2.1-1) for the tailings flushing program for 2011. These collection wells reduce the quantity of alluvial water flowing into the tailings area. Upper Chinle aquifer collection continued from wells CE2, CE5, CE6, CE11 and CE12 in 2011 (gold X symbols located south of the collection ponds), and this water was used as injection supply water for the Large Tailings Pile (LTP) flushing program described later in Section 2.1.5. Upper Chinle well CE7 was also pumped some in 2011 to the R.O. plant. A small portion of the tailings dewatering (1.4 gpm) was also an input to the R.O. plant.

#### 2.1.2.1 ALLUVIAL AQUIFER

Figure 2.1-1 shows the locations of five lines of alluvial aquifer collection wells (red x symbols). The S and D-lines are adjacent to the Large Tailings Pile and the K and C-lines are adjacent to the Small Tailings Pile. Alluvial wells M9 and MQ were added to the alluvial collection system in 2011. The L-line south of the Small Tailings Pile continued to operate in 2011 and includes collection wells 521, 522 and 639 which are located on the east side of Highway 605 (see Figure 4.1-1 for location). Alluvial water is pumped from these lines of collection wells to the R.O. plant or, depending on water quality; it is pumped to re-injection wells. Figure 2.1-2 on page 2.1-14 graphically presents collection rates for the last twelve years at the Grants Project. The alluvial collection system operated at an average rate of 257 gpm in 2011. Additionally, an average of 25 gpm was extracted from the alluvium for re-injection in 2011.

### 2.1.2.2 UP-GRADIENT ALLUVIAL WATER

Collection of alluvial water up-gradient of the tailings piles started in January of 1993 and continued through 2011. Wells P2, P3 and P4 were pumped in 2011 (see Figure 2.1-1). This up-gradient water was pumped to the supply for tailings flushing. The pumping of this up-gradient water prevents some of the alluvial water from entering the Grants Project area at the north side of the Large Tailings Pile and helps maintain the gradient reversal. The collection rate for this effort averaged 67 gpm during 2011 (see Figure 2.1-2). Monthly rates for the up-gradient wells are presented for 2011 in Figure 2.1-2.

### 2.1.2.3 UPPER CHINLE AQUIFER

Figure 2.1-2 shows the collection rate for Upper Chinle collection wells CE2, CE5, CE6, CE7, CE11 and CE12, which are located on the north and south sides of the collection ponds. Collection from Upper Chinle well CE2 started in 1999 and is expected to continue for several years. Collection from wells CE5 and CE6 started in August 2006 while pumping from wells CE11 and CE12 was initiated in October of 2006. These wells were used to supply water to the Large Tailings Pile for the tailings flushing program during 2011. Upper Chinle collection well CE7 was pumped to the R.O. plant some in 2011. The yearly average collection rate from the Upper Chinle was 88 gpm.

### 2.1.2.4 OFF-SITE (IRRIGATION)

Only the Section 28 center pivot irrigation system was operated in 2011 (see Figure 2.1-1 for locations). The 100 acres of pivot irrigation in Section 28 were used from June 14th through October 12th in 2011. Figure 2.1-1 shows the supply wells for these irrigated areas. In 2011, wells 634, 659, 886, 890, 951, and MS were used for the irrigation supply to the Section 28 area. Water from these supply wells is collected into a common piping system and is supplied to the center pivot. Only the Section 28 pivot was irrigated during a portion of the 2011 growing season with the vegetation in the irrigated area being baled at the end of the 2011 irrigation season. A total of 213 ac-ft of water was applied to the Section 28 irrigation area in 2011. The average uranium and selenium concentrations applied to the Section 28 field were 0.14 and 0.03 mg/l, respectively, in 2011. Water from San Andres well 951 was added to the irrigation supply to reach these reduced levels.

The cumulative volume of water applied to the irrigation (land treatment) field from 2000 through 2011 is presented in Figure 2.1-3 which shows that three billion gallons of water have been pumped from the Off-site (land treatment) collection wells. The volume of water pumped the last two years to the irrigation fields has decreased due to limits on the irrigation program. Figure 2.1-3 shows a comparison between the volumes of water pumped for the Off-site collection versus the volume of collection water of the On-site collection to the R.O. plant since 2000. The volume of Off-site collection water has been greater than 150 % of the volume of water collection On-site for the same period.

The 2011 Irrigation Report, ERG and Hydro-Engineering, LLC 2011, presents the monitoring results which shows no affects on the uranium and selenium concentrations in the underlying ground water from the HMC irrigation/land treatment program.

### 2.1.2.5 QUANTITY OF CONSTITUENTS COLLECTED FROM THE ALLUVIAL AQUIFER

Table 2.1-1 (page 2.1-25) presents the quantities of chemical constituents extracted from the On-site ground water system, the tailings piles and the toe drains. The ground water collection system has produced an average pumping rate of 258 gpm for the entire period between 1978 and 2011. The portion of the collection water that has been re-injected into the alluvial aquifer is not included in the values in Table 2.1-1. The quantity of constituents removed in 2011 was computed by multiplying the average concentration of a particular constituent for each source of water (ground water, toe drains and tails collection) by the volume of water pumped for each that year.

Figure 2.1-4 presents the volume of water and the pounds of uranium removed by the On-site and Off-site (land treatment) collection systems from 2000 through 2011. The light blue and green bars show the comparison of the two volumes for each year while the red and gold bars present the pounds of uranium removed respectively by the Off-site and On-site collection. The figure shows that the volume of water collected from the Off-site wells is very important and generally larger than the On-site collection but the pounds of uranium are small in this Off-site collection compared to the pounds removed by the On-site collection.

### 2.1.3 INJECTION

The fresh-water and R.O. injection systems, which aid in the reversal of the ground water gradients back toward the collection wells, consist of lines of injection wells and infiltration lines, which are oriented generally along the east, south and west perimeter of the two tailings piles and evaporation pond complex (see green and blue circles and infiltration lines on Figure 2.1-1).

In 2003, approximately 2100 feet of four-inch corrugated slotted polyethylene pipe was installed at a depth of approximately 6 feet below land surface west of the Large Tailings Pile to serve as a horizontal infiltration line (see green line on Figure 2.1-1). A filter sock was placed over the pipe thus negating the need for a sandpack. Water is currently being injected into this injection line (S injection line) at three locations. The 2011 injection rate for this horizontal injection line is included in the Broadview and Murray Acres injection rates, and was approximately 127 gpm for the year.

In July 2004, two 250 foot sections of injection line (EBA1 and EBA2) were added south of collection well 522 east of Highway 605 (see Figure 2.1-1 for location). The average injection rate for these two lines is estimated at 20 gpm and is included in the Broadview and Murray Acres injection rate.

A 400-foot extension to the S injection line was added on the north end of this line in 2005. Five EMA injection lines were added southwest of the Large Tailings while three ETA injection lines were added east of the Large Tailings in 2005 (see Figure 2.1-1).

#### 2.1.3.1 BROADVIEW AND MURRAY ACRES

The Broadview Acres injection system started in 1977 with the G line on the north side of this subdivision. Injection into the majority of the G-line wells was discontinued in mid-April of 2000 in order to supply more water to injection wells near the collection area. The J-line, wells X1 through X10, and wells X28 through X31 are also considered part of the Broadview Acres injection system. Alluvial fresh-water injection wells 523 and 524 were added to the Broadview Acres injection system in 2002 (see Figure 4.1-1).

All wells adjacent to the northeast corner and to the north and east of Murray Acres are included in the Murray Acres injection system. This system includes all of the M and WR series injection wells. The M line of the Murray Acres injection system was initially used in 1983. Injection into the M-line west of well WR1R was discontinued at the end of September of 2000, and injection into the WR-line, north of WR10, began at this time. The horizontal injection line, west of the Large Tailings Pile, (S. Inj. Line) was added to this system on August 25, 2003. Fresh-water injection into lines ETA1, ETA2 and ETA3 started in July of 2005 while injection into EMA1 with fresh water started in December, 2005.

Figure 2.1-5 (page 2.1-17) presents fresh-water injection rates for the last twelve years. An average of 581 gpm, or a total of 299 million gallons, was injected during 2011.

### 2.1.3.2 R.O. PRODUCT

The R.O. product water injection system currently supplies water to the EMA 2-5 infiltration lines to the south and west of the collection ponds. Until October, 2005, R.O. product water was discharged into the X line and injected into wells X1 through X10, X28 through X31 and into wells K2, K6, KA through KE, KM, KN, C4, C13, C5, C3R and PM. Fresh-water injection was commenced after that date for these wells. R.O. product was switched to injection lines EMA2 through EMA5 in October 2005. Figure 2.1-5 shows the rates of R.O. product water injection, which averaged 170 gpm in 2011 for a total of 87 million gallons.

### 2.1.3.3 UPPER CHINLE AQUIFER

Hydro-Engineering 2003b should be reviewed for a detail discussion of the geologic setting for the Chinle aquifers. From 1984 through early 1995, the Upper Chinle injection system consisted of injecting fresh water into Upper Chinle well CW5, located on the north side of Broadview Acres. This effort restored most of the area in the Upper Chinle aquifer between the two faults. Injection into well CW5 was resumed in April of 1997 and continues at present to complete the restoration of this aquifer.

In order to maintain head in the Upper Chinle aquifer east of the East Fault, injection of fresh water into well CW13, an Upper Chinle well, was begun in June, 1996. Injection into Upper Chinle well CW25, located on the western edge of the Upper Chinle outcrop east of Murray Acres, began in 2000. Injection into CW25 will increase the head in the Upper Chinle aquifer and force flow in the Upper Chinle back toward collection well CE2. Injection into Upper Chinle well 944 started in June of 2002, and injection into well CW4R started in 2003.

The red squares on Figure 2.1-5 present monthly average injection rates into Upper Chinle wells 944, CW4R, CW5, CW13 and CW25, with an overall 2011 average of 41 gpm.

### 2.1.3.4 MIDDLE CHINLE AQUIFER

Injection of San Andres fresh water into Middle Chinle well CW14 was started in December of 1997. This injection was initiated to prevent northward movement of alluvial water that recharges the Middle Chinle on the south side of Felice Acres. The injection rate averaged 14 gpm in 2011 (see Figure 2.1-5). This injection has prevented the movement of constituents further to the north and allows up-gradient collection from wells 482, 483, 493, 498, CW44 and CW45.

### 2.1.3.5 SECTIONS 28 AND 29

A test of fresh-water injection was initiated in late 1999 and continued through January of 2000 by pumping San Andres well 951, which is located in Section 20, (see Figure 2.1-1 for location of supply well 951). This water was subsequently injected into alluvial wells 682, 656, 894, 633 and 655 (see Figure 4.1-1 for location). This fresh-water injection in Sections 28 and 29 was resumed in March of 2002 to impede movement of ground water with modest contaminant concentrations in Section 28 until ongoing irrigation water extraction can reduce these low concentrations. Eight infiltration lines were added in 2005 in Sections 27 and 28 to replace the injection wells and adjust the location of this injection. Injection into lines NPV1 through NPV5 (5 of the 8 infiltration lines) was started on July 27, 2005 while injection into NPV6 was started in December 2005. Fresh water injection into alluvial wells 633 and 655 was restarted in June of 2010. Three additional fresh water infiltration lines (NPV9, NPV10, and NPV11) were added in 2011 to better contain the front of the Section 28 uranium plume. This injection rate averaged 232 gpm for 2011 with a total injected volume of 166 million gallons. Figure 2.1-5 presents the monthly injection rates into wells and infiltration lines located in Sections 28 and 29.

### 2.1.3.6 SECTIONS 35 AND 3

Fresh-water injection in the southwestern quarter of Section 35 was initiated in late 2002 utilizing production from Upper Chinle well CW18 and Middle Chinle well CW28. This water was injected into alluvial wells 641, 642, 848 and 868 (see Figure 4.1-1 for location).

Fresh-water injection into alluvial wells 643, 863, 865 and 866, located in the northeast portion of Section 3 was initiated in 2003. Injection into Middle Chinle wells CW30 and CW46 was added to this program in 2004 (see Figure 2.1-1). Seven infiltration lines in Section 3 and two infiltration lines in Felice Acres were also added in 2004. Two additional infiltraion lines, FA1 in central Felice Acres and WFA1 west of Felice Acres, were added in 2005. These injection wells and lines were supplied with water from San Andres well 943 in 2011. No pumping from well CW28 occurred in 2011 to supply injection water for wells 848 and 868. Injection into three additional infiltration lines (FA2, RCR8, and RCR9) was started in 2011.

Figure 2.1-5 presents the combined monthly injection rates for Sections 34, 35 and 3 fresh-water injection lines and wells (see brown diamond symbols on Figure 2.1-5). This injection effort is associated with the ground water restoration of the Sections 3 and 35 areas. Water collected from wells in Section 3 and 35 is used for the irrigation program. During 2011, the yearly average injection rate in Sections 34, 35 and 3 was 169 gpm.

### 2.1.4 RE-INJECTION

Alluvial water containing relatively low concentrations of contaminants is collected and is then injected into areas of the alluvial aquifer near the Large Tailings Pile with higher concentrations of contaminants in order to enhance restoration in this area. This aspect of the restoration plan at the Grants sites is referred to as the collection for re-injection program. The lower-concentration water will be as effective (see sulfate, uranium, selenium and molybdenum concentrations in plots for wells T and TA – see report Sec. 4.3) as fresh water during the initial stages of restoration, and therefore, re-injection is a beneficial use of this slightly contaminated ground water. Water collected from the L-line to the south of the Small Tailings Pile and wells

521, 522 and 639 was used for re-injection into the alluvial aquifer in 2011. The total collection for re-injection rate in 2011 averaged 25 gpm. Re-injection into alluvial wells X11, X12, D2 through D4, DAA, DAB, DL, DW, DY, DF, DG and DX were used in 2011. The monthly re-injection rates are depicted on Figure 2.1-2 as collection for re-injection use (COL/RE-INJ).

### 2.1.5 TAILINGS CONDITIONS

Tailings wells were installed in the Large Tailings Pile beginning in 1994, and wells have been periodically added through 2011. Forty-one additional tailings injection wells were drilled in 2011 and six additional or replacement 5 inch dewatering wells were also drilled in 2011. Data collected from these wells has been used to estimate the amount of drainable water in the re-contoured, stabilized tailings. The tailings wells are also a primary component of the tailings dewatering program. With the exception of some testing of dewatering options in 1999, no dewatering of the tailings occurred in 1998 and 1999 due to limited available capacity in the evaporation ponds. The complete dewatering program was restarted in 2000 and operated through mid-April 2002. Dewatering rates were reduced through the remainder of 2002 and 2003 due to limited available storage in the evaporation ponds. The dewatering wells were operated near capacity starting in April of 2004 and throughout 2005 and 2006. Dewatering rates were restricted in 2007, 2008, 2009 and 2010 due to limited available storage in the evaporation ponds. The dewatering wells were operated near their capacity in 2011.

Figure 2.1-6 (page 2.1-18) shows the locations of tailings wells that were available for pumping in 2011. The cumulative volume of tailings water pumped from 1995 through 2011 is presented on Figure 2.1-7. A total volume of 369 million gallons of water had been removed from the tailings via dewatering wells by the end of 2011. Of that total, 53 million gallons were pumped from the tailings in 2011. The yearly average collection rate from the tailings wells was 104 gpm in 2011.

Wells 929, 934, CE2, CE5, CE6, CE11, CE12, CW1, CW2, P2, P3 and P4 have been used to supply water for flushing the Large Tailings Pile in 2011. A total of 139 million gallons were injected into the tailings in 2011 from these wells, which is an average rate of 270 gpm. This injection for tailings flushing allows larger extraction rates from the tailings dewatering wells and reduces contaminant concentrations in the tailings.

The volume of water collected from the tailings dewatering wells (light blue bars) and the toe drains (green bars) are also presented on Figure 2.1-8 to show the variations of the collection water each year. This figure also shows the pounds of uranium removed with the tailings dewatering wells (red bars) and the toe drains (gold bars) for each year. The pounds of uranium removed from the toe drains are expected to continue to decrease, as they have the last couple of years, as the concentration from the toe drains decline due to the flushing program. The annual pounds of uranium removed are also expected to decline from the 2011 value with time due to the flushing program.

Table 2.1-1 presents the quantity of constituents collected from the tailings wells since dewatering began in 1995. Tables B.1-1 and B.1-2 of Appendix B present chemical analyses of tailings well water during 2011. Uranium is a key water quality parameter for the tailings solution. Four uranium figures are presented to convey the changes in uranium in the LTP with time. Figure 2.1-9 presents the uranium concentrations in the tailing solution in 2000 shortly after the start of the flushing program. The red pattern shows where uranium concentrations were greater than 40 mg/l while the magenta gives the area where 30 to 40 mg/l concentration existed. The green pattern shows the area of 20 to 30 mg/l and the cyan color shows where uranium concentrations are less then 10 mg/l. Figures 2.1-10, 2.1-11 and 2.1-12 present the tailings uranium solution concentrations for additional times in 2004, 2008 and 2011 respectively. These figures show the decline in uranium concentrations with time. The 2011 contours generally show declining concentrations in the outer sand dikes from ongoing flushing activities which has occurred only in the slime area in recent years. Declines in uranium concentrations in the slime core area also occurred in 2011.

### 2.1.6 TOE DRAIN CONDITIONS

A series of toe drains have been installed around the Large Tailings Pile to intercept perched ground water seeping from the tailings into the alluvium. The locations of the toe drains and their associated sumps are shown on Figure 2.1-6. Nine sumps are located around the perimeter of the Large Tailings Pile that are utilized for collection of toe seepage. Two of these sumps are tied to the old tailings decant towers (East and West reclaim sumps).

the Large Tailings Pile that are utilized for collection of toe seepage. Two of these sumps are tied to the old tailings decant towers (East and West reclaim sumps).

Figure 2.1-7 shows that 353 million gallons of water have been pumped from the toe drains. An average rate of 27.4 gpm of water was collected from the toe drains in 2011, which is significantly less than the 2010 rate. This decrease in rate is due to larger a dewatering rate from the tailings in 2011.

Table 2.1-1 also presents the 2011 quantity of constituents collected from the toe drains (see Tables B.2-1 and B.2-2 of Appendix B for toe drain sump water-quality results for 2011).

## 2.1.7 LINED EVAPORATION PONDS

The use of lined evaporation collection ponds (East Collection Pond and West Collection Pond) began in October of 1986 when the two ponds were constructed. The No. 1 Large Evaporation Pond, located on the Small Tailings Pile, began receiving water in November of 1990. Usage of the No. 2 Large Evaporation Pond began in March of 1996. The No.3 Evaporation pond began operation in December of 2010.

The water from the well collection system and some water from the tailings dewatering wells and toe drains is pumped to the R.O. plant as feed water. The majority of the extracted tailings water is reported directly to the No. 2 Evaporation Pond for subsequent evaporation. Excess water is transferred from the East Collection Pond to the No. 2 Evaporation Pond. When necessary, water is transferred from the No. 2 Evaporation Pond to the No. 1 Evaporation Pond. This transfer is mainly through the turbo mister evaporation spray system. Both ponds use spray systems to enhance evaporation. A total of 110 million gallons (average rate of 214 gpm) of water was delivered to the evaporation pond system in 2011 in addition to the 15 million gallons (average rate of 29 gpm) of natural precipitation added to the pond. A total of 65 million gallons of water was transferred to EP3 from EP1 in 2011. The net evaporation from the evaporation system averaged 223 gpm in 2011, compared to 146 gpm in 2010.

Water quality samples results collected from the No. 1 and No. 2 Large Evaporation Ponds, the East Collection Pond (E COLL POND), and the West Collection Pond (W COLL POND) are presented in Tables B.3-1 and B.3-2 of Appendix B.

**TABLE 2.1-1. QUANTITIES OF CONSTITUENTS COLLECTED.**

| YEAR | SOURCE | TOTAL VOLUME PUMPED (GAL) | SULFATE (SO4) CONC. (MG/L) | SULFATE (SO4) AMT. (LB) | URANIUM (U) CONC. (MG/L) | URANIUM (U) AMT. (LB) | MOLYBDENUM (MO) CONC. (MG/L) | MOLYBDENUM (MO) AMT. (LB) | SELENIUM (SE) CONC. (MG/L) | SELENIUM (SE) AMT. (LB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1978 | G.W. | 27670033 | 5200 | 1200620 | 35 | 8081 | 40 | 9236 | 2 | 462 |
| 1979 | G.W. | 46371629 | 5200 | 2012095 | 35 | 13543 | 40 | 15478 | 2 | 774 |
| 1980 | G.W. | 39385860 | 5200 | 1708978 | 35 | 11503 | 40 | 13146 | 2 | 657 |
| 1981 | G.W. | 91613183 | 5200 | 3975155 | 35 | 26756 | 40 | 30578 | 2 | 1529 |
| 1982 | G.W. | 159848025 | 5200 | 6935910 | 35 | 46684 | 40 | 53353 | 2 | 2668 |
| 1983 | G.W. | 167018540 | 5200 | 7247043 | 35 | 48778 | 40 | 55746 | 2 | 2787 |
| 1984 | G.W. | 203258522 | 5200 | 8819519 | 35 | 59362 | 40 | 67842 | 2 | 3392 |
| 1985 | G.W. | 194074421 | 5200 | 8421015 | 35 | 56680 | 40 | 64777 | 2 | 3239 |
| 1986 | G.W. | 199326030 | 5200 | 8648886 | 35 | 58214 | 40 | 66530 | 2 | 3326 |
| 1987 | G.W. | 180881740 | 5200 | 7848576 | 35 | 52827 | 40 | 60374 | 2 | 3019 |
| 1988 | G.W. | 166460826 | 5200 | 7222843 | 35 | 48615 | 40 | 55560 | 2 | 2778 |
| 1989 | G.W. | 175780800 | 5200 | 7627243 | 35 | 51337 | 40 | 58671 | 2 | 2934 |
| 1990 | G.W. | 164378919 | 5200 | 7132508 | 35 | 48007 | 40 | 54865 | 2 | 2743 |
| 1991 | G.W. | 171497720 | 5200 | 7441397 | 35 | 50086 | 40 | 57242 | 2 | 2862 |
| 1992 | G.W. | 128398849 | 4925 | 5276234 | 27.2 | 29134 | 35.9 | 38419 | 1.60 | 1718 |
| 1992 | TOE | 8544670 | 12117 | 864006 | 53.2 | 3793 | 106.5 | 7595 | 1.73 | 123 |
| 1993 | G.W. | 115795020 | 5011 | 4841203 | 28.1 | 27130 | 45.4 | 43885 | 1.47 | 1425 |
| 1993 | TOE | 18357680 | 12117 | 1856262 | 53.2 | 8150 | 106.5 | 16315 | 1.73 | 265 |
| 1994 | G.W. | 98294087 | 4423 | 3624762 | 26.0 | 21146 | 27.3 | 22349 | 1.42 | 1162 |
| 1994 | TOE | 18337680 | 12117 | 1854240 | 53.2 | 8141 | 106.5 | 16299 | 1.73 | 264 |
| 1995 | G.W. | 108306398 | 3256 | 2942827 | 16.1 | 14553 | 19.2 | 17355 | 1.65 | 1491 |
| 1995 | TOE | 17711370 | 11370 | 1680500 | 54.6 | 8069 | 94.4 | 13952 | 2.25 | 332 |
| 1995 | TAILS | 5905740 | 8191 | 403680 | 36.1 | 1778 | 89.7 | 4420 | 0.15 | 7 |
| 1996 | G.W. | 122064160 | 3899 | 3967919 | 20.9 | 21225 | 26.8 | 27259 | 1.92 | 1950 |
| 1996 | TOE | 15431810 | 11537 | 1484295 | 46.4 | 5970 | 105.0 | 13509 | 1.29 | 166 |
| 1996 | TAILS | 9181390 | 9434 | 722129 | 40.2 | 3077 | 108.0 | 8236 | 0.18 | 14 |
| 1997 | G.W. | 94465562 | 4955 | 3836678 | 26.9 | 20892 | 33.4 | 25887 | 3.17 | 2456 |
| 1997 | TOE | 12029390 | 11094 | 1113808 | 41.8 | 419 | 100.0 | 10040 | 0.81 | 81 |
| 1997 | TAILS | 21292900 | 10284 | 1827575 | 45.8 | 8139 | 92.4 | 16420 | 0.14 | 25 |
| 1998 | G.W. | 74459130 | 5088 | 3161866 | 29.6 | 18385 | 34.8 | 21625 | 1.85 | 1151 |
| 1998 | TOE | 10321780 | 9870 | 850257 | 42.5 | 3665 | 95.2 | 8203 | 0.73 | 63 |
| 1999 | G.W. | 117752408 | 3363 | 3305027 | 16.6 | 16314 | 14.8 | 14545 | 2.06 | 2024 |
| 1999 | TOE | 8809890 | 11560 | 849976 | 54.3 | 3993 | 106.0 | 7794 | 0.46 | 34 |
| 1999 | TAILS | 120550 | 9420 | 9478 | 40.9 | 41 | 111.5 | 112 | 0.19 | 0 |
| 2000 | G.W. | 146609842 | 3358 | 4108868 | 18.8 | 23004 | 20.6 | 25206 | 1.94 | 2374 |
| 2000 | TOE | 8032870 | 9734 | 652590 | 58.6 | 3929 | 118.0 | 7911 | 0.34 | 23 |
| 2000 | TAILS | 12446810 | 9710 | 1008685 | 37.8 | 3927 | 127.0 | 13193 | 0.30 | 31 |
| 2001 | G.W. | 144925056 | 2770 | 3350438 | 19.6 | 23707 | 21.4 | 25884 | 1.65 | 1996 |
| 2001 | TOE | 9606280 | 9935 | 796529 | 43.1 | 3455 | 95.7 | 7673 | 0.78 | 63 |
| 2001 | TAILS | 31465370 | 8688 | 2281555 | 34.6 | 9086 | 89.2 | 23425 | 0.19 | 50 |
| 2002 | G.W. | 201357360 | 2748 | 4618092 | 14.9 | 25040 | 16.7 | 28065 | 1.23 | 2067 |
| 2002 | TOE | 17975520 | 9210 | 1381718 | 33.4 | 5011 | 88.7 | 13307 | 0.76 | 114 |
| 2002 | TAILS | 17817840 | 7670 | 1140588 | 23.5 | 3495 | 40.8 | 6067 | 0.12 | 18 |
| 2003 | G.W. | 177727419 | 2417 | 3585168 | 13.8 | 20470 | 15.5 | 22991 | 0.73 | 1083 |
| 2003 | TOE | 28418871 | 9457 | 2243048 | 35.6 | 8444 | 78.9 | 18714 | 4.35 | 1032 |
| 2003 | TAILS | 8890076 | 9800 | 727126 | 28.0 | 2078 | 92.0 | 6826 | 0.30 | 22 |
| 2004 | G.W. | 154422720 | 2272 | 2931913 | 11.3 | 14633 | 16.6 | 21386 | 0.79 | 1017 |
| 2004 | TOE | 26720928 | 8007 | 1787722 | 31.9 | 7115 | 67.6 | 15102 | 2.78 | 622 |
| 2004 | TAILS | 44745696 | 6360 | 2377848 | 23.1 | 8637 | 60.9 | 22769 | 0.20 | 75 |
| 2005 | G.W. | 130810679 | 2478 | 2705346 | 11.8 | 12883 | 15.5 | 16922 | 0.59 | 644 |
| 2005 | TOE | 20704320 | 8228 | 1421784 | 43.5 | 7517 | 87.5 | 15120 | 2.63 | 454 |
| 2005 | TAILS | 45685786 | 4389 | 1673497 | 18.7 | 7130 | 56.3 | 21467 | 0.18 | 69 |
| 2006 | G.W. | 132406109 | 1990 | 2199072 | 9.6 | 10609 | 14.3 | 15802 | 0.73 | 807 |
| 2006 | TOE | 20374782 | 7432 | 1263796 | 38.0 | 6462 | 76.2 | 12958 | 1.09 | 185 |
| 2006 | TAILS | 43707760 | 4278 | 1560550 | 17.6 | 6420 | 51.9 | 18932 | 0.14 | 51 |
| 2007 | G.W. | 137707200 | 2420 | 2781316 | 10.3 | 11838 | 16.7 | 19193 | 0.52 | 598 |
| 2007 | TOE | 25037779 | 6829 | 1427024 | 31.9 | 6666 | 67.3 | 14063 | 1.20 | 251 |
| 2007 | TAILS | 24561680 | 4130 | 846616 | 19.9 | 4079 | 61.1 | 12525 | 0.15 | 31 |
| 2008 | G.W. | 137145174 | 2672 | 3058408 | 11.5 | 13163 | 16.5 | 18886 | 0.61 | 698 |
| 2008 | TOE | 26140850 | 7847 | 1711992 | 31.6 | 6894 | 68.5 | 14945 | 1.58 | 345 |
| 2008 | TAILS | 5950324 | 4671 | 231968 | 16.0 | 795 | 42.8 | 2126 | 0.24 | 12 |
| 2009 | G.W. | 131564160 | 3145 | 3453318 | 15.5 | 17020 | 19.1 | 20660 | 0.85 | 933 |
| 2009 | TOE | 27238830 | 7792 | 1771396 | 35.0 | 7957 | 69.9 | 15891 | 0.81 | 184 |
| 2009 | TAILS | 29403070 | 3850 | 944782 | 13.7 | 3362 | 38.6 | 9472 | 0.24 | 59 |
| 2010 | G.W. | 125785118 | 2793 | 2932099 | 12.9 | 13542 | 16.6 | 17427 | 0.64 | 672 |
| 2010 | TOE | 18444330 | 6848 | 1054156 | 32.9 | 5065 | 52.1 | 8020 | 0.51 | 79 |
| 2010 | TAILS | 12953960 | 3018 | 326287 | 9.4 | 1016 | 33.5 | 3622 | 0.19 | 21 |
| 2011 | G.W. | 132573855 | 2908 | 3217590 | 14.4 | 15933 | 22.5 | 24895 | 1.23 | 1361 |
| 2011 | TOE | 14777020 | 6747 | 832101 | 29.9 | 3688 | 53.2 | 6561 | 0.44 | 54 |
| 2011 | TAILS | 54713150 | 2887 | 1318308 | 10.5 | 4795 | 33.5 | 15297 | 0.18 | 82 |
| SUM G.W. | | 4,600,136,554 | | 152,922,343 | | 935,159 | | 1,107,145 | | 58,764 |
| SUM TOE | | 353,016,650 | | 26,065,100 | | 110,714 | | 237,409 | | 4,601 |
| SUM TAILS | | 368,842,102 | | 16,082,367 | | 63,060 | | 169,612 | | 463 |
| COMBINED SUM | | 5,321,995,306 | | 195,069,810 | | 1,108,933 | | 1,514,166 | | 63,828 |

NOTE: Average concentrations for 1978 to 1991 were used in calculating the quantities of constituents removed.
Concentrations from the collection wells have gradually decreased from 1978 through 1991.
*G.W. = Ground water; TOE = Toe drains on edge of tailings; TAILS = Large tailings collection wells*

## 2.2 FUTURE OPERATION

Ground water quality restoration in 2012 will continue as a combination of fresh-water and R.O. product injection to maintain the overall piezometric gradient reversal between the lines of injection (M Line, WR Line, J Line and X Line) and contaminated water collection near the tailings piles. The reverse osmosis (R.O.) plant can be operated at a rate of up to 600 gpm but is projected to operate at an average rate of approximately 285 gpm in 2012 based on planned 2012 operation conditions. When the plant is operated at full capacity, approximately 380 gpm of R.O. product would be produced for injection into the alluvium and approximately 150 gpm of brine reject would be discharged to the evaporation ponds. A larger collection rate and use of the very good quality R.O. product for injection will continue to enhance the progress in restoration.

Water collected from the alluvial and Chinle aquifers, where there are relatively low levels of selenium and uranium, will continue to be selectively collected and used for re-injection in the initial phase of restoration of some areas. This re-injection will occur in the alluvium, where concentrations are greater than those of the injected water, until such time as injection with San Andres fresh water or R.O. product water will better complete the restoration. Use of the low-concentration re-injection water will be limited to areas up-gradient of the J, WR and X injection lines. For the purpose of this document, the reversal zone is called the collection area. To date, re-injection has occurred in wells X5 through X27, 1A, C4, D2 through D4 and DAA, DAB, DL, DW, DY, DF, DG, DQ, DX and K and a few tailings pile wells.

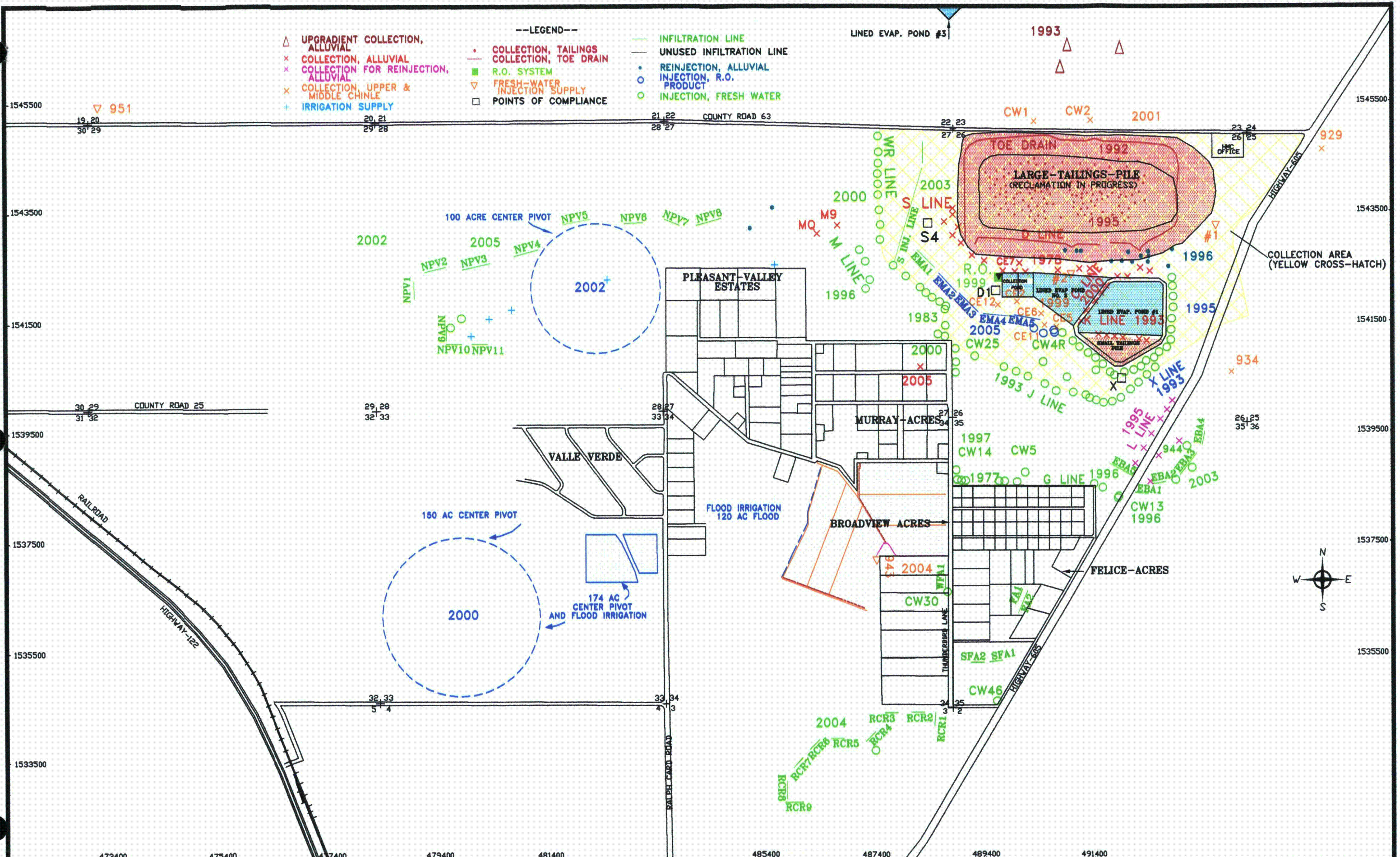
Collection from Upper Chinle wells CE2, CE5, CE6, CE7, CE11 and CE12 will continue to intercept contaminants in this aquifer. Injection into Upper Chinle wells 944, CW4R, CW5, CW13 and CW25 is planned to continue to control the direction of flow in these areas of the Upper Chinle aquifer.

Injection into well CW14 will be continued in order to build the head in this area of the Middle Chinle aquifer. This will prevent alluvial water from flowing into this portion of the Middle Chinle aquifer.

Irrigation with water from Sections 3, 27, 28, 32, 33 and 35 is planned to be continued in 2012. Fresh-water well injection lines in Section 28 will continue to be utilized in 2012 to restore these areas of low level aquifer contamination. Fresh-water injection will be continued in

Sections 35 and 3 in 2012 to complement the use of water for irrigation and assist in final aquifer restoration in this area.

Alternative restoration technologies (pump and treat and *insitu*) for managing contaminated water with small concentrations will continue to be evaluated in 2012. The removal of uranium in zeolite beds will continue to be tested to enable the water, after treatment, to be used in the restoration program. *Insitu* treatment will be tested to evaluate the treatment of ground water in the aquifer. Phosphate precipitation will also continue to be tested to evaluate the removal of small concentrations from the ground water.




SCALE: 1"=1600'
C:\PROJECTS\2012-06\08COLL-INJ.DWG
DATE: 2/23/12

FIGURE 2.1-1. LOCATION OF PRESENT INJECTION AND COLLECTION SYSTEMS WITH START OF OPERATION DATES, 2011

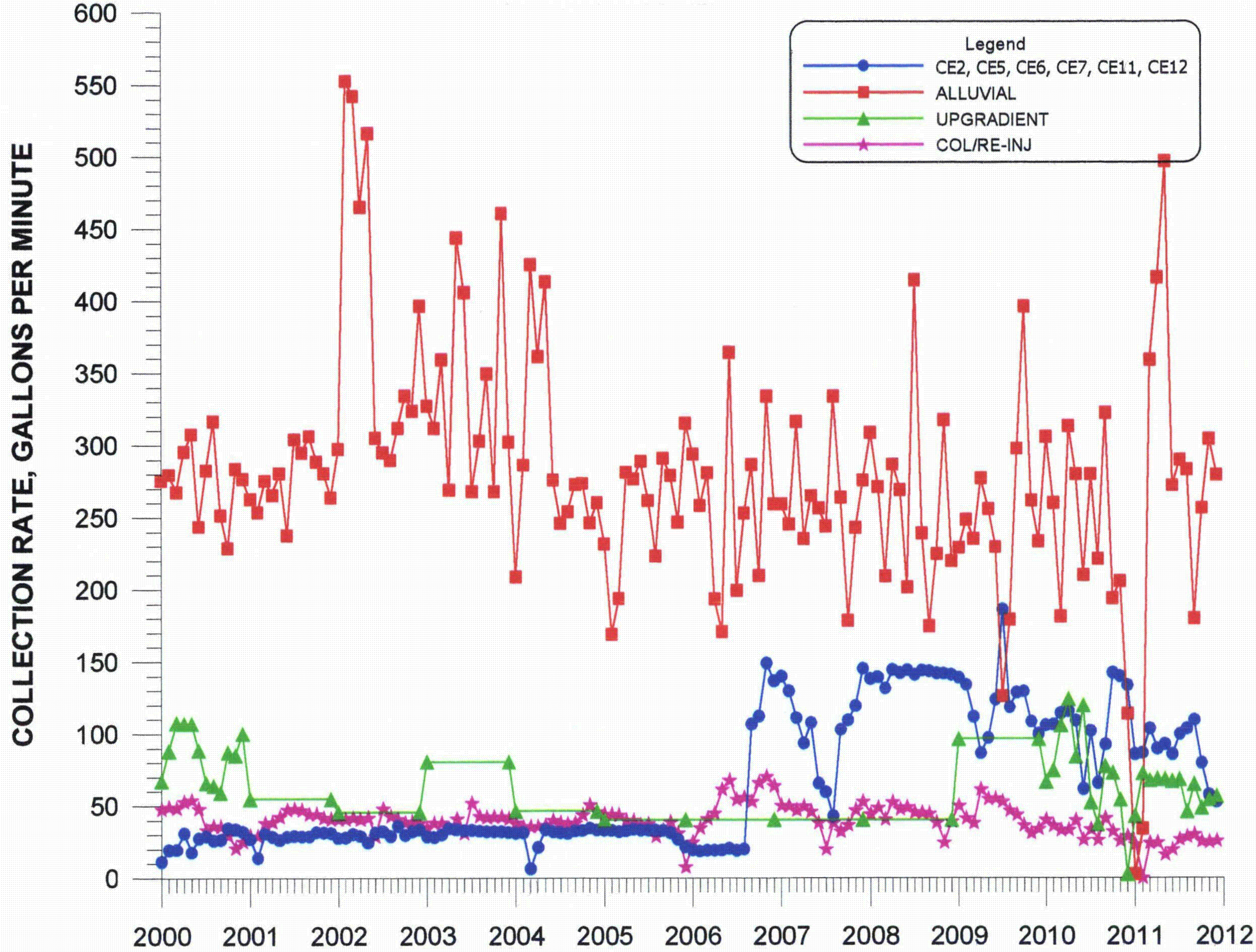



**FIGURE 2.1-2. AVERAGE MONTHLY COLLECTION RATES FOR THE ALLUVIAL AND UPPER CHINLE AQUIFERS.**

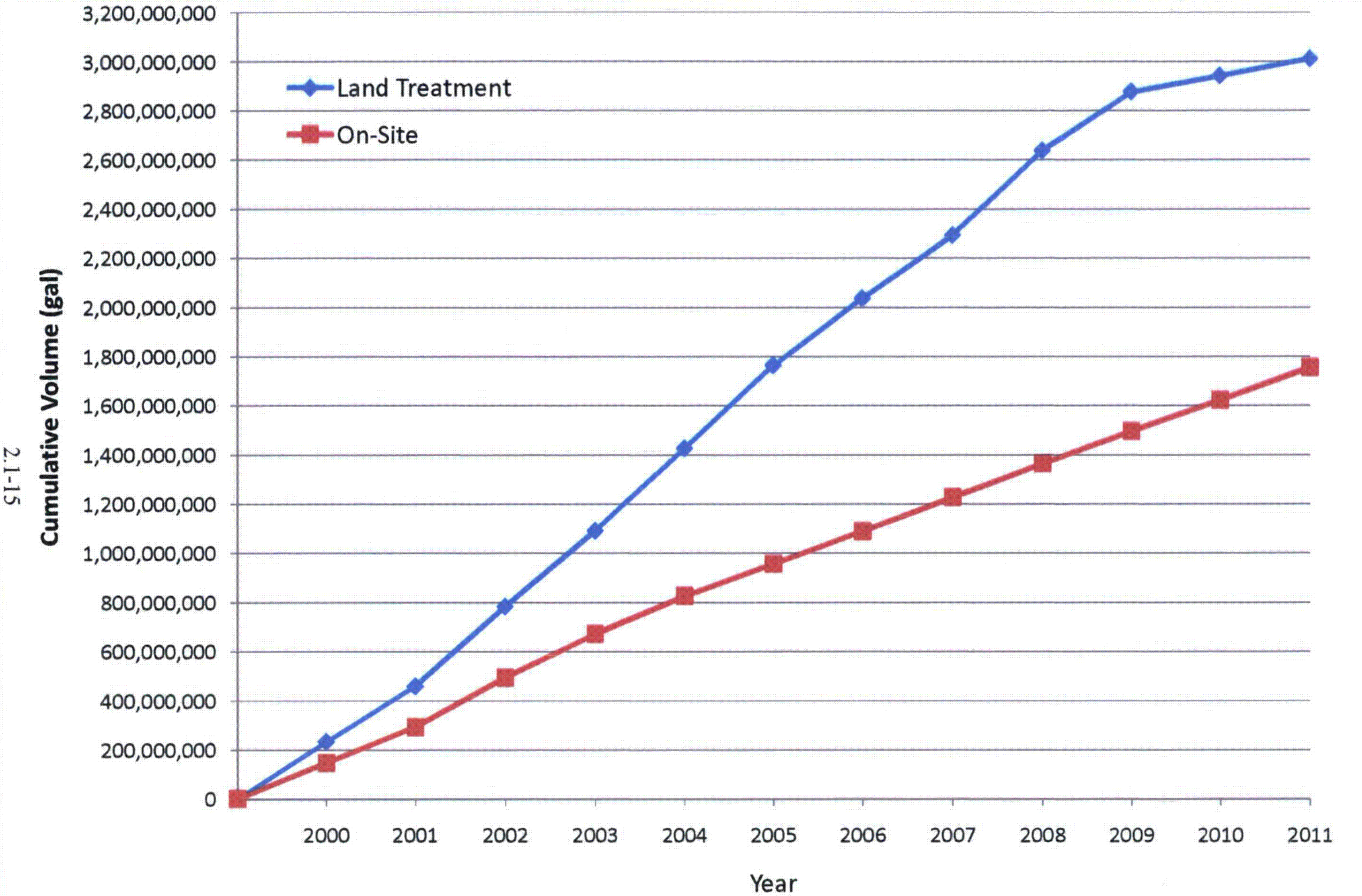



**Figure 2.1-3. Cumulative Volume of Land Treatment and On-Site Collection from 2000 to Present**

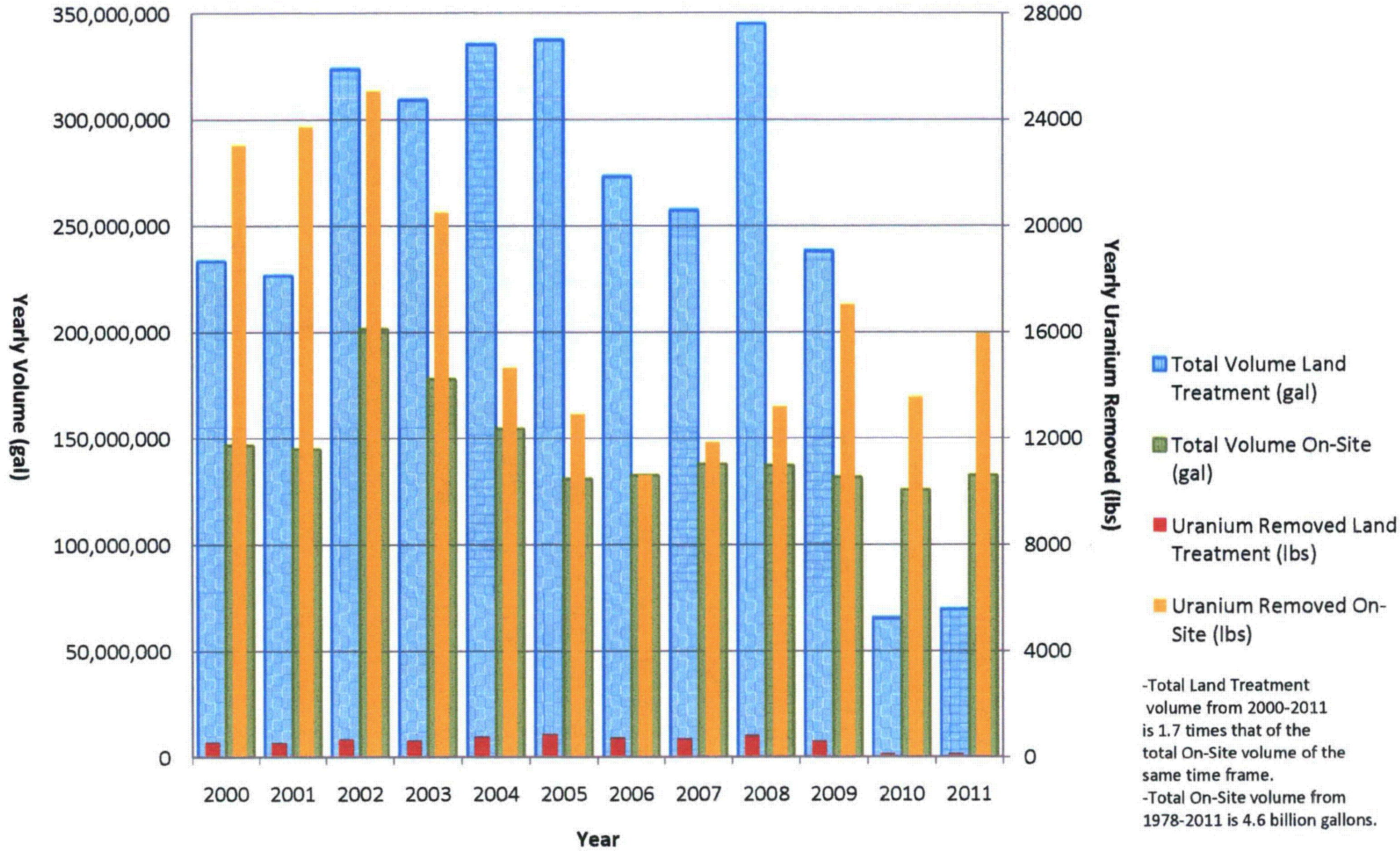



**Figure 2.1-4. Yearly Quantity of Water and Uranium Removed**

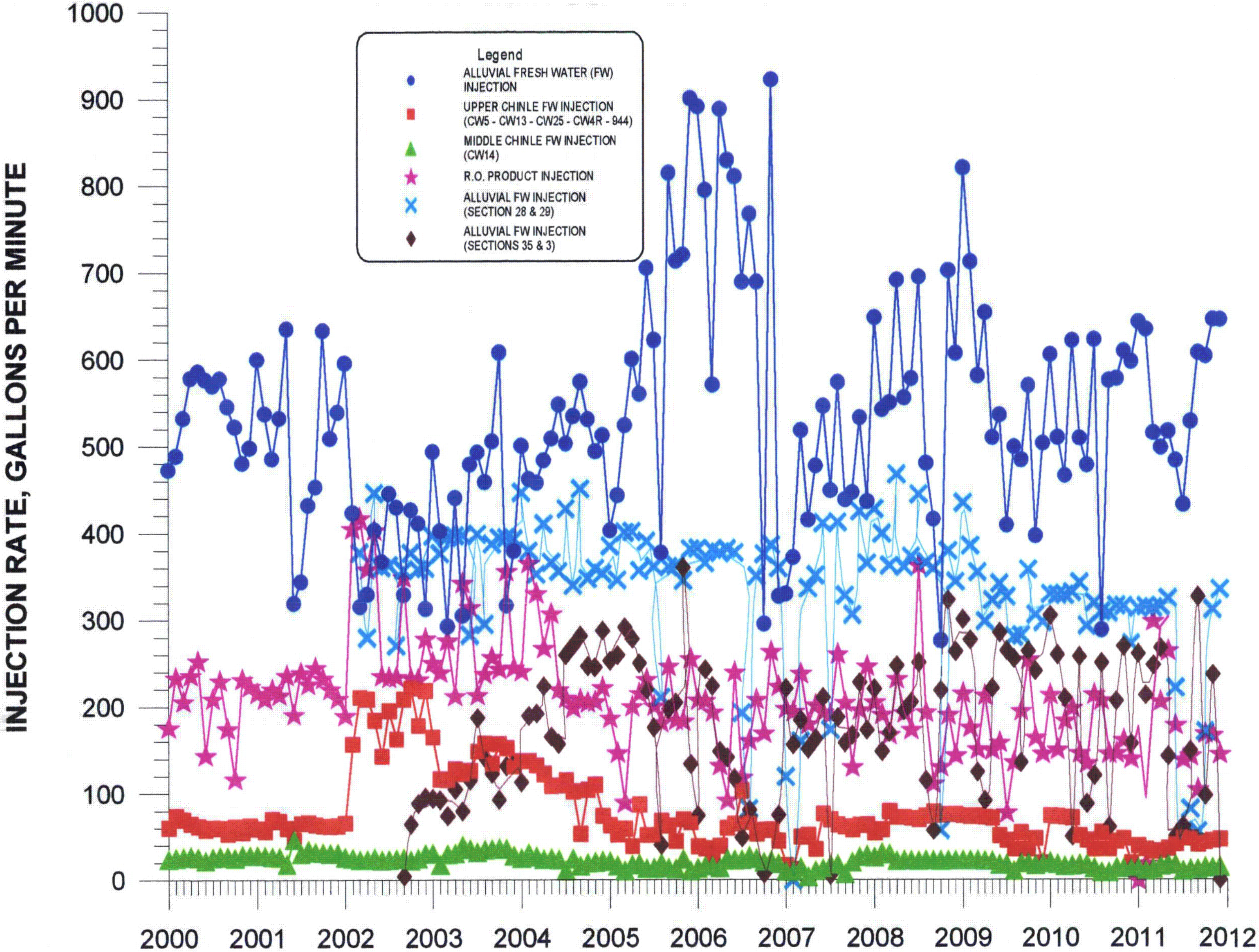



**FIGURE 2.1-5. AVERAGE MONTHLY INJECTION RATES FOR THE ALLUVIAL UPPER CHINLE AND MIDDLE CHINLE AQUIFERS.**

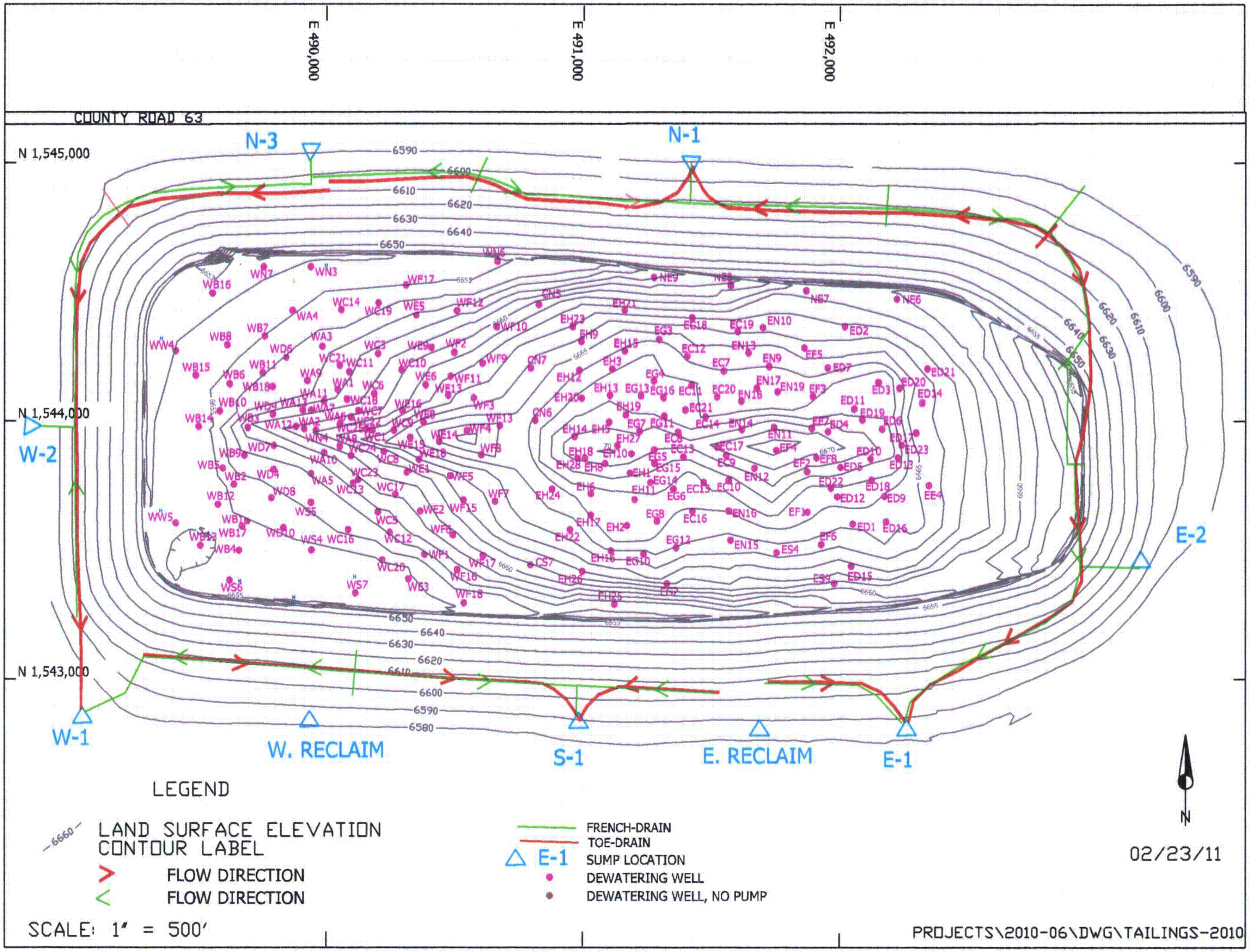



FIGURE 2.1-6. LOCATIONS OF TAILINGS DEWATERING WELLS, TOE DRAINS AND SUMPS

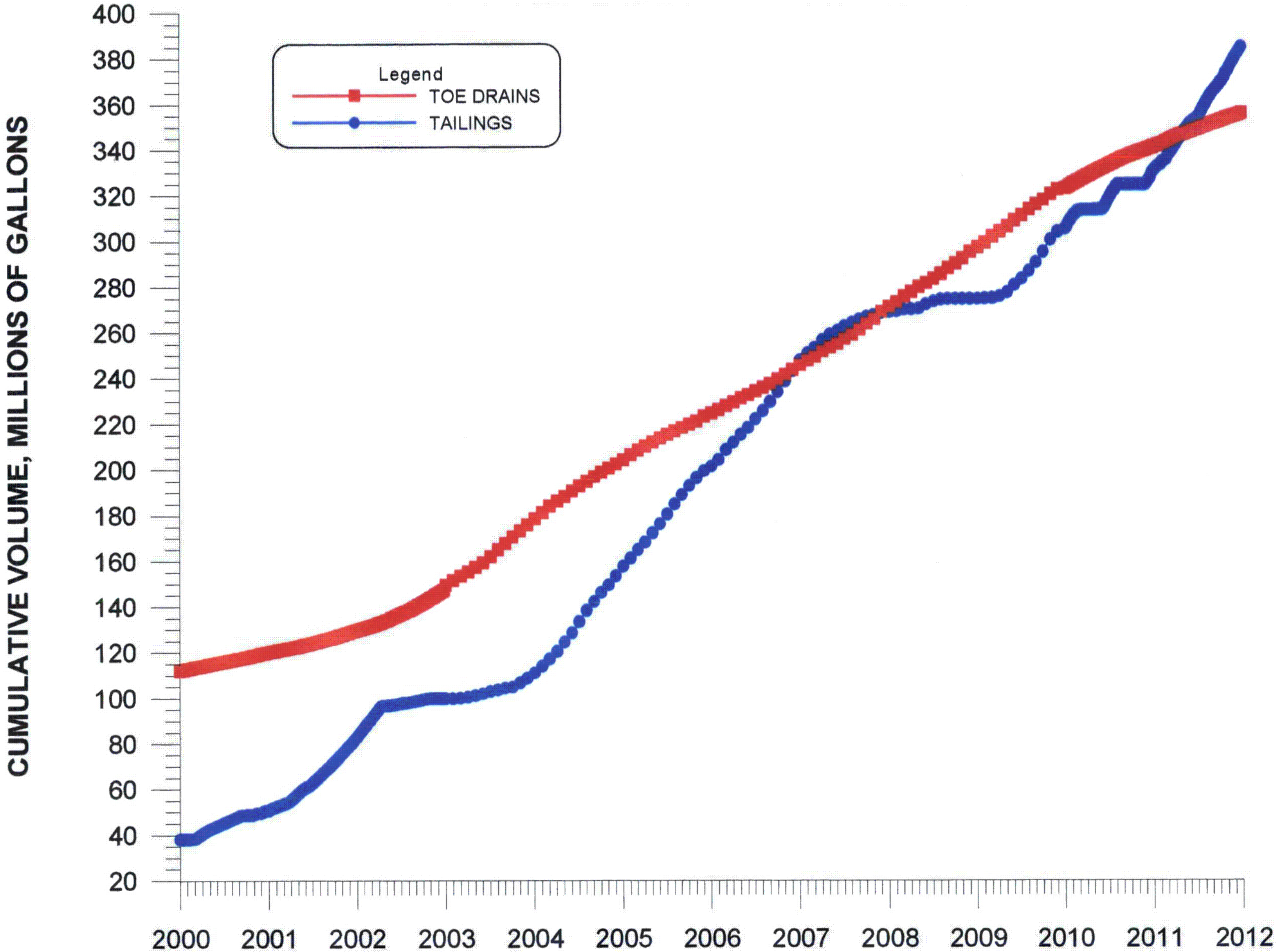



**FIGURE 2.1-7. CUMULATIVE VOLUME OF COLLECTION WATER FROM TAILINGS DEWATERING WELLS AND TOE DRAINS.**

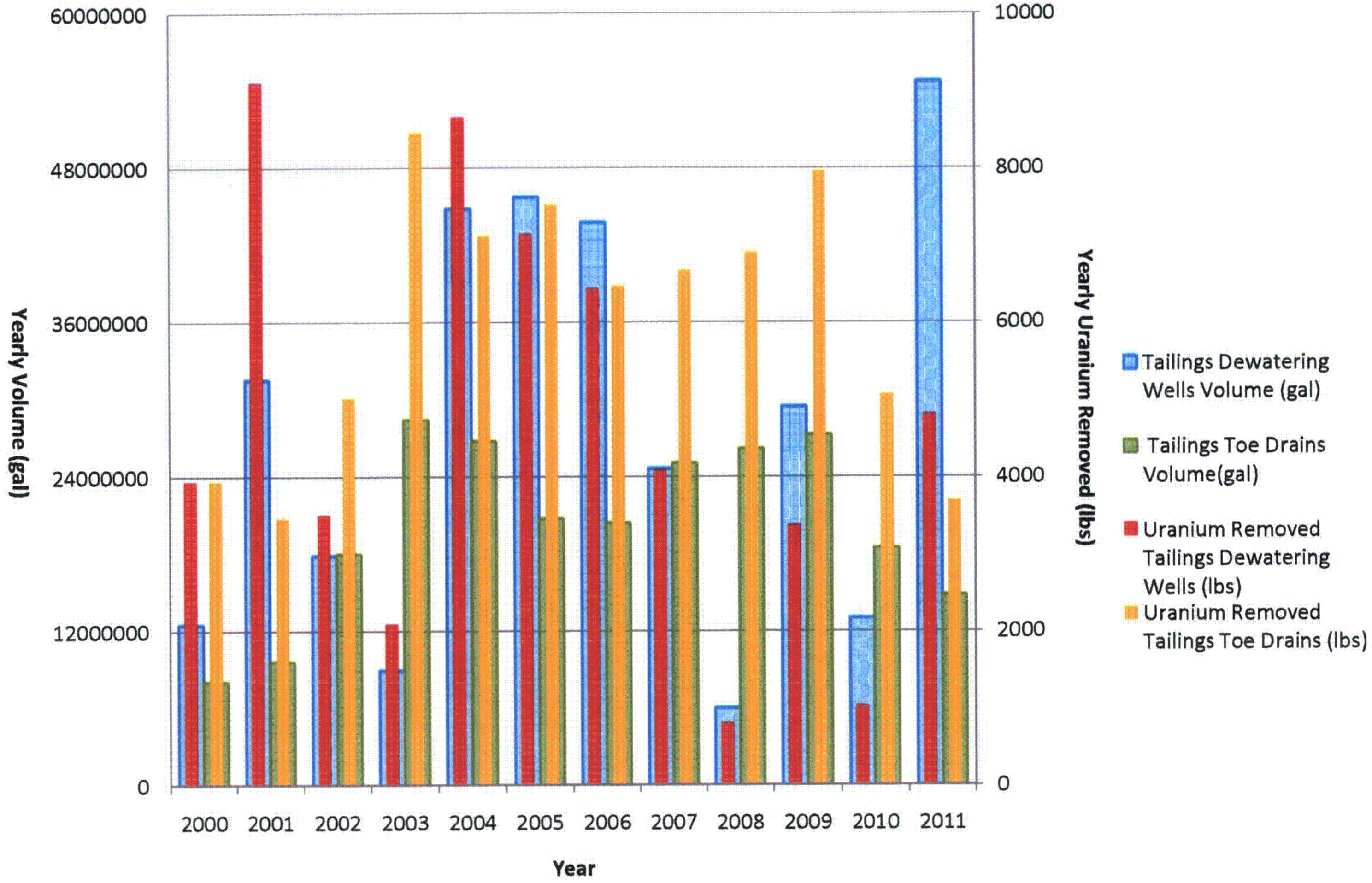



**Figure 2.1-8. Yearly Quantity of Tailings Water and Uranium Removed**

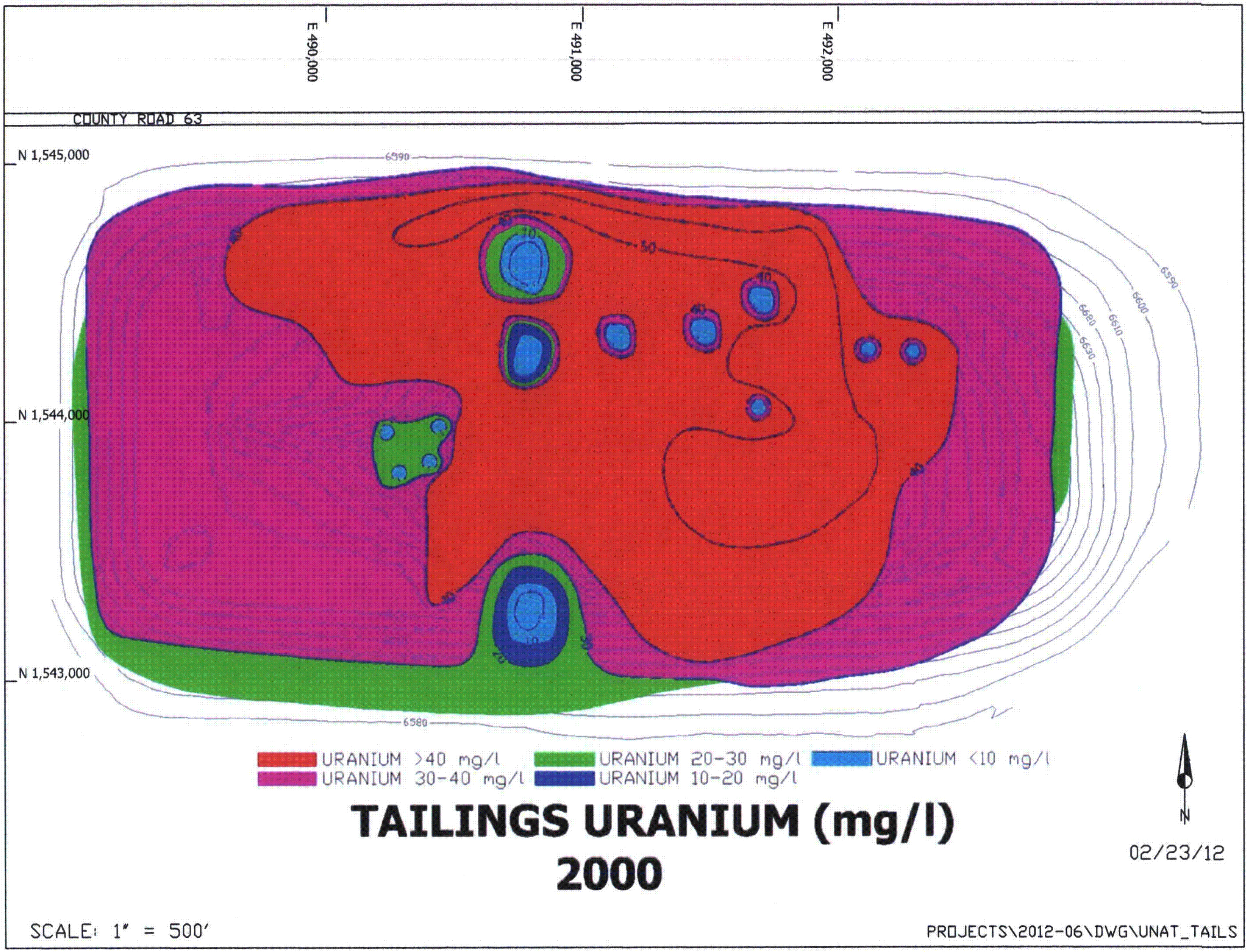



FIGURE 2.1-9. TAILINGS SOLUTION URANIUM CONCENTRATION, 2000

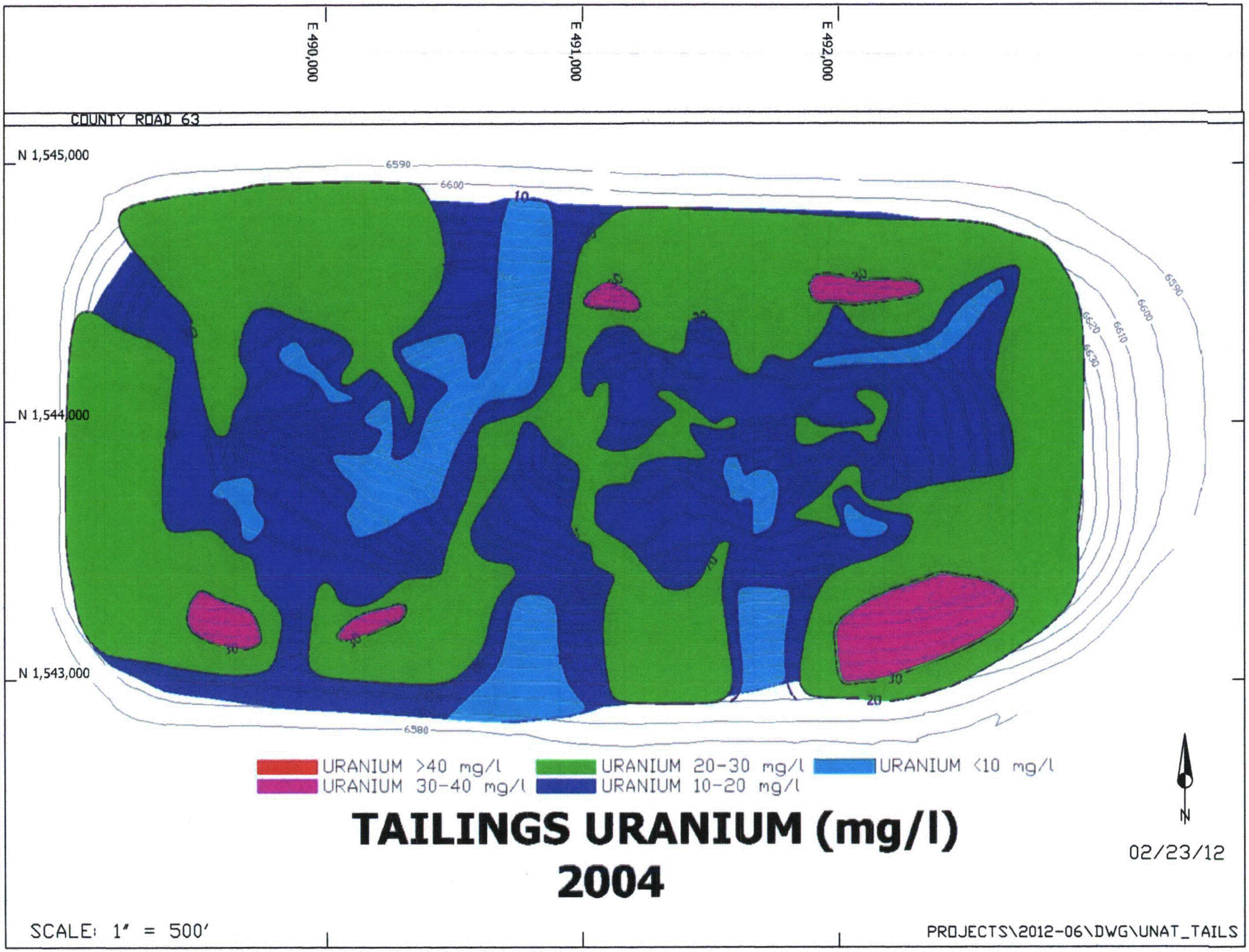





FIGURE 2.1-10. TAILINGS SOLUTION URANIUM CONCENTRATION, 2004

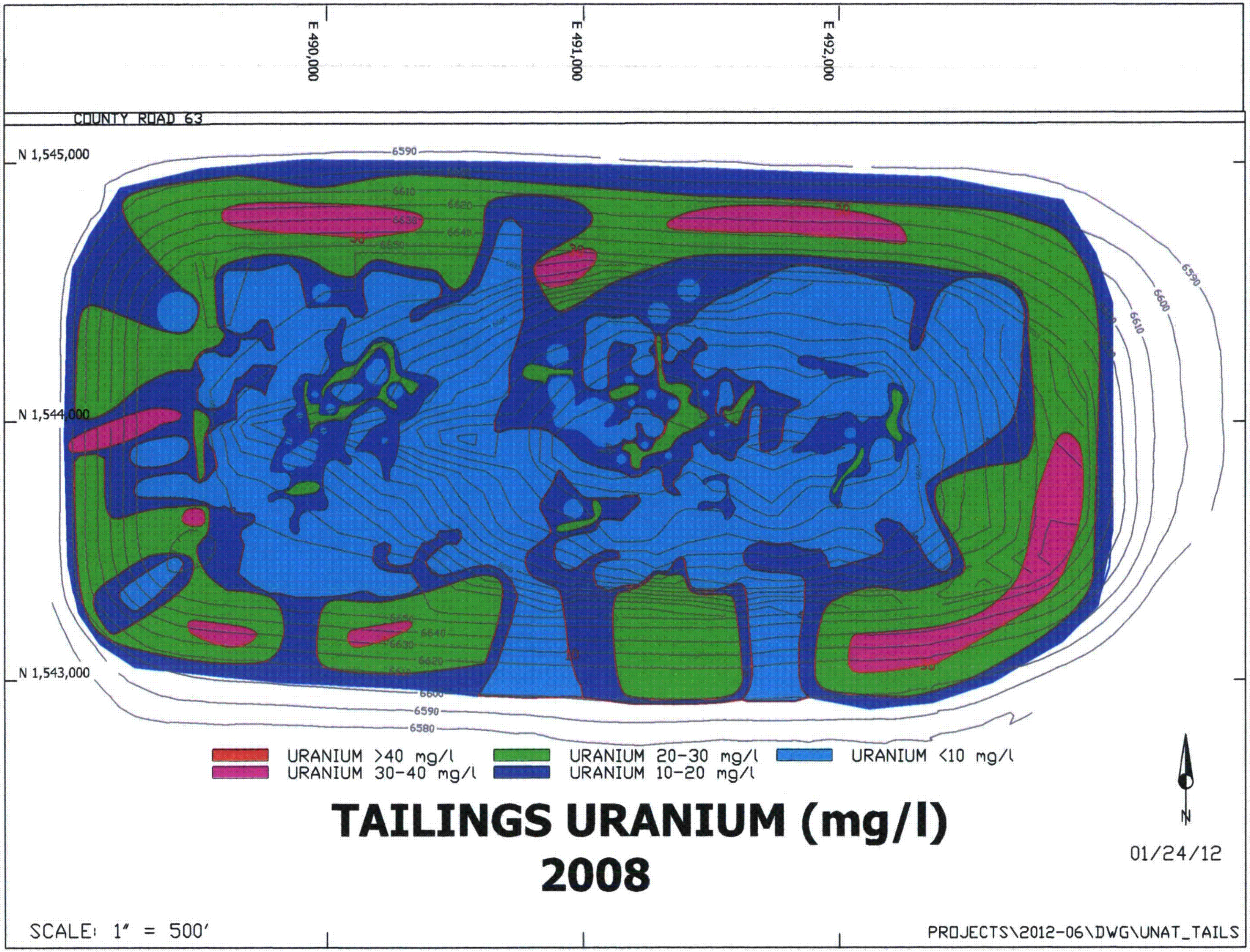



FIGURE 2.1-11. TAILINGS SOLUTION URANIUM CONCENTRATION, 2008

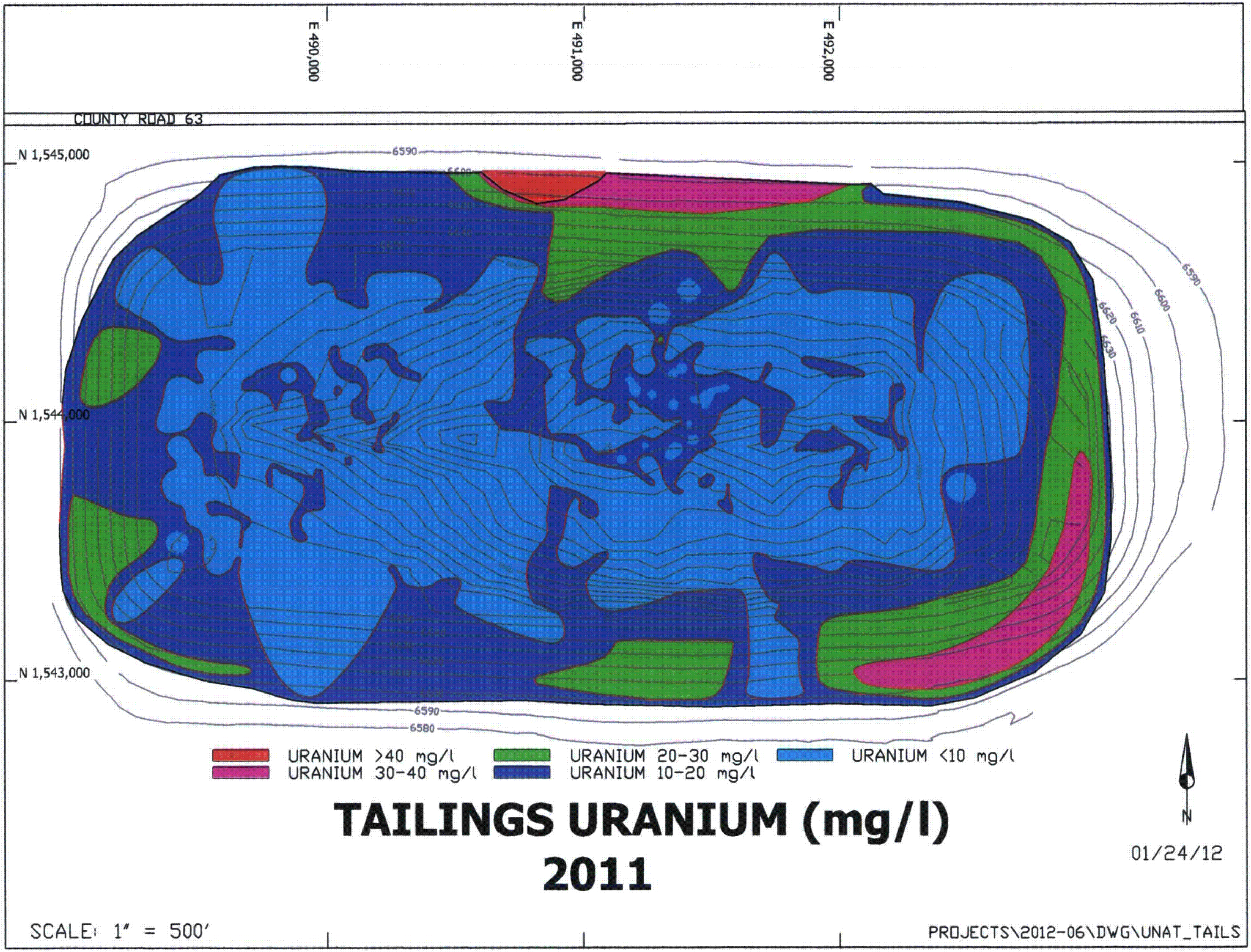





FIGURE 2.1-12. TAILINGS SOLUTION URANIUM CONCENTRATION, 2011

SECTION 3

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GROUND WATER MONITORING
FOR HOMESTAKE'S GRANTS PROJECT

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FIGURES



TABLES

# 3.0 SITE STANDARDS AND BACKGROUND CONDITIONS

## 3.1 ALLUVIAL SITE STANDARDS

Ten water-quality site standards (U, Se, Mo, SO4, Cl, TDS, NO3, Ra226 + Ra228, Th230 and V) have been set for the alluvial aquifer at the Homestake site by the United States Nuclear Regulatory Commission (NRC) and the site Radioactive Materials License was amended accordingly. These site standards were established on the basis of defining the full range in alluvial aquifer background concentration values for these constituents. The procedures used to establish background concentrations and subsequent setting of appropriate site standards were reviewed and approved by the NRC, the EPA, and the New Mexico Environmental Department (NMED). Adjustment of the site standards to account for the full range in natural background concentrations was important in assuring that appropriate site standards are set in relation to background concentrations.

The NRC alluvial aquifer site standards are shown in Table 3.1-1 and will be incorporated in the New Mexico Environment Department (NMED) DP-200 Discharge Plan when the permit is renewed. Alluvial site standards for the Grants Project are applicable at three points of compliance; these Point of Compliance (POC) wells are S4, D1, and X (see Figure 3.2-1 for locations); these wells are situated west and south of the tailings site locations.

## TABLE 3.1-1. GRANTS PROJECT ALLUVIAL SITE STANDARDS.

| Constituents | NRC License Site Standards | New Mexico Site Standards* |
|---|---|---|
| Uranium | 0.16 | 0.16 |
| Selenium | 0.32 | 0.32 |
| Molybdenum | 0.10 | 1.0** |
| Vanadium | 0.02 | ----- |
| RA-226 + Ra-228 | 5 | 30 |
| Thorium-230 | 0.3 | ----- |
| Sulfate | 1500 | 1500 |
| Chloride | 250 | 250 |
| TDS | 2734 | 2734 |
| Nitrate | 12 | 12 |

NOTE: All concentrations are in mg/l except: Ra-226 + Ra-228 and Th-230, which are in pCi/l.
* = Pending NMED renewal of DP-200 Discharge Plan
** = New Mexico Irrigation Standard

## 3.2 ALLUVIAL BACKGROUND WATER QUALITY

Background alluvial aquifer water-quality conditions at the Grants site are those found up-gradient or north of the Large Tailings Pile (see Figure 3.2-1). These conditions in the San Mateo alluvium have been monitored since 1976. Ground water flow in the San Mateo alluvial system is generally from the northeast to the southwest. Lobo Creek joins San Mateo Creek in the Felice Acres subdivision area at the Homestake site, although neither creek has a well-defined surface flow channel in this area. Surface-water flow occurs only after extreme precipitation events and then generally only within some reaches of the channels.

Hydrographs of up-gradient wells that have been used to define the background hydrologic conditions of the alluvial aquifer are presented in Section 4 of this report. Wells DD, DD2, P, P1, P2, P3, P4, Q, R and ND, located just north of the Large Tailings Pile, have been used for monitoring alluvial background water quality and are called the near up-gradient wells. An additional near up-gradient well, DD2, was drilled in 2008.

Additional alluvial background wells located farther north have also been sampled (wells 914, 920, 921, 922 and 950, see Figure 3.2-1 for locations). Information gathered from these wells has been used to further define the piezometric surface and water-quality conditions in the up-gradient alluvial aquifer and these wells are referred to as the far up-gradient wells.

**Figure** 3.2-1 presents the latest 2011 water-quality data for the near and far-up-gradient alluvial background wells for six parameters: sulfate, uranium, selenium, chloride, TDS and nitrate. Sulfate concentrations for the wells varied from 378 to 1780 mg/l in 2011. Uranium concentrations also varied over a large range, from 0.002 to 0.21 mg/l. The new upgradient monitoring well DD2 has the highest near upgradient uranium concentration and would have resulted in a higher site standard if its values had been used in setting the standard. Selenium concentrations also varied over a large range, from less than 0.005 to 0.69 mg/l.

Chloride concentrations in water sampled in 2011 from the up-gradient wells ranged from a low of 53 mg/l to a high of 93 mg/l. The TDS concentrations varied from 920 to 3000 mg/l. Nitrate concentrations also vary naturally over a large range in the alluvial aquifer, and ranged from less than 0.1 to 19 mg/l in 2011. Molybdenum concentrations were less than 0.03 mg/l, except for a value of 0.05 mg/l in well 922. Concentration versus time plots for near up-gradient wells DD, DD2, P, P4, Q and R are presented later in Section 4.3 of this report.

The 95th percentile of the historical background alluvial aquifer water-quality data for the Grants site was defined by ERG (1999a and 1999b). These documents, along with a hydrologic support document (Hydro-Engineering 2001c), were submitted to the NRC in 2001 with a request to adjust some of the site standards based on the full range of natural background conditions. The 95th percentile was used to define the upper limit of background. Background data for a ten year period of 1995 through 2004 was used to determine the 95th percentile values. The cumulative database for all of the background wells more adequately defines background concentrations, and this expanded database, based on near-up-gradient wells, was utilized in the two ERG (1999a and 1999b) studies. A tabulation of alluvial standards for the Grants Project area constituents is included in Figure 3.2-1.

The range in concentrations in the alluvial up-gradient wells[1] sampled during 2011 is tabulated in **Table** 3.2-1 with a list of the site standards. These site standards were established from data from the near up-gradient wells[2]. The following table (Table 3.2-1) summarizes the 2011 data for near up-gradient and far up-gradient wells for constituents of concern where site standards have been set for the Grants site. As shown by the present data, there is a large natural areal variability in the background water quality. Naturally occurring background variation is illustrated by the uranium concentrations, where concentrations in 2011 varied from 0.002 to 0.21 mg/l.

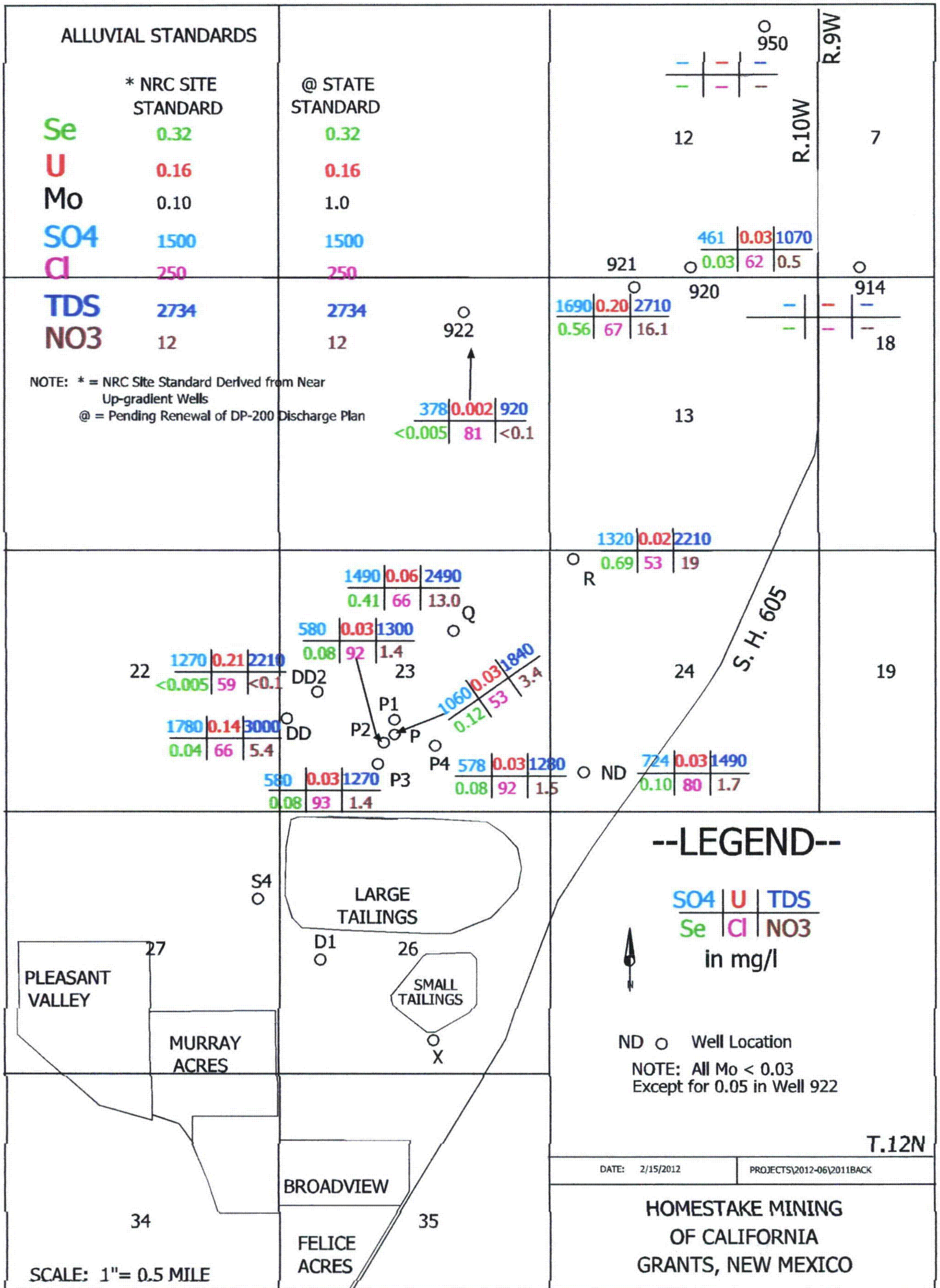



FIGURE 3.2-1. ALLUVIAL BACKGROUND GROUND WATER QUALITY, 2011

| TABLE 3.2-1 2011 BACKGROUND WELL DATA - ALLUVIUM | | | | | | | |
|---|---|---|---|---|---|---|---|
| | PARAMETERS | | | | | | |
| | Se | U | Mo | SO4 | Cl | TDS | $NO_3$ |
| NRC Site Standard | 0.32 | 0.16 | 0.10 | 1500 | 250 | 2734 | 12 |
| Pending NMED Standard | 0.32 | 0.16 | 1.0 | 1500 | 250 | 2734 | 12 |
| NEAR UP-GRADIENT WELLS | | | | | | | |
| DD | 0.04 | 0.14 | <0.03 | 1780 | 66 | 3000 | 5.4 |
| DD2 | <0.005 | 0.21 | <0.03 | 1270 | 59 | 2210 | <0.1 |
| ND | 0.10 | 0.03 | <0.03 | 724 | 80 | 1490 | 1.7 |
| P | 0.12 | 0.03 | <0.03 | 1060 | 53 | 1840 | 3.4 |
| P2 | 0.08 | 0.03 | <0.03 | 580 | 92 | 1300 | 1.4 |
| P3 | 0.08 | 0.03 | <0.03 | 580 | 93 | 1270 | 1.4 |
| P4 | 0.08 | 0.03 | <0.03 | 578 | 92 | 1280 | 1.5 |
| Q | 0.41 | 0.06 | <0.03 | 1490 | 66 | 2490 | 13.0 |
| R | 0.69 | 0.02 | <0.03 | 1320 | 53 | 2210 | 19.0 |
| FAR UP-GRADIENT WELLS | | | | | | | |
| 914 | - | - | - | - | - | - | - |
| 920 | 0.03 | 0.03 | <0.03 | 461 | 62 | 1070 | 0.5 |
| 921 | 0.56 | 0.20 | <0.03 | 1690 | 67 | 2710 | 16.1 |
| 922 | <0.005 | 0.002 | 0.05 | 378 | 81 | 920 | <0.1 |
| 950 | - | - | - | - | - | - | - |

[1] Wells DD, DD2, ND, P, P2, P3, P4, Q, R, 914, 920, 921, 922 and 950
[2] Wells DD, ND, P, P1, P2, P3, P4, Q and R

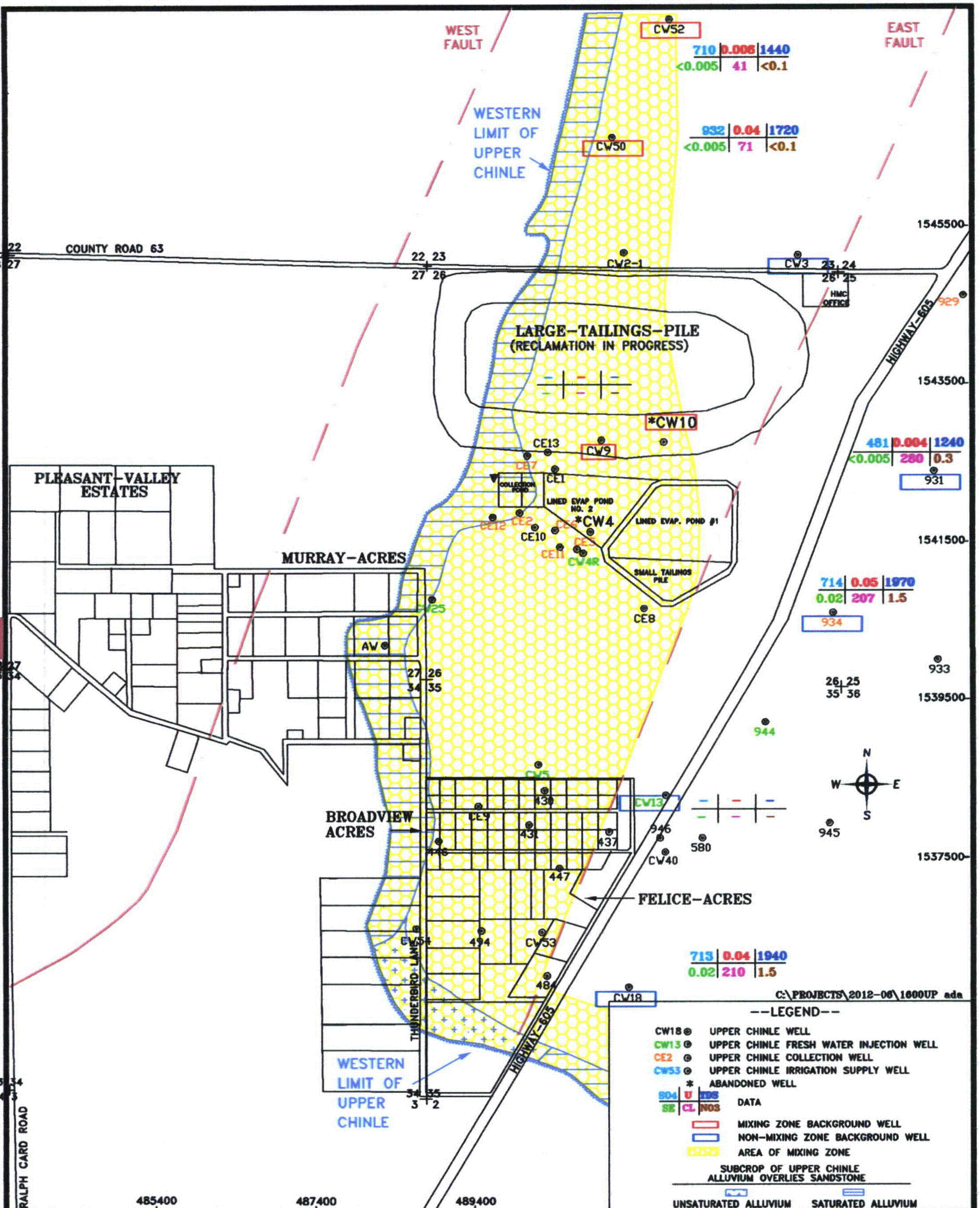
## 3.3 CHINLE SITE STANDARDS

Eight water quality site standards (U, Se, Mo, SO4, Cl, TDS, NO3, and V) have been set for the Chinle aquifers at the Homestake site by the NRC. The site standards were also established based on the full range of background concentration in the Chinle aquifers for these constituents. The procedures accepted and used to establish these site standards can result in a minor amount of observed natural concentrations exceeding the site standards.

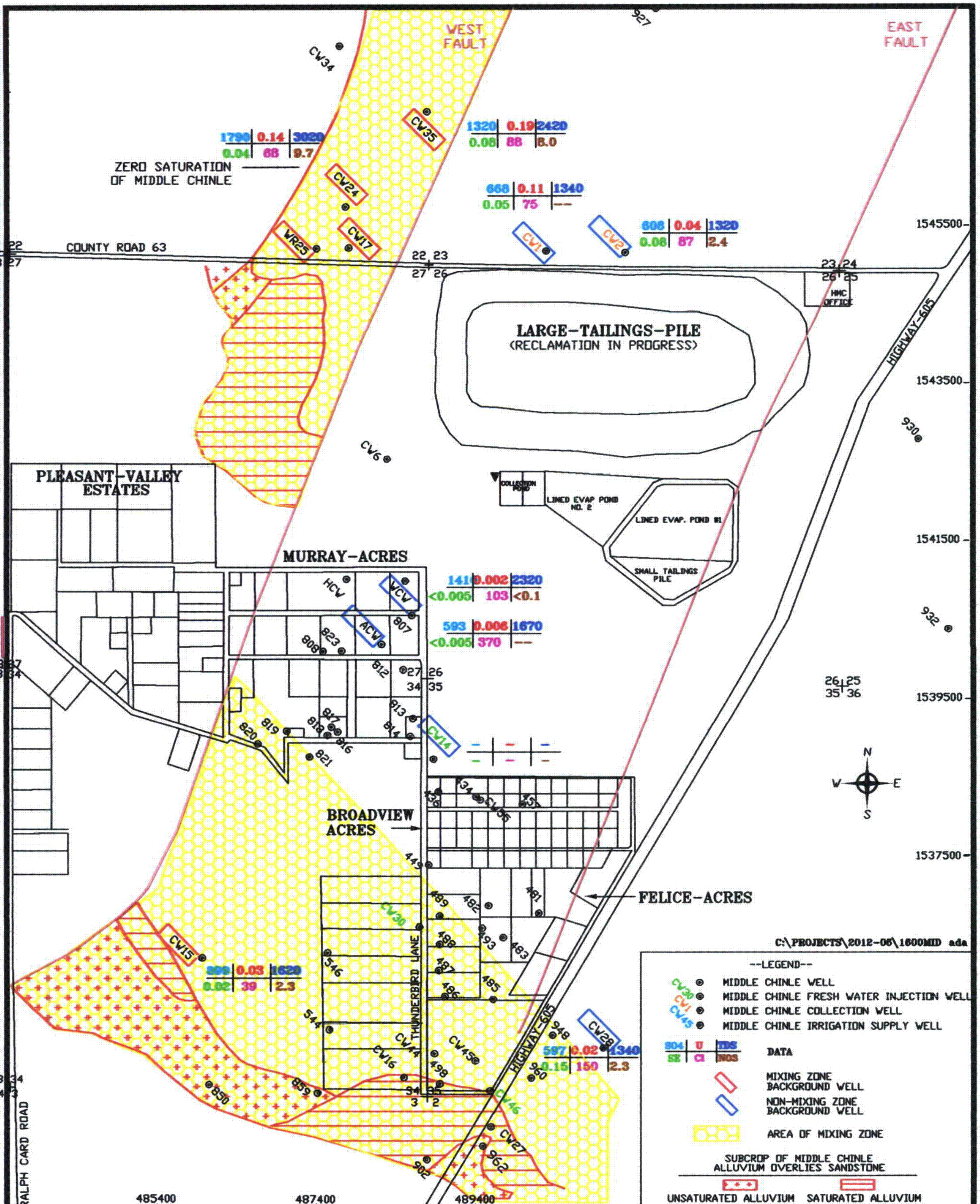
Site standards have been established for the Chinle mixing zone, Upper Chinle non-mixing zone, Middle Chinle non-mixing zone and Lower Chinle non-mixing zone. Separate site standards exist for each of these four Chinle aquifer zones. Figures 3.3-1 through 3.3-3 show the Upper Chinle, Middle Chinle and Lower Chinle aquifers with the portion of the aquifer in the mixing zone and the remainder that is in the non-mixing zone. Figure 3.3-1 presents the location of the Upper Chinle mixing-zone (yellow pattern) and the wells used in the analysis of background values. Wells within the mixing zone that were used in the mixing-zone background calculations have a red box around the well name. Wells used to define the Upper Chinle non-mixing zone are indicated by a light blue rectangular box around their name.

The mixing zone is the area in and near the subcrop area where alluvial water has entered the Chinle aquifer and changed the type of water in the mixing zone. The mixing zone has a higher calcium concentration and is similar to the alluvial aquifer calcium concentration. The Chinle formation still has the ability to change the water type as the alluvial water moves farther down gradient into the non-mixing zone.

Table 3.3-1 below presents the Chinle site standards for the four Chinle aquifer zones.




| | |
|---|---|
| HOMESTAKE MILL AND ADJACENT PROPERTIES ~ GRANTS, NM ~ TOWNSHIP-11&12N, RANGE-10W | DATE: 2/16/12 |
| FIGURE 3.3-1. UPPER CHINLE MIXING ZONE AND 2011 GROUND WATER QUALITY | SCALE: 1"= 750' |
| | PAGE: 3.3-2 |

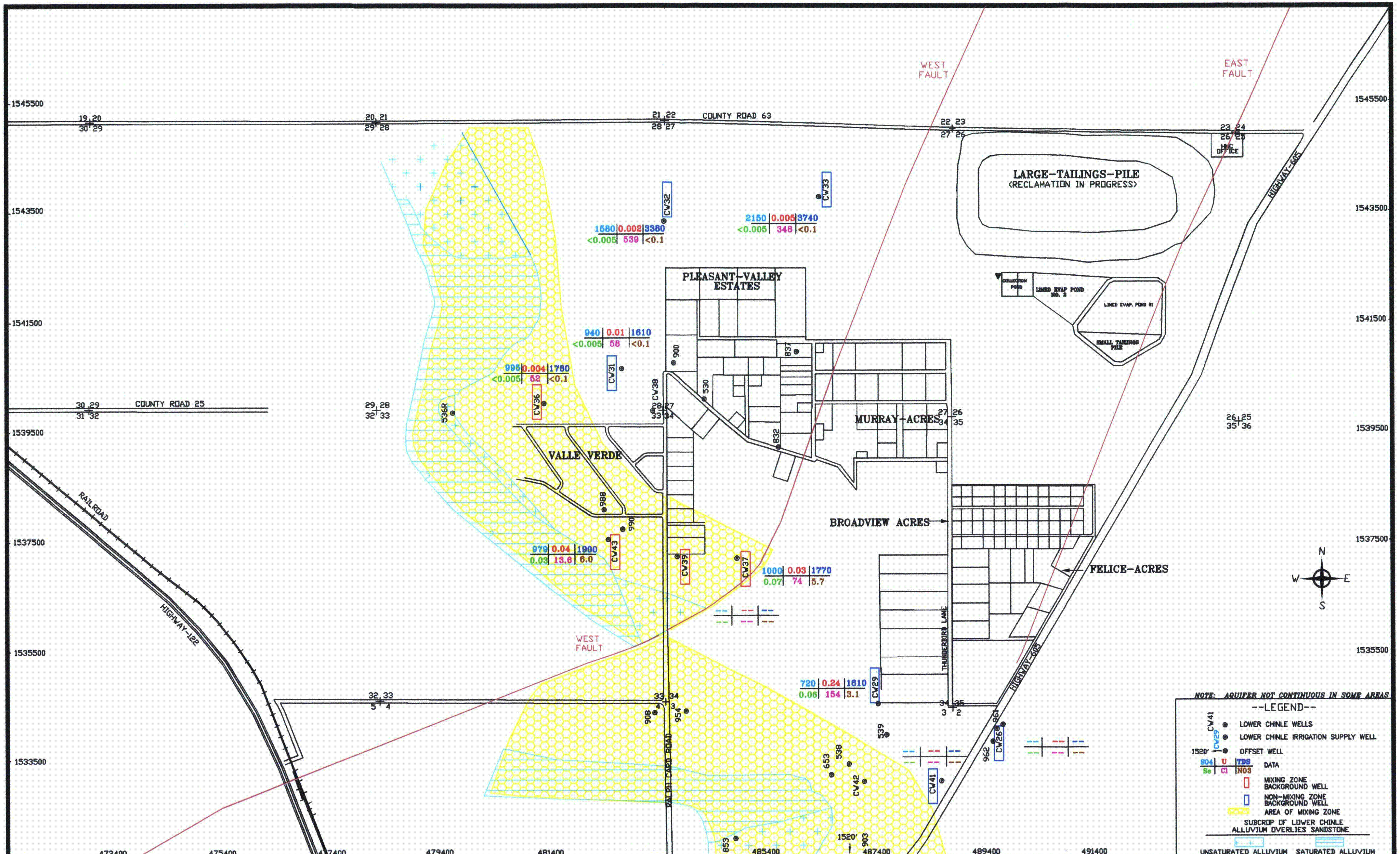



HOMESTAKE MILL AND ADJACENT PROPERTIES ~ GRANTS, NM ~ TOWNSHIP-11&12N, RANGE-10W

**DATE: 2/15/12**

**SCALE: 1"=750'**

**FIGURE 3.3-2. MIDDLE CHINLE MIXING ZONE AND 2011 GROUND WATER QUALITY**




| | |
|---|---|
| SCALE: 1" = 1000' | FIGURE 3.3-3. LOWER CHINLE MIXING ZONE AND 2011 GROUND WATER QUALITY |
| C:\PROJECTS\2012-06\1800LOW ada | |
| DATE: 2/15/12 | PAGE: 3.3-4 |

## TABLE 3.3-1. GRANTS PROJECT - CHINLE SITE STANDARDS

| Aquifer Zone | CONSTITUENT, concentrations in mg/l except Thorium-230 and Ra226+Ra228 in pCi/l. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Selenium | Uranium | Molybdenum | TDS | Sulfate | Chloride | Nitrate | Vanadium | Thorium-230 | Ra-226 +Ra-228 |
| Chinle Mixing | 0.14 | 0.18 | 0.10 | 3140 | 1750 | 250 | 15 | 0.01 | * | * |
| Upper Chinle Non-Mixing | 0.06 | 0.09 | 0.10 | 2010 | 914 | 412 | * | 0.01 | * | * |
| Middle Chinle Non-Mixing | 0.07 | 0.07 | 0.10 | 1560 | 857 | 250 | * | * | * | * |
| Lower Chinle Non-Mixing | 0.32 | 0.03 | 0.10 | 4140 | 2000 | 634 | * | * | * | * |

* Background water quality analyses for constituent determined that site standard is not necessary.

## 3.4 CHINLE BACKGROUND WATER QUALITY

The Chinle aquifer background water quality has been analyzed and presented to the NRC and NMED in Hydro-Engineering 2003b and ERG 2003. The background concentrations for the mixing zones in the Upper, Middle and Lower Chinle aquifers were grouped together to develop a mixing zone background level. The non-mixing zone water chemistry data for each of the three aquifers were analyzed separately. Table 3.4-1 presents the site standards that resulted from the analysis and related discussions with NRC, EPA and NMED concerning agreement on the standards. Figure 3.3-1 also presents the 2011 data collected from these background wells for selected parameters of sulfate, uranium, TDS, selenium, chloride and nitrate. This data is presented in a format similar to that used for the alluvial background data. The data for wells CW3, CW17 and WR25 are not presented on Figure 3.3-1 and 3.3-2 because concentrations are not natural in these wells for 2011. Table 3.4-1 also presents the 2011 data for the Chinle mixing zone background wells and the Upper, Middle and Lower Chinle non-mixing zone wells separated by their category.

The Upper Chinle mixing zone is presented in Figure 3.3-1 with a yellow pattern. Four wells are shown in the Upper Chinle mixing zone, and these wells were included with the Middle Chinle and Lower Chinle mixing-zone wells in establishing the mixing-zone background values. Four wells shown on Figure 3.3-1 were used to establish the Upper Chinle non-mixing zone background levels. This figure also presents the 2011 data collected for these background wells.

The Middle Chinle mixing zone is presented in Figure 3.3-2 with a yellow pattern. Five wells are shown in the Middle Chinle mixing zone, and these wells were included with the Upper Chinle and Lower Chinle mixing-zone wells in establishing the mixing-zone background values. Six wells shown on Figure 3.3-2 were used to establish the Middle Chinle non-mixing zone background levels. This figure also presents the 2011 data collected for these background wells.

Figure 3.3-3 presents the Lower Chinle mixing zone in a yellow pattern. This figure also shows which wells were used to establish the background concentrations in the mixing and non-mixing zones of the Lower Chinle aquifer. The 2011 data for the Lower Chinle wells previously used to define background concentrations are also presented on Figure 3.3-3. The Lower Chinle non-mixing zone background levels are somewhat problematic, because the water quality tends to deteriorate naturally as the ground water moves down-gradient. Therefore, the expected natural water quality deterioration is a function of the distance from the Lower Chinle subcrop beneath the alluvium to a particular point within the aquifer.

## TABLE 3.4-1. 2011 BACKGROUND WELL DATA - CHINLE

| | CONSTITUENT, concentrations in mg/l | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Aquifer Zone | Selenium | Uranium | Molybdenum | TDS | Sulfate | Chloride | Nitrate | Vanadium |
| CHINLE SITE STANDARDS | | | | | | | | |
| Chinle Mixing | 0.14 | 0.18 | 0.10 | 3140 | 1750 | 250 | 15 | 0.01 |
| Upper Chinle Non-Mixing | 0.06 | 0.09 | 0.10 | 2010 | 914 | 412 | * | 0.01 |
| Middle Chinle Non-Mixing | 0.07 | 0.07 | 0.10 | 1560 | 857 | 250 | * | * |
| Lower Chinle Non-Mixing | 0.32 | 0.03 | 0.10 | 4140 | 2000 | 634 | * | * |
| 2011 CHINLE MIXING ZONE WELLS | | | | | | | | |
| CW9 | - | - | - | - | - | - | - | - |
| CW50 | <0.005 | 0.04 | <0.03 | 1720 | 932 | 71 | <0.1 | <0.01 |
| CW52 | <0.005 | 0.006 | <0.03 | 1440 | 710 | 41 | <0.1 | <0.01 |
| CW15 | 0.02 | 0.03 | <0.03 | 1620 | 899 | 39 | 2.3 | - |
| CW24 | 0.04 | 0.14 | <0.03 | 3020 | 1790 | 68 | 9.7 | - |
| CW35 | 0.08 | 0.19 | <0.03 | 2420 | 1320 | 88 | 8.0 | - |
| CW36 | <0.005 | 0.004 | <0.03 | 1780 | 995 | 52 | <0.1 | - |
| CW37 | 0.07 | 0.03 | <0.03 | 1770 | 1000 | 74 | 5.7 | - |
| CW39 | - | - | - | - | - | - | - | - |
| CW43 | 0.03 | 0.04 | <0.03 | 1900 | 979 | 13.6 | 6.0 | - |
| 2011 UPPER CHINLE NON-MIXING ZONE WELLS | | | | | | | | |
| 931 | <0.005 | 0.004 | <0.03 | 1240 | 481 | 280 | 0.3 | - |
| 934 | 0.02 | 0.05 | <0.03 | 1970 | 714 | 207 | 1.5 | - |
| CW18 | 0.02 | 0.04 | <0.03 | 1940 | 713 | 210 | 1.5 | - |
| 2011 MIDDLE CHINLE NON-MIXING ZONE WELLS | | | | | | | | |
| ACW | <0.005 | 0.006 | <0.03 | 1670 | 593 | 370 | - | - |
| CW1 | 0.05 | 0.11 | 0.08 | 1340 | 668 | 75 | - | - |
| CW2 | 0.08 | 0.04 | <0.03 | 1320 | 608 | 87 | 2.4 | - |
| CW28 | 0.15 | 0.02 | <0.03 | 1340 | 597 | 150 | 2.3 | - |
| WCW | <0.005 | 0.002 | <0.03 | 2320 | 141 | 103 | <0.1 | - |
| 2011 LOWER CHINLE NON-MIXING ZONE WELLS | | | | | | | | |
| CW26 | - | - | - | - | - | - | - | - |
| CW29 | 0.06 | 0.24 | <0.03 | 1610 | 720 | 154 | 3.1 | - |
| CW31 | <0.005 | 0.01 | <0.03 | 1610 | 940 | 58 | <0.1 | - |
| CW32 | <0.005 | 0.002 | <0.03 | 3380 | 1580 | 539 | <0.1 | - |
| CW33 | <0.005 | 0.005 | <0.03 | 3740 | 2150 | 348 | <0.1 | - |
| CW41 | - | - | - | - | - | - | - | - |

* Background water quality analyses for constituent determined that site standard is not necessary.