FOURTH FIVE-YEAR REVIEW REPORT FOR HOMESTAKE MINING COMPANY SUPERFUND SITE CIBOLA COUNTY, NEW MEXICO

SEPTEMBER 2016

2008

2016

Prepared by

U.S. Environmental Protection Agency
Region 6
Dallas, Texas

500023383

FOURTH FIVE-YEAR REVIEW REPORT
HOMESTAKE MINING COMPANY SUPERFUND SITE
EPA ID#: NMD007860935
CIBOLA COUNTY, NEW MEXICO

This memorandum documents the U.S. Environmental Protection Agency's (EPA's) performance, determinations and approval of the Homestake Mining Company Superfund site (Site) fourth Five-Year Review under Section 121 (e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code Section 9621 (c), as provided in the attached Fourth Five-Year Review Report.

Summary of the Fourth Five-Year Review Report

The Site consists of three project areas called operable units (OUs). OU1 is identified as tailings seepage contamination of groundwater aquifers; OU2 is identified as long-term tailings stabilization, surface reclamation, and site closure; and OU3 is identified as radon concentrations in the neighboring subdivisions. The Site's remedy for OU1 and OU2 consists of long-term remedial actions, including a groundwater collection and injection system, reverse osmosis (RO) and zeolite treatment of contaminated groundwater, long-term stabilization of a large tailings pile (LTP) and a small tailings pile (STP), surface reclamation, monitoring and institutional controls. The Site's potentially responsible party (PRP) Homestake Mining Company (HMC) is implementing groundwater restoration activities as well as mill decommissioning and reclamation at the Site under the Nuclear Regulatory Commission's (NRC's) authority for license termination. EPA has not issued Records of Decision (RODs) for cleanup activities for OU1 and OU2. In 1989, EPA issued a no action ROD for OU3 (radon contamination) in neighboring subdivisions. Due to community concerns, EPA conducted additional investigations between 2010 and 2014 to support a supplemental human health risk assessment (HHRA) for the residential areas outside the facility's licensed boundary.

The groundwater collection and injection system is containing the highest contaminant concentrations within a defined collection area, primarily within the facility's licensed boundary. The system is also reducing contaminant concentrations in groundwater beyond the facility's licensed boundary. Residents in the neighboring subdivision utilize the public water supply extended to them pursuant to a 1983 CERCLA Consent Decree or have been given the option to connect to public water. An Institutional Control in the form of a health advisory is in place to caution current and future owners and private wells users about potential contamination. Contaminated soil at the former mill was excavated and disposed of in the LTP within the facility's licensed boundary. The mill was decontaminated, demolished and parts were buried in place or placed in the LTP. A final radon barrier and erosion protection cover were constructed on the sides of the LTP. Interim soil covers were constructed on the top of the LTP and on the STP. Radon mitigation systems and soil/debris removal efforts in the residential areas mitigated exposures to unacceptable levels of contaminants. Exposures to contamination are currently controlled.

EPA is currently reviewing historic information related to the cleanup being conducted at the Site under the NRC's authority. EPA is conducting the review to determine whether the established background levels, and subsequently the NRC-approved site cleanup levels, are appropriate under the CERCLA remedial investigation/feasibility (RI/FS) equivalency process. As part of the CERCLA equivalency process, EPA is also performing a groundwater assessment that includes sampling and geophysical investigation at the Site. Once the assessment is complete, EPA will follow the CERCLA process to complete a RI/FS, Proposed Plan and a ROD for OU1 and OU2.

Groundwater restoration under the New Mexico Water Quality Control Commission (NMWQCC) regulations (e.g. 20.6.2.4103 NMAC) require the achievement of site standards at any place of withdrawal for present or reasonable foreseeable future use, not just at point of compliance (POC) well locations. Also, according to EPA's *"Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions (OSWER 9355.0-129, November 2013)"*, groundwater remediation levels generally should be attained throughout the contaminant plume.

Human Exposure Status: Under Control

Contaminated Groundwater Status: Under Control

Actions Needed

The following actions must be taken for the remedy to be protective over the long term: complete review of EPA CERCLA equivalency including assessment of groundwater and issue RODs for OU1 and OU2; update the timeframe estimate for groundwater restoration based on current operating conditions and data; include an estimate of the time needed for groundwater restoration of those areas outside the facility's licensed boundary in addition to the areas downgradient of the source areas; investigate the source of the elevated uranium in the HMC supply wells in the San Andres aquifer to determine if pumping from the San Andres wells is drawing contamination into the deeper aquifer.

Determination

I have determined that the remedy for the Homestake Mining Company Superfund site is short-term protective. This Five-Year Review Report specifies the actions that need to be taken for the remedy to be protective over the long term.

9/13/16

Carl E. Edlund, P.E.
Director, Superfund Division
U.S. Environmental Protection Agency Region 6

Date

CONCURRENCES

FOURTH FIVE-YEAR REVIEW REPORT
HOMESTAKE MINING SUPERFUND SITE
EPA ID#: NMD007860935
CIBOLA COUNTY, NEW MEXICO

Sairam Appaji — 7/28/16
Sairam Appaji — Date
Remedial Project Manager

Blake Atkins — 8/4/16
Blake Atkins — Date
Chief, LA/NM/OK Section

John C. Meyer — 8/5/16
John C. Meyer — Date
Chief, Superfund Remedial Branch

Pamela Travis — 07/28/2016
Pamela Travis — Date
Attorney, Office of Regional Counsel

Mark A. Peycke — 08/09/16
Mark A. Peycke — Date
Chief, Superfund Branch, Office of Regional Counsel

Pamela Phillips — Date
Deputy Director, Superfund Division

ISSUES/RECOMMENDATIONS

FOURTH FIVE-YEAR REVIEW REPORT
HOMESTAKE MINING COMPANY SUPERFUND SITE
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Issues and Recommendations Identified in the Five-Year Review:

OU(s): OU1 and OU2	Issue Category: Other			
	Issue: Although remediation is underway under NRC authority, there is no EPA Record of Decision (ROD) in place for OU1 and OU2.			
	Recommendation: Complete EPA reassessment of background groundwater and complete the CERCLA equivalency analysis including issuance of a ROD for OU1 and OU2.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2018

OU(s): OU1	Issue Category: Remedy Performance			
	Issue: The 2012 Updated Corrective Action Program (CAP) estimated active groundwater restoration to be complete by 2020; however, the estimate was based on groundwater modeling, observed results from present operating conditions and predicted future operating conditions. Several operating conditions have changed since the groundwater modeling was conducted, including discontinuation of land treatment and active flushing of the LTP as well as an increase in the operating capacity of the water treatment systems. In addition, groundwater modeling estimated the time for POC wells to achieve constituent of concern (COC) groundwater protection standards; modeling did not predict COC concentrations for any other areas, including those areas outside the facility's licensed boundary.			
	Recommendation: Update the timeframe estimate for groundwater restoration based on current operating conditions and data. Include an estimate of the time needed for groundwater restoration of those areas outside the facility's licensed boundary in addition to the areas downgradient of the source areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/27/2017

OU(s): OU1	Issue Category: Remedy Performance			
	Issue: The source of the uranium exceedance in the San Andres supply wells at the Site is unclear.			
	Recommendation: Investigate the source of the elevated uranium in the HMC supply wells to determine if pumping from the San Andres wells is drawing site contamination into the deeper aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/27/2017

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
BVDA	Bluewater Valley Downstream Alliance
CAP	Corrective Action Program
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
cm	Centimeter
COC	Constituent of Concern
DOE	Department of Energy
dpm/cm^2	Disintegrations per Minute per Square Centimeter
EPA	U.S. Environmental Protection Agency
FYR	Five-Year Review
gpm	Gallons per Minute
IC	Institutional Control
LTP	Large Tailings Pile
HHRA	Human Health Risk Assessment
HMC	Homestake Mining Company
MCL	Maximum Contaminant Level
mg/l	Milligram per Liter
mg/kg	Milligram per Kilogram
mg/kg-day	Milligram per Kilogram per Day
mg/m^3	Milligram per Cubic Meter
mrem/yr	Millirem per Year
NCP	National Contingency Plan
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
O&M	Operation and Maintenance
OU	Operable Unit
pCi/g	Picocurie per Gram
pCi/L	Picocurie per Liter
pCi/m^2s	Picocurie per square meter per second
POC	Point of Compliance
PRP	Potentially Responsible Party
RAO	Remedial Action Objective
RO	Reverse Osmosis
ROD	Record of Decision
RPM	Remedial Project Manager
RSL	Regional Screening Level
STP	Small Tailings Pile
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TPP	Tripolyphosphate
UU/UE	Unlimited Use/Unrestricted Exposure

I. INTRODUCTION

The purpose of a Five-Year Review (FYR) is to evaluate the implementation and performance of a remedy to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP)(40 Code of Federal Regulations (CFR) Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the fourth FYR for the Homestake Mining Company Superfund site (Site). The triggering action for this policy review is the completion of the previous FYR on September 27, 2011. The FYR has been prepared because hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of three operable units (OUs). OU1 addresses groundwater restoration; OU2 addresses long-term tailings stabilization, surface reclamation and site closure; and OU3 addresses radon concentrations in the neighboring subdivisions. This FYR report addresses all site OUs.

The FYR was led by Sairam Appaji, EPA Remedial Project Manager (RPM), with contractor support provided by Skeo Solutions. Participants also included Stephen Harper, EPA Community Involvement Coordinator (CIC) and Angelo Ortelli, New Mexico Environment Department (NMED). Homestake Mining Company (HMC), the potentially responsible party (PRP), was notified of the initiation of the FYR. The review began on November 13, 2015.

Appendix A includes a list of documents reviewed as part of this FYR.

Site Background

The Site is located in a rural area of Cibola County, New Mexico, about 5.5 miles north of the village of Milan (Appendix B, Figure B-1). The Site includes HMC's former uranium mill, groundwater contaminated by site-related wastes and radon contamination in neighboring residential subdivisions. The uranium mill operated between 1958 and 1990. It was decommissioned and demolished between 1993 and 1995 as part of the mill site reclamation work required under Nuclear Regulatory Commission (NRC) Source Materials License No. SUA-1471 (License SUA-1471). The only current operations at the Site are related to the operation and maintenance (O&M) of the NRC-required Corrective Action Program (CAP) for groundwater restoration. The facility currently consists of two former tailings impoundments (referred to as the large and small tailings piles), a groundwater collection and injection system, a reverse osmosis (RO) water treatment facility, pilot and full-scale zeolite water treatment systems, two lined collection ponds, three lined evaporation ponds, a groundwater collection system for areas outside the facility's licensed boundary and associated equipment and structures (Appendix B, Figure B-2). Seepage from the tailings piles has resulted in contamination of the underlying groundwater aquifers with radiological and non-radiological contaminants. The aquifers are known locally as the San Mateo alluvial aquifer and the Upper, Middle and Lower Chinle aquifers.

HMC owns land in and around the former mill and leases much of it for livestock grazing. The major land use south and west of the facility's licensed boundary is residential development in the Pleasant Valley Estates, Murray Acres, Broadview Acres, Valle Verde and Felice Acres subdivisions. Since the previous FYR, a shed company began operations east of the facility's licensed boundary. Future land use is expected to be consistent with current use.

Appendix C includes a site chronology. Appendix D contains additional background information about the Site, including geology and history of contamination.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Homestake Mining Company		
EPA ID: NMD007860935		
Region: 6	**State:** NM	**City/County:** Grants/Cibola County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name: Sairam Appaji, with additional support provided by Skeo Solutions		
Author affiliation: EPA Region 6		
Review period: 11/13/2015 – 9/27/2016		
Date of site inspection: 1/12/2016		
Type of review: Policy		
Review number: 4		
Triggering action date: 9/27/2011		
Due date *(five years after triggering action date)*: 9/27/2016		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

The basis for taking action at the Site includes detections of the following constituents in the specified media:

Table 1: Constituent of Concern (COC) by Media

Groundwater[a]	Soil	Uranium Mill Tailings
Uranium	Radium-226	Radon-222 Emissions
Selenium	Thorium-230	
Molybdenum		
Vanadium		
Radium-226 and Radium-228		
Thorium-230		
Sulfate		
Chloride		
Nitrate		

Groundwater[a]	Soil	Uranium Mill Tailings
Total Dissolved Solids (TDS)		

Notes:

a. Groundwater COCs identified in the 2012 Updated CAP, which states "At the time of placement [in the LTP], concentrations of the 10 COCs in tailings pore water in the LTP were elevated."

The initial response at the Site addressed exposure of neighboring residents to groundwater contaminated with radiological and non-radiological constituents. Additional response actions at the Site addressed exposure to Radon-222 (commonly referred to as radon) in nearby homes and radiological constituents in residential soil, discrete items that contained radioactive contamination including pipe, rocks and petrified wood. Other potential historical exposure sources at the Site included uranium byproducts, contaminated surface soil, buildings, equipment and radon emissions to ambient air from the tailings piles.

Response Actions

Documents that detail the remedial decisions for the Site include NRC License SUA-1471, originally issued to HMC in 1957 by the Atomic Energy Commission;[1] a 1993 NRC-approved Decommissioning and Reclamation Plan (DRP); a 1989 NRC-approved groundwater CAP, updated in 2006 and 2012;[2] NMED-approved Discharge Permits DP-200 and DP-725; and the 1989 EPA Record of Decision (ROD) for OU3.

Pursuant to the 1983 Consent Decree, HMC financed the extension of the Village of Milan's municipal water supply to then-existing residences of the subdivisions and made payments to the Village of Milan for the residents' water usage over a period of ten years. The extension of the water supply was completed in 1985.

Pursuant to the 2009 Memorandum of Agreement (MOA) with NMED, HMC agreed to provide hookups to Milan's municipal water supply to additional residents.

NRC is addressing remedial activities at the Site under mill tailings regulations in 10 Code of Federal Regulations (CFR) 40, Appendix A, as amended, which conform with EPA standards in 40 CFR 192.

HMC completed updates to the DRP and groundwater CAP during this FYR period. NRC, EPA, NMED and the community provided comments and NRC is currently performing review of additional information that Homestake has provided in support of the CAP and DRP.

OU1 – Groundwater Restoration

HMC is implementing the groundwater restoration program under NRC License SUA-1471, a groundwater CAP, and NMED Discharge Permit DP-200. In September 2014, NMED issued to HMC a renewal and modification of Discharge Permit DP-200. The modification of DP-200 subsumed the conditions and requirements of DP-725, which previously regulated discharges to the collection and evaporation ponds. Therefore, NMED terminated Discharge Permit DP-725 in October 2014.

License SUA-1471 and the groundwater CAP defined general remedial action objectives (RAOs) for groundwater restoration, as follows:

- Remediate groundwater to levels stipulated in License SUA-1471 and NMED Discharge Permit DP-200.
- Dewater the large tailings pile (LTP) to remove this area as a continuing source of groundwater contamination.

[1] Site Summary on the NRC website: http://www.nrc.gov/info-finder/decommissioning/uranium/is-homestake.pdf.
[2] NRC is currently reviewing the 2012 Updated CAP. In the interim, HMC is implementing the groundwater restoration program as outlined in the 2012 Updated CAP.

- Prevent the consumption of contaminated groundwater by residents in the nearby subdivisions.

Remedy selection at the Site has been based on the procedures specified by NRC, NMED and the 1983 Consent Decree. The groundwater CAP drives the groundwater remedy for the Site with NRC, NMED and EPA providing approval and oversight.

The major components of the groundwater remedy include:

- Dewatering the LTP to remove contaminated groundwater and control the source area of the groundwater contamination.
- Provisions for an alternate and permanent water supply for nearby subdivision residents; financing of the cost of residents' water use for ten years (1985 through the end of 1994).
- Operation of a groundwater collection and injection system to reverse groundwater flow back toward the collection wells next to the tailings piles; treatment of the collected groundwater by RO and zeolite for re-injection or evaporation.

Groundwater cleanup standards are established by both NRC (License SUA-1471) and NMED (DP-200). In July 2006, the NRC issued Amendment 39 to License SUA-1471, which revised the list of groundwater protection standards. Table 2 lists the 2006 standards, which are still current. These standards have also been incorporated into NMED Discharge Permit DP-200 and the 2012 Updated CAP.

Table 2: Site Groundwater Protection Standards

Constituent	Alluvial Aquifer	Chinle Mixing Zone	Upper Chinle Non-Mixing Zone	Middle Chinle Non-Mixing Zone	Lower Chinle Non-Mixing Zone
Uranium	0.16 mg/L[a]	0.18 mg/L[a]	0.09 mg/L[a]	0.07 mg/L[a]	0.03 mg/L
Selenium	0.32 mg/L[a]	0.14 mg/L[a]	0.06 mg/L[a]	0.07 mg/L[a]	0.32 mg/L[a]
Molybdenum	0.1 mg/L	0.1 mg/L	0.1 mg/L	0.1 mg/L	0.1 mg/L
Radium-226 and Radium-228	5.0 pCi/L	NR[b]	NR[b]	NR[b]	NR[b]
Thorium-230	0.3 pCi/L	NR[b]	NR[b]	NR[b]	NR[b]
Sulfate	1,500 mg/L[a]	1,750 mg/L[a]	914 mg/L[a]	857 mg/L[a]	2,000 mg/L[a]
Chloride	250 mg/L	250 mg/L	412 mg/L[a]	250 mg/L	634 mg/L[a]
TDS	2,734 mg/L[a]	3,140 mg/L[a]	2,010 mg/L[a]	1,560 mg/L[a]	4,140 mg/L[a]
Nitrate	12 mg/L[a]	15 mg/L[a]	NR[b]	NR[b]	NR[b]
Vanadium	0.02 mg/L	0.01 mg/L	0.01 mg/L	NR[b]	NR[b]

Notes:
a) Values based on site-specific groundwater background concentrations
b) NR - Groundwater protection standards not required for constituents in this zone
pCi/L – picocurie per liter
mg/L – milligram per liter

OU2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

License SUA-1471 defines the following RAOs for OU2:

- Limit radon emissions from the tailings impoundments.
- Remediate soil contamination that resulted from windblown tailings.

License SUA-1471 and the Decommissioning and Reclamation Plan define the following major components of the OU2 remedy:

- Decontamination of the mill facilities and equipment.
- Demolition of the mill facilities and equipment.

- Burial of contaminated debris and asbestos-containing materials in the out slope of the LTP.
- Burial of uncontaminated debris and equipment in pits on the mill site.
- Excavation of surface soils contaminated with windblown tailings and burial in the out slope of the LTP.
- Construction of a final radon barrier on the two tailings piles to minimize radon emissions and reduce erosion.

In April 2013, HMC submitted an update to its Decommissioning and Reclamation Plan for NRC review and approval. Review of the update is ongoing.

Soil cleanup criteria for OU2 were based on the NRC requirements in 10 CFR 40, Appendix A, Criterion 6, which are repeated in the EPA requirements specified in 40 CFR 192. These regulations include a cleanup standard for radium-226 in the top 15 centimeters (cm) of soil of 5 picocuries/gram (pCi/g) above background and 15 pCi/g above background for each 15-cm depth increment below the top 15 cm. The NRC-approved background level for radium-226 at the mill site was established as 5.5 pCi/g. Therefore, the radium-226 cleanup standards are 10.5 pCi/g for the top 15 cm of soil, 20.5 pCi/g for the next 15-cm depth increment, increasing by 15 pCi/g for each successive 15 cm of depth.

OU3 – Radon in Neighboring Subdivisions

EPA signed the OU3 ROD on September 27, 1989. Although elevated indoor radon concentrations were discovered in a few houses in the subdivisions near the Site, EPA determined that there was no definitive correlation between the radon concentrations and the proximity of those homes to the mill facility. The selected remedial action was no further action; therefore, there are no RAOs under CERCLA. However, the decision formalized in the ROD did not constitute a finding by EPA that adequate protection was achieved in the neighboring subdivisions. To address concerns raised by residents, EPA conducted additional evaluation of the neighborhoods between 2010 and 2014.

There is no identified cleanup standard for OU3. The EPA action level for radon in home air (4.0 picocuries per liter (pCi/L)) guided selection of homes for radon mitigation systems, installed in 2012.

The soil action level established for the 2014 removal action at residential properties was 3.5 pCi/g of radium-226, inclusive of background in outdoor soils (1.03 pCi/g to 1.67 pCi/g). The total effective dose equivalent (TEDE) was 15 millirem per year (mrem/yr) above background.

An NRC license condition required HMC to monitor outdoor radon and windblown particulate levels at the facility boundary to ensure that conditions in the subdivisions do not significantly change before final site closure. Under 10 CFR 20 (Standards for Protection Against Radiation) the concentration of radon is limited to 3 pCi/L above background at HMC's licensed boundary.

Status of Implementation

OU1 – Groundwater Restoration

In 1976, groundwater sampling by HMC identified a contaminant plume in the alluvial aquifer that originated from the LTP. The plume was moving off site to the south and west. As a result of these findings, HMC implemented a state-approved groundwater restoration program in 1977. The program included installation of a line of groundwater injection wells along the southern boundary between the LTP and the downgradient residences. The purpose of this line of injection wells was to create a hydraulic barrier that reversed the natural flow direction of the contaminated groundwater away from the residences and back toward the tailings piles; however, initial efforts may have induced downward migration of contaminants. Between 1977 and 1982, HMC also installed groundwater collection wells near the tailings piles and evaporation ponds. These wells would collect tailings seepage and retrieve groundwater that may have migrated from the pile.

In 1983, EPA placed the Site on the Superfund program's National Priorities List (NPL). That same year, HMC and EPA signed an Agreement and Stipulation (Consent Decree). The Consent Decree required HMC to provide an extension of the Village of Milan municipal water system to four residential subdivisions (Broadview Acres, Felice Acres, Murray Acres and Pleasant Valley Estates). The agreement required HMC to pay for residents' water for 10 years. HMC connected residences to the Village of Milan's water supply system in 1985 and paid for water use until the end of 1994. At the time, EPA did not require additional response actions to remediate groundwater because HMC was already implementing a state-approved plan.

In September 1989, HMC submitted a CAP for groundwater remediation to NRC. The program was approved by NRC in License Amendment No. 8, dated July 20, 1990, by adding the requirement for implementation of the CAP as License Condition 35. The groundwater restoration program was modified again in January 15, 1989, to incorporate the RO groundwater treatment system. In 2006 and following an evaluation of background water quality, NRC issued License Amendment No. 39 to establish a revised list of groundwater protection standards for Site groundwater. Since that time, HMC has performed several operating modifications or adjustments under the oversight of NMED and NRC, which are summarized in the site chronology (Appendix C). In 2012, HMC submitted an Updated CAP to NRC for review and approval. This document summarized the history of groundwater restoration at the Site, and combined relevant information from annual reports and license conditions into a single document. It also included potential revisions to the restoration strategy in efforts to meet EPA and NMED requirements. Review of the 2012 Updated CAP is currently ongoing by NRC.

The current program includes a groundwater collection and injection system for the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers; a tailings toe drain system; a pilot zeolite water treatment system on top of the LTP; an RO water treatment system; two collection ponds; and three evaporation ponds.

Deep-well supplied fresh water or treated water is injected into the San Mateo alluvial aquifer and the Upper and Middle Chinle aquifers to reverse the natural gradients and to flush contaminants from the contaminated portions of the aquifers. Modifications have been made as restoration has progressed, including discontinuing injection in some downgradient alluvial wells and expanding injection closer to the collection wells. Figure B-4 in Appendix B, originally included in the 2014 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200, shows the locations of the present injection and collection system.

Collected groundwater is pumped to the RO treatment plant with smaller volumes directed to the pilot zeolite treatment system or pumped directly into evaporation ponds. Treated water from the RO and zeolite systems is re-injected into the aquifers for plume control. Evaporation of water at the ponds is enhanced through spray misters; the spray misters operate on a seasonal basis and are shut down during the winter months.

Since the previous FYR, HMC upgraded the RO groundwater treatment system, which utilizes a lime-caustic pre-treatment and clarification unit. Although the original system had a 600 gallon per minute (gpm) design capacity, it had been operating at less than 50 percent of its capacity due to limitations of its sand filtration unit. The expanded and upgraded RO system has the capacity to treat 1,200 gpm, doubling its capacity to treat groundwater. Upgrades to the system also included changing the filtration mechanism from sand filtration to microfiltration (using low pressure membranes) and installation of a new clarifier tank. The upgraded RO system began full-scale operation in February 2016.

HMC completed construction of a full-scale zeolite water treatment system on top of the LTP in 2016. The 1,200 gpm full-scale system was designed to supplement the existing 300 gpm pilot treatment system. Once complete, the two systems will be combined for a total design capacity of 1,500 gpm. The treated water from the zeolite treatment system will be used for plume control (as part of the injection/collection system) in the areas west and south of the facility's licensed boundary. To the extent possible and as site conditions allow, the treated water from zeolite will be used in lieu of fresh water for reinjection. The zeolite-based treatment system was in the testing phase in July 2016.

Downgradient of the facility's licensed boundary, groundwater remediation also included extraction of contaminated groundwater with land application treatment using four irrigation systems (a practice initially implemented in 2000). However, NMED prohibited use of the irrigation systems with a renewal/modification of DP-200 and the practice ended in 2012. Extracted groundwater is now treated using the upgraded RO and pilot zeolite treatment systems. Initially, the off-site groundwater restoration system consisted of 13 collection wells. By 2005, the off-site groundwater restoration system had expanded to 35 wells. Since the previous FYR, 550 wells, including injection and collection wells throughout the Site, were added to the program to expedite the cleanup process. This includes installation of 160 new alluvial wells in 2014.

HMC is also evaluating the efficacy of tripolyphosphate (TPP) injections as an additional mechanism for remediation. A TPP pilot test is underway that involves injection of TPP, or another phosphate source, into the alluvial aquifer inside the area of hydraulic control. The primary objective of the pilot testing is to evaluate the uranium immobilization efficacy of TPP in the alluvial aquifer and collect design parameters necessary for full-scale implementation. The most recent TPP injection occurred in August 2015.

The 2012 Updated CAP estimated active groundwater restoration to be complete by 2020; however, the estimate was based on groundwater modeling, results from present operating conditions and predicted future operation conditions. Several operating conditions have changed since the modeling was conducted, including discontinuation of land treatment and active flushing of the LTP, as well as an increase in the operating capacity of the water treatment systems. Based on these recent changes, this estimate should be revised based on current remedy components. The estimate should also clarify when groundwater outside the facility's licensed boundary will be restored.

OU2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

HMC decommissioned and dismantled the mill in the early 1990s, with some waste materials deposited in the LTP or buried next to the south side of the LTP. Following demolition of the mill facility, HMC removed soil contaminated by windblown tailings, ore storage and processing; HMC disposed of these materials in the LTP. HMC recontoured the LTP to improve long-term stability and to prepare for final closure. In 1994, HMC constructed a final radon barrier and erosion protection cover on the sides of the LTP as well as an interim radon cover on its top. In 1995, HMC constructed an interim radon cover on the portion of the small tailings pile (STP) not covered by evaporation pond 1. The placement of final radon barriers will not occur until groundwater restoration activities are complete.

In 2000, HMC began a tailings flushing program at the LTP. This program involved injection of water into the LTP and extraction via a large number of wells on the LTP. The program was a way to flush out contaminants in the tailings. Water collected by the wells was directed to the collection ponds or treated through the RO treatment system.

HMC conducted a pilot study in a portion of the LTP between December 2010 and May 2012 to evaluate the possibility of a rebound in contamination concentrations once the flushing program ends. Data from the study found that significant rebound was not expected. HMC ended the LTP flushing program in July 2015 and is currently collecting data to evaluate rebound.

The previous FYR also recommended re-evaluating stability of the LTP because a prior earthquake stability analysis had assumed unsaturated tailings. In 2010, the stability analyses were updated using the regional seismic parametric values, and the factors of safety under earthquake loading were well above minimums. Every year a third party independent, professional engineer (licensed in New Mexico) assesses the LTP conditions to ascertain that the 2010 analysis is still applicable to present conditions.

OU3 – Radon in Neighboring Subdivisions

EPA issued a no action ROD for OU3. However, residents in the neighboring subdivisions raised concerns that they had been exposed to unacceptable levels of radioactive contaminants through inhalation and ingestion. The residents alleged that the contaminants were transported into their homes through the spray mist from the evaporation pond associated with the groundwater remediation activities and through their use of contaminated groundwater for domestic uses (such as cooking, showering, washing, etc.). The residents were concerned about contaminants transported from the Site through the air or surface runoff to their backyards, and about consumption of produce in areas irrigated with contaminated groundwater and consumption of livestock meat from cattle exposed to contaminated grazing areas. To address these concerns, EPA conducted additional evaluation of the neighborhoods between 2010 and 2014 to gather data to support the development of a Human Health Risk Assessment (HHRA) for OU3. Data collection included:

- Screening, scanning and survey evaluation.
- Long-term indoor and outdoor radon exposure evaluation.
- Soil, produce and private well evaluation.

EPA evaluated the resulting data, conducted and finalized an HHRA in December 2014, and determined mitigation or removals, or both, were needed at several residential properties. These evaluations and removal efforts are summarized below.

Screening, Scanning and Survey Evaluation
Major components of the evaluation included radiation ground scans around 86 houses in the subdivisions south of the Site, collection of soil samples for analysis of radionuclides from areas with high scan readings, measurement of indoor exposure radiation levels (short term), and collection of wipe samples within select residences. EPA contractor Weston Solutions, Inc. conducted the work between September 2010 and May 2012. Weston Solutions, Inc. presented results of the investigation in the Removal Assessment Report for Homestake Mining Company, Grants, Cibola County, New Mexico, dated May 2012 (May 2012 Removal Assessment Report). Results are summarized in Section IV, Data Review, of this FYR.

Long-Term Indoor and Outdoor Radon Exposure Evaluation
EPA conducted long-term air radon monitoring at homes in the five subdivisions south and west of the Site and from homes in a background area. Results were presented in the Human Health Risk Assessment, Homestake Mining Co. Superfund Site, Cibola County, New Mexico, dated December 2014 (2014 HHRA), and are summarized in Section IV, Data Review, of this FYR.

Soil, Produce and Private Well Evaluation
EPA collected surface soil samples from the yards of each house with an access agreement. EPA also collected surface soil from the Site's three irrigation fields, two central pivot fields, evaporation pond banks and a background area. Surface soil samples were collected from four runs with the highest gamma radiation readings in the area between the evaporation ponds and the fence line. The samples were analyzed for metals and radionuclides.

EPA collected 10 samples of vegetables from various gardens in the subdivisions, 14 irrigation well water samples from private properties, and samples from the evaporation pond at the Site. Results are summarized in Section IV, Data Review, of this FYR.

Radon Mitigation and Removal Actions
Based on the long-term indoor and outdoor radon exposure evaluation, EPA determined that radon mitigation was warranted at 12 residential properties where radon in indoor air exceeded 4 pCi/L based on average annual

sampling. EPA installed mitigation systems in 11 homes[3]; one homeowner declined the mitigation effort. The source of high radon levels in these homes has not been identified. The HHRA found no significant difference between annual indoor radon levels in the five subdivisions and background levels. Installation of the mitigation systems was completed in 2012.

EPA determined that soil removal actions were warranted to address radioactive-contaminated soil at 16 properties. EPA identified two additional properties for removal of discrete items. The contaminated soil and other material found in the subdivisions were unrelated to Homestake Site. Removal actions at the properties were conducted between February and July 2014.

Institutional Control Review

Table 3 summarizes all institutional controls (ICs) for the Site, with additional OU-specific information below.

OU1 – Groundwater Restoration

Beginning in 2009, NMED requested the New Mexico Office of State Engineer (NM-OSE) to issue a health advisory to every person who applies for a well permit within the San Mateo Creek basin. The advisory cautions current and future owners and users of private wells within the San Mateo Creek basin that their well water could contain contaminant concentrations in excess of federal drinking water standards. The advisory was also published in two newspapers of general circulation in Cibola and McKinley counties. The NM-OSE Health Advisory is considered as an Information Device type of Institutional Control.

HMC also conducts an annual land use survey to meet annual license condition reporting requirements under License SUA-1471. This review includes an assessment of the five residential subdivisions south and west of the Site. The assessment determines whether occupied dwellings are using water service from the Village of Milan system for potable water consumption rather than private wells, particularly private domestic wells that are completed into the underlying shallow alluvial aquifer. If residences are not on the Village of Milan water supply, HMC will give the residences the opportunity to connect to the public water supply with HMC covering the cost of hookup. As of 2014, all residences in the subdivisions, except for one residence in Valle Verde, are connected to public water. The Valle Verde resident has declined the offer to connect to the Village of Milan water supply.

OU2 - Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

HMC currently restricts access within its license boundary with a security fence and warning signs. The facility maintains security support services, security alarm systems and site entry controls. Once site reclamation is complete, HMC will maintain the site controls until transfer of title to the Department of Energy (DOE). Upon title transfer from HMC to the DOE, the DOE will assume custody of and responsibility for the Site in perpetuity for the licensed area. Restrictions will need to be implemented to prevent disturbance of soil, waste and any remedy components; to prevent unacceptable future use; and to prevent use of groundwater for potable purposes.

OU3 - Radon in Neighboring Subdivisions

Decision documents did not require institutional controls for OU3. However, annual radon flux measurements and radon monitoring at the fenceline of the HMC boundary is required under the facility's NRC license.

[3] Radon mitigation systems consisted of single suction point active soil depressurization system with a radon-specific fan (RadonAway).

Table 3: Summary of Planned or Implemented Institutional Controls (ICs)

Media, engineered controls and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents[a]	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater	No	No	Parcels overlying the groundwater contaminant plumes	To caution current and future owners and users of private wells within the San Mateo Creek basin that their well water could contain contaminant concentrations in excess of federal drinking water standards	New Mexico Office of State Engineer Health Advisory (2009)
	No	Yes[b]	Parcels overlying the groundwater contaminant plumes in the five neighboring residential neighborhoods	To determine whether current residents are using the public water supply for potable water consumption	Amendment 34 to SUA-1471 (approved 2002) requires submittal of a land-use survey on an annual basis
Groundwater, soil and waste within the NRC license boundary	Yes	No	Parcels within the NRC license boundary	To prevent disturbance of soil, waste and any remedy components; to prevent unacceptable future use; to prevent use of groundwater for potable purposes	Restrictive Covenants to be filed after EPA issues a ROD for OU1 and OU2 and full reclamation and closure of the Site.

Notes:
a) EPA decision documents have not yet been issued for OU1 and OU2.
b) Required by reporting requirements under License SUA-1471.

Systems Operations/Operation & Maintenance (O&M)

OU1 – Groundwater Restoration

License SUA-1471 and NMED Discharge Permit DP-200 stipulate O&M requirements for OU1. Several internal documents kept at the facility also outline O&M activities. The O&M activities include:

- Operation, maintenance and monitoring of the groundwater injection and collection wells, as well as associated piping.
- O&M of the RO treatment plant, zeolite treatment systems, collection ponds and evaporation ponds.
- Groundwater sampling and monitoring.
- Air monitoring.
- Maintenance of air monitoring stations and groundwater monitoring wells.

HMC personnel are at the Site daily during the week performing O&M activities. Daily and weekly inspections verify the condition of RO treatment plant and zeolite treatment system components. Monitoring of collected water is performed as a part of O&M. More than 5.8 billion gallons of groundwater have been extracted from the on-site collection system between 1978 and 2014. More than 1.1 million pounds of uranium have been removed from groundwater with subsequent treatment by the RO system. Total volume of groundwater collected and

quantities of constituents removed by the on-site contaminated groundwater collection and tailings dewatering systems from 1978 to 2014 are shown in Appendix G.

O&M also includes periodic monitoring of several hundred groundwater monitoring wells and continual O&M of dozens of collection and injection wells.

OU2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

NRC licensing requirements require HMC to conduct annual inspections of the tailings piles and pond dikes, and annual radon flux surveys for the tailings piles. The annual inspections include visual observations of the tops and outslopes of both tailing piles and of the dikes, slopes and liners of the evaporation ponds. The inspections also include review of piezometer readings, tailings collection well and tailings drainage sump collection rates, leak detection monitoring records for evaporation ponds 2 and 3, settlement monitoring survey data, pond level measurements and other data. Annual reports submitted to NRC, EPA and NMED document results of the inspections and the radon flux surveys.

O&M for OU2 also consisted of those activities associated with the tailings flushing program, which ceased operation in 2015.

OU3 - Radon in Neighboring Subdivisions

There is no current long-term O&M for OU3. Generally the radon mitigation systems are known to operate without any maintenance problems for many years before the motor in the unit wears out. EPA has installed these systems at other sites and have not experienced maintenance issues. The homeowners have been instructed to contact the installer for servicing any repairs beyond the warranty period.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2011 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Short-term Protective	Based on current information, the remedy at OU1 is protective of human health and the environment through the use of a groundwater collection and injection system at the Site and the use of a health advisory. The health advisory informs current and future residents of potential risks of drinking water standard exceedances in the use of water from private wells and minimizes the possibility of new wells being installed within the area of contamination, thus limiting the primary exposure pathway of ingestion. There is no evidence of current exposure from any media at this time.
2	Short-term Protective	Based on current information, the remedy at OU2 is protective of human health and the environment due to the stabilization of the tailings piles, surface reclamation and decommissioning of the mill. Soil contaminated by windblown tailings was excavated and disposed of in the LTP and the mill facility was decontaminated, demolished and parts were either buried in place or placed in the LTP. A radon barrier and erosion protection cover were constructed on the sides of the LTP, and an interim soil cover was constructed on its top and on the STP.
3	Protectiveness Deferred	Although the OU3 ROD called for no further action, EPA recognized the need to monitor outdoor radon and windblown particulate levels south of the disposal area to ensure that conditions in the neighboring subdivisions remain protective until final site closure. Therefore, EPA continues to review outdoor radon monitoring and particulates data collected at the facility boundary. Also, in September 2010, EPA began collecting sample data to support the development of an HHRA, to include

OU #	Protectiveness Determination	Protectiveness Statement
		indoor and outdoor radon samples. The sample collection will continue on a quarterly basis until November 2011. A HHRA is expected in spring 2012 which will provide information needed to support a determination of the protectiveness of the OU3 remedy. Therefore, the determination of protectiveness for OU3 is deferred until completion of the HHRA.
Sitewide	Protectiveness Deferred	The remedy, exclusive of OU3 at the Site, is protective of human health and the environment through the combined effects of HMC's ongoing groundwater remedial action with associated groundwater monitoring, and the dissemination of a health advisory through the State's well permitting process, which advises prospective well owners of the potential existence of groundwater exceeding drinking water standards.

Table 5: Status of Recommendations from the 2011 FYR

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	Extraction of large quantities of water from the San Andres Formation and subsequent injection, primarily into the alluvial aquifer, has created localized areas with an artificial head difference of approximately 100 feet that, combined with the presence of faults and associated fracturing in the bedrock, increases the risk of downward migration of contaminants.	Minimize use of clean water and develop an alternate source, such as treatment of extracted groundwater, for use in injection into the alluvial and Chinle Formation aquifers remedy.	Ongoing	HMC continues to extract groundwater from the San Andres aquifer for injection into the alluvial and Chinle aquifers. HMC recently completed construction of the full-scale zeolite treatment system and completed expansion and upgrades to the RO treatment facility. Water treated with these alternative technologies is expected to significantly reduce reliance on San Andres water for injection.	NA
1	Rebound conditions are unknown in the tailings flushing program. The flushing program is also likely decreasing the stability of the LTP due to the increased saturation of the pore spaces. The earthquake stability analysis assumed unsaturated tailings and did not account for the increased percentage of fluid-filled pore space resulting from the relatively recent tailings flushing program.	Conduct a pilot study in a portion of the LTP to quantify possible contaminant concentration rebound effects and demonstrate that rebound will not occur once the flushing program has ended. The earthquake stability analysis should be reevaluated to account for the increased fluid-filled pore space resulting from the relatively recent tailings flushing program.	Completed	HMC conducted a pilot study in a portion of the LTP between December 2010 and May 2012 to evaluate the possibility of a rebound in contamination concentrations once the LTP flushing program ends. The study found that significant rebound of the contaminants was not expected. HMC discontinued the LTP tailings flushing program in 2015 and is collecting additional data to monitor actual rebound conditions at the Site. HMC re-evaluated the stability of the LTP in 2010 and found that the factors of safety under earthquake loading were well above minimums. Every year a	5/1/2012

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
		The protectiveness is dependent on a revised earthquake risk analysis.		third party independent, professional engineer assesses the LTP conditions to ascertain that the 2010 analysis is still applicable to present conditions. The 2014 annual inspection results for the LTP, included in the 2014 Annual Report, noted that the "slope stability analysis of the LTP updated in 2010 is still valid for 2014; the stability parameters have not changed negatively during 2014 and are expected to gradually improve even more as the flushing program winds down and the LTP phreatic surface declines. The static and pseudo-static factors of safety remain well above the design minimum values of 1.5 and 1.0, respectively."	
2	A persistent plume of elevated uranium contamination just south of the former mill site may be a remnant of the LTP contaminant plume and may continue to impact groundwater. In addition, an historic irrigation ditch established in the 1920s that ran through the future Homestake mill property, and presumably was backfilled to original grade during construction of the mill, may be serving as a preferential pathway for leached contaminants to groundwater.	Determine whether a remnant of the LTP contaminant plume is continuing to impact groundwater. Investigate the backfilled irrigation ditch that ran through the HMC property to determine whether it serves as a preferential pathway for the migration of leached contaminants to groundwater.	Considered But Not Implemented	HMC provided a response, also included in the 2013 update to the Decommissioning and Reclamation Plan, that the historical record of the mill contains no information, coupled with subsequent mill site area reclamation and post-reclamation gamma surveys of the reclaimed area that indicated no radiological anomalies, to support the speculation that the old irrigation ditch plays any part in movement of contaminated groundwater on the HMC site. HMC further noted that the movement of uranium and other COCs in groundwater has been investigated for 35 years and remediation is making progress. A study of the ditch would not change the groundwater restoration plan.	4/1/2013
2	The east side slope of the STP/evaporation pond 1 had moderate to large furrows and the west side of the westernmost collection pond had	Provide some type of native vegetative cover or erosion protection cover to the east side slope of the STP/evaporation	Completed	HMC began repair of the outslope rills and placement of clean fill on the east outslopes to provide a wider crest road for increased safety of maintenance vehicles.	2/1/2015

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
	moderate furrows, both of which appeared to be the result of rainfall/erosion.	pond 1 and the west side of the westernmost collection pond to prevent erosion.		Currently, the earthen slopes on these structures are addressed on an as-needed basis to eliminate rills and rodent burrows; additional clean fill material is placed as needed to repair potential erosion areas. A seed mixture for native vegetative cover is currently being evaluated by HMC in conjunction with the local Natural Resources Conservation Department.	
3	Annual air monitoring reports in 2006-2010 indicate releases of radon outside the area covered by the NRC license, in concentrations exceeding EPA standards.	EPA is currently in the process of completing a radon survey and a determination of the radon source (if possible), and specific recommendations will be made upon completion of the survey. This information will be incorporated into an HHRA in the spring of 2012.	Completed	EPA completed a radon survey in 2012, which included screening and sampling of 86 residential properties south and west of the Site. Results were presented in the May 2012 Removal Assessment Report. Based on sampling results, radon mitigation systems were installed at 11 residential properties where radon in indoor air exceeded 4 pCi/L based on average annual sampling; however, the source of radon in these homes has not been identified. EPA also conducted removal actions at 18 properties with radiological contaminated soil/debris. EPA finalized the HHRA for OU3 in December 2014.	12/1/2014
3	The 2006-2010 annual air monitoring report indicates that releases of radon exceeded the annual average concentrations allowed under 40 CFR 192.02(b)(2).	EPA is currently in the process of completing a radon survey and a determination of the radon source (if possible), and specific recommendations will be made upon completion of the survey. This information will be incorporated into an HHRA in the spring of 2012.	Completed	Please see the OU3 status above.	12/1/2014
3	Radon air monitors along the Homestake fenceline have continuously recorded	EPA is currently in the process of completing a radon survey and a	Completed	Please see the OU3 status above.	12/1/2014

OU #	Issue	Recommendation	Current Status	Current Implementation Status Description	Completion Date (if applicable)
	outdoor ambient air radon concentrations associated with cancer risk levels that are greater than EPA's acceptable cancer risk range of 1 x 10^{-4} to 1 x 10^{-6}, as published in the National Contingency Plan.	determination of the radon source (if possible), and specific recommendations will be made upon completion of the survey. This information will be incorporated into an HHRA human health risk assessment in the spring of 2012.			

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a newspaper posting in the *Cibola Beacon* on 12/15/2015, stating that there was a FYR and inviting the public to submit any comments to EPA. Appendix E includes a copy of the public notice. The results of the review and the report will be made available at the site information repository located at New Mexico State University, Grants Campus Library, at 1500 Third Street in Grants, New Mexico.

During the FYR process, interviews were conducted with representatives of the NMED and the PRP, as well as local residents, to document any perceived problems or successes with the remedy that has been implemented to date**.** The results of these interviews are summarized below. Appendix F includes interview summary forms.

NMED indicated that it has had extensive interaction with HMC throughout the permit renewal process for DP-200 and that HMC has been cooperative and responsive to NMED requests for information. NMED noted that HMC has met the requirements of DP-200 since renewal in 2014, and is in compliance with the permit conditions. NMED also noted that HMC has made a concerted effort to accelerate groundwater remediation at the Site, with construction of the upgraded RO water treatment plant and zeolite water treatment system. NMED is also aware of complaints and inquiries from local residents. These include, but are not limited to, concerns over the overall remedial strategy, over-pumping and use of the San Andres aquifer, potential cross-contamination of the San Andres aquifer (from overlying contaminated aquifers), use of zeolite as a viable treatment technology, flushing of the LTP, radon background and monitoring, and the approved groundwater background concentrations (remediation standards). NMED noted that a health advisory is in place, but the State of New Mexico does not have a mechanism in place to enforce the institutional control.

The PRP's O&M representative noted that HMC continues to make significant gains with regard to water remediation activities and that significant progress was made over the past five years. He stated that the current remedy is soundly based in science and is effective. The monitoring data over the past 15 years support the remediation efforts. COCs, including selenium, uranium and molybdenum, are showing significant reductions. New systems implemented in the past five years include the new zeolite water treatment system, an improved RO water treatment plant and expanded well field. He also noted that HMC is conducting a pilot study using TPP. These changes have a significantly positive effect on the protectiveness of the remedy, as they have enabled HMC to treat more contaminated water at a faster rate.

Local residents expressed concern over the progress of remediation at the Site, which has stretched nearly 40 years. HMC paid for public water for ten years, but the groundwater [for use with private wells] still is not clean. Residents cannot use their wells and now they have to pay for water. Some residents expressed interest in EPA taking more of a lead role at the Site. They noted that communication with NRC had been a problem in the past, but that EPA has communicated better with the residents in recent years. Some residents noted that the Site has had both financial and physical effects on the community. Property values are down. One resident noted that there is a high incidence of cancers in people living closest to the Site. Another resident had concerns over the recent residential yard soil cleanups, including the background values used and the completeness of the cleanup. There was also concern about the new treatment technologies at the Site, and whether any of the new work will make the plumes bigger.

Data Review

OU1 – Groundwater Restoration

The data reviewed for OU1 include analytical and water level data from monitoring, injection and collection wells, as originally presented in HMC's 2011 through 2014 Annual Monitoring Reports/Performance Reviews (annual reports). The current monitoring program consists of several hundred groundwater monitoring wells, most of which are located in the alluvial aquifer. Wells in the Upper, Middle and Lower Chinle Formation and the San Andres aquifer are also monitored. Sampling is conducted at least annually; however, some wells are sampled more frequently.

The 2014 annual report stated that over 120 million gallons of water was extracted from the Alluvial aquifer on-site and 56 million gallons were extracted off-site. Approximately 1.5 million gallons was extracted from the Upper Chinle Formation on-site in 2014 and 167,000 gallons were extracted off-site. An additional 38 million gallons was extracted from the Middle Chinle off-site in 2014. Contaminants removed from the Alluvial aquifer include 2.6 million pounds of sulfate, 11,000 pounds of uranium, 16,000 pounds of molybdenum and 643 pounds of selenium. Contaminants removed from the Upper Chinle include 71,000 pounds of sulfate, 342 pounds of uranium, 434 pounds of molybdenum and 9 pounds of selenium.

Groundwater monitoring is used to characterize the contaminant plumes, evaluate performance of the restoration strategies and demonstrate progress made in restoring groundwater to meet site standards. Uranium and selenium are the most widespread contaminants at the Site; therefore, the groundwater monitoring data review focuses on uranium and selenium concentrations and distributions within each aquifer unit.

Groundwater Flow

Water level elevation maps showing groundwater flow direction in the alluvial, Upper, Middle and Lower Chinle and the San Andres aquifers are included in Appendix G (Figures G-1 through G-5). Review of the maps shows that groundwater flow directions in the alluvial and Chinle aquifers have been altered by operation of the collection/injection system. The groundwater gradient in the alluvial and Upper Chinle aquifers south of the LTP has been reversed, with groundwater flowing back toward the collection wells, which is consistent with the intent of the collection/injection system.

Plume Characterization

Plume maps showing the distribution of selenium in the alluvial aquifer in 1999 and 2014 are included in Appendix G (Figures G-6 and G-7). Plume maps were not available between 1999 and 2014. The 2014 selenium plume map shows the main plume under the LTP has decreased in size and concentration compared to the 1999 plume. Selenium concentrations in 2014 do not exceed 5 mg/L, whereas the 1999 map shows an area with concentrations above 5 mg/L south of the LTP. An area southwest of Felice Areas, with elevated selenium concentrations in 1999, was also restored prior to 2014. The 2014 map shows that selenium has been restored to below the cleanup standard (0.32 mg/L) in all of the residential areas south and southwest of the Site. The 2014 map does show an area of elevated selenium concentrations (between 0.32-1 mg/L) east of Highway 605 that was

not detected in 1999. Injection/collection wells are located in this area to aid in restoration (Appendix B, Figure B-4).

Comparison of the 1999 and 2014 uranium plumes for the alluvial aquifer (Appendix G, Figures G-8 and G-9) indicates that the plume has decreased in size and concentration, although not to the same degree as selenium. The plume northwest of Valle Verde subdivision that was greater than the site standard (0.16 mg/L) has been pulled back about 1 mile to the east. The area greater than 10 mg/L was also reduced in 2014. The 2014 uranium plume patterns also show that the concentrations in southern Felice Acres have been reduced to below 1.0 mg/L, compared to levels up to 10 mg/L in 1999. The area with concentrations greater than 0.5 mg/L in southern Felice Acres is much smaller than in 1999; however, concentrations persist above the site standard (0.16 mg/L) in this residential area. HMC installed additional wells southwest of Felice Acres in 2014[4]; however, additional efforts may be needed to aid restoration of this area.

Plume maps showing the distribution of uranium in the Upper, Lower and Middle Chinle aquifers in 1999 and 2014 are included in Appendix G, Figures G-10 through G-15. The plumes in the Lower and Middle Chinle aquifers have generally decreased in size and magnitude, but uranium concentrations persist above the cleanup standard in the Broadview Acres, Felice Areas and west of the LTP in the Middle Chinle aquifer and southwest of Felice Areas in the Lower Chinle. The uranium plume in the Upper Chinle shows higher concentrations and a larger plume footprint under the LTP in 2014 than in 1999, possibly as a result of the tailings flushing program. The plume is well defined and is expected to be remediated with the current network of collection/injection wells.

Compliance with Site Standards

There are five Point of Compliance (POC) wells: S4, D1, and X in the alluvial aquifer and CE2 and CE8 in the Upper Chinle aquifer. These wells are sampled during annual and semi-annual sampling events. The site standards must be met at these locations to comply with the NRC license and to demonstrate that NRC groundwater restoration objectives have been met. Note that groundwater restoration under the New Mexico Water Quality Control Commission (NMWQCC) regulations (e.g. 20.6.2.4103 NMAC) requires the achievement of site standards at any place of withdrawal for present or reasonable foreseeable future use, not just at POC well locations. EPA guidance also indicates that groundwater remediation levels generally should be attained throughout the contaminant plume. However, this evaluation is limited to the five POC wells used to comply with the NRC license. There are no POC wells for the other aquifers. Key constituents of interest in the alluvial and Upper Chinle aquifers are sulfate, total dissolved solids (TDS), chloride, uranium, selenium and molybdenum.

The alluvial aquifer POC wells are west and south of the LTP and the STP. POC wells S4 and D1 exceeded the site standard for uranium and molybdenum during each of the last five years. POC well X did not exceed any site standards during the FYR period with the following exceptions: in 2011, POC well X exceeded the radium-226 standard in one sample, and in 2013, well X exceeded the molybdenum standard in two out of four sampling events. Concentration trend plots for each COC were provided in the 2014 annual report. Appendix G includes the uranium plots for POC wells S4 and D1 (Figures G-16 and G-17) and the molybdenum plots for POC wells S4, D1 and X (Figures G-18, G-19 and G-20, respectively). Uranium and molybdenum concentrations at well S4 have been decreasing or stable since 2004 and during this FYR period. Uranium and molybdenum concentrations at well D1 were decreasing or stable between 2000 and 2007, but spiked in 2008, and have been sporadic during this FYR period. Restoration in this area is ongoing.

The Upper Chinle aquifer POC wells are south of the LTP and STP. During the last five years, POC well CE2 exceeded the site standard for the mixing zone for uranium, molybdenum and selenium. POC well CE8 did not exceed any of the site standards. Appendix G includes uranium and molybdenum plots for CE2 and CE8 (Figure G-21 and G-22). POC well CE2 shows increasing uranium and molybdenum concentrations since 2000, which coincides with the start of pumping from this well in 1999. These increasing concentrations have continued during

[4]Wells installed in 2014 can be found in the October 2014 Status Report: Remediation Strategy and March 2015 Supplemental Information on Remedial Strategy.

this FYR. This increase is expected as it draws contaminated groundwater towards it. Restoration in this area is continuing.

Table G-1 in Appendix G provides a summary of the COCs that exceeded the site standards in 2014, the general locations of the exceedance for the alluvial aquifer as well as the other aquifers for which there were exceedances.

San Andres Aquifer Monitoring
The San Andres aquifer has been used as the source for fresh water injection into the alluvial and Chinle aquifers. As a result, HMC established a monitoring program for the San Andres aquifer and currently samples seven wells at least annually.

Sampling results from 2014 identified uranium in all but one of the San Andres aquifer wells monitored. Deep well 951R, located west of the LTP and west of the West Fault, reported a maximum detected concentration of 0.08 mg/L. This concentration exceeds the federal Safe Drinking Water Act maximum contaminant level (MCL) of 0.03 mg/L and is the highest level recorded in this well since sampling began at this well in 2012. Well 951R is a replacement well for well 951. In 2015, uranium also exceeded the MCL in wells 951R and 943. HMC should conduct further investigation to determine if pumping from the San Andres wells is drawing contamination down into the deeper aquifer. Under NMED's direction, HMC is currently conducting a well-integrity investigation of all seven San Andres wells. Interim reports regarding this investigation are currently under review by NMED.

The Department of Energy (DOE) completed a "Site Status Report on the Flow and Contaminant Transport in Vicinity of the Bluewater New Mexico, Disposal Site" in November 2014. The site status report indicates that uranium contamination in the San Andres aquifer has migrated eastward from the Bluewater site to the HMC site, and possibly that uranium-contaminated San Mateo Creek alluvial groundwater has migrated southward and impacted the northwestern-most municipal well (Milan Well #4) through vertical migration by pumping groundwater from the San Andres aquifer.

OU2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

The data review for OU2 evaluated the tailings flushing program for the LTP through the end of 2014. The review also considered data from inspections of the STP, LTP, pond dikes, slopes and evaporation ponds as well as the radon flux surveys, originally presented in the 2011 through 2014 annual reports.

Between 1995 through the end of 2014, 480 million gallons of water has been removed from the tailings via dewatering wells.[5] Of that, 24 million gallons were pumped from the tailings in 2014. Contaminants removed from the tailings since dewatering began include 19.8 million pounds of sulfate, 76,000 pounds of uranium, 209,000 pounds of molybdenum and 710 pounds of selenium (Appendix G, Table G-2).[6]

Uranium is a key water quality parameter for the tailings solution. Appendix G, Figure G-23 shows uranium concentrations in the tailing solution in 2000, shortly after the start of the flushing program. Figure G-24 shows uranium concentrations in 2014. These figures show the decline in uranium concentrations with time.

The tailings flushing program ended in July 2015; however, data continue to be collected to evaluate potential rebound conditions, the results of which will be presented in future annual reports.

The 2014 annual inspection of the tailings piles and evaporation ponds found that they were in generally good condition and were being maintained within the operating limits of the NRC license and NMED permits and the

[5] Tailings wells were installed in the LTP beginning in 1994 and wells were periodically added through 2014.

[6] The 2014 Annual Report states that the quantity of constituents removed in 2014 was computed by multiplying the average concentration of a particular constituent for each source of water (groundwater, toe drains and tails collection) by the volume of water pumped for each during that year.

respective facility designs. A slump was observed in the fill under the pond liner of evaporation pond 1, along about 200 feet of the south inslope of the pond from the southeast corner westward. The slump at evaporation pond 1 should be protected against further displacement to protect the liner. During 2014, leaks in the liners for evaporation ponds 2 and 3 were also repaired.

Radon flux measurements for the LTP in October 2014 resulted in average flux of 20.95 picocuries per square meter per second (pCi/m^2s), or slightly above the desired 20 pCi/m^2s goal. As a result, HMC increased the interim cover in areas with flux monitoring locations where the measurements were higher than other areas of similar size. New measurements were made in November 2014. The addition of interim cover to these areas resulted in an average flux for the LTP of 19.70 pCi/m^2s, below the goal. The measurements for the STP resulted in an average flux of 6.84 pCi/m^2s. Radon flux measurements at the tailings piles in 2012 and 2013 were below the desired 20 pCi/m^2s goal; data from 2011 were slightly above the goal at 20.96 pCi/m^2s at the LTP. This also resulted in the installation of additional interim cover in 2011.

OU3 - Radon in Neighboring Subdivisions

The OU3 data review considered data from the May 2012 Removal Assessment Report, data from the December 2014 HHRA, prepared by EPA, and data from the December 2014 Removal Report for Morman Farms, Multiple Properties, Milan, Cibola County, New Mexico (2014 Removal Report), prepared by Weston for EPA.

Between October 2010 and December 2011, 885 indoor radon samples were collected from 79 houses in the five neighboring subdivisions and 28 houses in the background community of Bluewater Village. EPA selected Bluewater Village as the best available area to serve as background based on selection criteria documented in the 2014 HHRA. Results indicated that 11 of the 79 houses from the five subdivisions had average annual radon above the EPA 4 pCi/L recommended action guideline. The maximum detected result, excluding results from basements, was 7.2 pCi/L (from a home in Valle Verde subdivision). Three houses in the background area also exceeded the EPA recommended action guideline. The HHRA did not find a significant difference between the five subdivisions indoor radon levels and the background indoor radon levels. The average of indoor radon levels at the five subdivisions (1.86 pCi/L) was only slightly higher than the background average indoor radon level (1.57 pCi/L). Although the source of the elevated radon in homes was not identified, EPA elected to install radon mitigation systems in the homes with levels exceeding the EPA 4 pCi/L recommended action guideline. Ten of the 11 homes were mitigated through the Superfund removal program; one resident refused mitigation.

EPA also collected 751 outdoor long-term radon samples from several areas around the HMC facility, the five subdivisions and Bluewater Village (background area). One hundred twenty-two radon monitors were placed along the fenceline between the HMC property and the residential areas; 120 radon monitors were placed within the HMC property; 353 radon monitors were placed in the five subdivisions; and 156 monitors were placed in Bluewater Village (Appendix G, Figure G-26). The HHRA determined that statistical comparison between outdoor radon at the five subdivisions versus outdoor radon at the background area identified a statistically significant increase in the average at the five subdivisions over that in the background area. The average outdoor radon levels at the five subdivisions and the background area were 1.29 pCi/L and 0.46 pCi/L, respectively.

The HHRA determined that the average upgradient radon-222 gas levels (0.62 pCi/L) was higher than the downgradient air radon-222 levels (0.44 pCi/L) within the HMC facility boundaries. In contrast, total radon (radon-222 + thoron gas) measured at the downgradient air monitors within the HMC facility boundaries showed higher levels than the upgradient air total radon levels, indicating a potential nearby source of total radon, which EPA believes to be the LTP.

EPA collected surface soil samples from the yards of each house where an access agreement was granted. EPA also collected surface soil from the Site's three irrigation fields, two central pivot fields, evaporation pond banks and a background area. Surface soil samples were also collected from four runs with the highest gamma radiation readings in the area between the evaporation ponds and the fence line. The samples were analyzed for metals and

radionuclides. Summary statistics are found in the HHRA. The HHRA reviewed the data and concluded that soil results did not show that contamination had migrated from the evaporation ponds.

Results from the garden vegetable samples found that radium-226 and radium-228 were not detected. Potassium 40 was detected in the vegetable samples. Potassium 40 was also found in the soil samples and in the background soil at the same concentrations. Potassium 40 is not site related and is naturally found in soil and vegetation at the five neighboring subdivision areas.

EPA collected 14 irrigation well water samples from private properties. Figure G-27 in Appendix G presents the radon results for the 11 residences with private well water. A federal MCL for radon in groundwater has not been established; however the proposed MCL is 300 picocuries per liter (pCi/L) and the proposed alternative maximum contaminant level is 4,000 pCi/L. Five of the samples exceeded the proposed MCL. The HHRA concluded that the results indicate that well water is contaminated with radon gas and has the potential to contribute to indoor air radon levels in houses that use groundwater for domestic purposes. However, because the residences are connected to the Village of Milan water system the direct exposure pathway is incomplete for all but the one resident in Valle Verde who has refused connection to the public water supply. The HHRA also concluded that radon in private well water is contributing a relatively small amount of radon to indoor air based on the detected concentrations and the radon in groundwater to air transfer factor.[7]

The May 2012 Removal Assessment Report included the results of radiation ground scans around 86 houses in the subdivisions south of the Site, collection of soil samples for analysis of radionuclides from areas with high scan readings, measurement of indoor exposure radiation levels (short term), and collection of wipe samples within select residences.

Of the properties screened and sampled, the 2012 Removal Assessment Report concluded that 48 residential properties had outdoor levels above the Derived Concentration Guideline Level, which was a value calculated for each individual residence. Ten properties had discrete items that contained radioactive contamination, including pipe, rocks and petrified wood. Indoor scanning indicated that one home had an indoor total effective dose equivalent (TEDE) greater than the EPA risk-based action level of 15 mrem/yr, and five other residences had total combined outdoor and indoor doses above 15 mrem/yr. Analytical results from each of the 191 soil samples collected and analyzed for total uranium were less than the EPA Regional Screening Levels (RSLs) action level of 230 milligrams per kilogram (mg/kg). All 78 indoor-surface alpha-wipe sample results exhibited gross alpha concentrations less than the NRC action level of 20 disintegrations per minute per 100 square centimeters (20 dpm/100 cm^2).

In April 2013, EPA re-evaluated the removal assessment data and compared to new background data to determine which properties were eligible for a removal action. The results identified 20 properties that were eligible for removal of contaminated soils and five properties that were eligible for discrete-items removals (2014 Removal Report). EPA added one other property to the removal list after discussions with the property owner. Of the eligible properties, three property owners declined the EPA offer for soils removal; two additional property owners were non-responsive; and three property owners declined discrete-items removals. Consequently, removal actions associated with 18 residential properties of soils (16 properties) and discrete items (2 properties) were conducted between February and July 2014. Figure G-25 of Appendix G shows the locations of the removals. Following removal actions, a Certified Health Physicist generated property status statements for each property verifying that the project cleanup levels (radium-226 in outdoor soils of less than 3.5 pCi/g inclusive of background; TEDE of less than 15 mrem/yr above background) were achieved. EPA mailed letters to the removal property owners with the results of removal actions at their respective properties.

[7] The National Academy of Sciences (NAS 1999) recommends that EPA use 10,000 pCi/L in water to 1 pCi/L in air as the best estimate of the transfer of radon in drinking water to radon in indoor air (through showering, cooking and other household water uses).

Site Inspection

The site inspection took place on January 12, 2016. Participants included Sai Appaji, EPA; Angelo Ortelli, NMED; Jesse Toepfer and Bill Ferdinand, Barrick Gold (HMC);[8] Treat Suomi and Johnny Zimmerman-Ward, Skeo Solutions. The purpose of the inspection was to assess the protectiveness of the remedy. Photographs taken during the site inspection and a completed checklist are in Appendix D and E, respectively.

The site inspection started at the on-site HMC offices, with Barrick Gold providing an overview of activities at the Site since the previous FYR. Site inspection participants then drove to the top of the LTP to get an overall view of the Site. From the south side of the tailings piles, site inspection participants viewed evaporation ponds 1 and 2, as well as the collection ponds and the RO treatment building. On top of the LTP, site inspection participants viewed the pilot zeolite system and the full-scale zeolite system, which was almost ready for full-scale operation at the time of the inspection. Contractors were working to complete plumbing connections during the site inspection. Piping and wells left over from the injection system were viewed on top of the LTP. Site inspection participants drove down the tailings pile and observed evaporation pond 3 north of the Site and the TPP injection area, including the associated shed and wells. Site inspection participants then toured the updated RO treatment building, including the new clarifier, equalization tanks, microfiltration units, and the old and new RO systems. Site inspection participants then drove on the STP to view evaporation ponds 1 and 2, and around the STP to observe the face of the pile. Participants also observed new well clusters on a locked access road south of the Site.

On January 12, 2016, Skeo Solutions staff visited the designated site repository, New Mexico State University, Grants Campus Library, as part of the site inspection. Documents, including monitoring reports, as recent as 2015 were available for the public to view on compact disc. Some older documents were available in paper.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary:

OU1 – Groundwater Restoration

Yes. The review of documents indicates that the groundwater restoration remedy is being implemented as intended. The primary documents that detail remedial decisions for OU1 are NRC License SUA-1471, the NRC-approved groundwater CAP and NMED groundwater discharge plans.

The groundwater restoration program currently includes an extensive groundwater collection and injection system, an RO water treatment facility, a zeolite-based water treatment system, two collection ponds and three evaporation ponds. Operation of the groundwater collection/injection system has been partially successful at restoring groundwater to the approved standards. Contaminants removed from the Alluvial aquifer include 2.6 million pounds of sulfate, 11,000 pounds of uranium, 16,000 pounds of molybdenum and 643 pounds of selenium. Contaminants removed from the Upper Chinle include 71,000 pounds of sulfate, 342 pounds of uranium, 434 pounds of molybdenum and 9 pounds of selenium. Monitoring data show that the flow of groundwater has been reversed from the injection wells and infiltration trenches at the facility boundary back toward the collection wells, as intended. The injection/collection system has helped contain the most highly contaminated groundwater within the collection area, which includes groundwater under the tailings piles, collection and evaporation ponds 1 and 2. Although contaminant levels have generally decreased over time, they still exceed the groundwater cleanup standards at the POC wells and in some portions of the alluvial and Chinle aquifers.

[8] In 2001, HMC merged with Barrick Gold Corporation as a wholly-owned subsidiary (HHRA, 2014).

Contaminant levels remain above groundwater cleanup standards in the alluvial and Chinle aquifers outside the facility boundary and in residential neighborhoods. Injection/collection continues in areas where contaminant concentrations exceed cleanup standards. The uranium plume in the alluvial aquifer extends southwest of the Felice Acres development (Appendix G). New wells were added in this area in 2014; however, additional efforts may be needed to aid restoration efforts. Most residents in the developments south and southwest of the Site are connected to public water. The only exception is a resident in Valle Verde who declined to connect to the public water supply. HMC is working with property owners to plug and abandon private wells.

Sampling results from 2014 and 2015 identified uranium in San Andres well 951R as well as well 943 at a concentration that exceeds the uranium MCL. Groundwater protection standards for the San Andres aquifer have not been established. The source of the elevated uranium in the San Andres aquifer requires further investigation to determine if pumping from the San Andres wells is drawing contamination down into the deeper aquifer. The DOE's 2014 "Site Status Report on the Flow and Contaminant Transport in Vicinity of the Bluewater New Mexico Disposal Site" also indicates that uranium contamination in the San Andres aquifer has migrated eastward from the Bluewater site to the HMC site, and possibly that uranium-contaminated San Mateo Creek alluvial groundwater has migrated southward and impacted the northwestern-most municipal well (Milan Well #4) through vertical migration by pumping groundwater from the San Andres aquifer.

Since the previous FYR, HMC has discontinued land treatment of extracted groundwater. Off-site extracted groundwater is now treated through the RO or pilot zeolite treatment systems. HMC upgraded the RO treatment system to treat 1,200 gpm, doubling its capacity to treat groundwater. HMC also constructed a full-scale zeolite water treatment system, capable of treating 1,500 gpm. HMC now has the capacity to treat 2,700 gpm, which is significantly more than the original 300 gpm operating capacity of the older RO treatment system. Water treated with these alternative technologies is expected to reduce reliance on San Andres water for injection. Since the previous FYR, HMC added 550 wells, including injection and extraction wells, to the program in efforts to expedite the cleanup process.

The 2012 Updated CAP estimated active groundwater restoration to be complete by 2020; however, the estimate was based on groundwater modeling, results from present operating conditions and predicted future operation conditions. Several operating conditions have changed since the modeling was conducted, including discontinuation of land treatment and active flushing of the LTP, as well as an increase in the operating capacity of the water treatment systems. The modeling predicted when COC concentrations at the POC wells would be achieved; modeling did not predict COC concentrations for any other areas. Based on these recent changes, this estimate should be revised based on current remedy components.

The complexity of the OU1 remedial system requires daily O&M. HMC has full-time staff for that purpose. This level of O&M appears to be adequate to maintain the groundwater remedial system. HMC is exploring opportunities for optimization of the remedy and evaluating the efficacy of TPP injections as an alternative groundwater treatment technology.

Institutional controls for the Site currently include a NM-OSE Health Advisory issued to every person who applies for a well permit within an area inside the San Mateo Creek basin. HMC also conducts an annual land use survey to meet annual license condition reporting requirements under NRC License SUA-1471. Institutional controls (i.e. NM-OSE order for a moratorium on the permitting of new wells) are currently in place to caution residents from drinking contaminated groundwater.

An EPA ROD for groundwater restoration has not been issued for OU1. However, EPA is reviewing assessment and response actions taken under NRC and NMED authority to determine if they are functionally equivalent to the CERCLA cleanup process or if additional investigations or response actions are warranted. EPA is also re-evaluating background concentrations for the alluvial and Chinle aquifers at the Site. After completing the analysis, EPA plans to issue a ROD for OU1.

OU2 - Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

Yes. Several OU2 remedy components have been implemented as intended. The remaining components for final reclamation and closure, included in HMC's 2013 update to the Decommissioning and Reclamation Plan, are anticipated to be implemented once OU1 groundwater restoration is complete.

To date, HMC has decommissioned and dismantled the mill, with some waste materials and impacted soils deposited in the LTP. HMC recontoured the LTP, constructed a final radon barrier and erosion protection cover on its sides, and placed an interim radon cover on its top. HMC also constructed an interim radon cover on a portion of the STP. The covers appear to be functioning as designed. HMC conducts regular O&M of the OU2 remedy components to maintain effectiveness of the remedy and takes corrective action as needed. In 2014, these actions included additional interim cover on the LTP because of elevated radon flux measurements and repairs to the evaporation ponds due to liner leaks. HMC should determine the need for future corrective action for the slump at evaporation pond 1 to protect against further displacement and protect the pond's liner.

Between 2000 and 2015, HMC implemented a tailings flushing program to mobilize contaminant mass in the tailings piles with subsequent capture of the aqueous-phase contamination by the collection system. As of the end of 2014, HMC estimates that 76,000 pounds of uranium and other site contaminants have been removed from the tailings since dewatering began. HMC is collecting additional data to evaluate potential rebound now that the tailings flushing program has ceased.

Following approved closure of the LTP, NRC will implement institutional controls for the former mill facility. Following HMC's specific license termination, a custodial agency, DOE, will ensure continued long-term care, including monitoring and maintenance to protect the public health and safety, as required by 10 CFR 40.28.

An EPA ROD for OU2 cleanup has not been issued. However, EPA is currently evaluating NRC activities to determine whether they are functionally equivalent to the CERCLA cleanup process or if additional investigations or response actions are warranted. Once this analysis is complete, EPA plans to issue a ROD for OU2.

OU3 - Radon in Neighboring Subdivisions

EPA did not require a remedy for OU3 in the September 1989 ROD. However, EPA conducted additional evaluation of the neighboring subdivisions between 2010 and 2014. Data from the investigations were used to develop an HHRA and to identify residences where removal actions were necessary to protect human health.

Although the HHRA found no significant difference between the five subdivisions' annual indoor air radon levels and the background annual indoor air radon levels, EPA elected to install radon mitigation systems in 11 homes with radon levels above 4 pCi/L; one additional homeowner declined to have a mitigation system installed. The mitigation systems are operating as intended and have reduced indoor air radon concentrations in these homes to levels below the EPA 4 pCi/L recommended action guideline[9].

EPA also conducted removal actions in 2014 to address radioactive-contaminated soil at 16 properties and radioactive discrete material at two additional properties. The removal actions successfully achieved cleanup levels. EPA determined that the radiological soil and debris was unrelated to the Site, but elected to conduct the removal actions to protect human health.

An O&M Plan for OU3 is not in place. Generally the radon mitigation systems are known to operate without any maintenance problems for many years before the motor in the unit wears out. EPA has installed these systems at other sites and have not experienced maintenance issues. The homeowners have been instructed to contact the installer for servicing any repairs beyond the warranty period.

[9] Data presented in the Radon Mitigation Project Report, prepared by New Mexico Radon Services for Environmental Quality Management, Inc., dated September 2012

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

OU1 – Groundwater Restoration

Radiological and some non-radiological contaminants in groundwater are regulated under NRC License SUA-1471 and under the New Mexico Water Quality Control Commission's groundwater restoration requirements (NMED Discharge Permit DP-200). Some of the current groundwater standards, including those for uranium in all but the Lower Chinle Non-Mixing Zone, are based on 95 percent Upper Tolerance Limits of background concentrations, which are higher than health risk-based levels and promulgated legal standards. After coordinating with EPA and NMED, NRC published an Environmental Assessment in May 2006 and a Finding of No Significant Impact in June 2006, and issued License Amendment 39 to NRC License SUA-1471 in July 2006 to document the revised list of groundwater standards. These groundwater protection standards have been incorporated into the NMED discharge permit and remain valid. When EPA issues a ROD for the OU1 remedy, this ROD will also include a complete list of applicable or relevant and appropriate requirements (ARARs) for the Site that will be evaluated during future FYRs.

Land use in OU1 has been primarily agricultural with some low density residential use. Since the previous FYR, a shed manufacturing company began operations across the street from the Site. Future land use is expected to be consistent with current use. No human health or ecological routes of exposure have changed and no new receptors have been identified that could affect the protectiveness of the remedy at OU1.

No new contaminants or contaminant sources were identified at OU1. No unanticipated toxic byproducts of the remedy have been identified at OU1.

Current toxicity values for groundwater COCs, sourced from the November 2015 RSL table (http://www.epa.gov/risk/risk-based-screening-table-generic-tables) and the Preliminary Remediation Goals (PRGs) for Radionuclides Table (https://epa-prgs.ornl.gov/radionuclides/download.html) are summarized in Appendix J. Since toxicity data for only three COCs were included in the previous FYR, changes in toxicity values for only these three COCs were reviewed. Since the previous FYR, the reference concentration for uranium has changed from 3×10^{-4} mg/m^3 (milligrams per cubic meter) to a more stringent value of 4×10^{-5} mg/m^3. This change does not affect the groundwater cleanup standards for uranium, which are primarily based on background. In addition, the inhalation pathway is not significant for uranium exposures from groundwater. Other contaminant characteristics have not changed in a way that would affect protectiveness of the remedy. Risk assessment methodologies have not changed in a way that could affect protectiveness of the remedy.

Significant progress toward meeting RAOs has been made during the past five years. Upgrades and expansion of the RO water treatment facility, startup of the full-scale zeolite-based treatment system and installation of hundreds of new injection/extraction wells are expected to expedite groundwater restoration to complete active restoration by 2020. However, as previously mentioned, this date of completion requires an update based on current conditions.

OU2 – Long-Term Tailings Stabilization, Surface Reclamation and Site Closure

The cleanup criteria for OU2 were based on the NRC requirements in 10 CFR 40, Appendix A, Criterion 6, which are repeated in the EPA requirements specified in 40 CFR 192. These regulations include a cleanup standard for radium-226 in the top 15 cm of soil of 10 pCi/g (5 pCi/g above background) and 20.5 pCi/g (15 pCi/g above background) for each 15-cm depth increment below the top 15 cm. The regulations have not changed; therefore, the cleanup standards remain valid.

The requirements in 10 CFR 40, Appendix A, Criterion 6 (6) were revised to include a benchmark dose criterion to address residual uranium and thorium during mill cleanups. Though the requirement does not apply to sites

with a previously-approved decommissioning plan, NRC has indicated that it would be applied to new areas of contamination. In the event that these areas are identified in the future, HMC will develop dose-based (radium-226 benchmark dose) cleanup criteria using appropriate methods. These criteria, if established, can be used to evaluate protectiveness in future FYRs.

When EPA issues a ROD for the OU2 remedy, this ROD will also include a complete list of ARARs for the Site that will be evaluated during future FYRs.

Land use at OU2 is expected to remain consistent with current use. Homestake owns substantial acreage around the licensed boundary and land use is not expected to significantly change in the near future. Following completion of groundwater restoration at the Site, remaining features will be decommissioned and closed in accordance with the 2013 update to the Decommissioning and Reclamation Plan. Final decommission and reclamation activities will include final closure of the LTP and STP, closure and demolition of the groundwater treatment systems, closure of the two collection ponds and three evaporation ponds, demolition of remaining site structures, reclamation of remaining contaminated soils, final surface contouring and topseeding, and installation of necessary security features (fencing, etc.). HMC currently anticipates full closure by 2022; however, this date is based on the anticipated completion of active groundwater restoration by 2020. This date may require revision based on current conditions.

No human health or ecological routes of exposure have changed and no new receptors have been identified that could affect the protectiveness of the remedy at OU2. No new contaminants or contaminant sources were identified at OU2 during the FYR period.

OU3 - Radon in Neighboring Subdivisions

EPA finalized an HHRA for OU3 in December 2014. The HHRA identified chemicals and radionuclides of potential concern, identified the pathways and routes of intake for contaminants, and quantitatively evaluated the potential excess lifetime cancer and non-cancer risk. The HHRA made the following conclusions:

- Indoor radon gas levels at the five subdivisions were similar to levels at the indoor radon background location.
- Risk from outdoor radon gas was slightly higher at the five subdivisions than in the background area. Compared to indoor radon, the risk from outdoor radon is less.
- The excess cancer risk from direct and indirect exposure to soil (ingestion, inhalation, external and produce ingestion), excluding background, is estimated at 6×10^{-5} in site-related life-time cancer risk, which exceeds EPA's point-of-departure of 1×10^{-6} but is within EPA acceptable risk range (1×10^{-6} to 1×10^{-4}).
- If raising cattle or poultry for domestic uses, the increase in excess cancer risk from indirect exposure to soil (i.e., ingestion of meat, ingestion of milk, ingestion of poultry and eggs, etc.) is within EPA acceptable risk range, except for ingestion of milk, which is slightly above the upper end of the risk range.
- If using well water for domestic consumption, the cancer risk (2.2×10^{-3}) exceeds EPA's acceptable risk range of 1×10^{-6} to 1×10^{-4}. Risk from site-related contaminants in groundwater were not delineated in the risk assessment. Residences of the five subdivisions have been connected to the Milan municipal water supply system with one exception. This response action was taken to abate risks from exposure to contaminants in groundwater.
- The source of excess cancer risk is 1.3×10^{-3} from inhalation exposure to background sources and 5×10^{-4} from exposure to HMC sources. The level of risk presented by the HMC facility apart from background would generally indicate the need for long-term cleanup in the Superfund program because it exceeds EPA's acceptable risk range (1×10^{-6} to 1×10^{-4}). Long-term cleanup is ongoing.

Although the source of the elevated radon in homes was not identified, EPA elected to install radon mitigation systems in the homes with levels exceeding the EPA 4 pCi/L recommended action guideline. This action level has not changed.

No human health or ecological routes of exposure have changed and no new receptors have been identified that could affect protectiveness of the remedy at OU3. No new contaminants or contaminant sources were identified at OU3 during the FYR period.

QUESTION C: Has any **other** information come to light that could call into question the protectiveness of the remedy?

EPA is currently evaluating the NRC activities to determine if they are functionally equivalent to CERCLA cleanup. This review is expected to determine the need to conduct an ecological risk assessment for the Site. EPA is also conducting a reassessment of the background groundwater quality for the alluvial and Chinle aquifers as part of this effort.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the FYR:
OU3

Issues and Recommendations Identified in the FYR:

OU(s): OU1 and OU2	**Issue Category: Other**			
	Issue: Although remediation is underway under NRC authority, there is no EPA ROD in place for OU1 and OU2.			
	Recommendation: Complete EPA reassessment of background groundwater and complete the CERCLA equivalency analysis including issuance of a ROD for OU1 and OU2.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	EPA	EPA	9/30/2018

OU(s): OU1	**Issue Category: Remedy Performance**
	Issue: The 2012 Updated CAP estimated active groundwater restoration to be complete by 2020; however, the estimate was based on groundwater modeling, observed results from present operating conditions and predicted future operating conditions. Several operating conditions have changed since the groundwater modeling was conducted, including discontinuation of land treatment and active flushing of the LTP as well as an increase in the operating capacity of the water treatment systems. In addition, groundwater modeling estimated the time for POC wells to achieve COC groundwater protection standards; modeling did not predict COC concentrations for any other areas, including those areas outside the facility's licensed boundary.
	Recommendation: Update the timeframe estimate for groundwater restoration based on current operating conditions and data. Include an estimate of the time

	needed for groundwater restoration of those areas outside the facility's licensed boundary in addition to the areas downgradient of the source areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/27/2017

OU(s): OU1	**Issue Category: Remedy Performance**			
	Issue: The source of the uranium exceedance in the San Andres supply wells at the Site is unclear.			
	Recommendation: Investigate the source of the elevated uranium in the HMC supply wells to determine if pumping from the San Andres wells is drawing site contamination into the deeper aquifer.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	9/27/2017

OTHER FINDINGS

In addition, the following are recommendations that were identified during the FYR but do not affect current and/or future protectiveness:

- Uranium concentrations persist above the site standard (0.16 mg/L) in southern Felice Acres in the alluvial aquifer. Although HMC installed additional wells southwest of Felice Acres in 2014, additional efforts may be needed to aid restoration of this area.
- HMC should determine the need for future corrective action for the slump at evaporation pond 1 to protect against further displacement and protect the pond's liner.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statements		
Operable Unit: OU1	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:*
Protectiveness Statement: The OU1 remedy is currently protective of human health and the environment because: the groundwater collection/injection system is containing the highest contaminant concentrations within a defined collection area, primarily within the facility's licensed boundary; the system is also reducing contaminant concentrations in groundwater beyond the facility's licensed boundary; residents near the Site utilize the public water supply or have been given the option to connect to public water. An Institutional Control in the form of a health advisory is in place to caution current and future owners and users of private wells about potential contamination. In order for the remedy to be protective in the long term, the following actions need to be taken: Complete EPA reassessment of background groundwater and complete the CERCLA equivalency analysis including issuance of a ROD for OU1 and OU2. Update the timeframe estimate for groundwater restoration based on current operating conditions and data. Include an estimate of the time needed for groundwater restoration of those areas outside the facility's licensed boundary in addition to the areas downgradient of the source areas. Investigate the source of the elevated uranium in HMC supply wells in the San Andres aquifer to determine if pumping from the San Andres wells is drawing site contamination into the deeper aquifer.		

Operable Unit: OU2	*Protectiveness Determination:* Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The OU2 remedy is currently protective of human health and the environment because soil contaminated by windblown tailings was excavated and disposed, the mill facility was decontaminated, demolished, and disposed of in the LTP. A final radon barrier and erosion protection cover were constructed on the sides of the LTP, and an interim soil cover was constructed on its top and on the small tailings pile resulting in exposures to contamination are being currently controlled. In order for the remedy to be protective in the long-term, complete the CERCLA equivalency analysis including issuance of a ROD for OU1 and OU2.		

Operable Unit: OU3	*Protectiveness Determination:* Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The ROD issued for OU3 was a no action ROD. However, EPA conducted removal actions to address concerns identified during supplemental investigations conducted between 2010 and 2014. These removal actions are protective of human health and the environment. Radon mitigation systems and soil/debris removal efforts mitigated exposures to unacceptable levels of contaminants.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Short-term Protective	*Planned Addendum Completion Date:* Click here to enter a date
Protectiveness Statement: The remedy at the Site is currently protective of human health and the environment. The removal actions conducted at OU3 are protective of human health and the environment. However, in order for the remedy to be protective in the long-term, the actions identified in the OU1 and OU2 protectiveness statements need to be taken.	

VIII. NEXT REVIEW

The next FYR report for the Homestake Mining Company Superfund site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

2011 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Prepared by Homestake Mining Company of California and Hydro-Engineering, LLC. March 2012.

2012 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Prepared by Homestake Mining Company of California and Hydro-Engineering, LLC. March 2013.

2013 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Prepared by Homestake Mining Company of California and Hydro-Engineering, LLC. March 2014.

2014 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200. Prepared by Homestake Mining Company of California and Hydro-Engineering, LLC. March 2015.

First Five-Year Review Report For Homestake Mining Company Superfund Site, Cibola County, New Mexico. Prepared by CH2M Hill for U.S. EPA Region 6. September 2001.

Decommissioning and Reclamation Plan Update 2013, SUA-1471, Homestake Grants Reclamation Project, Cibola County, New Mexico. Prepared by ARCARDIS U.S., Inc. for Homestake Mining Company of California. April 2013.

Discharge Permit DP-200, Homestake Mining Company of California Uranium Millsite. Prepared by New Mexico Environment Department, Groundwater Quality Bureau.

Grants Reclamation Project Updated Corrective Action Program (CAP). Prepared by Homestake Mining Company of California for the Nuclear Regulatory Commission. March 2012.

Homestake – Grants Uranium Recovery Facility, Site Summary from the NRC website: http://www.nrc.gov/info-finder/decommissioning/uranium/is-homestake.pdf

Human Health Risk Assessment, Homestake Mining Co. Superfund Site, Cibola County, New Mexico. Prepared by U.S. EPA. December 2014.

Record of Decision, Homestake Mining Company, Radon Operable Unit, Cibola County, New Mexico. Prepared by U.S. EPA Region 6. September 1989.

Removal Assessment Report for Homestake Mining Company, Grants, Cibola County, New Mexico. Prepared by Weston Solutions, Inc. for U.S. EPA Region 6. May 2012.

Removal Report for Mormon Farms, Multiple Properties, Milan, Cibola County, New Mexico. Prepared by Weston Solutions, Inc. for U.S. EPA Region 6. December 2014.

Risk Assessment of Radon in Drinking Water. Prepared by National Academy of Sciences. National Academy Press. Washington, DC. 1999.

Second Five-Year Review Report For Homestake Mining Company Superfund Site, Cibola County, New Mexico. Prepared by U.S. EPA Region 6. September 2006.

Third Five-Year Review Report For Homestake Mining Company Superfund Site, Cibola County, New Mexico. Prepared by U.S. EPA Region 6. September 2011.

APPENDIX B – SITE MAPS

Figure B-1: Site Location Map

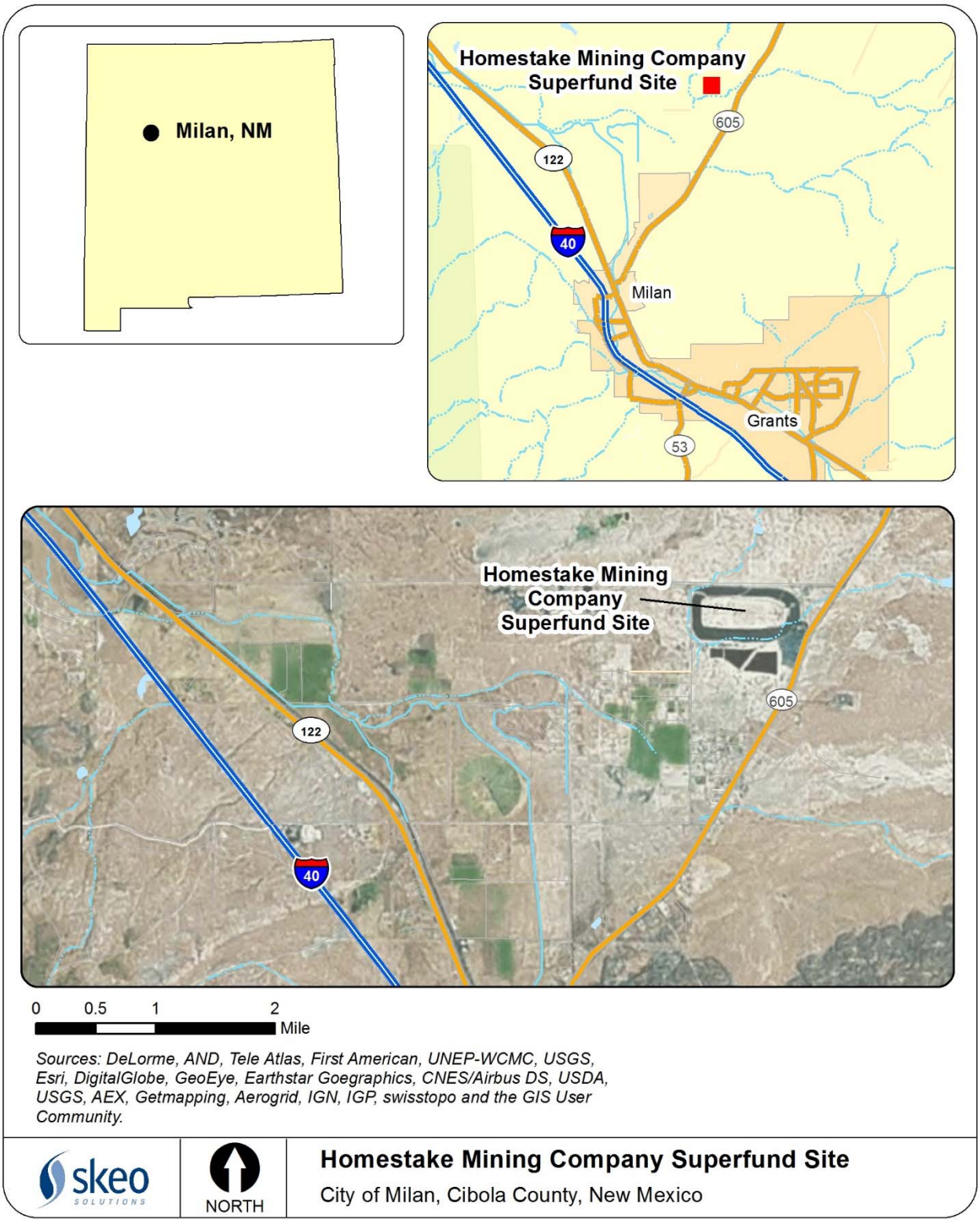


Figure B-2: Detailed Site Map

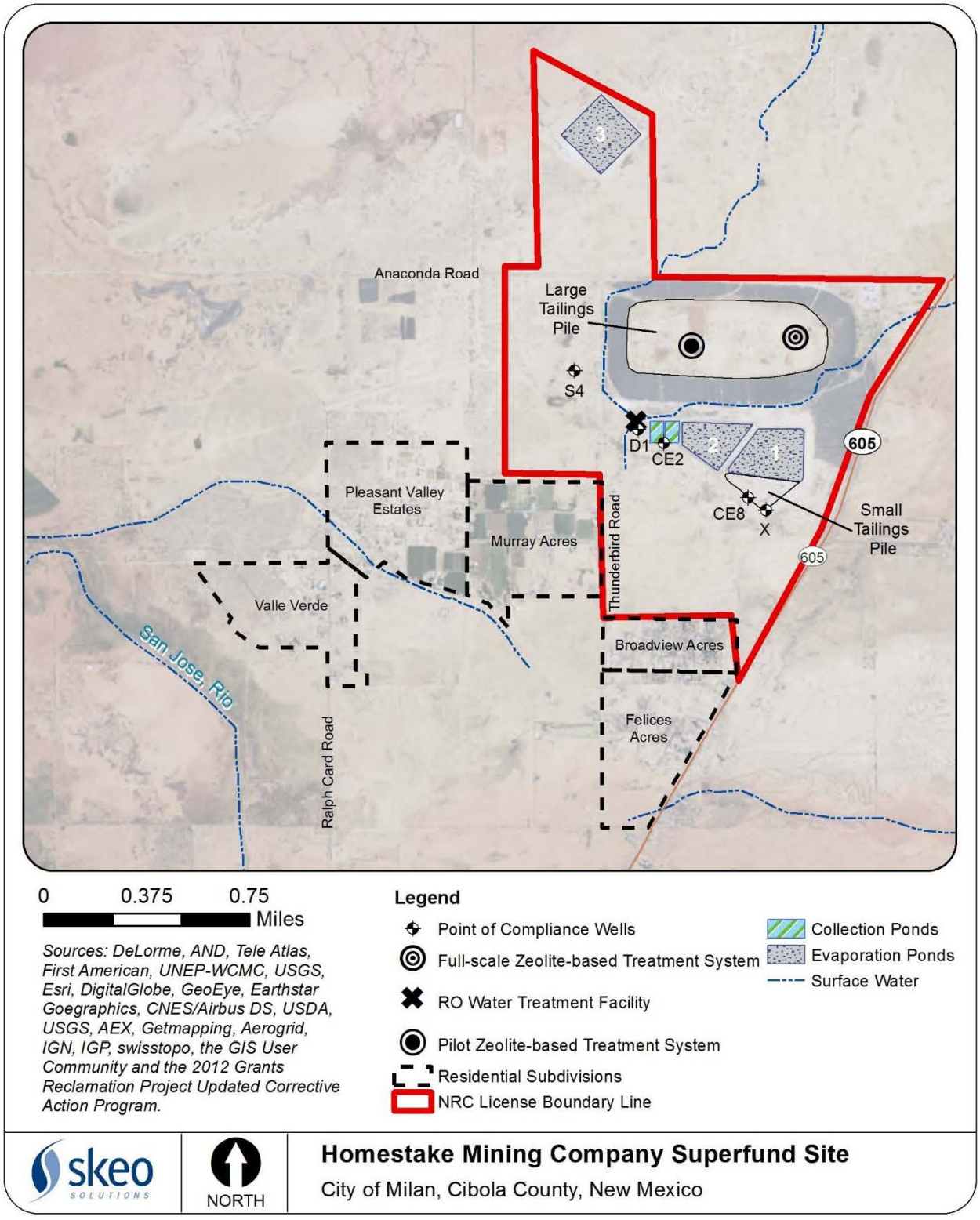


Figure B-3: Parcels Map

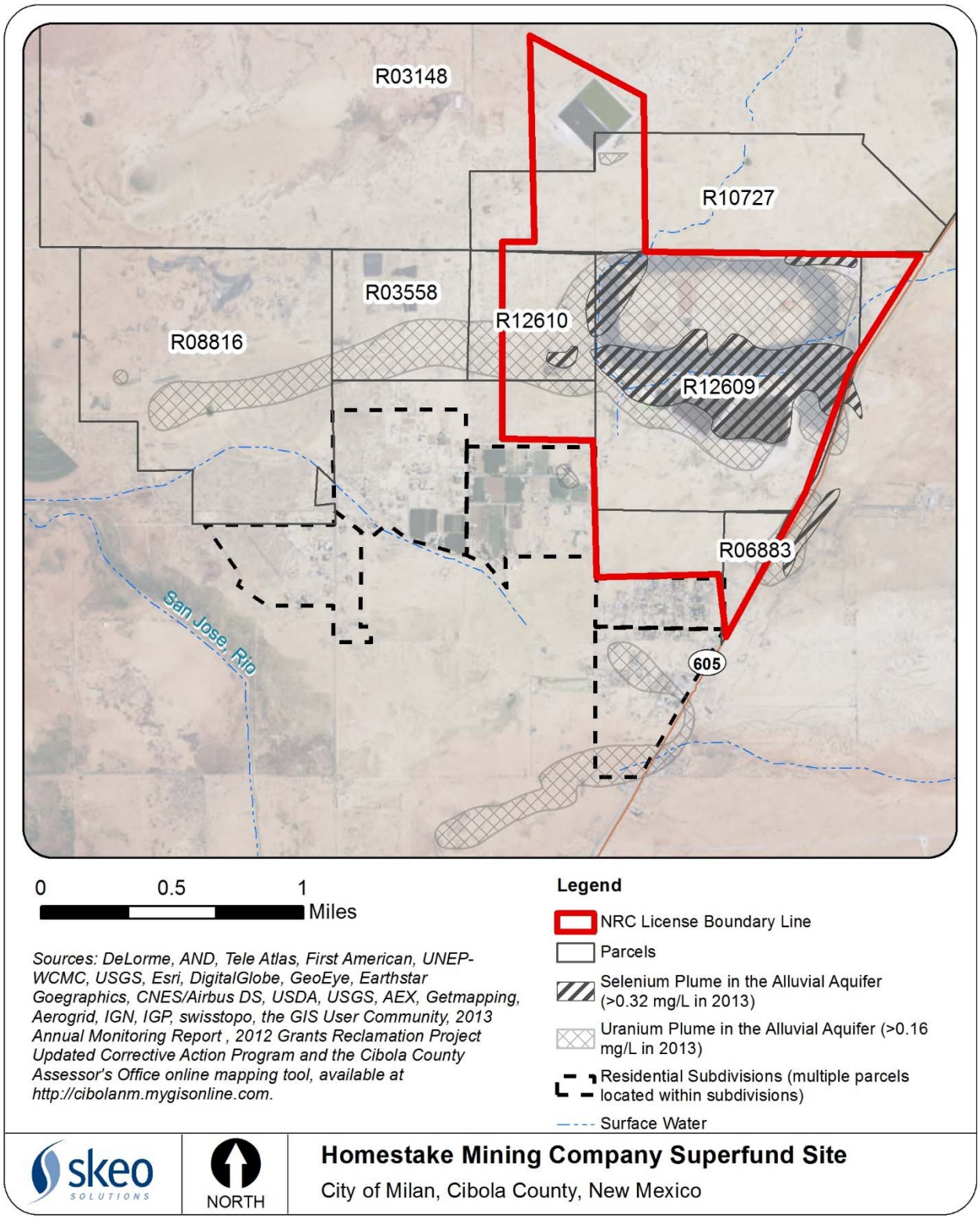
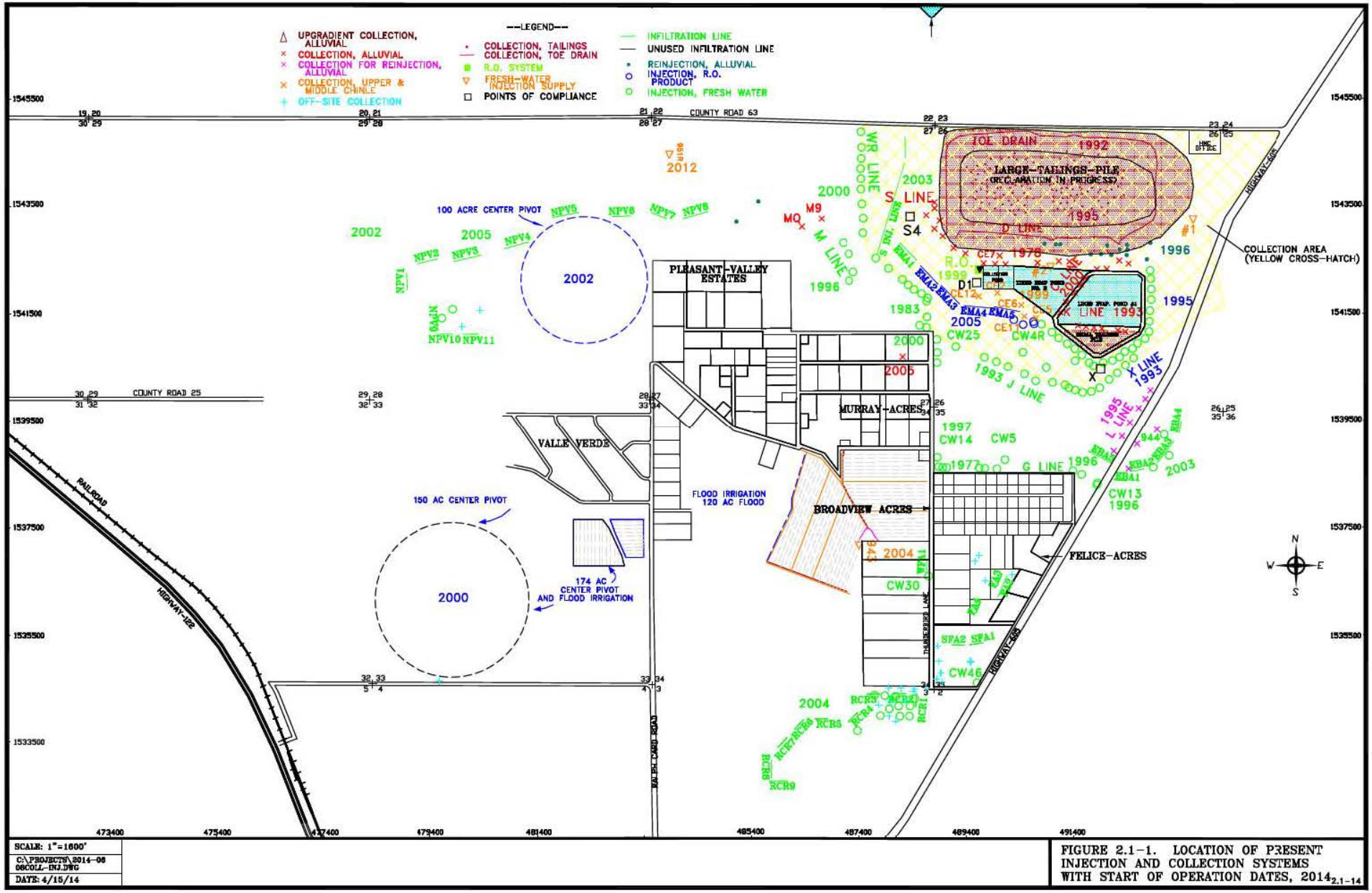


Figure B-4: Injection and Collection Well Map (Source: 2014 Annual Monitoring Report/Performance Review)



APPENDIX C – SITE CHRONOLOGY

Event	Date
Uranium mining mill operations began at the Site	1958
The New Mexico State Engineers Office first observed groundwater contamination near the Site	1961
New Mexico signed an agreement with the NRC authorizing the State to regulate uranium milling activities under the Atomic Energy Act	1974
A New Mexico Environment Improvement Division and EPA study determined that residential well water in one of the neighboring subdivisions showed elevated selenium levels	1974-1975
NMED and HMC reached an agreement on a groundwater protection plan, establishing a groundwater injection and collection system and an associated monitoring program, and providing bottled water for downgradient residents	August 1976
HMC implemented the groundwater protection plan; groundwater remediation began with fresh-water injection into six alluvial wells on the north side of Broadview Acres (OU1)	1977
HMC installed additional collection and injection wells, including those in Murray Acres and Broadview Acres[10]	1978-1982
EPA proposed the Site for the Superfund program's NPL	December 30, 1982
EPA listed the Site on the NPL	September 8, 1983
EPA and HMC signed a Consent Decree requiring HMC to pay for an extension of the Village of Milan municipal water system to four residential subdivisions, and to pay for basic water services for the residences of these subdivisions for 10 years.	November 29, 1983
NMED approved groundwater discharge plan DP-200 (OU1)	1984
HMC completed a Phase II Feasibility Study (FS) (OU1)	1986
The Milan water supply was installed for Broadview Acres, Felice Acres, Murray Acres and Pleasant Valley Estates subdivisions (OU1)	1986
New Mexico returned regulatory authority for uranium mills to NRC	1986
EPA issued an Administrative Order on Consent to HMC to conduct a Remedial Investigation (RI)/FS for the Radon OU (OU3); HMC initiated the RI/FS	June 30, 1987
HMC finished the RI/FS for the Radon OU (OU3); EPA issued a no further action Record of Decision (ROD) for OU3	September 27, 1989
HMC submitted an Updated CAP for groundwater remediation to the NRC (OU1)	September 1989
Uranium milling operations at the Site ceased	1990
HMC constructed evaporation pond 1 on top of the STP (OU1)	1990
HMC finished installation of a toe drainage system around the LTP	August 1992
HMC began reclamation activities to clean up soils and decommission the mill. HMC submitted a reclamation plan to NRC.	1993
EPA Region 6 and NRC sign a Memorandum of Understanding (MOU) detailing each agency's responsibilities and authority at the Site	1993
HMC re-contoured the west side of the LTP (OU2)	1993
EPA released HMC from the 1983 CD (OU1)	1994
HMC re-contoured the east side of the LTP (OU2)	1994
HMC completed demolition of the mill and surface reclamation activities (OU2)	1995
HMC began collection of lower concentration water for re-injection into the higher concentration areas in the alluvial aquifer (OU1)	1995
HMC tested dewatering of the LTP (OU2)	1995

[10] Additional groundwater injection and collection wells have been added throughout the groundwater restoration effort and are not included further in this chronology. Please refer to the 2012 Updated CAP for history of the groundwater injection/collection systems at the Site.

Event	Date
HMC completed installation of the interim soil cover on the STP	October 1995
HMC began using evaporation pond 2 (OU1)	1996
HMC initiated fresh water injections in Upper Chinle well CW13 (OU1)	1996
EPA prepared a Preliminary Close-out Report	September 23, 1996
NRC approved the soil cleanup and mill reclamation (OU2)	1999
HMC added a reverse osmosis (RO) unit to treat water and produce RO product water for injection into the alluvial aquifer (OU1)	1999
HMC initiated the flushing program for the LTP (OU2)	2000
EPA approved the first FYR	September 27, 2001
HMC added 60 acres of irrigation area (OU1)	2002
HMC initiated fresh water injection in Section 28; fresh water injection into Upper Chinle well 944; fresh water injection into the alluvial aquifer east of Felice Areas and fresh water injection east of Broadview Acres (OU1)	2002
HMC added a second RO unit to the treatment plant to increase RO treatment capacity from 300 to 600 gallons per minute (OU2)	2002
HMC added a fresh water injection line west of the LTP and initiated fresh water injection into Section 3 (OU2)	2003
HMC added 24 acres of flood irrigation area in Section 33, injection lines in Section 3 and injection lines east of Broadview Acres and in southern Felice Acres (OU2)	2004
HMC expanded the groundwater collection and irrigation system (OU1)	2005
NMED approved revised site groundwater background concentrations for each aquifer unit (OU1)	2005
NMED sampled residential wells in nearby subdivisions based on recommendations from the Bluewater Valley Downstream Alliance (BVDA) (OU1)	2005
EPA issued the second FYR	September 26, 2006
HMC submitted the Updated CAP to NRC	December 2006
EPA completed the Remedy System Evaluation (RSE), a broad evaluation that considered the remedy goals, conceptual site model, aboveground and subsurface performance and site closure strategy.	December 2008
NMED issued a health advisory to limit groundwater exposure	2009
NMED and HMC reach a Memorandum of Agreement for HMC to provide additional water hook-ups to residents	2009
The Agency for Toxic Substances and Disease Registry (ATSDR) issued a Health Consultation Report	June 2009
NMED approved discharge plan DP-725 and evaporation pond 3	2009
EPA began multi-media sampling effort in support of the human health risk assessment	2010
EPA issued an Addendum to the RSE	December 2010
EPA recommended NRC implement the RSE recommendations	March 2011
EPA issued a deficiency letter to NRC regarding HMC's non-compliance with radon standards and potential ARARs	2011
NMED granted temporary permission for land application of alluvial water in Section 28; temporary permission was denied for land application of alluvial water in Section 33 center pivot and Sections 33 and 34 flood irrigation areas	2011
HMC completed repairs to the LTP and STP, damaged by July 2010 storms, and replaced stormwater downdrains	February 2011
EPA issued the third FYR	September 29, 2011
Meeting held with representatives of the NRC, EPA, NMED, DOE and HMC to discuss the RSE recommendations. NRC indicated that it did not plan to specifically require HMC to implement any of the recommendations. However, HMC would have to address some of the issues in the Updated CAP for the Site to demonstrate compliance with the license termination criteria. At the meeting, HMC expressed a	January 2012

Event	Date
willingness to evaluate a number of the RSE recommendations to determine if remedial process efficiencies could be improved.	
EPA issued an Administrative Order on Consent to HMC	February 24, 2012
HMC submitted the Updated CAP to NRC, EPA and NMED for review and approval (OU1)	March 2012
HMC submitted a revised Decommissioning and Reclamation Plan to NRC for review and approval (OU2)	2013
EPA installed radon mitigation systems at 10 residential properties; one property owner whose residence was eligible for a system refused mitigation efforts (OU3)	2012
EPA conducted a soil/debris removal effort at 18 residential properties (OU3)	2014
EPA issued the final HHRA for OU3	December 2014

APPENDIX D – SITE BACKGROUND

D.1 Physical Characteristics

The Site includes a former uranium mill, portions of the underlying aquifers contaminated by site-related wastes (tailings) and contamination in neighboring residential subdivisions. HMC operated the mill from 1958 to 1990 before demolishing most of the mill facility in the early 1990s. Existing facility features include a small office and maintenance complex, small and large tailings piles, an RO water treatment facility, pilot and full-scale zeolite treatment systems, two wastewater collection ponds and three evaporation ponds. The LTP is unlined, covers about 215 acres, is 85 to 90 feet tall and contains about 20 million tons of tailings. The STP is also unlined and covers about 40 acres, is 25 feet tall and contains about 2 million tons of tailings. Evaporation pond 1 was constructed on top of the STP.

Five housing subdivisions are located south and southwest of the former mill. The nearest residence is located in Murray Acres and is about 0.6 miles from the center of either tailings pile.

The Site lies above the San Mateo alluvium, which is over 120 feet deep. The alluvium is generally sandy silt; however, two distinct sand and gravel horizons occur at the top and bottom of the unit. The lower sand and gravel horizon is relatively continuous throughout the area and is a source of water in the region. Directly under the alluvium is the Chinle Formation (with Upper and Lower members), composed primarily of shale and siltstone with three sandstone units. The Chinle Formation is underlain by the San Andres Limestone. The Chinle beds have been tilted up to ten degrees (generally to the northeast) and been extensively faulted in the site area due to uplift of the Zuni Mountains southwest of the Site. The natural groundwater flow in the alluvial aquifer is generally to the southwest, while flow direction in the bedrock aquifers is generally eastward (downdip) under natural conditions.

Surface drainage across the Site is predominantly directed to the southwest. Ponding occurs after significant precipitation, but this water either evaporates or infiltrates into the ground. The Site lies partially within the floodplain of the San Mateo Creek, which is part of the Rio Grande drainage basin. The Arroyo Del Puerto is an ephemeral tributary stream to the San Mateo Creek drainage, which is also ephemeral at their confluence. This confluence is about 10 miles north of the Site. San Mateo Creek has perennial flow at its headwaters on the north flank of Mount Taylor; intermittent flow over its middle reach, which is normally dry in the summer except for high rainfall events; and ephemeral in its lower reach where it meets Rio San Jose Creek near Milan. During peak runoff from snow melt in the late spring or during heavy summer and fall rain storms, flood waters pass through the Site and continue to the five residential subdivisions southwest of the Site.

D.2 Land and Resource Use

HMC owns land in and around the former mill property. HMC leases much of the land for livestock grazing. The area containing the evaporation ponds, groundwater treatment plant, tailings piles and office and maintenance complex is fenced to exclude grazing. Certain small areas in the southern and western portions of the Site boundary are seasonally used for livestock grazing.

The major land use south and southwest of the Site is residential development in the Pleasant Valley Estates, Murray Acres, Broadview Acres, Valle Verde and Felice Acres subdivisions. Several lots within these developments are vacant or contain horse barns, corrals or equipment storage. Some dwellings are vacant or have been permanently abandoned and are in disrepair. Most of these houses use the Milan municipal water supply. In 2012 one residence in Valle Verde was found to still be using water from a domestic well supply. The resident has refused offers to connect to the public water supply (2014 Annual Monitoring Report, HMC).

Future land use is expected to be consistent with current use. Although the New Mexico Office of the State Engineer issued a health advisory to prevent people from installing private wells, a future resident could install a well and use it for domestic purposes.

D.3 History of Contamination

Milling operations occurred at the Site between 1958 and 1990. Operations used an alkaline leach-caustic precipitation process to extract and concentrate uranium oxide from uranium ores. The milling process byproducts (waste) were placed in two tailings piles onsite (STP and LTP). The STP contains approximately 1.2 million tons of tailings from ore milled under contracts with the federal government. The LTP contains approximately 21 million tons of tailings from ore milled under both federal government and commercial contracts. Because the tailings piles were not constructed with engineered liners, they likely began leaking soon after milling operations began. Early FYR reports state that groundwater contamination was first identified in 1961; however, the source of this information could not be corroborated.

In the mid-1970s high levels of selenium were detected in residential wells completed in the alluvial aquifer, which prompted groundwater remedial activities. In addition to the tailings pile sources, soil contamination from uranium ore storage and windblown tailings continued until the OU2 soil cleanup was completed. It is possible that leaching of soil contaminants left in place continued to contaminate groundwater, because the soil cleanup standard was based on human-health risk rather than potential for contaminants to leach to groundwater; this may explain the area of persistent groundwater contamination south of the former mill site.

An important change in the remedial strategy occurred about 15 years ago when the tailings-flushing program began. As designed, this flushing has resulted in considerable mobilization of contaminant mass that would not otherwise be occurring. Injection of “clean” groundwater into impacted alluvial and Chinle Formation aquifers has been a major part of the OU1 remedial strategy. This has been done to help hydraulic control of the contaminant plumes; however, it has also diluted contaminant concentrations in samples from nearby monitoring wells, making it difficult to assess contaminant trends. Periodic movement and/or addition of injection lines has added to the difficulty in assessing trends.

D.4 Initial Response

The OU1 initial response was due to detection of elevated selenium in residential water supply wells southwest of the mill facility in 1976. The original groundwater remedy has been revised and expanded on HMC’s initiative. The current system includes hundreds of monitoring, injection wells/infiltration lines and collection wells located over thousands of acres.

The decision to close the mill facility triggered the initial response for OU2. Cleanup of the mill facilities and contaminated soils was completed in 1995; however, final closure of the tailings piles has not occurred due to a change in remedial strategy from that presented in the original tailings piles closure plan. The original strategy was to dewater the LTP as much as possible, assure that at least 90 percent consolidation had occurred, and then construct the final radon cover. However, in 2000 the tailings flushing program began, which injected considerable quantities of water and, therefore, final closure of the LTP has been postponed. NRC is the lead agency overseeing cleanup. HMC follows the NRC closure process, approved pursuant to the NRC license. There have been no interim response actions.

APPENDIX E – PRESS NOTICE

Homestake Mining Company Superfund Site
Public Notice
U. S. Environmental Protection Agency, Region 6

December 2015

The U.S. Environmental Protection Agency Region 6 (EPA) will be conducting the fourth five-year review of remedy implementation and performance at the Homestake Mining Company Superfund site (Site) in Milan, Cibola County, New Mexico. The Site includes a former uranium mill, contaminated portions of the underlying groundwater aquifers and contamination in neighboring subdivisions. The land immediately south and west of the Site consists of residential developments. Land near the Site is also used for agricultural and livestock purposes. The groundwater remedial actions included source control, plume control, evaporation and reverse osmosis system. The five-year review will determine if the remedies are still protective of human health and the environment.

The five-year review is scheduled for completion in September 2016. The report will be made available to the public at the following local information repository:

New Mexico State University,
Grants Campus Library
1500 Third Street
Grants, New Mexico 87020
(505) 287-6639

Site status updates are available on the Internet at http://www.epa.gov/superfund/homestake-mining

All media inquiries should be directed
to the EPA Press Office at (214) 665-2200

For more information about the Site, contact:

Sairam Appaji/Remedial Project Manager
(214) 665-3126
or 1-800-533-3508 (toll-free)
or by email at appaji.sairam@epa.gov

Stephen Harper/Community Involvement Coordinator
(214) 665-2727
or 1-800-533-3508 (toll-free)
or by email at harper.stephen@epa.gov

APPENDIX F – INTERVIEW FORMS

Homestake Mining Co. Superfund Site		**Five-Year Review Interview Form**	
Site Name:	**Homestake Mining Co.**	**EPA ID No.:**	**NMD007860935**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions (EPA Contractor)**
Subject Name:	**Angelo Ortelli** **Kurt Vollbrecht**	**Affiliation:**	**NMED** **NMED Mining Environmental Compliance Section**
Subject Contact Information:	**(505) 827-2866**		
Time:		**Date:**	**February 16, 2016**
Interview Location:			
Interview Format (circle one):	**In Person**	**Phone**	**Mail** **Other: Email**

Interview Category: **State Agency**

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   HMC has been cooperative and responsive to NMED requests for information. HMC has met the requirements of DP-200 since renewal in 2014, and is in compliance with the permit conditions. HMC has made a concerted effort to accelerate groundwater remediation at the Site. HMC has significantly increased their reverse osmosis (RO) system capacity, and have completed pilot testing of a 300-gpm zeolite treatment system and are now planning to implement full-scale treatment at a 1500-gpm capacity. HMC has also drilled several new alluvial and Chinle aquifer wells to increase the extraction of contaminated groundwater from persistent plumes located southeast and west of the Large Tailings Pile (LTP).

2. What is your assessment of the current performance of the remedy in place at the Site?

   Since renewal of DP-200 in 2014 HMC has addressed issues with pre-filtration of water entering the existing (Phase 1) 600-gpm RO system allowing that system to operate at full capacity for the first time since construction. Construction of an additional (Phase 2) 600-gpm RO system is complete and currently on-line. Construction of the 1200-gpm zeolite system is also nearly complete. Implementation of the increased RO capacity and use of zeolite treatment technology will result in effective acceleration of the remedy. With the increased treatment capacity, HMC was able to discontinue land application/irrigation of contaminated groundwater four years ago, and flushing of the LTP ended in July 2015.

3. Are you aware of any complaints or inquiries regarding site-related environmental issues or remedial activities from residents in the past five years?

   There have been many complaints and inquiries from residents proximal to the Site. These include, but are not limited to concerns over the overall remedial strategy, over-pumping and use of the San Andres/Glorieta aquifer, potential cross-contamination of the San Andres/Glorieta aquifer (from overlying contaminated aquifers), use of zeolite as a viable treatment technology, flushing of the LTP, radon background and monitoring, and the approved groundwater background concentrations (remediation standards). These are just some of the key issues raised by the public.

4. Has your office conducted any site-related activities or communications in the past five years? If so, please describe the purpose and results of these activities.

NMED has had extensive interaction with HMC during the past five years. Prior to 2014 these communications were mostly related to the technical review of the remedy as a component of the renewal process for DP-200. Since approval of DP-200, NMED has had infrequent contact with HMC to insure the requirements of DP-200 are being met.

In addition, HMC's Closure Manager hosts conference calls with all agencies on the first Wednesday of each month to provide updates on remedial progress at the Site.

5. Are you aware of any changes to state laws that might affect the protectiveness of the Site's remedy?

   No.

6. Are you comfortable with the status of the institutional controls at the Site? If not, what are the associated outstanding issues?

   There is currently a health advisory in place (published in January 2009) that would limit the installation of private wells within the contaminated aquifers. However, the State of New Mexico has no mechanism to enforce institutional controls. As part of the efforts to address cross-contamination of the San Andres aquifer, HMC also completed the plugging and abandonment of the old Murray Acres Association Irrigation well (OSE Permit No. B-5) in December 2014.

7. Are you aware of any changes in projected land use(s) at the Site?

   No.

8. Do you have any comments, suggestions or recommendations regarding the management or operation of the Site's remedy?

   Over the past several years management of the ground water remedy has improved substantially. Continued movement in this direction is expected in the future.

Site Name:	**Homestake Mining Co.**	**EPA ID No.:**	**NMD007860935**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions (EPA Contractor)**
Subject Name:	**Resident 1**	**Affiliation:**	**Affected Resident**
Subject Contact Information:			
Time:	**1:00 P.M.**	**Date:**	**January 12, 2016**
Interview Location:	**Kiva Café, Milan, NM**		

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **Residents**

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   I worked for Homestake off and on in the past. I saw the site in 1958 when operations began. In 1957 I worked for Kerr-McGee and saw Homestake go up and come down. Homestake was using mill solution for cleanup.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   I have some real problems since it has taken 40 years and Homestake is nowhere near clean up. Even when "cleaned up" alluvial is not as clean as when I dug my well in 1964.

3. What have been the effects of this Site on the surrounding community, if any?

   There have been a lot of problems. Half of the community that lived in subdivisions worked in uranium. It created friction with those who worked for Homestake and those who don't. We have meetings and EPA comes, we have pro-uranium and anti-uranium groups. I don't mind nuclear power.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   No.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Pretty well, they've had regular meetings and we understand EPA's position. We would prefer if they were in the front seat driving as opposed to the backseat, or not in the car at all as in the beginning. Many locals, including me, drilled our own wells and paid for it ourselves. Then Homestake put in community water and promised to pay for water for 10 years, after which we were supposed to be able to use our wells again. The cleanup has taken longer and we have to pay for potable water. It seems that in 1977 when Homestake got the new project manager, things flatlined. We would like to see the water cleaned up. We keep getting a pushed out date for that. I can't water my lawn because I don't want to pay for the water. We've been promised clean water for 40 years and it's still not done.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

Yes, I have a private well, but I haven't used it in years. The state hydro told me it was ok to use outside, but after I watered apple trees, the leaves turned black, so I stopped using it. We also have a San Andres well which we use for irrigation, but it is picking up radionuclides and TDS that wasn't there in the past.

7. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

   Hurry up and get the job done. They currently have the Cadillac of all procedures and we wish they had started with this cleanup. Why hasn't this new cleanup been introduced before? It was enlightening to see the first site FYR to see what a big problem we had. We've had responses from EPA recently as it appears to be who's in driver's seat. We don't get responses from NRC in the same way.

Site Name:	**Homestake Mining Co.**	**EPA ID No.:**	**NMD007860935**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions (EPA Contractor)**
Subject Name:	**Resident 2**	**Affiliation:**	**Affected Resident**
Subject Contact Information:			
Time:	**1:30 P.M.**	**Date:**	**January 12, 2016**
Interview Location:	**Kiva Café, Milan, NM**		

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **Residents**

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   Yes, I have lived where I am since fall of 1978. Homestake had a pit where they were doing blasting about 11 years ago and I think it broke the seal on my deep, San Andres well. The water level changed from 200 to 80. The last time the well was sampled was in conjunction with the State, EPA and Homestake, there was no power at well, so they brought in a generator. And no one likely wants to go through the hassle again. We haven't used the well for about 10 years. Whenever they extended the water line to us, we tapped in. Not because the well was contaminated but because we were concerned Homestake would eventually screw it up. We intended to use the well for yard and trees, but we'll have to get it sampled. Last samples said it was fine. Two houses down from us has a San Andres well that is contaminated.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   This has been going on for 40 years, or at least the contamination has been known for more than 40 years. The first 25 years of the program was not done in earnest, seemed to be a lot of window dressing and smoke screens. In the 1980s, the Homestake manager told him he was told to do as little, spend as little as possible. At the time I was the general manager for Kerr-McGee. We know that a lot of early work was poorly done; injections weren't deep enough. When they decided on injection and extraction, the wells drove the pollution further out. The geology is complex. The location of the Homestake Mill was picked for political reasons, to provide jobs and income for the county. It was a bad placement of a mill. They also made mistakes with their treatment process, they used carbonate leach, but it should've been an acid leach. The mill was labor intensive and used a split circuit to treat.

3. What have been the effects of this Site on the surrounding community, if any?

   The word "devastation" is used a lot and may be overused. It's hard to say what property values would've been if there was no contamination. I think my place is worth less than half of what it would be without contamination. People living closest to the site (i.e., in Murray Acres) have a high incidence of cancers, which his likely related to the mill, but it's hard to prove. There have been financial and physical effects on the community.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   There have been a few incidents in the past. From other community members, we heard of a breach of impoundments that flowed through Murray Acres. There was also a dustup with an agricultural contractor regarding some cattle grazing.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   In the last few years it has been much better. In the past, EPA's involvement was pretty low key. NRC has not been supportive or communicating well with us. We're ok with how EPA communications are going now.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

   Yes, see #1.

7. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

   In my honest opinion, they will never ever be able to clean the water to usable limits. You'll never get them down to drinking water standards and there will always be contamination in the alluvial. We're concerned Homestake will get a pass from NRC, it will be transferred to DOE, and then they'll realize, like Anaconda or Kerr-McGee, that isn't actually done. Alternatively, we could be bought out and moved. But where do you draw the line, who has been impacted enough, etc. We're doubtful we'd be bought out and moved. We'll keep paddling up a creek with a broken paddle and we'll do this again in 5 years. I think progress is being made, but it is slow. The government entities need to make Homestake pay for our water going forward. We were promised it would be cleaned up in 10 years, but it's not and we can't even grow gardens because we have to pay for water. It has destroyed the value of our belongings.

Site Name:	**Homestake Mining Co.**	**EPA ID No.:**	**NMD007860935**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions (EPA Contractor)**
Subject Name:	**Resident 3**	**Affiliation:**	**Affected Resident**
Subject Contact Information:			
Time:	**2:00 P.M.**	**Date:**	**January 12, 2016**
Interview Location:	**Kiva Café, Milan, NM**		

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **Residents**

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   Yes, I know a good deal, but probably not everything as I moved to the area in January of 2001. I live 2 miles from the plant and about 1.5 miles from the ponds.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   I have a background in psych and science and have worked with companies like GE/Westinghouse in the past with zirconium chemicals. When I was interested in the property I bought here, I was warned by others about potential contamination in the area. I researched Homestake on the EPA web site, which was my main source of information. I also asked around town. No one seemed to know a lot. What I read online was that only the alluvial was contaminated and it would be clean by 2003 and that contamination was only around the plant. Then there was not much going on until about 2005 when the company came back in. A realtor came to me and asked me to sell, but I didn't. Then someone came by and told me about an upcoming mining meeting. This was after that community meeting at the gym that got heated between the pro and anti- uranium folks. I participated in the meeting and since then it has been one huge disappointment after another. Additional aquifers are not contaminated and information has gone downhill, not just with Homestake. I joined BVDA and participated in other meetings and did a lot of online research. I did nuclear fuel chain research. Mining and the local issues are just the beginning of the spectrum as you get to nuclear weapons. Now no one knows how to dispose of waste. I was impressed with the information provided by the two men considering reopening the Mt. Taylor mine. They had considered many of the potential problems and issues we brought up. We have great reservations about reopening Mt. Taylor. Look at what happened at Three Mile Island, Chernobyl and Fukushima. Fukushima seems to have killed mining interest. Seems the problem is being chased instead of getting in front of it. Getting involved here has made me more aware of other issues. Other folks have been here much longer than me and done much more. I don't see myself as an adversary, but as a partner. I think they should see if it's possible to clean up this area before opening a new one.

3. What have been the effects of this Site on the surrounding community, if any?

   It has divided us. Our properties are contaminated. I had soil removed from my property, but they didn't do a complete job. I had windblown sand against the fence, and they did the inside of the fence, but not the dune at the fence, so now it just blows back in. It took 2 years to get the yard cleanup started and 3 hours to clean yard. The background level area was moved and that affected the amount that was cleaned up. I'm concern that the point they picked had contaminated soils wash down from the valley and it provided a ponding area of sediments that had artificially high contamination.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   Haven't heard of any. In the past year, there has been drilling south of me and we've been suggesting they get monitoring wells out in front of the plume, so I'm not surprised to see that the plumes seem to be moving. We've found out Homestake is building a new reverse osmosis plant. This all shows that they are chasing after the plume. We're concerned they'll keep the numbers low, hand off the project to DOE and it will rebound. New strategies triggered by hearing previous plans didn't work. Seems like they've ramped up with the reverse osmosis and the zeolite. I think what they're doing could be making the plume bigger, although maybe weaker at the same time, and the pumping may suck water out of the tailings piles.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Meeting with Homestake and EPA was good and I was impressed with information presented at last meeting about Mt. Taylor.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

   Yes, I have a well that is inside my building but I don't use it. I think it is disconnected. I ran across a letter alerting the manager (who previously occupied my building) of the possible contamination of the well. I think the land is subsiding as the well casing is sticking out of the ground more than it used to.

7. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

   I think they need to keep trying to get ahead of the contamination and try to communicate better. New wells were new to me when I saw them drilling. Their location makes me realize that the contamination is now past my property and it's obviously moved beyond the hydraulic barrier and down Thunderbid Road. Homestake hired a public relations person, which was helpful. I had lots of respect for the Mt Taylor guys as they seemed even keeled. I see us as community partners with Homestake and I would like to see them step up operations as much as they can. They added evaporation pond 3, but it wasn't big enough. They keep chasing and need to get ahead of it. They should set up an operation that could be turned back on when DOE took over. What happens if it rebounds?

Site Name:	**Homestake Mining Co.**	**EPA ID No.:**	**NMD007860935**
Interviewer Name:	**Johnny Zimmerman-Ward**	**Affiliation:**	**Skeo Solutions (EPA Contractor)**
Subject Name:	**Resident 4**	**Affiliation:**	**Affected Resident**
Subject Contact Information:			
Time:	**1:30 P.M.**	**Date:**	**February 5, 2016**

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:**

Interview Category: **Residents**

1. Are you aware of the former environmental issues at the Site and the cleanup activities that have taken place to date?

   I am aware of the attempted cleanup activities; but there have been no successful cleanup activities to date.

2. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   This is a ludicrous question. They have been supposedly trying to clean this up for 40 years now and all they have done is dilute it. Even after the USGS folks told them flushing wasn't working and wasn't an appropriate method for cleanup, they continued to flush. We had to fight to get that USGS remedial evaluation study underway and they didn't heed it. This is probably one of the worst cleanups in the country.

3. What have been the effects of this Site on the surrounding community, if any?

   According to EPA's own recent report, we've been exposed to way more than the acceptable radon risk in ambient air. Bulldozers scraped some contaminated soils back up on the pile and we were told the radon was cleaned up, but we found a lot of our houses were still very high in radon. We have lived with that for years. This is not just a problem for our generation, but also for future generations. Studies have shown it affects genes and successive generations. We're concerned about ours and future generations. It is a travesty that this is still going on. And this is just the air we're talking about, what about the years that kids played in tailings piles and families drank contaminated groundwater. We've been living in a soup of contamination.

4. Have there been any problems with unusual or unexpected activities at the Site, such as emergency response, vandalism or trespassing?

   No.

5. Has EPA kept involved parties and surrounding neighbors informed of activities at the Site? How can EPA best provide site-related information in the future?

   Yes, they tell us what they're not doing and what they can't do. I want them to help us help them find a solution. We've done a lot as a community, such as hired experts, etc. We've helped them more than other communities have done and still they're telling us what can't be done.

6. Do you own a private well in addition to or instead of accessing city/municipal water supplies? If so, for what purpose(s) is your private well used?

   Yes, it's used for irrigation. I can't drill a domestic, livestock or garden well because water I would drill into is contaminated.

7. Do you have any comments, suggestions or recommendations regarding any aspects of the project?

   Yes, I think Sam Coleman and Ron Curry need to quit talking and start acting. We've listened to them and we get surveys and studies and reports and we get absolutely no action. Every minute there is no action people are breathing in a radon soup.

Site Name: **Homestake Mining Co.** **EPA ID No.:** **NMD007860935**
Interviewer Name: **Affiliation:**
Subject Name: **Jesse R. Toepfer** **Affiliation:** **HMC**
Subject Contact Information: **505.290.3067**
Time: **Date:**
Interview Location:

Interview Format (circle one): **In Person** **Phone** **Mail** **Other:** **Email**
s

Interview Category: **O&M**

1. What is your overall impression of the project, including cleanup, maintenance and reuse activities (as appropriate)?

   Homestake continues to make strident gains with regard to its water remediation activities. I have a high degree of confidence that we are on the right track, and that we have made significant progress over the past 5 years.

2. What is your assessment of the current performance of the remedy in place at the Site?

   I believe it is soundly based in science, and it is effective.

3. What are the findings from the monitoring data? What are the key trends in contaminant levels that are being documented over time at the Site?

   The monitoring data over the past 15 years supports the remediation efforts. The constituents of concern (COCs), including selenium, uranium, and molybdenum, are showing significant reductions in accordance with the site's remediation strategy.

4. Is there a continuous on-site O&M presence? If so, please describe staff responsibilities and activities. Alternatively, please describe staff responsibilities and the frequency of site inspections and activities if there is not a continuous on-site O&M presence.

   There is a continuous O&M presence. Homestake's staff and crew check the site's conveyance pipelines, evaporation ponds and water treatment systems multiple times a day. On the weekends, a crew technician is assigned "water watch," and is required to patrol the site, check on the water treatment systems and is "on-call" should any of those systems come offline. The site's environmental technicians are trained to perform a multitude of electromechanical activities necessary for the ongoing remediation efforts. Supervision of site activities is performed by the Closure Manager, the Project Superintendent and the Senior Engineer.

5. Have there been any significant changes in site O&M requirements, maintenance schedules or sampling routines since start-up or in the last five years? If so, do they affect the protectiveness or effectiveness of the remedy? Please describe changes and impacts.

   Homestake has a few new systems that have been implemented over the past 5 years: a new zeolite water treatment system, an improved RO water treatment plant and an expanded well-field. Homestake is additionally pursuing a pilot study using Tripolyphosphate (TPP), but as this is still just a pilot study, it does not represent a commissioned system in actual service. The Homestake staff and crew have been trained to manage and operate these new systems, and where applicable, new procedures and maintenance requirements have been implemented. Sampling routines remain consistent with the requirements set forth in

the NRC License and NMED Discharge Permit. These changes have a significantly positive effect on the protectiveness of the remedy as they have enabled Homestake to treat more impacted water at a faster rate.

6. Have there been unexpected O&M difficulties or costs at the Site since start-up or in the last five years? If so, please provide details.

   No.

7. Have there been opportunities to optimize O&M activities or sampling efforts? Please describe changes and any resulting or desired cost savings or improved efficiencies.

   Homestake continues to seek out ways to streamline and optimize its operations. Upgrades to the RO water treatment plant and well-field, as well as an on-going transition to computer-based monitoring and recording continue to have an increasingly positive effect on sampling efforts and O&M activities.

8. Do you have any comments, suggestions or recommendations regarding O&M activities and schedules at the Site?

   Homestake continues to work with regulators to ensure the Sit is being remediated and managed in accordance with the NRC License and NMED Discharge Permit.

APPENDIX G –DETAILED DATA ANALYSIS

Table G-1: Exceedances of Site Standards for COCs by Aquifer, 2014

Aquifer	COCs with Exceedances	Location(s) of Exceedance
Alluvial Aquifer	Sulfate	Area east of Valle Verde; Area close to LTP and STP
	Chloride	
	TDS	
	Uranium	Collection area near tailings; Two wells in northern Felice Acres; Several wells in southern Felice Acres; One well in Murray Acres
	Selenium	Collection area near LTP and STP
	Molybdenum	Area near LTP and STP; Southeast of the STP; Area in central Section 27 (west of LTP)
	Nitrate	Area north and west of LTP; Small area southeast of Valle Verde
	Radium-226 and Radium-228	Immediately under the LTP
	Thorium-230	Immediately under the LTP
Upper Chinle Aquifer	Sulfate	Wells near or on the LTP
	Chloride	
	TDS	
	Uranium	Area near the LTP and collection ponds Four wells north and in Broadview and Felice Acres
	Selenium	Mixing zone near LTP and collection ponds; Two wells in non-mixing zone
	Molybdenum	Several wells near the tailings and south of Collection ponds; Two wells north of Broadview Acres
	Nitrate	Two wells in the LTP area
	Radium-226 and Radium-228	Few wells in western portion of LTP
	Vanadium	One well near the LTP
Middle Chinle Aquifer	Sulfate	Four wells in mixing zone area
	Chloride	Three wells west of West Fault; One well in Murray Acres
	TDS	Three wells in Felice Acres; One well in Broadview Acres; One well in Murray Acres; Four wells west of West Fault
	Uranium	Mixing zone wells in western portion of Felice Acres; Non-mixing zone wells in western portion of Broadview Acres; Several wells west of West Fault
	Selenium	Wells 481 and 493 in Felice Acres; Wells CW17, CW56, CW61, CW62, CW71 and CW72 in mixing zone
	Molybdenum	Several wells west of West Fault
Lower Chinle Aquifer	Sulfate	Far downgradient wells
	Chloride	
	TDS	
	Uranium	Six wells located near the subcrop of the Lower Chinle aquifer with the alluvial aquifer; Two non-mixing zone wells

Notes:
Source: Executive Summary of the 2014 Annual Report, HMC and Hydro-Engineering, 2015

Table G-2: Quantities of Constituents Collected (Source: 2014 Annual Monitoring Report)

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	2723830	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
2012	G.W.	143304728	3070	3671785	13.4	16027	16.8	20093	0.62	742
2012	TOE	12201316	6476	659465	26.8	2729	48.9	4980	0.43	44
2012	TAILS	56486600	2632	1240823	8.9	4196	26.2	12352	0.17	80
2013	G.W.	122813790	2793	2862836	12.5	12813	16.2	16605	0.73	748
2013	TOE	9211575	6453	496105	26.7	2053	53.3	4098	0.35	27
2013	TAILS	31489800	2448	643368	7.5	1971	23.6	6202	0.12	32
2014	G.W.	124070324	2570	2661212	11.4	11805	15.8	16361	0.63	652
2014	TOE	9427490	5683	447149	21.2	1668	46.0	3619	0.15	12
2014	TAILS	24487100	2788	569782	7.8	1594	27.1	5538	0.16	33
SUM G.W.		4,990,325,396		165,335,766		991,736		1,185,099		62,939
SUM TOE		383,857,031		28,499,920		120,851		256,667		4,816
SUM TAILS		481,305,602		19,854,647		75,615		209,002		710
COMBINED SUM		5,855,488,029		213,690,333		1,188,202		1,650,768		68,465

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

Figure G-1: Groundwater Flow Direction – Alluvial Aquifer (Source: 2014 Annual Monitoring Report/Performance Review)

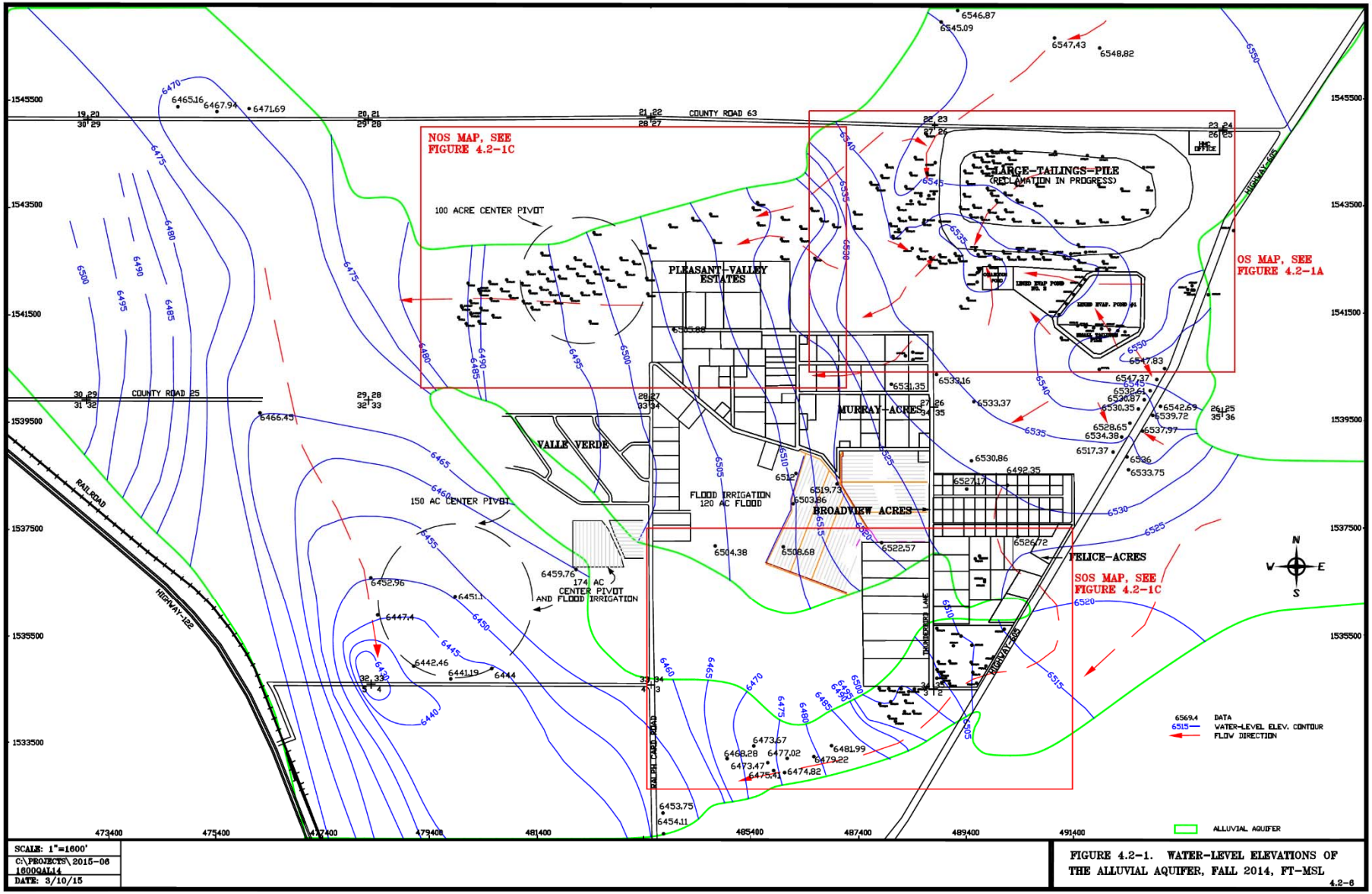


Figure G-2: Groundwater Flow Direction – Upper Chinle Aquifer (Source: 2014 Annual Monitoring Report/Performance Review)

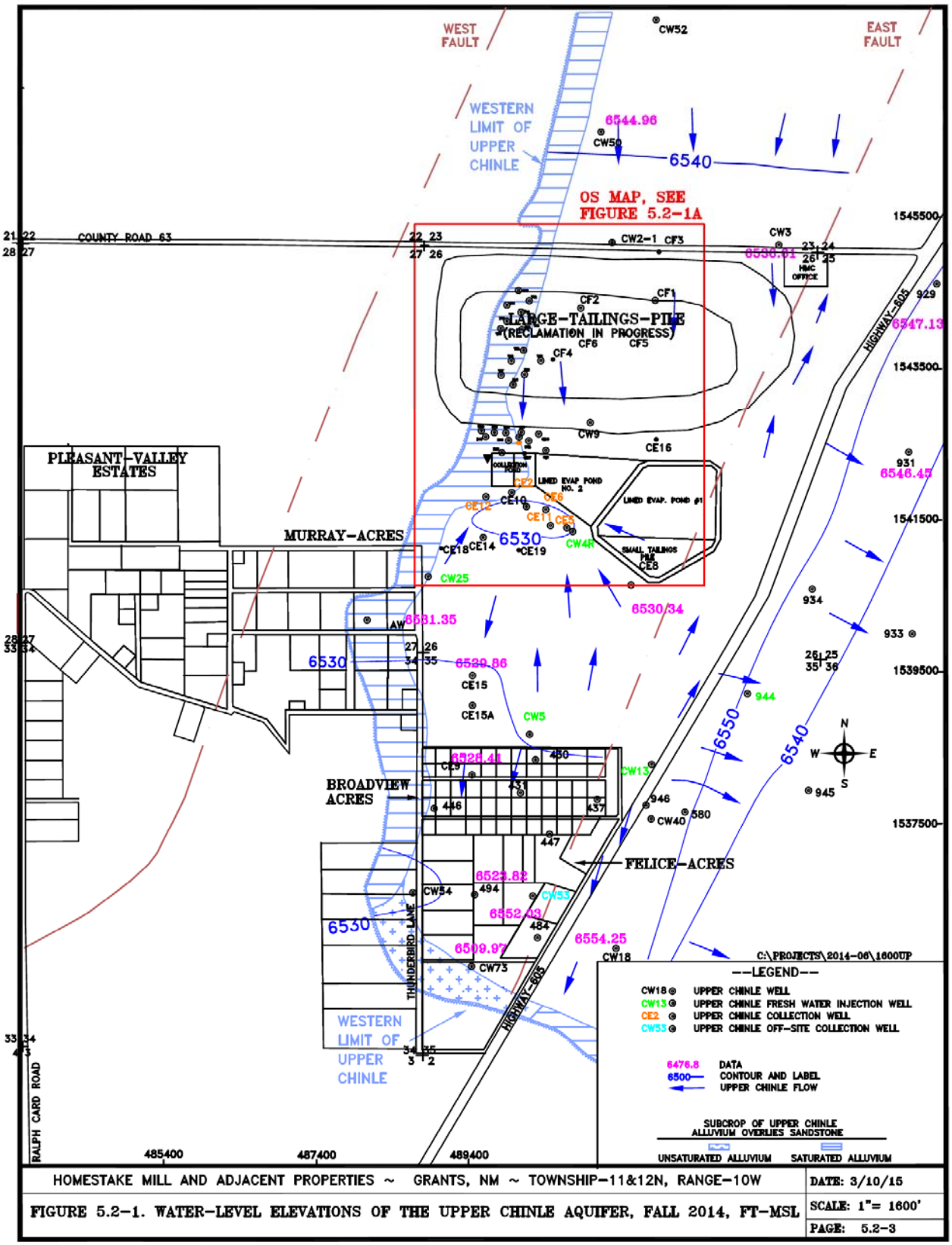


Figure G-3: Groundwater Flow Direction – Middle Chinle Aquifer (Source: 2014 Annual Monitoring Report/Performance Review)

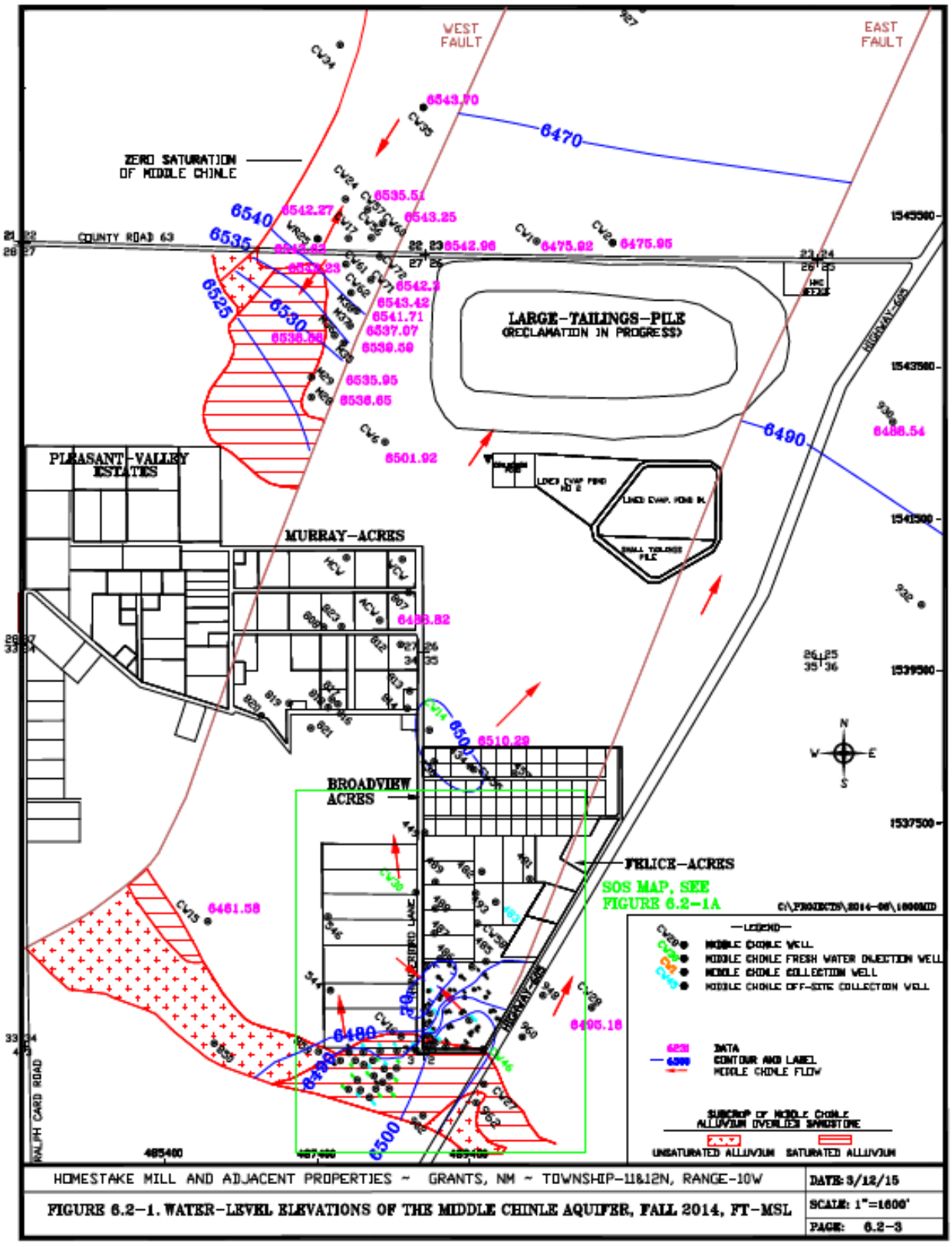


Figure G-4: Groundwater Flow Direction – Lower Chinle Aquifer (Source: 2014 Annual Monitoring Report/Performance Review)

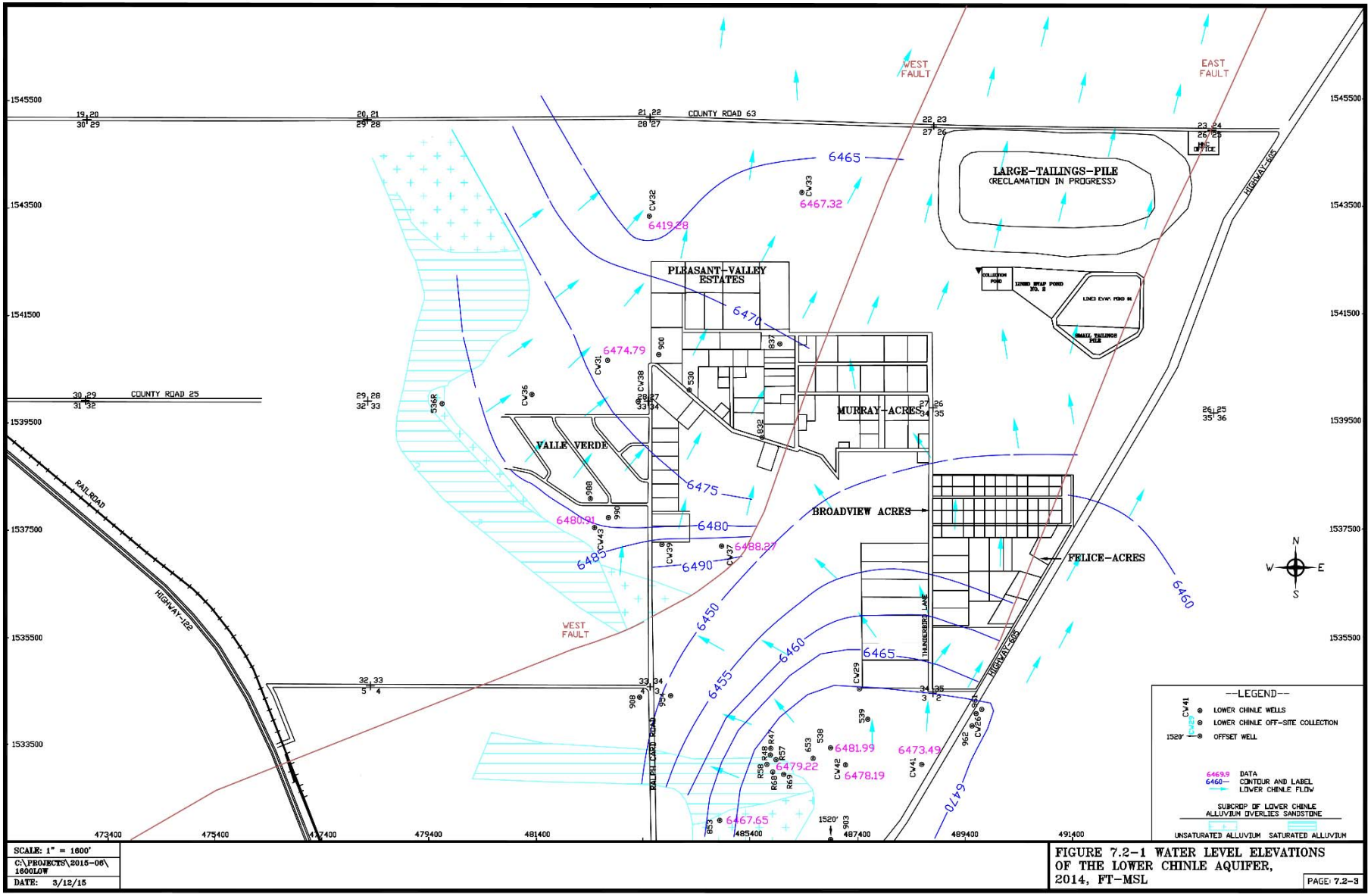


Figure G-5: Groundwater Flow Direction – San Andres Aquifer (Source: 2014 Annual Monitoring Report/Performance Review)

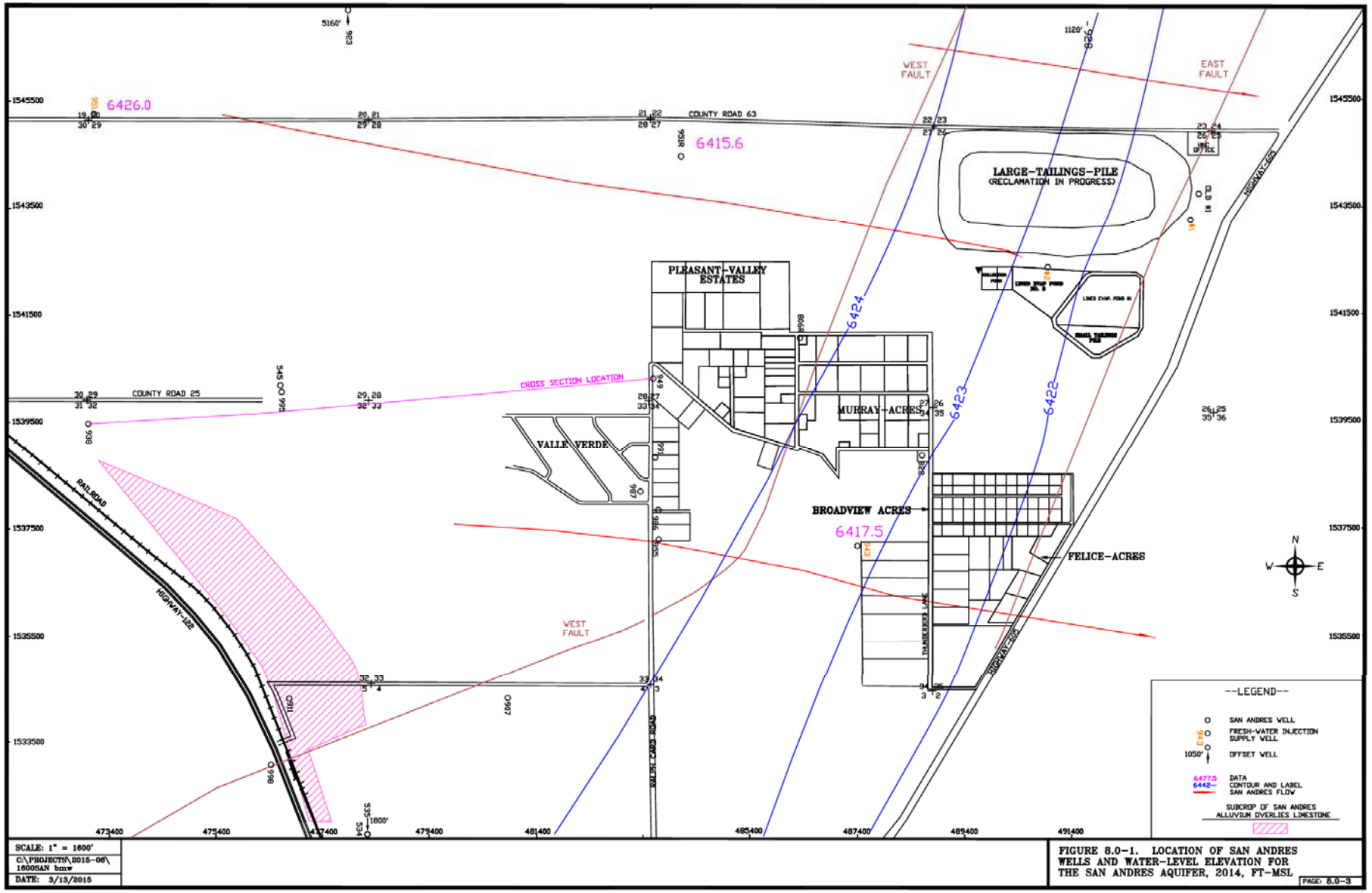


Figure G-6: Selenium Concentrations in the Alluvial Aquifer - 1999 (Source: 2014 Annual Monitoring Report/Performance Review)

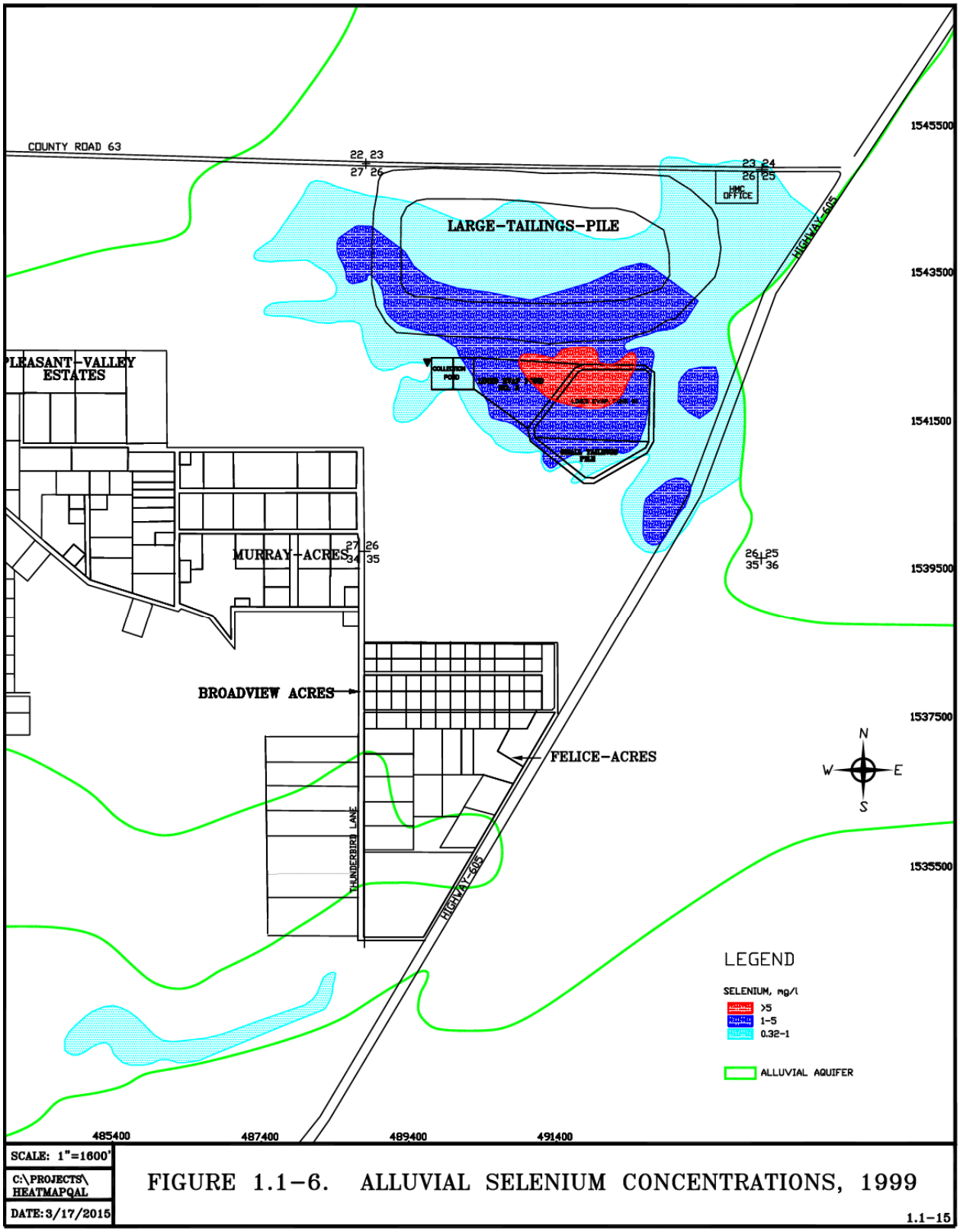


Figure G-7: Selenium Concentrations in the Alluvial Aquifer - 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

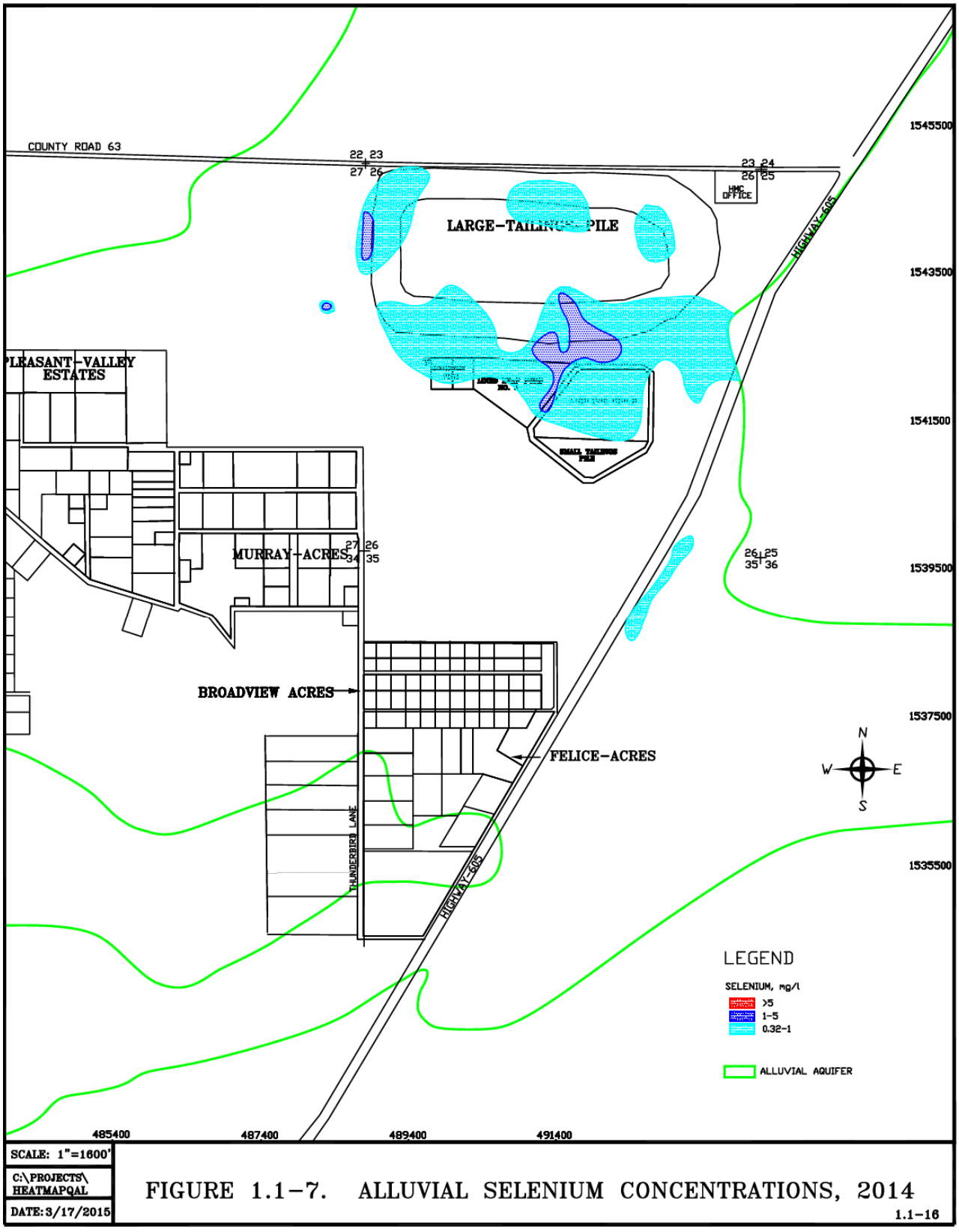


Figure G-8: Uranium Concentrations in the Alluvial Aquifer - 1999 (Source: 2014 Annual Monitoring Report/Performance Review)

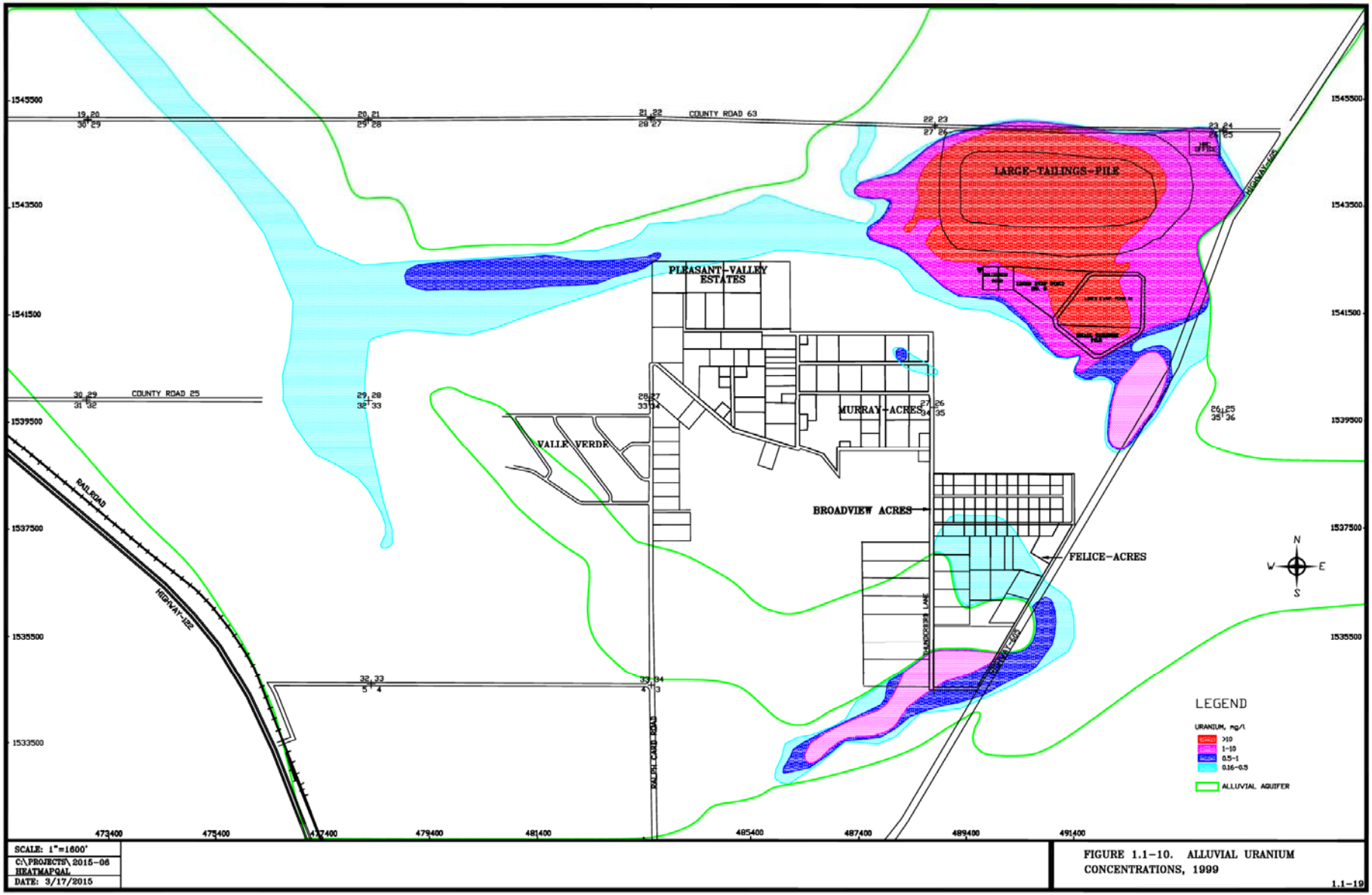


Figure G-9: Uranium Concentrations in the Alluvial Aquifer - 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

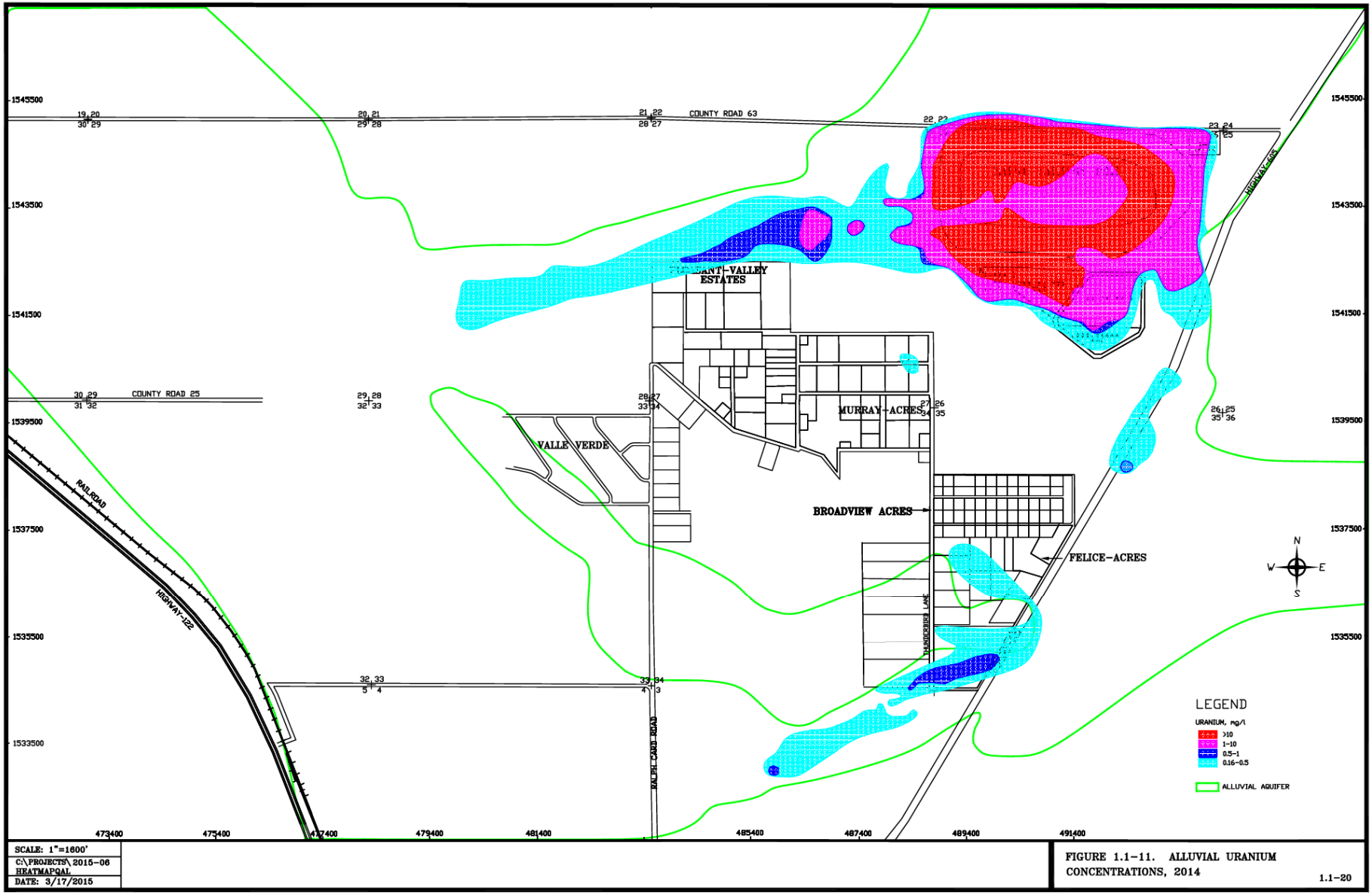


Figure G-10: Uranium Concentrations in the Upper Chinle Aquifer - 1999 (Source: 2014 Annual Monitoring Report/Performance Review)

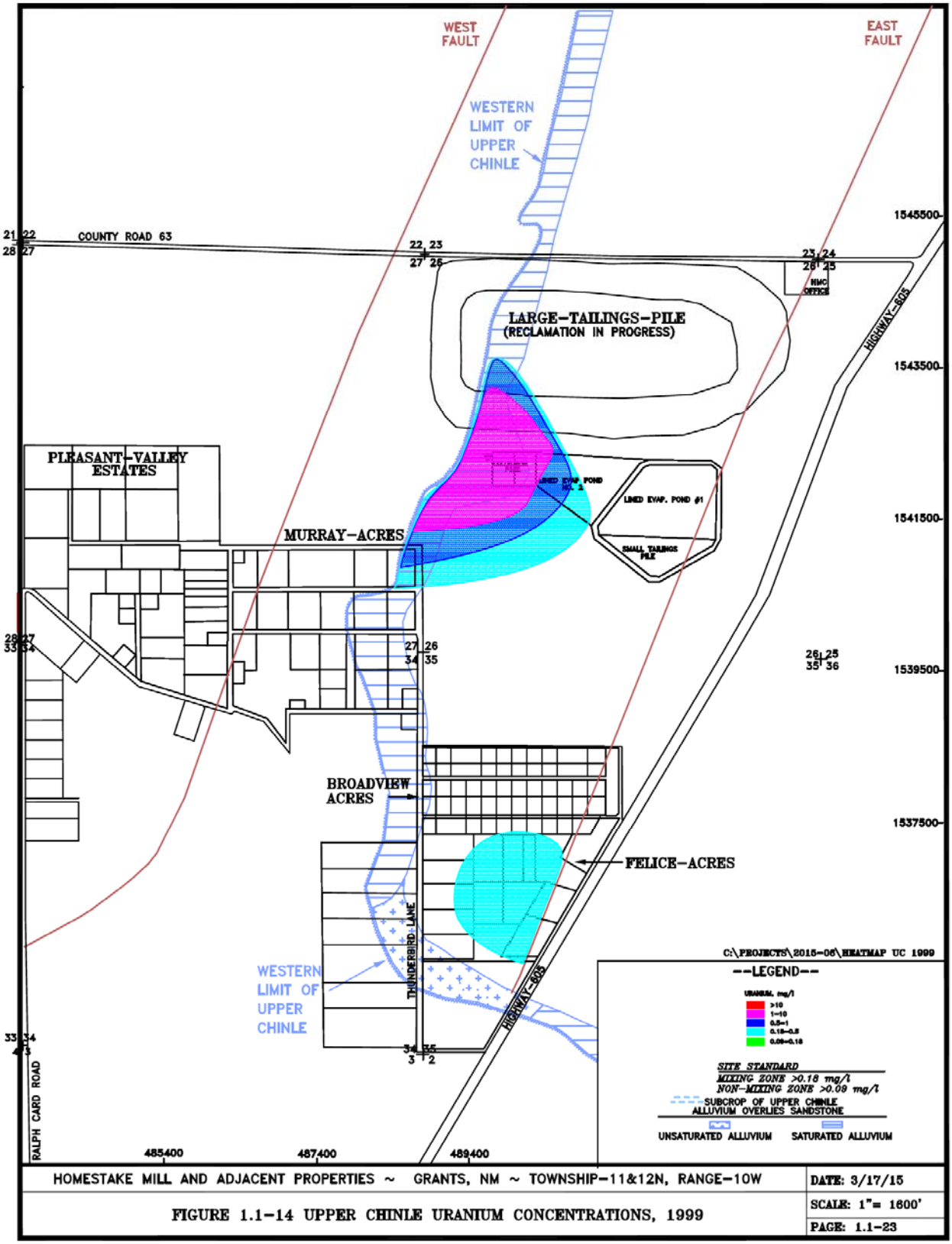


Figure G-11: Uranium Concentrations in the Upper Chinle Aquifer - 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

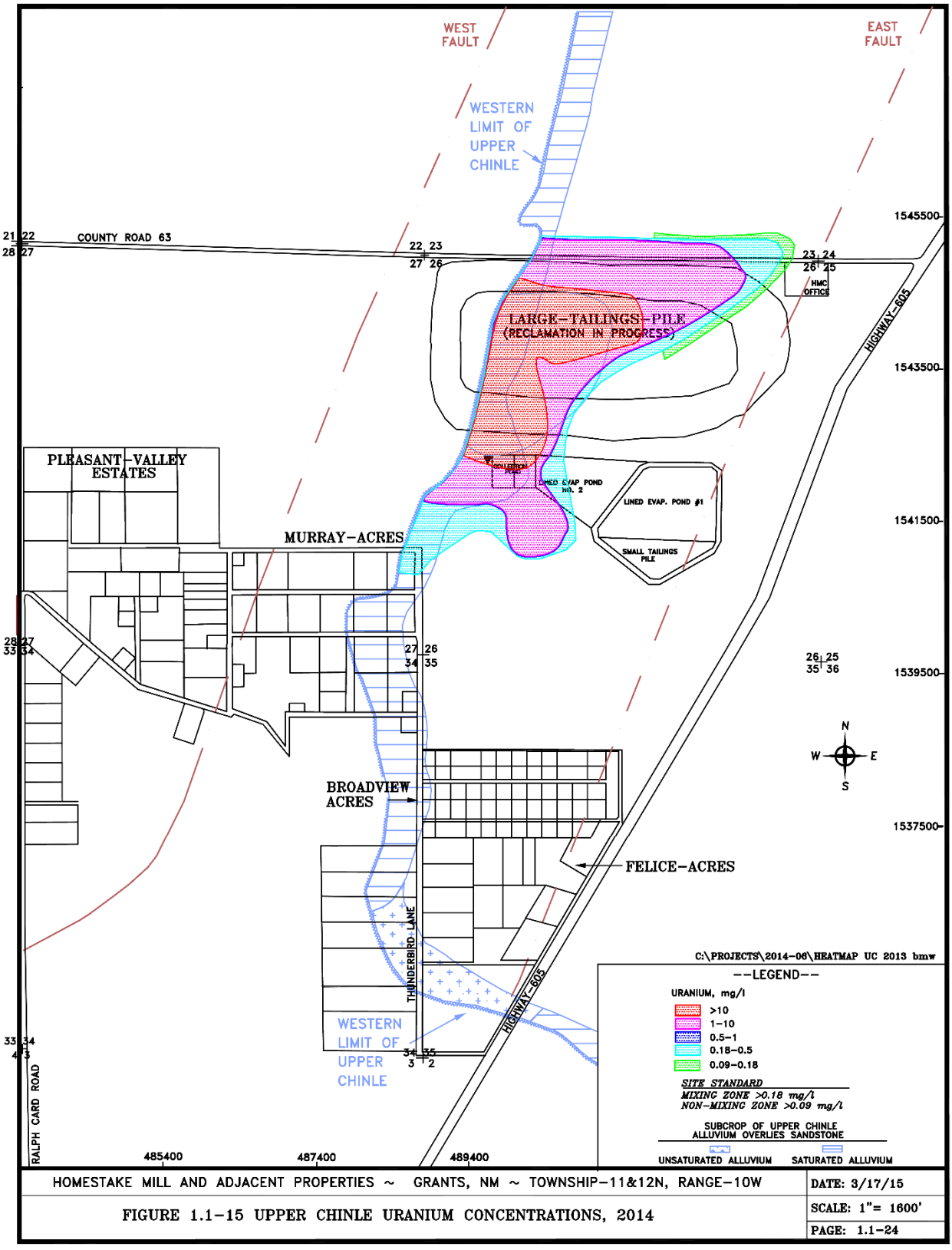


Figure G-12: Uranium Concentrations in the Middle Chinle Aquifer - 1999 (Source: 2014 Annual Monitoring Report/Performance Review)

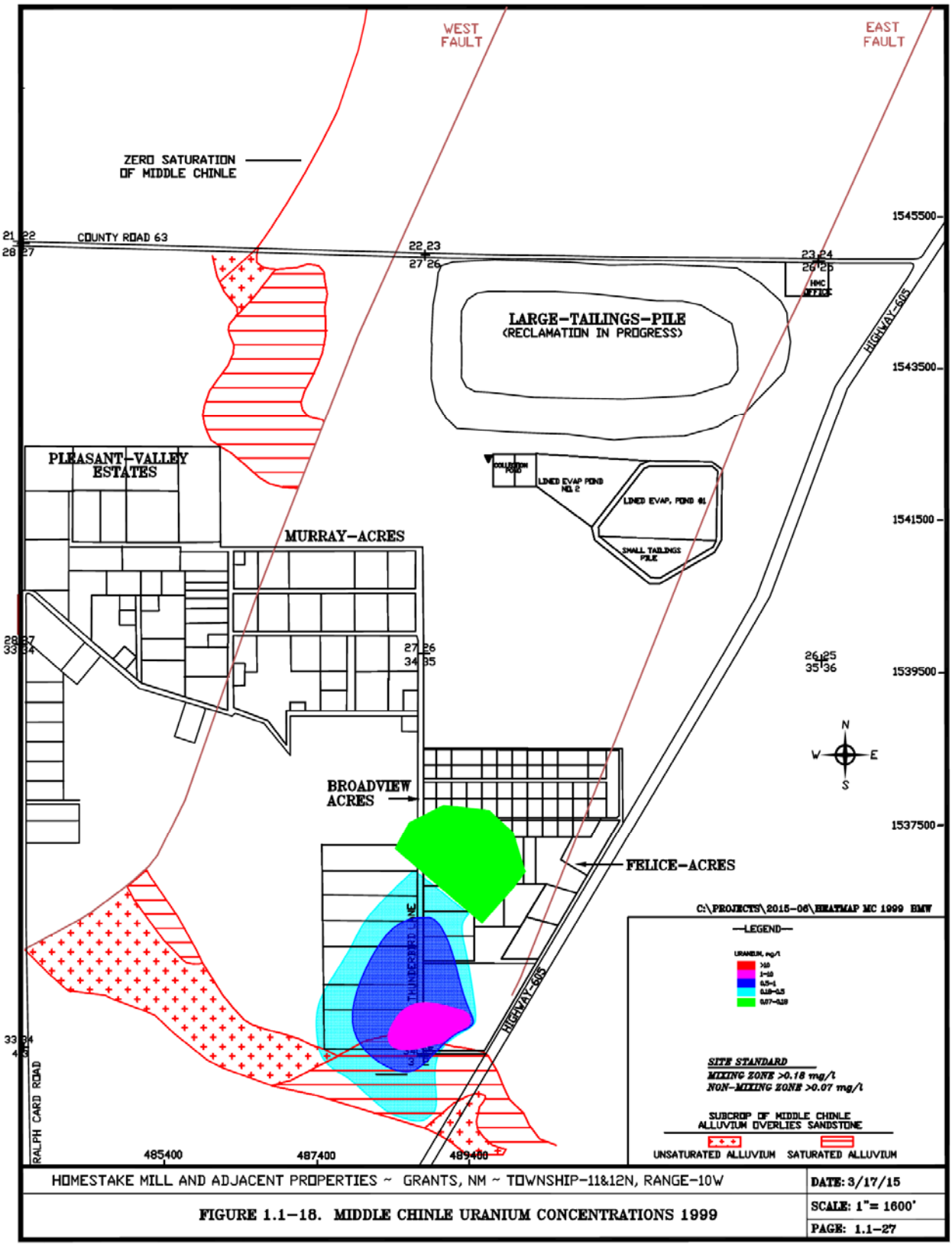


Figure G-13: Uranium Concentrations in the Middle Chinle Aquifer - 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

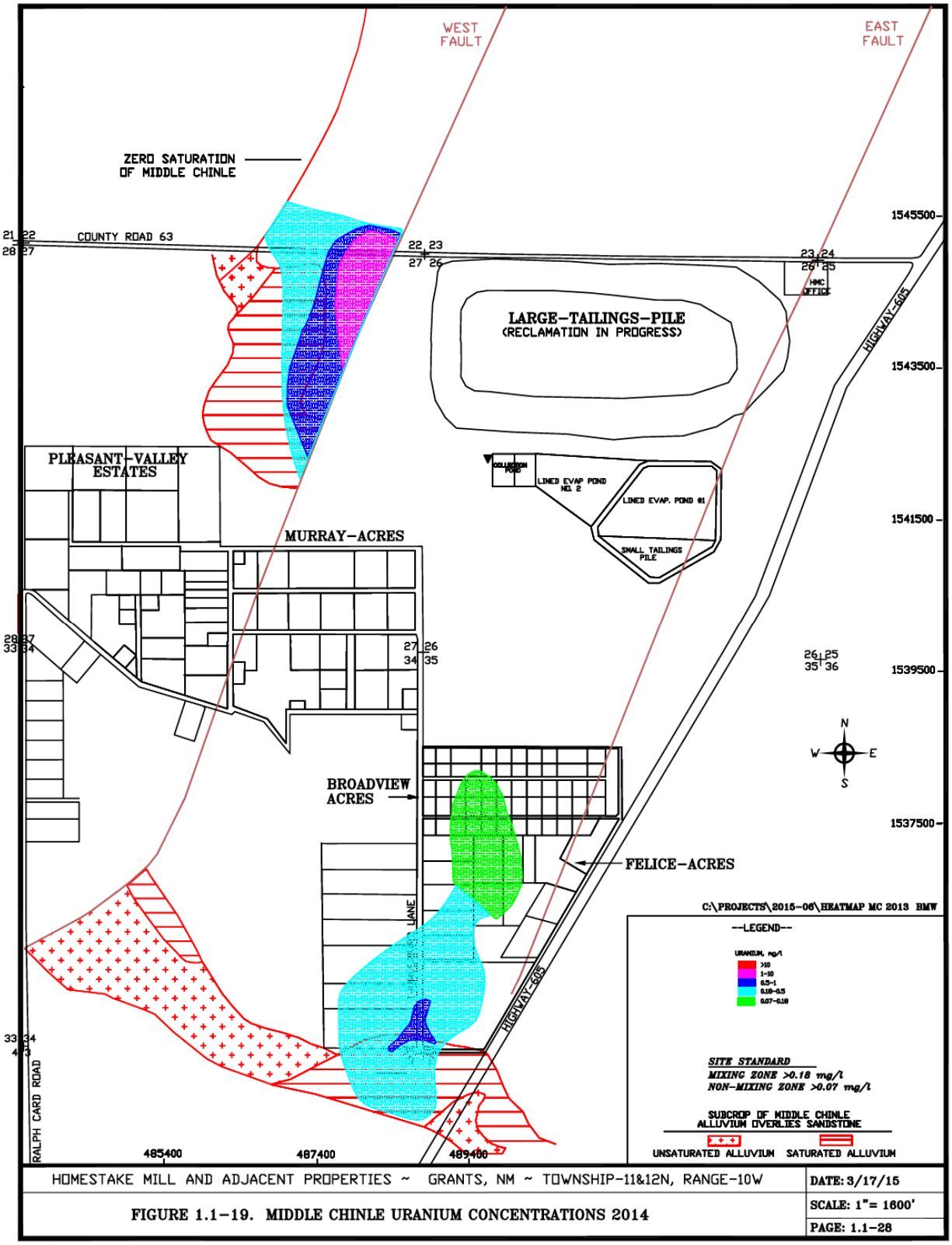


Figure G-14: Uranium Concentrations in the Lower Chinle Aquifer - 1999 (Source: 2014 Annual Monitoring Report/Performance Review)

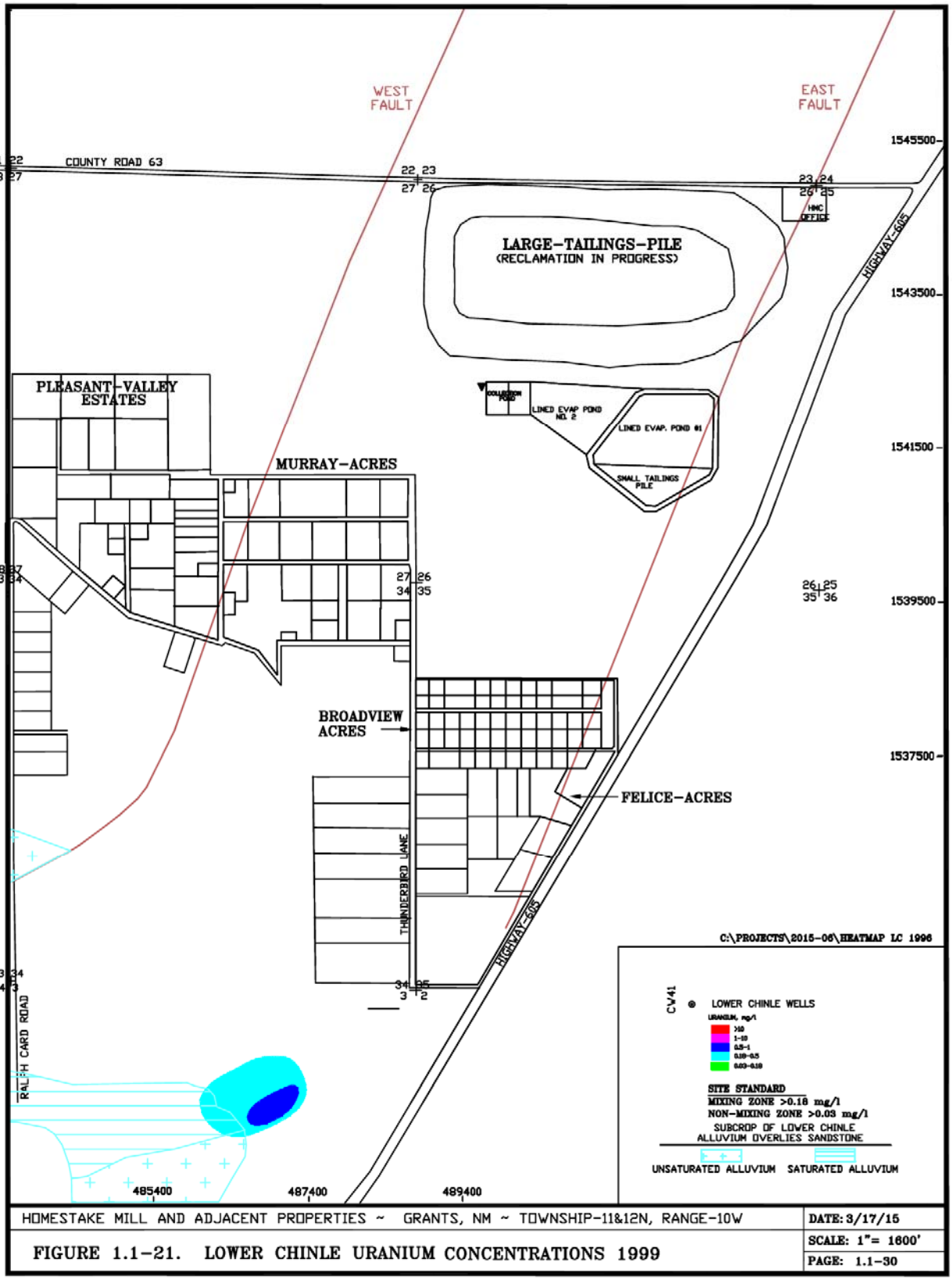


Figure G-15: Uranium Concentrations in the Lower Chinle Aquifer - 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

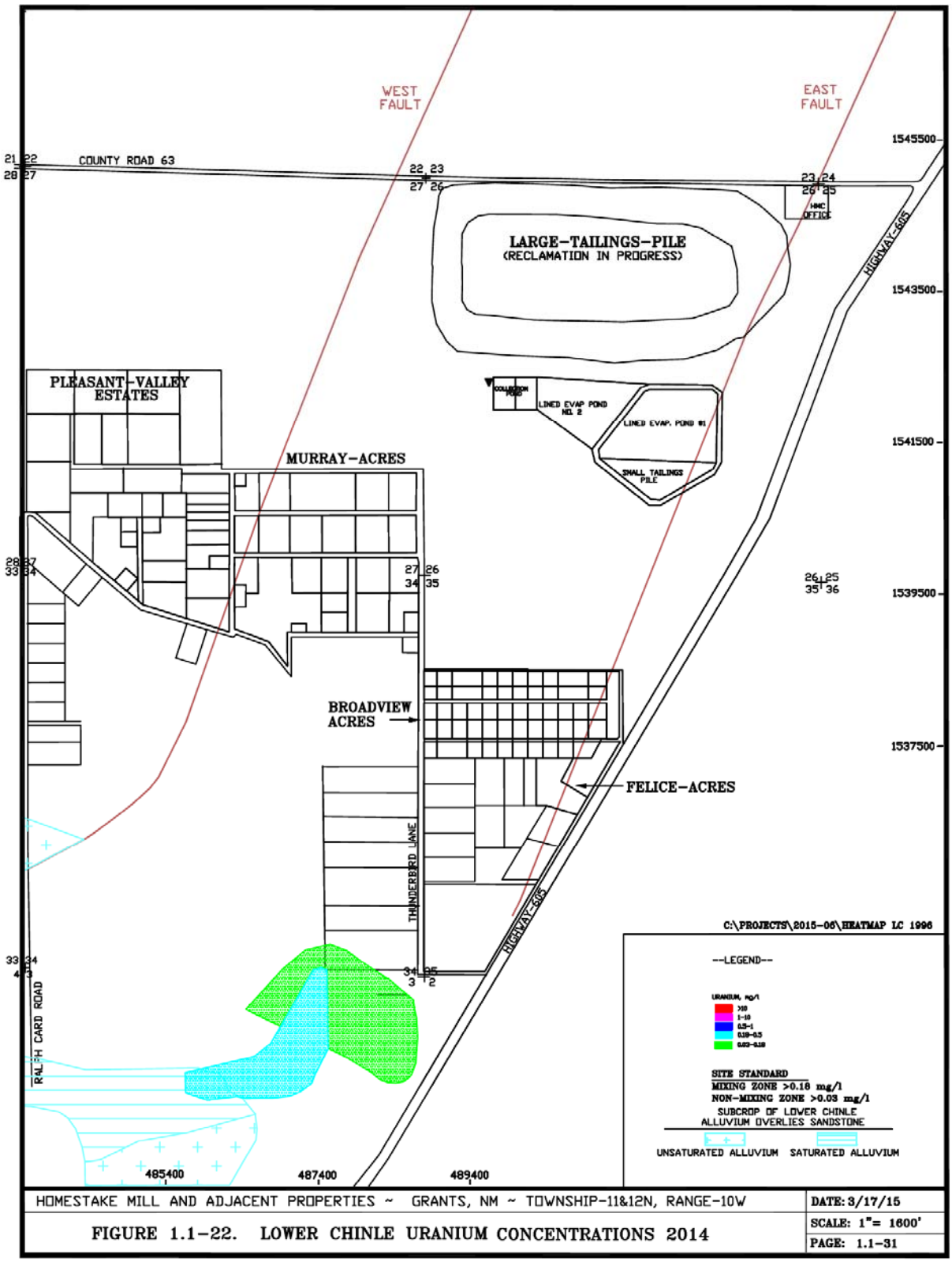


Figure G-16: Uranium Concentrations at POC Well S4 (Source: 2014 Annual Monitoring Report/Performance Review)

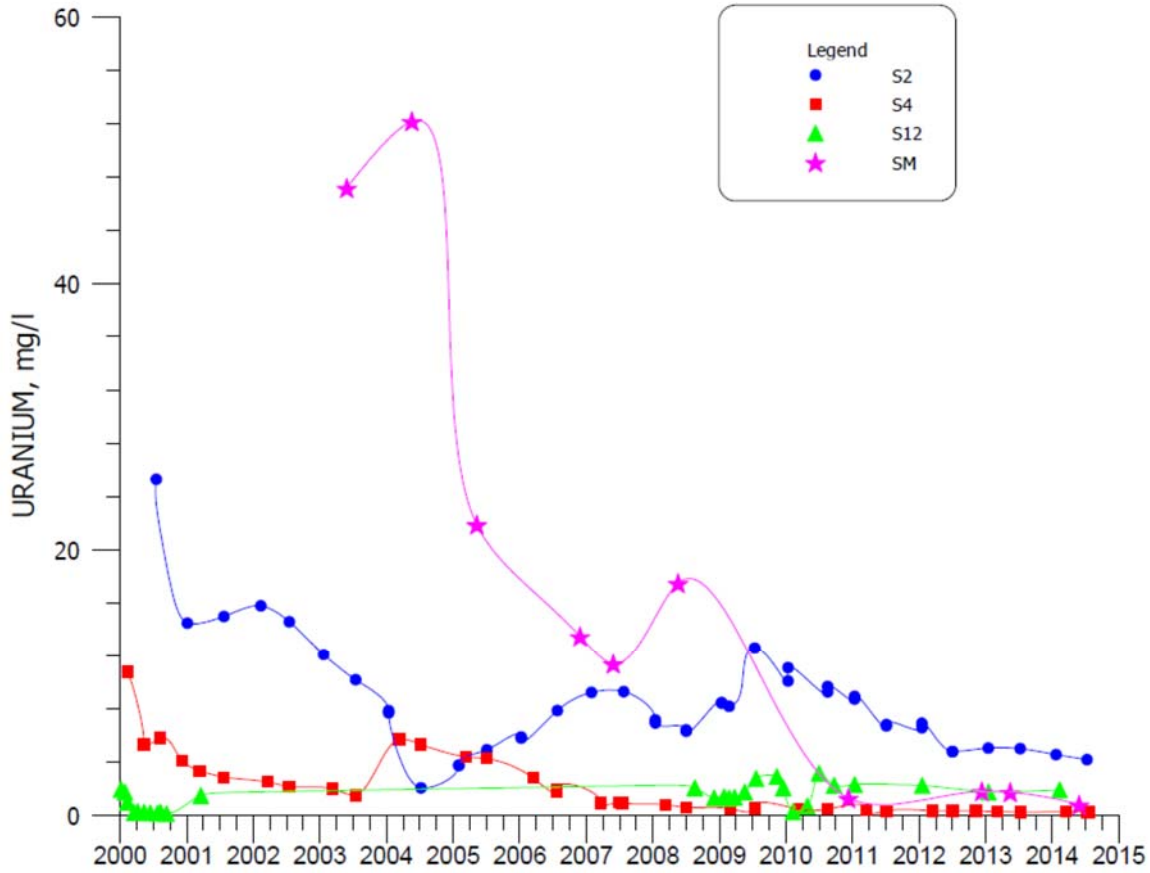


FIGURE 4.3-55. URANIUM CONCENTRATIONS FOR WELLS S2, S4, S12 AND SM.

Figure G-17: Uranium Concentrations at POC Well D1 (Source: 2014 Annual Monitoring Report/Performance Review)

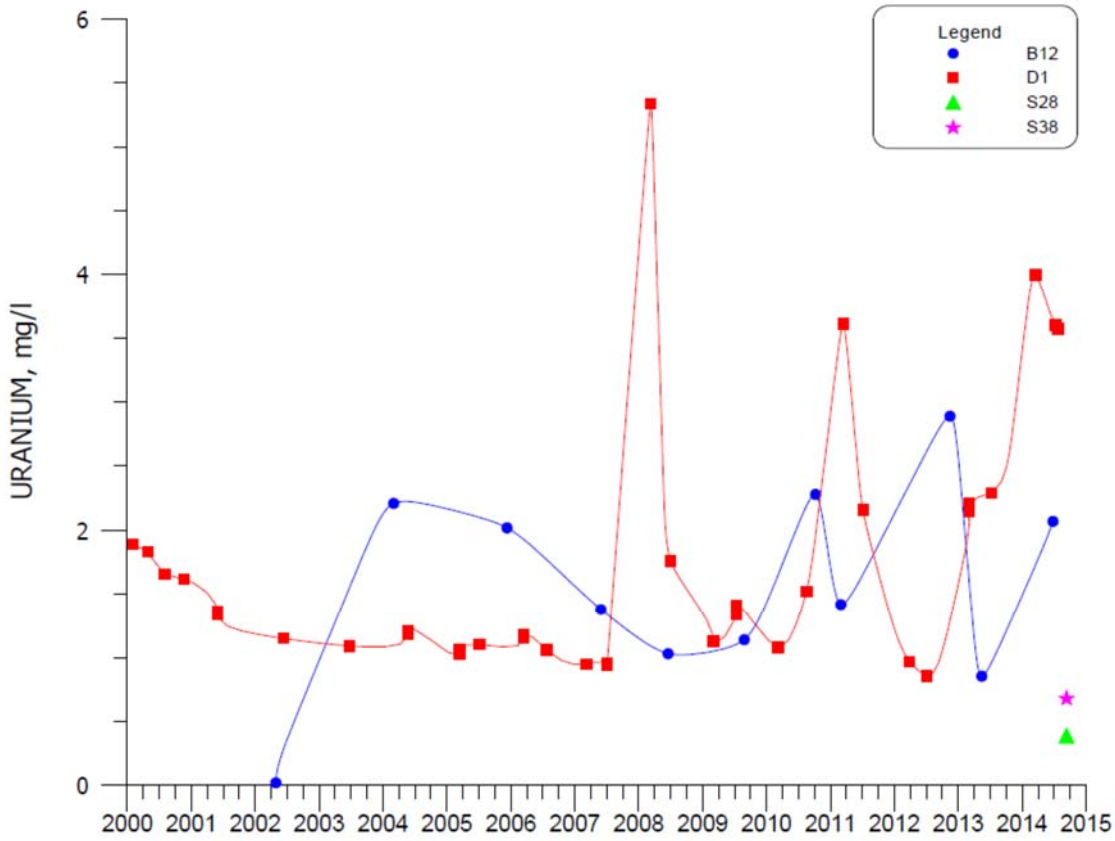


FIGURE 4.3-57. URANIUM CONCENTRATIONS FOR WELLS B12, D1, S28 AND S38.

Figure G-18: Molybdenum Concentrations at POC Well S4 (Source: 2014 Annual Monitoring Report/Performance Review)

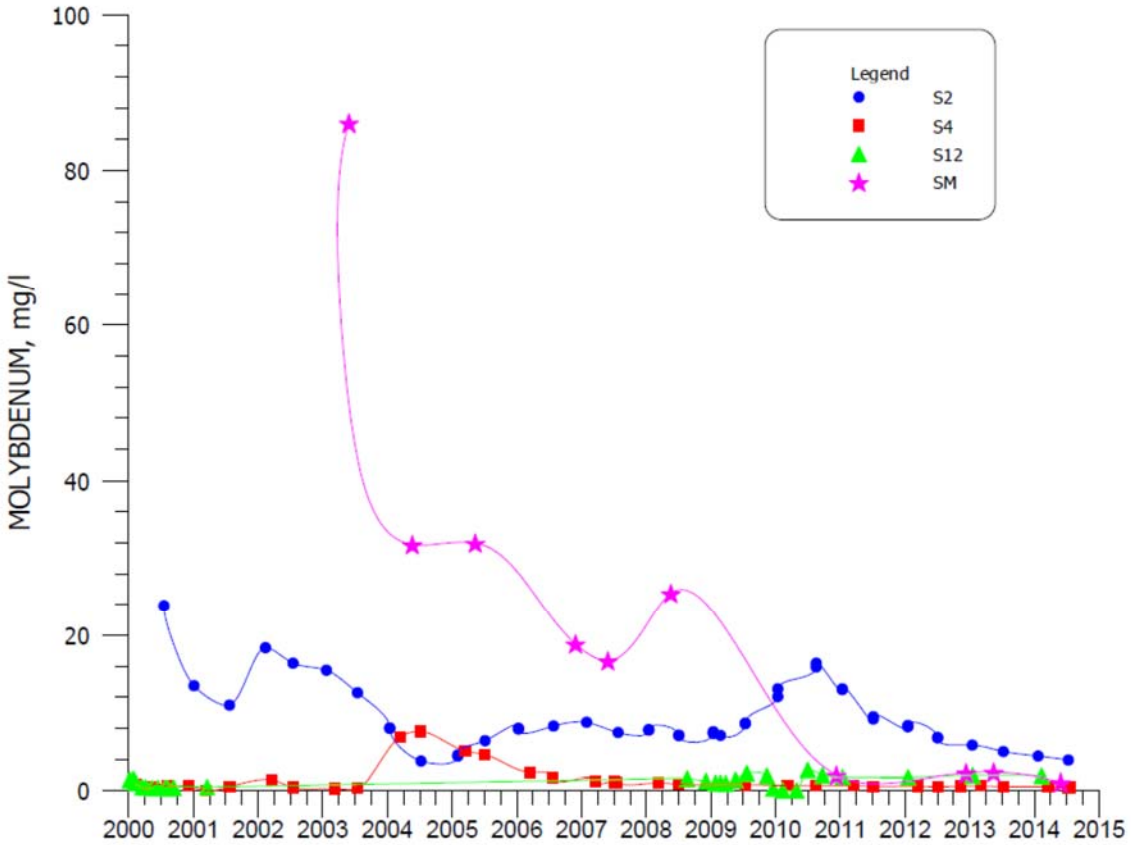


FIGURE 4.3-89. MOLYBDENUM CONCENTRATIONS FOR WELLS S2, S4, S12 AND SM.

Figure G-19: Molybdenum Concentrations at POC Well D1 (Source: 2014 Annual Monitoring Report/Performance Review)

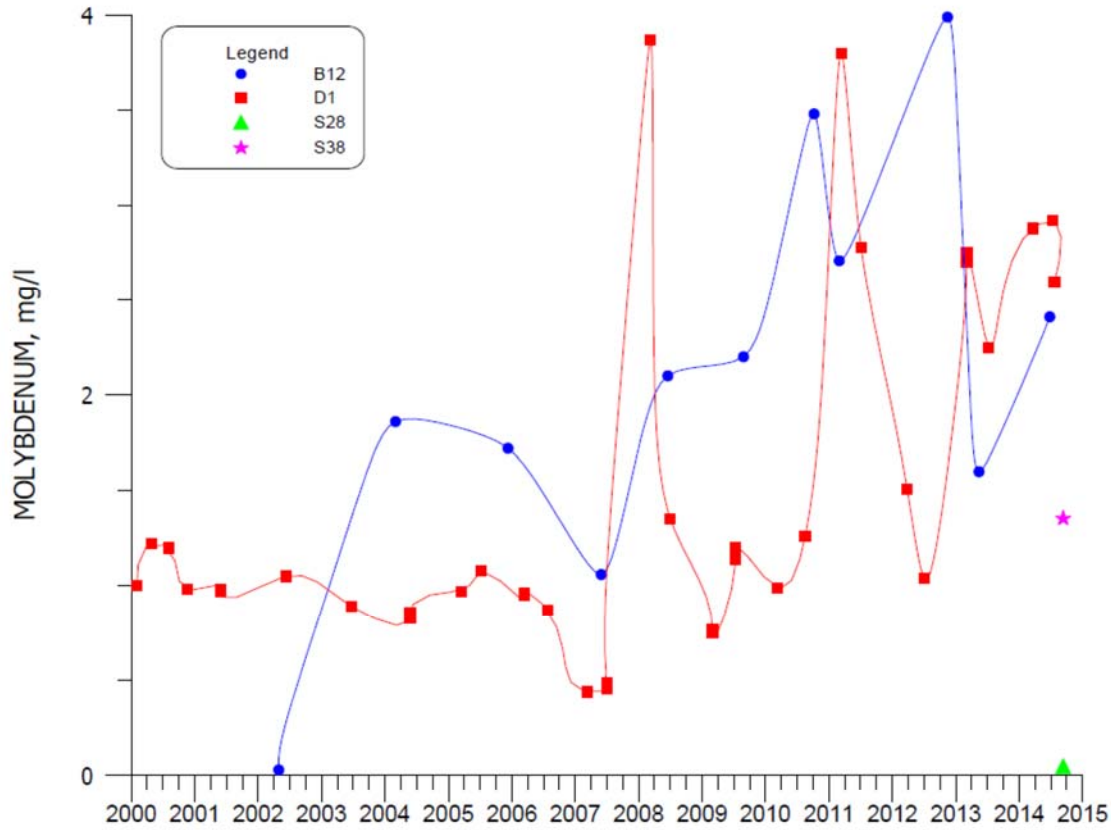


FIGURE 4.3-91. MOLYBDENUM CONCENTRATIONS FOR WELLS B12, D1, S28 AND S38.

Figure G-20: Molybdenum Concentrations at POC Well X (Source: 2014 Annual Monitoring Report/Performance Review)

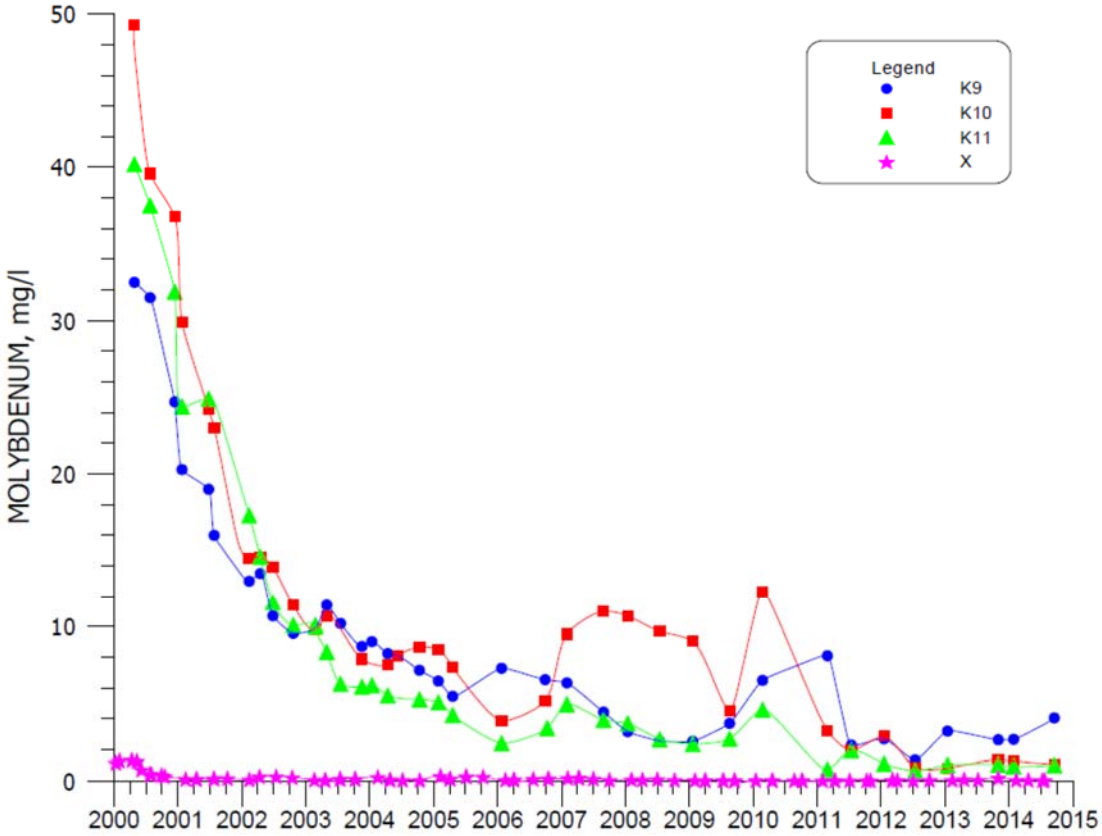


FIGURE 4.3-94. MOLYBDENUM CONCENTRATIONS FOR WELLS K9, K10, K11 AND X.

Figure G-21: Uranium Concentrations at POCs CE2 and CE8 (Source: 2014 Annual Monitoring Report/Performance Review)

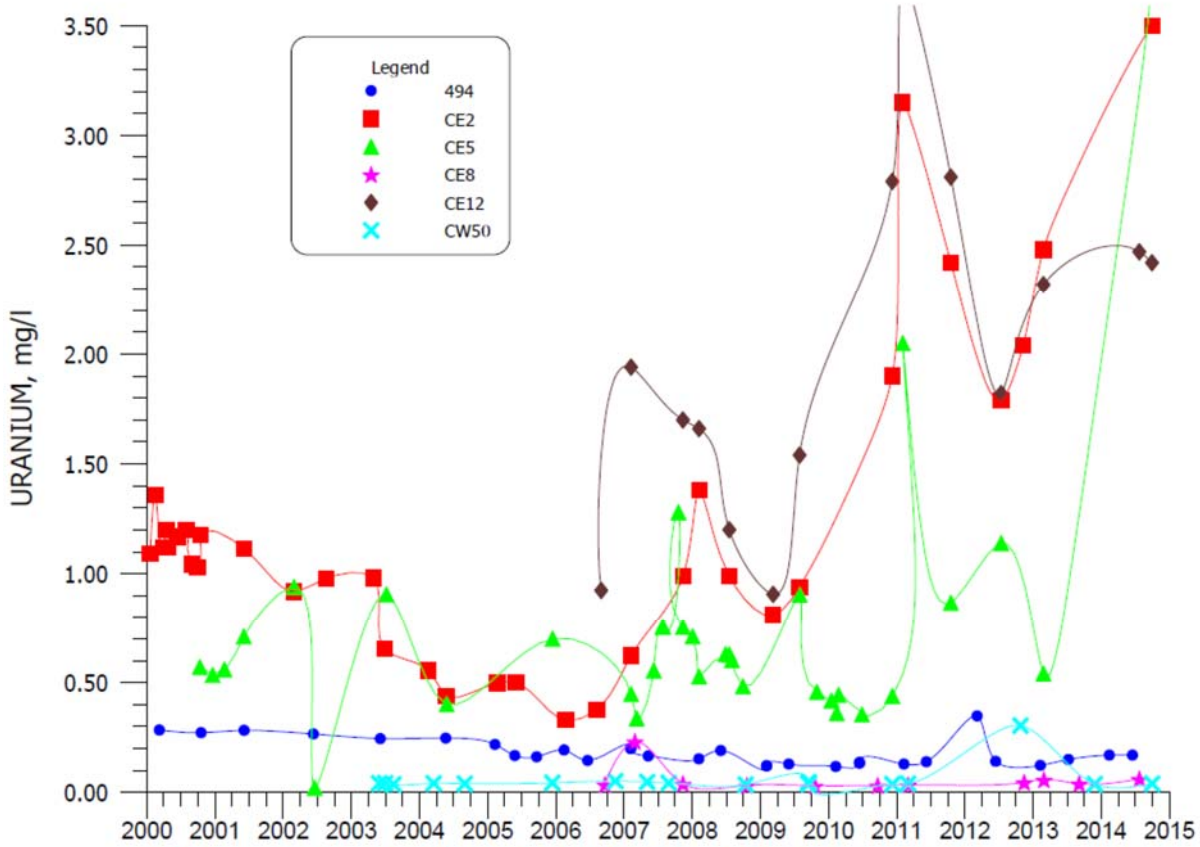


FIGURE 5.3-12. URANIUM CONCENTRATIONS FOR MIXING ZONE WELLS 494, CE2, CE5, CE8, CE12, AND CW50

Figure G-22: Molybdenum Concentrations at POCs CE2 and CE8 (Source: 2014 Annual Monitoring Report/Performance Review)

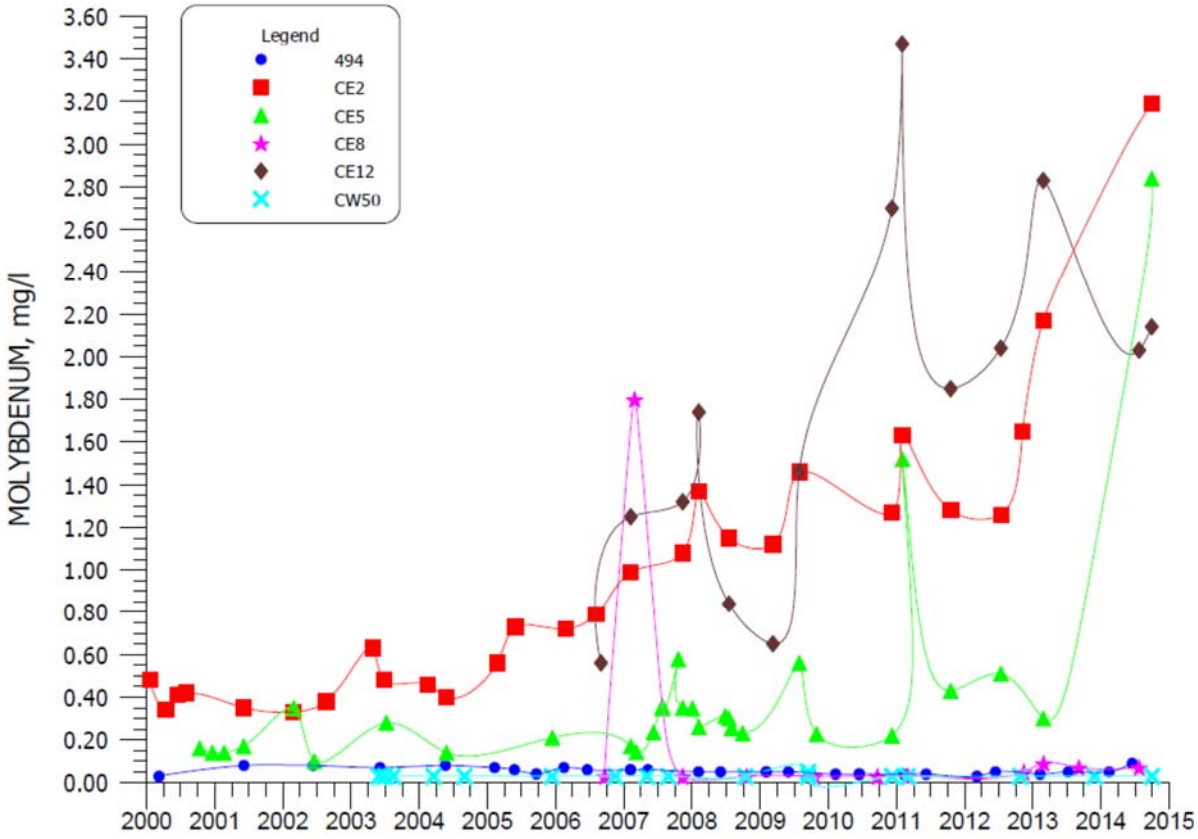


FIGURE 5.3-18. MOLYBDENUM CONCENTRATIONS FOR MIXING ZONE WELLS 494, CE2, CE5, CE8, CE12, AND CW50

Figure G-23: Uranium Concentrations in Tailings Solution, 2000 (Source: 2014 Annual Monitoring Report/Performance Review)

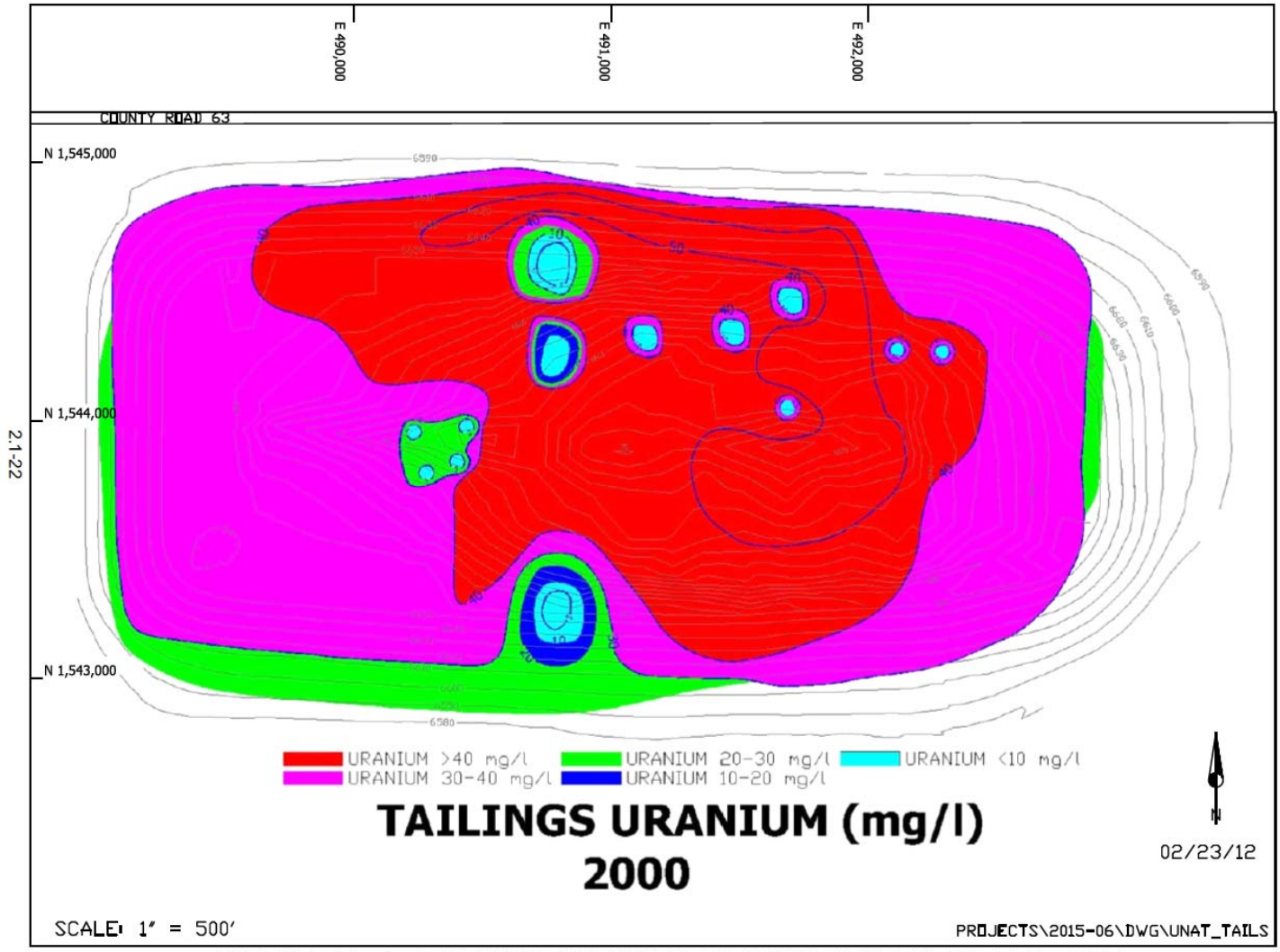


FIGURE 2.1-9. TAILINGS SOLUTION URANIUM CONCENTRATION, 2000

Figure G-24: Uranium Concentrations in Tailings Solution, 2014 (Source: 2014 Annual Monitoring Report/Performance Review)

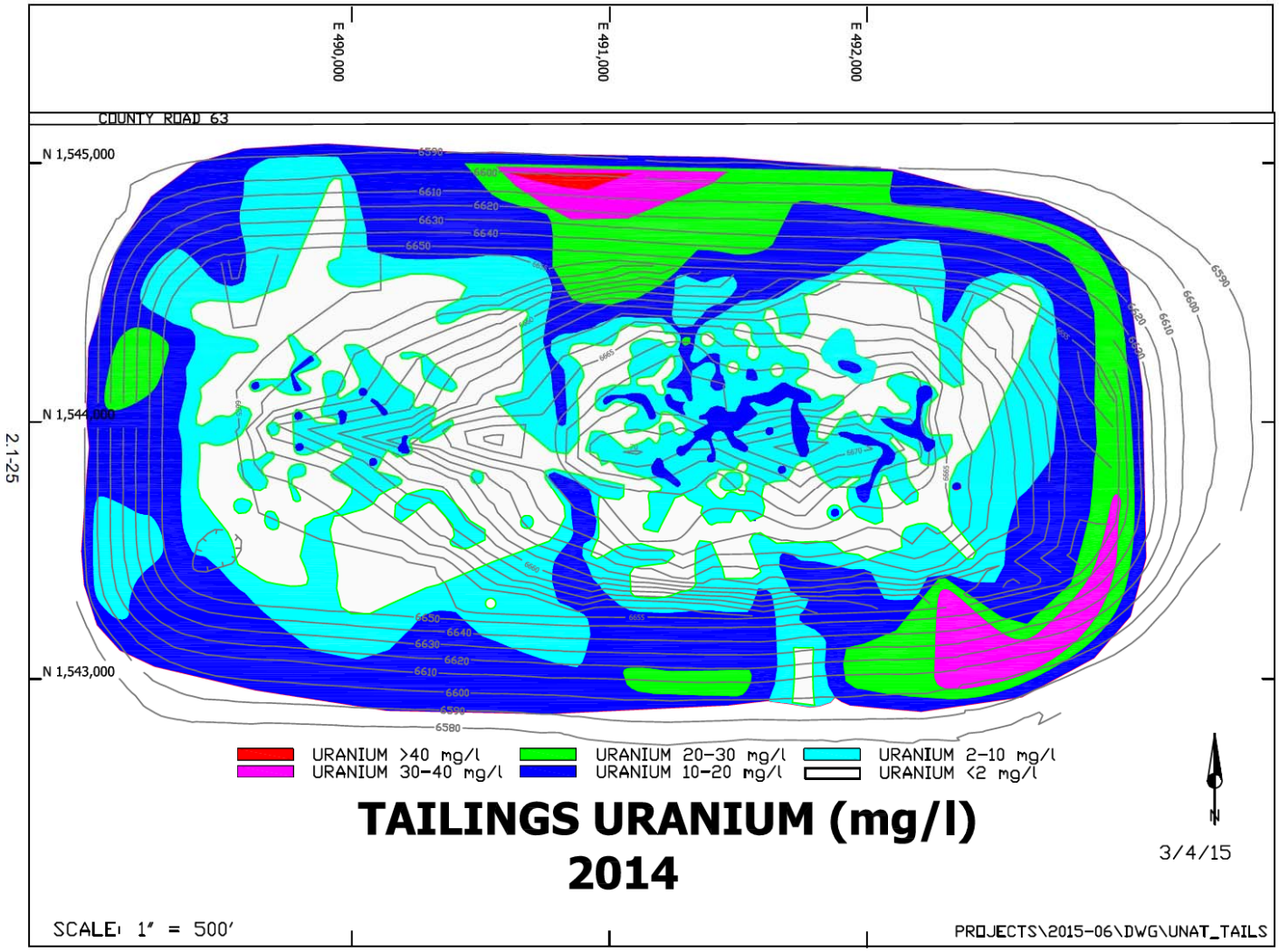


FIGURE 2.1-12. TAILINGS SOLUTION URANIUM CONCENTRATION, 2014

Figure G-25: Locations of 2014 Soil/Debris Removal Actions

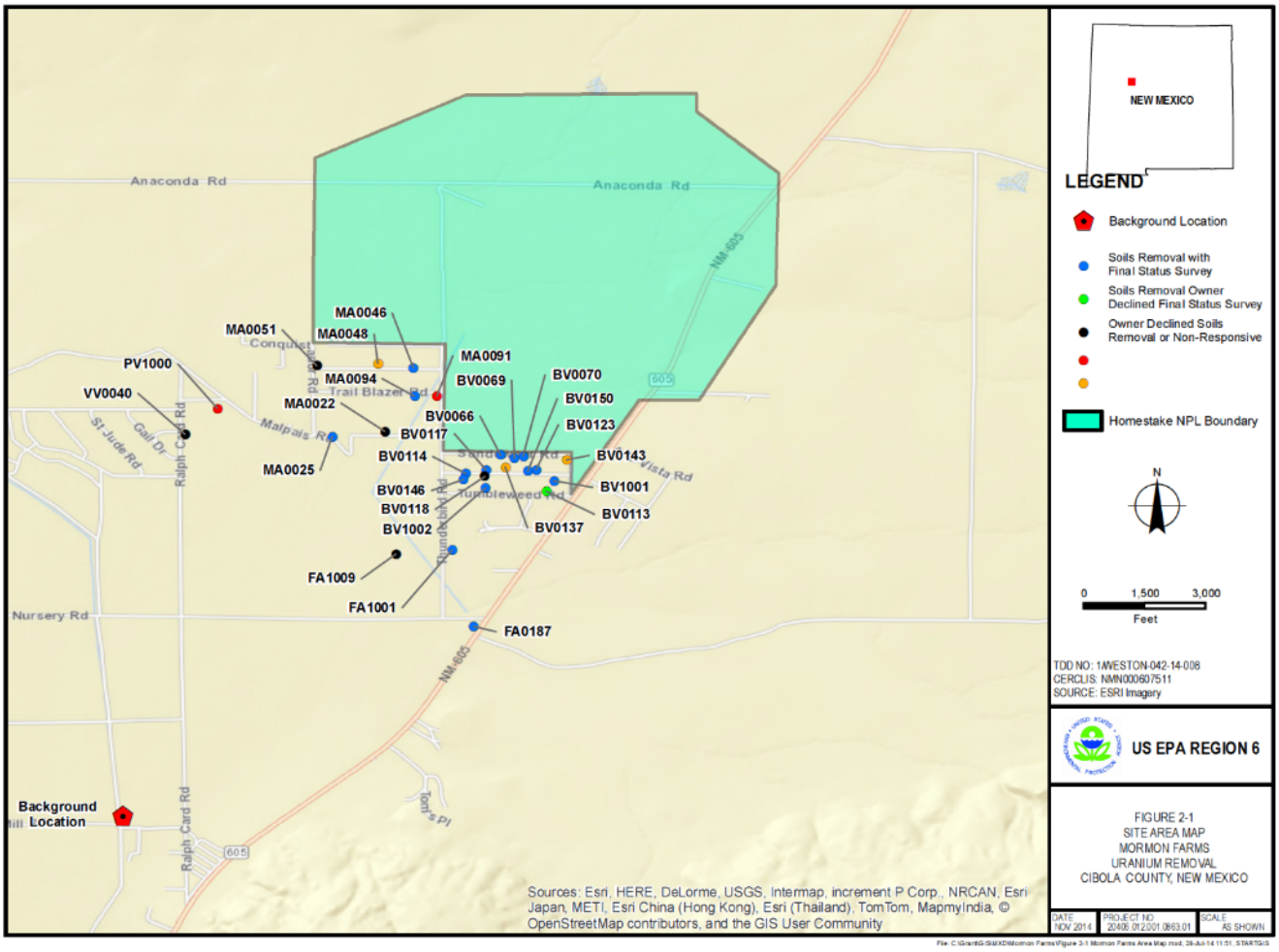


Figure G-26: Radon Monitoring Locations (Source: 2014 HHRA)

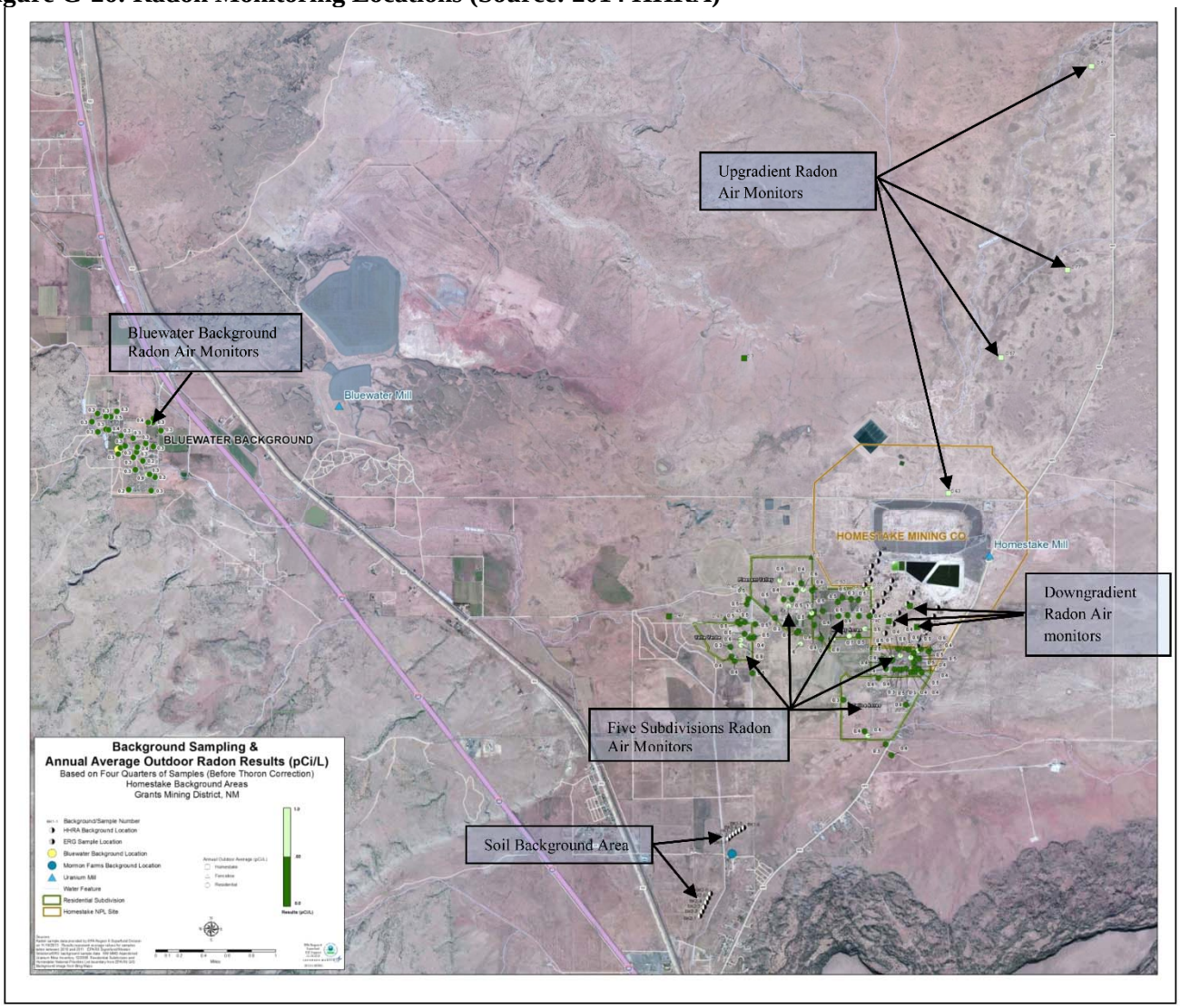
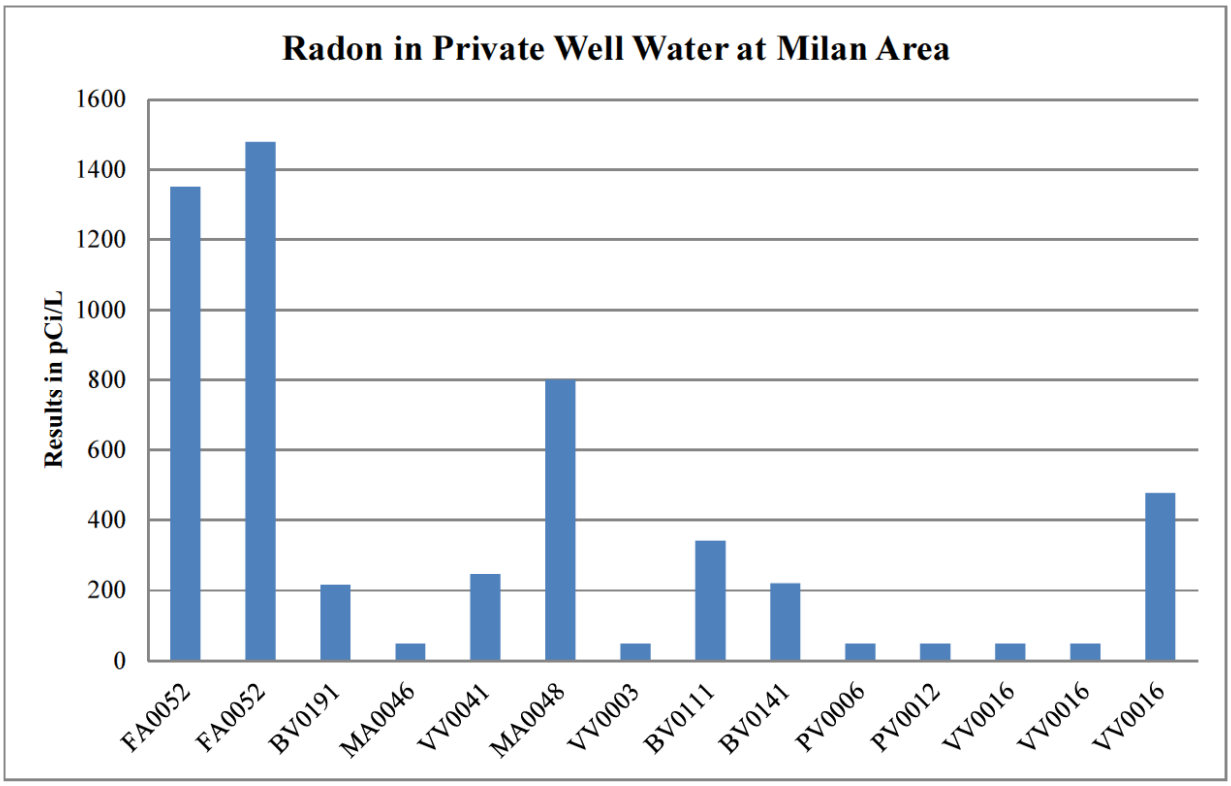


Figure G-27: Radon in Private Well Water (Source: 2014 HHRA)



APPENDIX H –SITE INSPECTION CHECKLIST

FIVE-YEAR REVIEW SITE INSPECTION CHECKLIST

I. SITE INFORMATION

Site Name: Homestake Mining Company	**Date of Inspection:** 01/12/2016
Location and Region: Cibola County, New Mexico/Region 6	**EPA ID:** NMD007860935
Agency, Office or Company Leading the Five-Year Review: EPA Region 6	**Weather/Temperature:** 20s and clear

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Ground water pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other: _____
- ☐ Monitored natural attenuation
- ☒ Ground water containment
- ☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (check all that apply)

1. **O&M Site Manager** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems, suggestions ☐ Report attached: _____

2. **O&M Staff** _____ Name _____ Title _____ Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone: _____
   Problems/suggestions ☐ Report attached: _____

3. **Local Regulatory Authorities and Response Agencies** (i.e., state and tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices). Fill in all that apply.

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

   Agency _____
   Contact _____Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached:_____

   Agency _____
   Contact _____ Name _____ Title _____ Date _____ Phone No.
   Problems/suggestions ☐ Report attached: _____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone No.
Problems/suggestions ☐ Report attached:_____

4. **Other Interviews** (optional) ☐ Report attached: _____

III. ON-SITE DOCUMENTS AND RECORDS VERIFIED (check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☒ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: _____

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A

☒ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

3. **O&M and OSHA Training Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

4. **Permits and Service Agreements**

☐ Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
☒ Effluent discharge	☒ Readily available	☒ Up to date	☐ N/A
☐ Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
☐ Other permits: _____	☐ Readily available	☐ Up to date	☐ N/A

Remarks: _____

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A

Remarks: _____

7. **Ground Water Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

8. **Leachate Extraction Records** ☒ Readily available ☒ Up to date ☐ N/A

Remarks: _____

9. **Discharge Compliance Records**

☐ Air ☐ Readily available ☐ Up to date ☐ N/A

☐ Water (effluent) ☐ Readily available ☐ Up to date ☐ N/A

Remarks: _____

10. **Daily Access/Security Logs** ☐ Readily available ☐ Up to date ☐ N/A

Remarks: _____

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for state

☐ PRP in-house ☐ Contractor for PRP

☐ Federal facility in-house ☐ Contractor for Federal facility

☐ _____

2. **O&M Cost Records**

☐ Readily available ☐ Up to date

☐ Funding mechanism/agreement in place ☐ Unavailable

Original O&M cost estimate: _____ ☐ Breakdown attached

Total annual cost by year for review period if available

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

From: _____ To: _____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs during Review Period**

Describe costs and reasons: _____

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing Damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A

Remarks: _____

B. Other Access Restrictions

1. **Signs and Other Security Measures** ☐ Location shown on site map ☐ N/A

Remarks: HMC property includes an office building, maintenance/storage buildings, water towers, tailings piles, evaporation ponds, collection ponds and an RO water treatment plant. The office

building and maintenance/storage buildings are surrounded by a chain-link fence which is unlocked only during business hours. The remainder of the property is surrounded by barbed-wire fencing.

C. Institutional Controls (ICs)

1. **Implementation and Enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A

Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A

Type of monitoring (e.g., self-reporting, drive by): _____

Frequency: _____

Responsible party/agency: _____

Contact _____ _____ _____ _____

Name Title Date Phone no.

Reporting is up to date ☐ Yes ☐ No ☒N/A

Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A

Violations have been reported ☐ Yes ☐ No ☒ N/A

Other problems or suggestions: ☐ Report attached

2. **Adequacy** ☐ ICs are adequate ☒ ICs are inadequate ☐ N/A

Remarks: Institutional controls (ICs) are not yet in place within the NRC licensed boundary. There is an advisory for new well installations in the area. Under the IC put into place in 2009, NMED requires the New Mexico Office of the State Engineer to issue a health advisory to every person who applies for a well permit within the area referenced in the drinking water advisory; the advisory was published in two newspapers of general circulation in Cibola and McKinley counties. HMC is also required to conduct an annual land use survey to determine if properties are connected to public water or use private water supply.

D. General

1. **Vandalism/Trespassing** ☐ Location shown on site map ☒ No vandalism evident

Remarks: _____

2. **Land Use Changes On Site** ☒ N/A

Remarks: _____

3. **Land Use Changes Off Site** ☐ N/A

Remarks: New shed company across the street from the Site.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads Damaged** ☐ Location shown on site map ☒ Roads adequate ☐ N/A

Remarks: _____

B. Other Site Conditions

Remarks: Site is in good condition.

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (low spots) ☐ Location shown on site map ☒ Settlement not evident
   Arial extent: _____ Depth: _____
   Remarks: _____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
   Lengths: _____ Widths: _____ Depths: _____
   Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Arial extent: _____ Depth: _____
   Remarks: _____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
   Arial extent: _____ Depth: _____
   Remarks: _____

5. **Vegetative Cover** ☒ Grass ☐ Cover properly established
   ☐ No signs of stress ☐ Trees/shrubs (indicate size and locations on a diagram)
   Remarks: Site had snow on it at time of site inspection.

6. **Alternative Cover** (e.g., armored rock, concrete) ☐ N/A
   Remarks: In good condition on slopes.

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
   Arial extent: _____ Height: _____
   Remarks: _____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
   ☐ Wet areas ☐ Location shown on site map Arial extent: _____
   ☐ Ponding ☐ Location shown on site map Arial extent: _____
   ☐ Seeps ☐ Location shown on site map Arial extent: _____
   ☐ Soft subgrade ☐ Location shown on site map Arial extent: _____
   Remarks: _____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map
   ☒ No evidence of slope instability
   Arial extent: _____
   Remarks: _____

B. Benches ☐ Applicable ☒ N/A

(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay

Remarks: _____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay

Remarks: _____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay

Remarks: _____

C. Letdown Channels ☒ Applicable ☐ N/A

(Channel lined with erosion control mats, riprap, grout bags or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ No evidence of settlement

Arial extent: _____ Depth: _____

Remarks: _____

2. **Material Degradation** ☐ Location shown on site map ☒ No evidence of degradation

Material type:_____ Arial extent: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☒ No evidence of erosion

Arial extent: _____ Depth: _____

Remarks: _____

4. **Undercutting** ☐ Location shown on site map ☒ No evidence of undercutting

Arial extent: _____ Depth: _____

Remarks: _____

5. **Obstructions** Type: _____ ☒ No obstructions

☐ Location shown on site map Arial extent: _____

Size: _____

Remarks: _____

6. **Excessive Vegetative Growth** Type: _____

☒ No evidence of excessive growth

☐ Vegetation in channels does not obstruct flow

☐ Location shown on site map Arial extent: _____

Remarks: _____

D. Cover Penetrations ☒ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: _____

2. **Gas Monitoring Probes**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☒ N/A

Remarks: _____

3. **Monitoring Wells** (within surface area of landfill)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☒ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

4. **Extraction Wells Leachate**

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ Evidence of leakage at penetration ☐ Needs maintenance ☐ N/A

Remarks: _____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☒ N/A

Remarks: _____

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

1. **Gas Treatment Facilities**

☐ Flaring ☐ Thermal destruction ☐ Collection for reuse

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Gas Collection Wells, Manifolds and Piping**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Gas Monitoring Facilities** (e.g., gas monitoring of adjacent homes or buildings)

☐ Good condition ☐ Needs maintenance ☐ N/A

Remarks: _____

F. Cover Drainage Layer ☒ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☒ Functioning ☐ N/A

Remarks: _____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A

Remarks: _____

G. Detention/Sedimentation Ponds ☒ Applicable ☐ N/A

1. **Siltation** Area extent: _____ Depth: _____ ☐ N/A

☐ Siltation not evident

Remarks: _____

2. **Erosion** Area extent: _____ Depth: _____

☒ Erosion not evident

Remarks: _____

3. **Outlet Works** ☒ Functioning ☐ N/A

Remarks: _____

4. **Dam** ☒ Functioning ☐ N/A

Remarks: _____

H. Retaining Walls ☐ Applicable ☐ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident

Horizontal displacement: _____ Vertical displacement: _____

Rotational displacement: _____

Remarks: _____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident

Remarks: _____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☒ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A

☐ Vegetation does not impede flow

Area extent: _____ Type: _____

Remarks: _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident

Area extent: _____ Depth: _____

Remarks: _____

4. **Discharge Structure** ☐ Functioning ☐ N/A

Remarks: _____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident

Area extent: _____ Depth: _____

Remarks: _____

2. **Performance Monitoring** Type of monitoring: _____

☐ Performance not monitored

Frequency: _____ ☐ Evidence of breaching

Head differential: _____

Remarks: _____

IX. GROUND WATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Ground Water Extraction Wells, Pumps and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing and Electrical**

☒ Good condition ☒ All required wells properly operating ☐ Needs maintenance ☐ N/A

Remarks: _____

2. **Extraction System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

B. Surface Water Collection Structures, Pumps and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps and Electrical**

☐ Good condition ☐ Needs maintenance

Remarks: _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes and Other Appurtenances**

☐ Good condition ☐ Needs maintenance

Remarks: _____

3. **Spare Parts and Equipment**

☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided

Remarks: _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (check components that apply)

☐ Metals removal ☐ Oil/water separation ☐ Bioremediation

☐ Air stripping ☐ Carbon adsorbers

☐ Filters: _____

☐ Additive (e.g., chelation agent, flocculent): _____

☒ Others: Extraction wells, three evaporation ponds, two wastewater collection ponds, zeolite treatment and an RO treatment plant.

☒ Good condition ☐ Needs maintenance

☐ Sampling ports properly marked and functional

☐ Sampling/maintenance log displayed and up to date

☐ Equipment properly identified

☐ Quantity of ground water treated annually: _____

☐ Quantity of surface water treated annually: _____

Remarks: _____

2. **Electrical Enclosures and Panels** (properly rated and functional)

☐ N/A ☒ Good condition ☐ Needs maintenance

Remarks: _____

3. **Tanks, Vaults, Storage Vessels**

☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs maintenance

Remarks: _____

4. **Discharge Structure and Appurtenances**

☐ N/A ☒ Good condition ☐ Needs maintenance

Remarks: _____

5. **Treatment Building(s)**

☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair

☒ Chemicals and equipment properly stored

Remarks: _____

6. **Monitoring Wells** (pump and treatment remedy)

☐ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

D. Monitoring Data

1. **Monitoring Data**

☒ Is routinely submitted on time ☒ Is of acceptable quality

2. **Monitoring Data Suggests:**

☐ Ground water plume is effectively contained ☐ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition

☐ All required wells located ☐ Needs maintenance ☐ N/A

Remarks: _____

X. OTHER REMEDIES

If there are remedies applied at the site and not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.	
XI. OVERALL OBSERVATIONS	
A.	**Implementation of the Remedy**
	Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is designed to accomplish (e.g., to contain contaminant plume, minimize infiltration and gas emissions). The objective of the OU1 remedy is long-term remediation of tailings-contaminated groundwater. The objective of the OU2 remedy is long-term stabilization and closure of the tailings disposal area, including a land-cleanup program for wind-blown tailings. In the OU3 ROD, EPA stated no further action for this OU; however, EPA tested and cleaned up residential yards with contamination. With the new zeolite treatment system and an expanded RO system on line, the remedy will likely be functioning as intended by NRC and HMC. HMC has been actively seeking ways to enhance and speed up the rate of restoration of the contaminated groundwater. Other monitoring data is collected to verify that no airborne emissions are coming from the Site. The monitoring program shows that the Site is operating within the conditions of its NRC license and NMED permits.
B.	**Adequacy of O&M**
	Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. O&M is adequate.
C.	**Early Indicators of Potential Remedy Problems**
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future. None, if all new remedies are implemented at full scale.
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. None, once all new remedies implemented.

APPENDIX I –SITE INSPECTION PHOTOS

Signage at the HMC on-site office

Fencing and signage near the HMC office

Top of the LTP

Wells on top of the LTP

Full-scale zeolite treatment facility on top of the LTP

Platform for the full-scale zeolite treatment

Full-scale zeolite treatment system vents

Support building and tanks at the full-scale zeolite treatment system

Pilot zeolite treatment system tanks

Pits and piping for the pilot zeolite treatment system

View of evaporation ponds 1 and 2 on top of the STP

Rock and radon cover for the LTP

View of evaporation pond 1 from the LTP

View of the wastewater collection ponds

Evaporation pond 2

Evaporation pond 3

RO water treatment facility

Interior of the new RO treatment facility

New microfiltration units within the RO treatment system facility

TPP pilot test support building

TPP pilot test area

APPENDIX J – TOXICITY REVIEW TABLE

Table J-1: Changes in Toxicity Values for Groundwater COCs

Groundwater COC	Toxicity Data from the 2011 FYR[a]		Current Toxicity Data[b]		Change in Toxicity Since Last FYR
	RfD[c] (mg/kg-day)[e]	RfC[d] (mg/m^3)[f]	RfD (mg/kg-day)[e]	RfC (mg/m^3)[f]	
Uranium	$3x10^{-3}$	$3x10^{-4}$	$3x10^{-3}$	$4x10^{-5}$ (g)	RfC decreased
Selenium	$5x10^{-3}$	$2x10^{-2}$	$5x10^{-3}$	$2x10^{-2}$	None
Molybdenum	NA	NA	$5x10^{-3}$	NA	RfD listed
Radium-226 and Radium-228	NA	NA	NA	NA	NA
Thorium-230	NA	NA	NA	NA	NA
Sulfate	NA	NA	NA	NA	NA
Chloride	NA	NA	NA	NA	NA
TDS	NA	NA	NA	NA	NA
Nitrate	1.6	NA	1.6	NA	None

Notes:

a) Source is Table 8 of the 2011 FYR
b) Source is the November 2015 Regional Screening Level table, accessed March 3, 2016, available at: http://www.epa.gov/risk/risk-based-screening-table-generic-tables; ; Cancer slope factors and inhalation unit risk were not available for any of the COCs
c) Reference Dose
d) Reference Concentration
e) mg/kg-day – milligram per kilogram per day
f) mg/m^3 – milligram per cubic meter
g) Source is the ATSDR

Table J-2: Toxicity Values for Radionuclides of Concern

Isotope	Soil Ingestion Slope Factor (risk/pCi)	Adult Soil Ingestion Slope Factor (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/year per pCi/g)
U-238	1.34E-10	4.66E-11	6.40E-11	8.66E-11	2.4E-08	1.24E-10
U-238+D	1.97E-10	5.62E-11	8.70E-11	1.21E-10	2.4E-08	1.19E-07
Th-230	1.66E-10	7.73E-11	9.14E-11	1.19E-10	3.4E-08	8.45E-10
Ra-226	6.77E-10	2.95E-10	3.85E-10	5.14E-10	2.8E-08	2.50E-08
Ra-228	1.98E-09	6.70E-10	1.04E-09	1.42E-09	4.4E-08	3.43E-11

APPENDIX K – ARARS REVIEW

ARARs Review

CERCLA Section 121(d)(1) requires that Superfund remedial actions attain "a degree of cleanup of hazardous substance, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment." The remedial action must achieve a level of cleanup that at least attains those requirements that are legally applicable or relevant and appropriate. In performing the FYR for compliance with ARARs, only those ARARs that address the protectiveness of the remedy are reviewed.

EPA has not issued decision documents for OU1 and OU2; therefore, detailed review of ARARs for these OUs is not applicable. It is expected that EPA will issue a ROD for these OUs by 2018, which include a comprehensive list of ARARs.

Appendix A of the OU3 ROD identified the following ARARs for OU3:

- 10 CFR Part 20, Standards for Protection Against Radiation.
- 10 CFR Part 40, Appendix A. Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content.
- 40 CFR Part 192. Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.
- State of New Mexico ARARs.

These ARARs have not changed in a way that could affect protectiveness of the remedy.