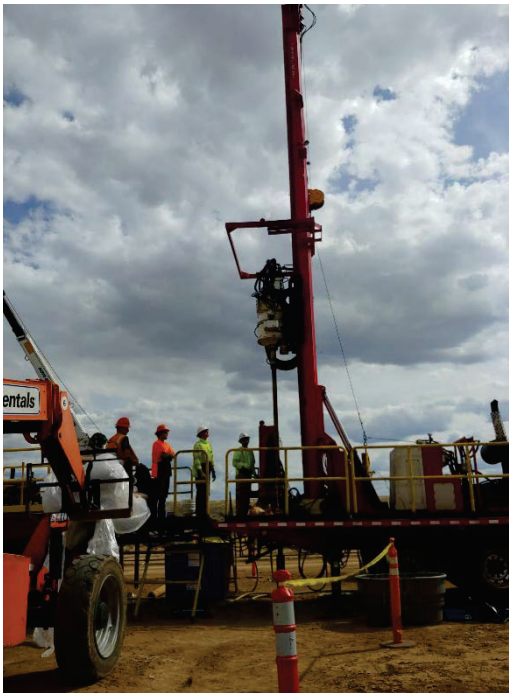
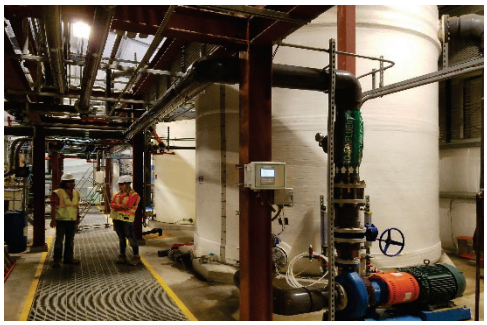
FIFTH FIVE-YEAR REVIEW REPORT FOR HOMESTAKE MINING COMPANY SUPERFUND SITE CIBOLA COUNTY, NEW MEXICO

SEPTEMBER 2021





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FIFTH FIVE-YEAR REVIEW REPORT
HOMESTAKE MINING COMPANY SUPERFUND SITE
EPA ID#: NMD007860935
CIBOLA COUNTY, TEXAS

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

Summary of the Fifth Five-Year Review Report

The Site is a former uranium mill and tailing disposal facility located in Cibola County, New Mexico. It occupies approximately 1,085 acres of land and includes a large tailing pile, containing approximately 21 million tons of radioactive tailing material, and a small tailing pile, containing about 1.2 million tons of radioactive tailing material. Both tailing piles are unlined. The Site also includes groundwater contamination that resulted from tailing seepage at the piles. Groundwater contaminants include uranium, selenium, and other radionuclides and metals. The Site was operated from 1958 until 1990. Groundwater contamination was first discovered in 1960 by the New Mexico Department of Health.

The Site was placed on EPA's National Priorities List (NPL) of CERCLA sites in 1983 because of groundwater contamination. It is also a Title II Uranium Mill Tailings Radiation Control Act (UMTRCA) site that is regulated by the U.S. Nuclear Regulatory Commission (NRC) through Source Materials License SUA-1471 (NRC License SUA-1471). The Site is also regulated by the New Mexico Environment Department (NMED), through Groundwater Discharge Permit DP-200. Homestake Mining Company of California (HMC), the potentially responsible party and licensee, conducts decommissioning, reclamation, and closure activities and long-term groundwater corrective action at the Site. The former mill area and the tailing disposal site comprise the HMC Facility. The HMC Facility is within a fenced area that defines the NRC license boundary. There are water treatment facilities, evaporation and collection ponds, and a network of injection and collection wells that are operated at the Site as part of the ongoing groundwater corrective action. There is also an extensive network of monitoring wells used to assess groundwater quality and flow within a shallow alluvial aquifer and multiple bedrock aquifers. There are 394 acres of land located outside of the NRC license boundary that were historically used for irrigation as a means to dispose of contaminated groundwater; they are referred to as land treatment areas. The only current operations at the Site, in addition to groundwater corrective action, are related to security, maintenance, and environmental monitoring.

EPA has divided the Site into three project areas called operable units (OUs). OU1 addresses tailing seepage contamination of the groundwater aquifers. OU2 addresses long-term tailing stabilization, surface reclamation, and site closure. OU3 addresses radon contamination in neighboring residential

subdivisions. EPA has yet to select a remedy under its CERCLA authority for either OU1 or OU2; the existing UMTRCA remedies are implemented by HMC under the direction of NRC. EPA negotiated a settlement agreement with HMC, in 1983, for HMC to provide an alternate water supply to residences with private wells impacted by tailing seepage. Under that agreement, HMC connected the residences to the village of Milan municipal water supply distribution system and paid for ten years of the residents' water usage. EPA selected a "no further action" in a record of decision for OU3 in 1989. At that time, EPA determined the radon contamination in indoor and ambient (outdoor) air at the subdivisions was from naturally occurring background levels of radon. EPA concluded that the large tailing pile, though a potential source of radon emissions, did not contribute significantly to the radon contamination in the subdivisions.

From 2010 to 2014, EPA conducted additional investigations and performed a supplemental human health risk assessment for the neighboring subdivisions due to concerns raised by the community. The results of the investigations led EPA to conduct removal actions to mitigate indoor air radon levels, in 2012, and soil contamination at residential yards, in 2014. The indoor air radon and soil contamination were not attributed to the Site.

OU1 groundwater corrective action has been conducted at the Site since 1977. The objective of the corrective action is to achieve Groundwater Protection Standards (cleanup levels) established by NRC in accordance with UMTRCA and NRC License SUA-1471. Some NRC cleanup levels were revised in 2006 to reflect background groundwater quality, which was determined to be significantly above federal drinking water standards and State of New Mexico (State) groundwater standards. The NRC-directed groundwater corrective action has helped contain the most highly contaminated groundwater within the NRC licensed boundary and prevented the further migration of the contaminant plumes by hydraulic containment. Hydraulic containment is created by the injection of treated water that is compliant with NRC cleanup levels and fresh water from a deep, unimpacted aquifer at designated wells, and the extraction (pumping) of contaminated groundwater at other wells. The extracted contaminated groundwater is piped to on-site water treatment facilities and the treated water is reinjected back into the aquifer. The residual brine from the treatment process is evaporated at the ponds constructed on site. Institutional controls in the form of a state health advisory for private water well owners and users and a state order prohibiting well drilling are in place to limit exposure to contaminated groundwater. All residences with contaminated private water wells are currently connected to the village of Milan's municipal water supply distribution system. This was performed by HMC under the agreement with EPA in 1983 and a subsequent agreement with NMED for providing an alternate water supply.

OU2 decommissioning and surface reclamation activities have been conducted at the Site since the late 1980s. Contaminated soil at the former mill was excavated and disposed of at the large tailing pile. The mill was decontaminated and demolished, and parts were buried in place or at the large tailings pile. Windblown contamination in surface soil within and outside of the NRC license boundary was excavated to meet UMTRCA standards and placed on the side slopes of the large tailing pile as part of decommissioning activities in the early 1990s. A final radon barrier and erosion protection cover were constructed on the side slopes of the large tailings pile. Interim soil covers were placed on the top of the large tailings pile and on the small tailings pile to reduce radon emissions while groundwater treatment facilities, ponds, and injection/collection wells were in operation on top of the tailing piles. Placement of

the final radon barriers on the tailing piles will be performed once groundwater corrective actions are completed. Exposure to contamination at the HMC Facility and the other areas within the NRC license boundary is currently controlled by restricting access through perimeter fencing. HMC monitors radon flux at the large tailing pile and air particulates, gamma radiation, and radon at the perimeter of the NRC license boundary as part of an air monitoring program required under NRC License SUA-1471. Monitoring data at the license boundary currently meet UMTRCA requirements for protection of the public from radiation.

In 2013, HMC and EPA initiated a process to assess whether response actions conducted at the Site, in accordance with the requirements of UMTRCA and NRC License SUA-1471, were equivalent to CERCLA requirements for protectiveness, and to satisfy NPL deletion requirements of the National Contingency Plan (NCP) (*i.e.,* CERCLA equivalency). This assessment showed that the UMTRCA response actions would be considered consistent with the NCP if such actions, when evaluated as a whole, are in substantial compliance with the NCP and result in a CERCLA-quality cleanup. As the NCP requires the performance of a remedial investigation and feasibility study for supporting CERCLA remedy selection, many of the prior actions substantially satisfied those requirements. However, missing elements included a baseline risk assessment and performance of the feasibility study. HMC completed a human health risk assessment for its facility and the land treatment areas, and compiled the results of the risk assessment and previous investigations into a final remedial investigation report that was approved by EPA in June 2020. HMC also began the feasibility study pursuant to a settlement agreement negotiated with EPA, dated August 2020. A draft feasibility study report was submitted to EPA for review in December 2020.

During the settlement negotiations for performance of the feasibility study, HMC notified EPA that it believed it was technically impracticable, from an engineering perspective, to restore groundwater to the current NRC cleanup levels. HMC requested that EPA consider invoking a waiver of groundwater standards due to technical impracticability and selecting an alternate remedial strategy for protecting human health and the environment in a future CERCLA record of decision. HMC agreed to perform a technical impracticability evaluation as part of the settlement agreement that would support a waiver of groundwater standards in the record of decision, if deemed reasonable and technically sound by EPA. A draft technical impracticability evaluation report was submitted to EPA for review in November 2020.

EPA and NMED are currently performing a reassessment of background groundwater quality to determine if the original background study completed by HMC, and used by NRC to establish groundwater cleanup levels above federal drinking water standards, reflects natural background conditions. Once the background reassessment is completed, EPA will develop preliminary cleanup levels that will inform the ongoing CERCLA feasibility study and remedy selection process.

After completion of the feasibility study, EPA plans to issue a record of decision documenting the selection of CERCLA remedies for OU1 and OU2. EPA will conduct public, tribal, and state participation processes in accordance with the NCP prior to selecting the remedies.

Following completion of the UMTRCA remedies at OU1 and OU2, the tailing disposal site and potentially other areas within the NRC license boundary will be transferred to the U.S. Department of

Energy's Office of Legacy Management for long-term surveillance and maintenance in accordance with UMTRCA.

This fifth five-year review is performed at EPA's discretion as a matter of EPA policy. It is not required to meet the statutory mandate of CERCLA Section 121(c) because no CERCLA remedies have been selected by EPA for this Site; there are no records of decision for OU1 and OU2, and EPA selected "no further action" in a record of decision for OU3. Therefore, this fifth five-year review is not intended to make CERCLA protectiveness determinations on UMTRCA remedies at OU1 and OU2 or recommend actions to ensure a CERCLA level of protectiveness for those remedies. UMTRCA remedies are subject to UMTRCA standards to protect the public. The recommended actions made in this review are only intended to ensure protectiveness of the prior CERCLA response actions and decisions made by EPA that address site-related contamination; specifically, the "no further action" decision for OU3 radon contamination in neighboring subdivisions. The ongoing CERCLA equivalency process, including the remedial investigation and feasibility study, will lead to future EPA decision-making for OU1 and OU2 CERCLA remedies that provide for a CERCLA level of protectiveness.

Environmental Indicators

Human Exposure Status: Exposure to groundwater contamination is under control through EPA and State response actions for providing an alternate water supply and putting in place institutional controls to restrict groundwater usage. Exposure to soil contamination is under control through UMTRCA response actions that achieve UMTRCA soil cleanup standards. Exposure to radiation contamination in air is under control by UMTRCA response actions that achieve UMTRCA radiation standards for protecting the public.

Contaminated Groundwater Status: The migration of contaminated groundwater is under control by UMTRCA groundwater corrective action.

Sitewide Ready for Reuse: The Site has not yet achieved the Sitewide Ready for Anticipated Use performance measure.

Actions Needed

The following action must be taken to confirm that EPA's 1989 record of decision for "no further action" on off-site radon contamination is still appropriate:

- Perform an update of the 2014 human health risk assessment for radon in the neighboring subdivisions using new toxicity data and the updated EPA electronic calculator for performing radiation risk assessments at CERCLA sites. In performing this update, include individual risk calculations for the various lighter radionuclides in the decay chain and use a sum-of-the-fractions approach for calculating total risk from radionuclides in ambient air.

Determination

I have determined that a protectiveness determination of the CERCLA "no further action" record of decision at the Homestake Mining Company Superfund site cannot be made at this time until further information is obtained. The attached fifth Five-Year Review Report specifies the action that needs to be taken to obtain the information required to complete the protectiveness determination. It is expected that

this action will take approximately one year to complete, at which time a protectiveness determination will be made.

WREN STENGER

Digitally signed by WREN STENGER
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Wren Stenger
Director, Superfund and Emergency Management Division
U.S. Environmental Protection Agency, Region 6

Date

ISSUES/RECOMMENDATIONS

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

Issues/Recommendations				
Issues and Recommendations Identified in the FYR:				
OU(s): OU3	**Issue Category: Other**			
	Issue: EPA selected "no further action" in a 1989 record of decision for radon contamination in neighboring subdivisions. From 2010 to 2014, EPA conducted additional investigations and performed a supplemental human health risk assessment for the subdivisions. A review of the toxicity data used in the 2014 risk assessment shows that not all of the data are still valid and that there is new toxicity information relevant to the risk assessment. Additionally, the computerized mathematic model (electronic calculator) used by EPA for conducting radiation risk assessments for radionuclides at CERCLA sites has been updated in October 2020. Furthermore, EPA has determined that the calculation of risk from exposure to radionuclides in ambient air should include separate calculations of risk for the lighter radionuclides in the decay chain and the use of a "sum-of-the-fractions" approach for determining total risk.			
	Recommendation: Update the baseline human health risk assessment for radon in ambient air in the neighboring subdivisions using the current toxicity data and the updated EPA Rad PRG Calculator. For the update, include separate calculations for the various lighter radionuclides and use a "sum-of-the-fractions" approach for determining total risk. This updated risk assessment will inform the ongoing CERCLA feasibility study and remedy selection process for OU1 and OU2, including response actions for controlling site-related sources of radon contamination.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA		10/31/2022

Table of Contents

LIST OF ABBREVIATIONS AND ACRONYMS xii
I. INTRODUCTION 1
Site Background 2
FIVE-YEAR REVIEW SUMMARY FORM 7
II. RESPONSE ACTION SUMMARY 7
Basis for Taking Action 7
Response Actions 8
Status of Implementation 21
Systems Operations/Operation and Maintenance 30
III. PROGRESS SINCE THE PREVIOUS REVIEW 32
IV. FIVE-YEAR REVIEW PROCESS 33
Community Notification, Community Involvement and Site Interviews 33
Data Review 37
Site Inspection 46
V. TECHNICAL ASSESSMENT 46
QUESTION A: Is the remedy functioning as intended by the decision documents? 46
QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels and remedial action objectives used at the time of the remedy selection still valid? 47
QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy? 50
VI. ISSUES/RECOMMENDATIONS 50
OTHER FINDINGS 51
VII. PROTECTIVENESS STATEMENTS 51
VIII. NEXT REVIEW 52
APPENDIX A – REFERENCE LIST A-1
APPENDIX B – SITE CHRONOLOGY B-1
APPENDIX C – GROUNDWATER RESTORATION PROGRAM SUPPORTING DOCUMENTATION C-1
APPENDIX D – PUBLIC NOTICE D-1
APPENDIX E – INTERVIEW FORMS E-1
APPENDIX F – DATA REVIEW SUPPORTING DOCUMENTATION F-1
APPENDIX G – 2019 SITE VISIT PHOTOGRAPHS G-1
APPENDIX H – TOXICITY DATA EVALUATION FOR 2014 HHRA H-1

Tables

Table 1: Chemicals and Radionuclides of Concern, by Media 8
Table 2: NRC 2006 Site Cleanup Levels – Groundwater 12
Table 3: Summary of Planned or Implemented Institutional Controls 27
Table 4: Protectiveness Determinations/Statements from the 2016 FYR Report 32
Table 5: Status of Recommendations from the 2016 FYR Report 34
Table 6: Annual Average Radon Gas Concentrations 43
Table B-1: Site Chronology B-1
Table C-1: Summary of Changes to the Groundwater Restoration System C-1
Table C-2: Quantities of Constituents Collected On Site C-2

Table H-1: Oral Cancer Toxicity Value Review (Soil Ingestion) H-1
Table H-2: Oral Cancer Toxicity Value Review (Food Ingestion) H-1
Table H-3: Inhalation Cancer Toxicity Value Review H-2
Table H-4: External Exposure (Radiation) Cancer Toxicity Value Review H-3
Table H-5: Non-Cancer Ingestion Toxicity Value Review H-4
Table H-6: Non-Cancer Inhalation Toxicity Value Review H-4

Figures

Figure 1: Site Vicinity Map 5
Figure 2: Site Map 6
Figure 3: Institutional Control Map 29
Figure 4: Radiological Air Monitoring and Sampling Locations 45
Figure C-1: Generalized Geological Cross Section C-4
Figure C-2: Location of Detailed Geologic Cross Sections C-5
Figure C-3: Detailed Geological Cross Section B-B' C-6
Figure C-4: Detailed Geological Cross Section D-D' C-7
Figure C-5: Upper Chinle Aquifer Mixing Zone and Background Wells C-8
Figure C-6: Middle Chinle Aquifer Mixing Zone and Background Wells C-9
Figure C-7: Middle Chinle Aquifer Mixing Zone and Background Wells C-10
Figure C-8: Location of Present Injection and Collection Systems C-11
Figure F-1: Water-Level Elevations of the Alluvial Aquifer – 2020 ..... F-1
Figure F-2: Water Level Elevations of the Upper Chinle Aquifer – 2020 ..... F-2
Figure F-3: Water Level Elevations of the Middle Chinle Aquifer – 2020 ..... F-3
Figure F-4: Water Level Elevations of the Lower Chinle Aquifer – 2020 ..... F-4
Figure F-5: Water Level Elevations of the San Andres–Glorieta Aquifer – 2020 ..... F-5
Figure F-6: 2016 Alluvial Aquifer Uranium Plume Map F-6
Figure F-7: 2020 Alluvial Aquifer Uranium Plume Map F-7
Figure F-8: 2016 and 2020 Alluvial Aquifer Uranium Plume Maps – Downgradient Plume Area in West Channel F-8
Figure F-9: 2016 Alluvial Aquifer Injection and Collection System – West Channel F-9
Figure F-10: 2020 Alluvial Aquifer Injection and Collection System – West Channel F-10
Figure F-11: 2016 and 2020 Alluvial Aquifer Uranium Plume Maps – Downgradient Plume Area in East Channel F-11
Figure F-12: 2016 Alluvial Aquifer Injection and Collection System – East Channel F-12
Figure F-13: 2020 Alluvial Aquifer Injection and Collection System – East Channel F-13
Figure F-14: 2015 and 2020 Alluvial Aquifer Uranium Plume Maps – Large Tailing Pile F-14
Figure F-15: 2020 Alluvial Aquifer Injection and Collection System – Large Tailing Pile F-15
Figure F-16: 2016 Alluvial Aquifer Selenium Plume Map F-16
Figure F-17: 2020 Alluvial Aquifer Selenium Plume Map F-17
Figure F-18: 2017 Alluvial Aquifer Selenium Plume Map – Along State Highway 605 and South of STP (mg/L) and Injection/Collection System F-18
Figure F-19: Upper Chinle Uranium Plume Maps, 2016 and 2020 ..... F-19
Figure F-20: Middle Chinle Uranium Plume Maps, 2016 and 2020 ..... F-20
Figure F-22: Middle Chinle Water-Level Map for Felice Acres Subdivision – Thunderbird Lane Area, 2016 ..... F-22
Figure F-24: Lower Chinle Uranium Plume Maps, 2016 and 2020 ..... F-24
Figure F-25: San Andres-Glorieta Aquifer Water Quality, 2020 ..... F-25
Figure F-26: Large Tailing Pile Well Locations and Water-Level Elevations 2020 ..... F-26
Figure F-27: Large Tailing Pile Cross Section Depicting Tailing Saturation 2020 ..... F-27

Figure F-28: Yearly Quantity of Tailing Water and Uranium Removed from the LTP – 2000 to 2020 .F-28
Figure F-29: Large Tailing Pile – Water-Level Elevation Changes for Tailing Wells 2009-2020.....F-29
Figure F-30: Large Tailing Pile – Tailing Uranium Concentrations in 2000.....F-30
Figure F-31: Large Tailing Pile – Tailing Uranium Concentrations in 2015 and 2019.....F-31
Figure F-32: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Sand Tailing Wells at Large Tailing Pile 2004-2020 .....F-32
Figure F-33: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Sand Tailing Wells at Large Tailing Pile 2016-2020 .....F-33
Figure F-34: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Slime Tailing Wells at Large Tailing Pile 2006-2020 .....F-34
Figure F-35: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Slime Tailing Wells at Large Tailing Pile 2016-2020 .....F-35
Figure F-36: Tailing Monitoring Wells in 2020 .....F-36

LIST OF ABBREVIATIONS AND ACRONYMS

ACL	Alternate Concentration Limit
ARAR	Applicable or Relevant and Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
BERA	Baseline Ecological Risk Assessment
BVDA	Bluewater Valley Downstream Alliance
CAP	Corrective Action Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cm	Centimeter
COC	Contaminant of Concern
COPC	Chemical of Potential Concern
CSM	Conceptual Site Model
DOE	Department of Energy
DOE-LM	Department of Energy - Office of Legacy Management
EPA	United States Environmental Protection Agency
FS	Feasibility Study
FYR	Five-Year Review
GCAP	Groundwater Corrective Action Program
gpm	Gallons per Minute
GWPS	Groundwater Protection Standards
HHRA	Human Health Risk Assessment
HMC	Homestake Mining Company
HQ	Hazard Quotient
IC	Institutional Control
LTA	Land Treatment Area
LTP	Large Tailings Pile
MASE	Multicultural Alliance for a Safe Environment
MCL	Maximum Contaminant Level
mg/L	Milligrams per Liter
mrem/yr	Millirems per Year
NCP	National Contingency Plan
NMED	New Mexico Environment Department
NM-OSE	New Mexico Office of State Engineer
NPL	National Priorities List
NRC	Nuclear Regulatory Commission
NRRB	National Remedy Review Board
O&M	Operation and Maintenance
Order	State Engineer Order
OU	Operable Unit
pCi/g	Picocuries per Gram
pCi/L	Picocuries per Liter
pCi/m^2s	Picocuries per Square Meter per Second
PRG	Preliminary Remediation Goals
PRP	Potentially Responsible Party
RI	Remedial Investigation
RO	Reverse Osmosis
ROC	Radionuclides of Concern
ROD	Record of Decision

ROPC	Radionuclide of Potential Concern
SAG	San Andres-Glorieta
SOP	Standard Operating Procedure
STP	Small Tailings Pile
TBC	To-Be-Considered
TDS	Total Dissolved Solids
TEDE	Total Effective Dose Equivalent
TI	Technical Impracticability
UCL	Upper Confidence Level
UMTRCA	Uranium Mill Tailings Radiation Control Act
UU/UE	Unlimited Use and Unrestricted Exposure

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order 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 performing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) at 40 CFR Section 300.430(f)(4)(ii), and considering EPA policy.

This is the fifth FYR for the Homestake Mining Company Superfund site (the Site). This review is being conducted at EPA's discretion as a matter of EPA policy.[1] The triggering action for this discretionary review is the previous FYR completed in September 2016. Since EPA has not selected a CERCLA remedy at this Site, and the only EPA record of decision (ROD) to date is a "no further action" decision for off-site radon,[2] this FYR is not intended to make CERCLA protectiveness determinations on remedies conducted under the direction of other regulatory authorities or recommend actions to ensure a CERCLA level of protectiveness for those remedies. Protectiveness determinations made in this FYR are only intended to ensure protectiveness of CERCLA response actions and decisions for the Site. This discretionary FYR has been performed because hazardous substances, pollutants or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site is regulated by EPA, the U.S. Nuclear Regulatory Commission (NRC), and the state of New Mexico (State). NRC regulates the Site through Source Material License SUA-1471 (License SUA-1471),[3] issued pursuant to Title II of the 1978 Uranium Mill Tailings Radiation Control Act (UMTRCA). The New Mexico Environment Department (NMED) regulates the Site through Groundwater Discharge Permit DP-200, issued pursuant to the 1978 New Mexico Water Quality Act. EPA regulates the Site through its CERCLA authority. CERCLA is also known as the Superfund law. EPA placed the Site on the National Priorities List (NPL) of Superfund sites in 1983, primarily due to groundwater contamination.

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[1] Five-year reviews are conducted to meet the statutory mandate under CERCLA Section 121(c) or as a matter of policy. In accordance with CERCLA and the NCP, a five-year review is required for all remedial actions selected under CERCLA Section 121 that result in any hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. As there have been no remedial actions selected at this Site under CERCLA Section 121, a five-year review is not mandated.

[2] Radon is an odorless, colorless, radioactive gas. It is created from the decay of uranium and radium found naturally in rock and soil.

[3] Source Material is defined in 10 CFR Part 40 (Domestic Licensing of Source Material) as (1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of uranium, thorium, or any combination thereof.

The Site consists of three operable units (OUs).[4] OU1 addresses groundwater contamination caused by seepage from saturated byproduct material,[5] referred to as tailing,[6] that was produced from the uranium milling operation and slurried by pipe into unlined impoundments at the Site. OU2 addresses long-term tailing stabilization, surface reclamation and site closure. OU3 addresses radon concentrations in neighboring residential subdivisions. Currently, the remedies for OU1 and OU2 are being conducted under the authority of NRC, pursuant to UMTRCA. EPA has yet to select a CERCLA remedy for OU1 or OU2 but is planning to do so in future decision-making. EPA issued a "no further action" ROD for OU3 in 1989. This FYR Report discusses all the UMTRCA and CERCLA response actions being conducted at the Site for the three OUs, but only addresses CERCLA protectiveness for the 1989 decision at OU3.

Homestake Mining Company of California (HMC), the Site's potentially responsibly party (PRP) and licensee, is implementing groundwater corrective actions, as well as decommissioning, reclamation, and closure activities, for OU1 and OU2 in accordance with NRC License SUA-1471.

The EPA remedial project manager Mark Purcell led this FYR. Participants included the EPA community involvement coordinator, Adam Weece, the NMED project manager, Ashlynne Winton, and Ryan Burdge and Jill Billus from the EPA FYR contractor, Skeo. HMC, as the Site's PRP, was notified of the initiation of this FYR. The review began on July 15, 2020.

Appendix A lists resources used in the development of this FYR Report. Appendix B includes a chronology of major site events.

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 (Milan) (Figure 1). The Site includes HMC's former uranium processing mill and tailing disposal site complex, known as the HMC Facility, and groundwater contaminated by site-related wastes. The Site also includes 394 acres of land owned by HMC that were used historically for irrigation to dispose of contaminated groundwater; these parcels of land are referred to as land treatment areas (LTAs). The uranium mill operated between 1958 and 1990. The mill was decommissioned and demolished between 1993 and 1995 as part of the mill site reclamation work required under NRC License SUA-1471. The only current operations at the former mill complex are related to security, groundwater remediation and environmental monitoring.

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[4] During cleanup, EPA can divide a site into a number of distinct areas depending on the complexity of the problems associated with the site. These areas are called operable units and may address geographic areas of a site, specific site problems, or areas where a specific action is required.

[5] The Atomic Energy Act, as revised in 1978 and in 2005 by the Energy Policy Act (EPAct), defines byproduct material, in Section 11e.(2), as the tailing or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content.

[6] Uranium mill tailing is primarily the sandy or fine-grained (slime) process waste material from a conventional uranium mill that crushes the ore, then extracts (leaches) and concentrates the uranium. The leaching process also extracts other "heavy metal" constituents such as molybdenum, selenium and vanadium. Uranium mill tailing is defined in 10 CFR Part 40 as byproduct material.

The tailing disposal site consists of a large tailing pile (LTP) and a small tailing pile (STP). The LTP covers an area of about 200 acres and contains an estimated 21 million tons of radioactive tailing material. The STP covers an area of about 40 acres and contains about 1.2 million tons of radioactive tailing material.

Components of the groundwater corrective action are located at the Site and operated to mitigate tailing seepage impacts to underlying groundwater. These components consist of groundwater injection and collection (pumping) wells, toe drains, infiltration trenches, two water treatment plants that utilize reverse osmosis[7] (R.O.) and zeolite[8] treatment technologies, collection and evaporation ponds, and support facilities (Figure 2). These features are located within a fenced area of approximately 1,085 acres that is licensed by NRC for uranium milling and closure activities. There are also groundwater injection and collection wells located outside the NRC licensed boundary that are part of the groundwater corrective action and four former LTAs (*see* Figure 2). There is a large network of monitoring wells at the Site which is used to assess groundwater quality and flow in multiple groundwater aquifers.

Site operations and seepage from the tailing piles have contaminated soil and the underlying groundwater aquifers with radiological and non-radiological contaminants. The aquifers are known locally as the San Mateo Creek alluvial aquifer and the Upper, Middle, and Lower Chinle bedrock aquifers of the Triassic Chinle Group. The Permian San Andres-Glorieta (SAG) aquifer is a deeper regional aquifer that underlies the Site, but it is not currently known to be impacted by site-related contamination. There are two geologic faults at the Site that extend in a northeast-southwest direction across the entire Site and are referred to as the West Fault and the East Fault. Fault displacements can exceed 100 feet in some places, resulting in the separation of the bedrock aquifers into discrete and separate aquifers within each fault block. Figure C-1 in Appendix C depicts a generalized geological cross section of the aquifers beneath the Site. Detailed geological cross sections that include the faults, and a map showing the locations of the detailed sections, are depicted on Figures C-2 through C-4 in Appendix C. General groundwater flow directions for each aquifer are also depicted on the cross sections.

Surface water nearest to the Site is ephemeral and flows along San Mateo Creek, Lobo Creek, and the Rio San Jose (*see* Figure 1). The San Mateo Creek and Lobo Creek basins both drain onto the HMC Facility. Two Lobo Creek drainage paths enter the east side of the HMC Facility. A diversion levee was constructed to the north of the mill area to divert surface water discharges from the northern branch of Lobo Creek. During flood events, the levee diverts Lobo Creek water to a north diversion channel located north of the LTP, preventing the water from flowing across the former mill area.

HMC owns land in and around its facility and leases much of it to other parties for livestock grazing. The major land use south and west of the HMC Facility is residential development in the Pleasant Valley Estates, Murray Acres, Broadview Acres, Valle Verde, and Felice Acres subdivisions (*see* Figure 2).

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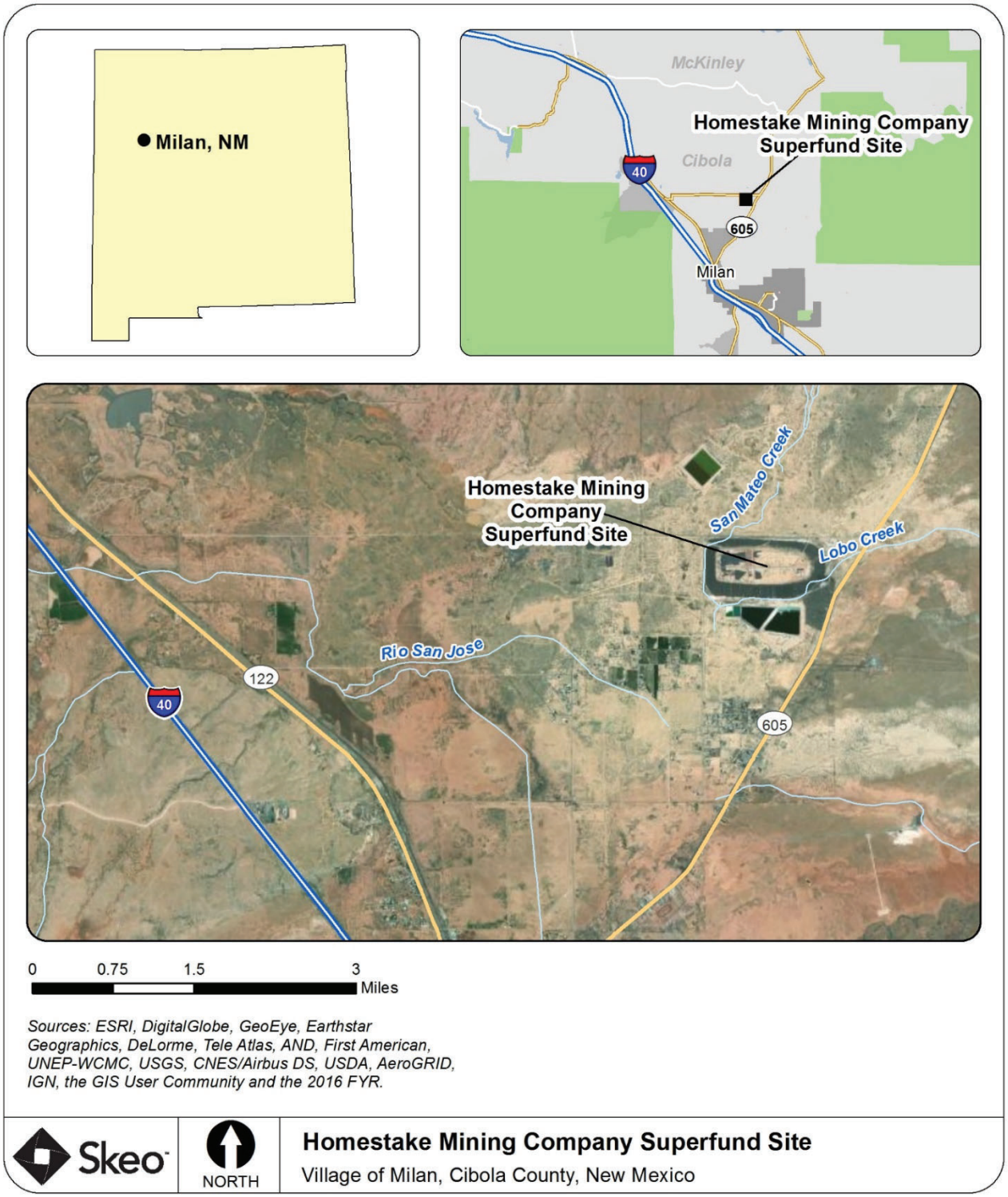
[7] Reverse osmosis is a technology that is used to remove a large majority of contaminants from water by pushing the water under pressure through a semi-permeable membrane (synthetic lining).

[8] Zeolites are a group of naturally-occurring and synthetically produced minerals with unique adsorption capabilities. Zeolites are used in industrial applications for water and waste water treatment, nuclear waste, agriculture, animal feed additives and in biochemical applications.

Future land use is expected to be consistent with current use for residential, agriculture, livestock grazing, and commercial/industrial purposes.

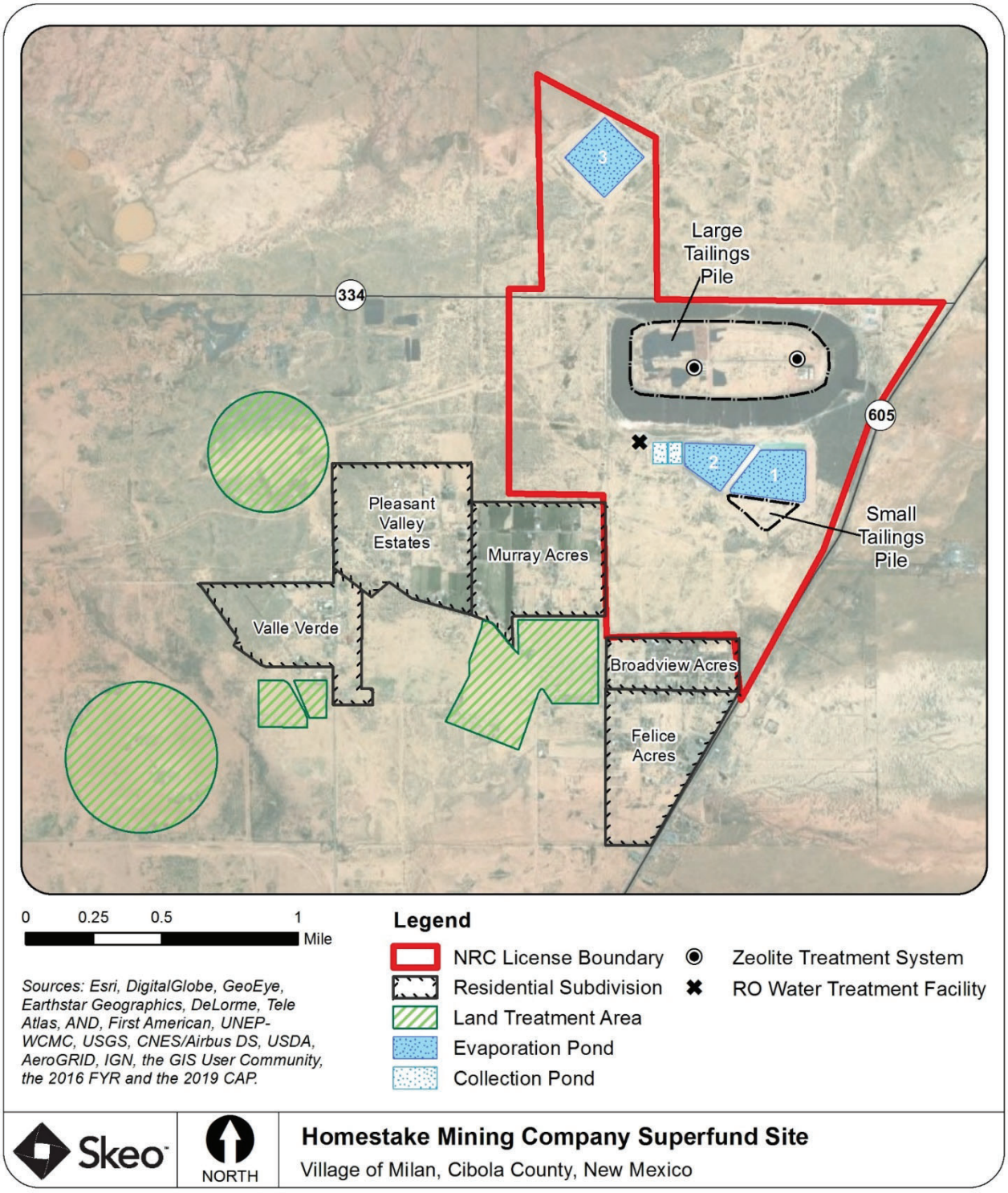
The HMC Facility uses bottled water for drinking. The HMC Facility also uses water from a production well for other domestic and sanitary uses; the well produces water from the SAG aquifer. Residences located downgradient of the HMC Facility have been connected to the Milan municipal water supply distribution system by HMC in accordance with settlement agreements with EPA and NMED. HMC has historically paid, and currently pays, the residents' water bills for this usage.

Figure 1: Site Vicinity Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Figure 2: Site Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Homestake Mining Company		
EPA ID: NMD007860935		
Region: 6	**State:** New Mexico	**City/County:** Milan/Cibola
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	**Has the Site achieved construction completion?** Not Applicable – No CERCLA remedy selected	
REVIEW STATUS		
Lead agency: EPA		
Author name: Mark Purcell, with additional support provided by Skeo		
Author affiliation: EPA Region 6		
Review period: 7/15/2020 – 9/13/2021		
Date of site inspection: No inspection due to Covid 19 Pandemic		
Type of review: Discretionary		
Review number: 5		
Triggering action date: 9/13/2016		
Due date *(five years after triggering action date)*: 9/13/2021		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Groundwater contamination was first discovered at the Site by the New Mexico Department of Health in 1960. In 1975, EPA sampled several wells in the Broadview and Murray Acres subdivisions as part of a larger study of the Grants Mineral Belt, an area in northwestern New Mexico where significant uranium mining and milling occurred, starting in the 1950s. EPA determined that groundwater, which was being used for drinking water, had high concentrations of selenium. In 1976, the New Mexico Environmental Improvement Division (predecessor to NMED) and HMC signed a Groundwater Protection Plan. That same year, HMC identified a contaminant plume in the alluvial aquifer that originated from the LTP. The plume was moving in a downgradient direction to the south and west. Under the 1977 New Mexico

Water Quality Act and NMED's groundwater discharging permitting program, NMED required HMC to implement a groundwater restoration program.

Site investigations performed since the NPL listing in 1983 identified several chemicals and radionuclides[9] in site media above levels of concern. Table 1 lists the site chemicals and radionuclides of concern.

Table 1: Chemicals and Radionuclides of Concern, by Media

Chemical/Radionuclide	Media
Uranium, selenium, molybdenum, vanadium, radium-226 + radium-228, thorium-230, sulfate, chloride, nitrate, total dissolved solids	Groundwater
Radium-226 and uranium	Soil
Radon	Indoor and outdoor air

Source: Section V, Item 27, of the August 2020 EPA Administrative Settlement Agreement and Order on Consent for Feasibility Study.

Response Actions

Uranium milling and closure operations at the HMC Facility have been regulated through the following radioactive materials licenses since operations began in 1958:

- From 1958 to 1974, the Atomic Energy Commission regulated the facility under License SUA-708;
- From 1974 to 1986, the State regulated uranium milling operations at the Site as an Agreement State;[10]
- In 1986, the State relinquished its licensing authority to the NRC; at that time, the NRC issued License SUA-1471, replacing License SUA-708.

EPA placed the Site on the NPL in 1983 at the request of the State due to groundwater contamination. At that time, EPA and HMC signed a settlement agreement requiring HMC to pay for an extension of the Milan municipal water supply distribution system to the neighboring residential subdivisions where private water wells were contaminated by tailing seepage.

[9] A radionuclide is a radioactive form of a chemical element. Some occur naturally in the environment, such as uranium, radium, radon, and thorium, while others are man-made, either deliberately or as products of nuclear reactions. Every radionuclide emits radiation at its own specific rate when it decays or transforms into another radionuclide.

[10] An "Agreement State" is a state that has entered into an agreement with NRC under section 274 of the Atomic Energy Act of 1954 (42 U.S.C. 2021) authorizing the state to regulate certain uses of radioactive materials within the state.

EPA does not license uranium mills but establishes environmental standards under UMTRCA that must be adopted by NRC and Agreement States. EPA regulations at 40 CFR Part 192 apply to remediation of both inactive uranium mill tailing and uranium milling facilities and address emissions of radon, as well as other radiological and non-radiological contaminants, into surface water and groundwater.

In 2013, HMC initiated an evaluation of the response actions performed at the Site under UMTRCA and NRC License SUA-1471 to determine if they were consistent with CERCLA and the NCP (CERCLA equivalency). Additionally, it was determined that the response actions performed at the Site by HMC, when evaluated as a whole, could be considered consistent with the NCP if they substantially complied with the requirements of the NCP and resulted in a CERCLA-quality cleanup (40 CFR Section 300.700 (c)(3)(i)). The requirements set forth in the NCP for achieving a CERCLA-quality cleanup include the performance of a remedial investigation and feasibility study (RI/FS) and selection of a remedy to be documented in a ROD.[11]

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[11] The NCP RI/FS and remedy selection process specified at 40 CFR Section 300.430 includes the following:

- Remedial Investigation (RI) – The RI is a process to assess site conditions and potential risk to human health and the environment. The RI emphasizes data collection and site characterization to determine the nature and extent of contamination, and includes sampling of environmental media (air, soil, surface water, groundwater). Site characterization includes an evaluation of background levels for each medium. Background refers to constituent concentrations or locations that are not influenced by releases of contamination from the Site and is usually described as naturally occurring or anthropogenic (a result of human activities). The RI also includes the performance of a site-specific baseline risk assessment to characterize the current and potential threats to human health and the environment that may be posed by site contamination. The results of the baseline risk assessment help establish acceptable (health-based) exposure levels for use in developing preliminary remediation goals, remedial action objectives, and remedial alternatives in the FS.

- Feasibility Study (FS) – The FS is a process to develop, screen, and evaluate a range of remedial alternatives (cleanup options) to the extent necessary to select a remedy. The FS emphasizes data analysis and is performed using data gathered during the RI to define the objectives of the cleanup and identify preliminary applicable or relevant and appropriate requirements. The FS consists of an initial phase to develop and screen a broad set of alternatives against three of nine NCP criteria for evaluating and selecting a CERCLA remedy: effectiveness, implementability, and cost. This is followed by a detailed analysis on a limited number of viable alternatives carried over from the screening phase of the FS. The detailed analysis is performed using the following seven of the nine NCP criteria:
    - Overall protection of human health and the environment
    - Compliance with applicable or relevant and appropriate requirements
    - Long-term effectiveness and permanence;
    - Reduction of toxicity, mobility, or volume through treatment;
    - Short-term effectiveness;
    - Implementability; and
    - Cost.

  The first two of the above-listed criteria are "threshold" requirements that each alternative must meet in order to be eligible for selection. The five other criteria listed above are "balancing" criteria that identify key tradeoffs (advantages and disadvantages) among the alternatives that provides sufficient information for EPA to balance the tradeoffs. The final two NCP criteria are state/tribal acceptance and community acceptance. These are evaluated during the final step in the process, which is the selection of the remedy.

HMC submitted a CERCLA Equivalency Package to EPA in 2013 that describes site activities in the context of how or to what degree they should be considered equivalent to CERCLA and NCP requirements. The documents in the package included a collection of existing data from previous investigations, analysis of alternatives, treatability studies, and other work performed at the Site. After reviewing the documents, EPA determined there were components of the NCP RI/FS process that needed to be completed to demonstrate substantial compliance with the NCP requirements. These activities included preparing an RI report documenting the previous investigations at OU1 and OU2, performing a baseline risk assessment as part of the RI, conducting a FS to develop and analyze remedial alternatives that support EPA's selection of a remedy, and documenting EPA's remedy in a ROD for OU1 and OU2.

A final RI Report for OU1 and OU2 was completed by HMC in March 2020 and approved by EPA in June 2020. HMC completed a baseline human health risk assessment (HHRA) for the HMC Facility and the LTAs and a baseline ecological risk assessment (BERA) for the Site. The risk assessment results were documented in the RI Report.

EPA and HMC entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) for performance of the FS in August 2020. Under the ASAOC, HMC agreed to conduct the FS to evaluate remedial alternatives to the extent necessary to analyze if the current response actions at the Site substantially comply with the requirements of CERCLA and the NCP for achieving a CERCLA-quality cleanup, or to identify additional response actions to supplement the previous work or new alternatives that would achieve such compliance with CERCLA and the NCP and support future EPA decision-making. The FS for OU1 and OU2 is ongoing.

EPA issued a "no further action" ROD for OU3 (radon contamination in neighboring residential subdivisions) in 1989. However, at the request of two community environmental groups, the Bluewater Valley Downstream Alliance (BVDA) and the Multicultural Alliance for a Safe Environment (MASE), in 2010, EPA performed a supplemental HHRA for the five subdivisions (hereinafter HHRA-Subdivisions). The findings of the HHRA-Subdivisions were included in the 2016 FYR report. They were also summarized in the 2020 RI Report.

A CERCLA remedy has not yet been selected and documented in a ROD for OU1 and OU2. Therefore, EPA will not be assessing the CERCLA level of protectiveness of OU1 and OU2 in this FYR. EPA has

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- Selection of the Remedy – Remedy selection is a two-step process that involves: (1) the identification of a preferred alternative by EPA in conjunction with the state, and the participation of the public, tribes, and state in the decision-making process; and (2) a reassessment by EPA that the preferred alternative provides the best balance of tradeoffs factoring in any new information or points of view expressed by the state/tribes, or the community, followed by a final selection of the remedy by EPA that is documented in a ROD. If EPA decides to modify aspects of the preferred alternative, or selects another alternative that provides a more appropriate balance of the NCP criteria, after considering comments, EPA shall include a discussion of the significant changes to the remedy in the ROD along with a written summary of the significant comments and EPA's responses to each issue. For the public participation process, EPA shall prepare a Proposed Plan that describes the alternatives evaluated during the FS and identifies the best alternative in meeting the NCP criteria. The Proposed Plan and supporting analysis and information shall be made available to the public for review. EPA shall also hold a 30- to 60-day public comment period and present the preferred alternative at a public meeting to be held during the public comment period.

included a summary of activities conducted to date under other regulatory authorities in the subsequent sections, but will not address OU1 and OU2 in the Technical Assessment, Issues and Recommendations, and Protectiveness Statement sections of this FYR report. As noted above, EPA will select a CERCLA remedy for OU1 and OU2 in a ROD following completion of the CERCLA RI/FS equivalency process and the formal public, tribal, and state participation processes for CERCLA remedy selection. After that time, FYRs will be conducted, as appropriate, following CERCLA remedy selection.

The following sections describe the OU-specific remedial objectives and components for those cleanup activities currently underway.

OU1 – Tailings Seepage Contamination of Groundwater Aquifers

HMC is implementing groundwater corrective action under NRC License SUA-1471, an NRC-required Groundwater Corrective Action Program (GCAP) for groundwater restoration, and NMED Discharge Permit DP-200, renewed in September 2014. The GCAP was approved by NRC in 1989. Updates to the GCAP were prepared by HMC in 2006 and 2012; however, they were never approved by NRC. The most recent update (December 2019) is currently under NRC review. The objective or goal of the groundwater corrective action, as set forth in UMTRCA requirements at 10 CFR Part 40, Appendix A, Criterion 5D, is to return hazardous constituent concentration levels in groundwater to the concentration levels set by NRC as Groundwater Protection Standards (GWPS) (*i.e.,* cleanup levels). NRC License SUA-1471 and the GCAP define additional general objectives for groundwater restoration as follows:

- Remediate groundwater to levels set as standards; and
- Prevent the consumption of contaminated groundwater by residents in the nearby subdivisions.

The GCAP defines the groundwater restoration program for the Site. The major components of the groundwater restoration program currently include the following:

- Passive dewatering of the LTP to remove contaminated tailing water. Toe drains and French drains located along the perimeter of the LTP collect some of the tailing water draining out of the LTP. The remainder of the tailing water seeps downward to the underlying groundwater aquifers where it is collected by the network of groundwater collection wells.
- Provisions for an alternate and permanent water supply for nearby subdivision residents whose properties are located in the area of site-related groundwater contamination. HMC financed the cost of residents' water use for 10 years after reaching a settlement agreement with EPA in 1983 for providing an alternate water supply. HMC has recently resumed such financing.
- Operation of a groundwater injection and collection system to reverse groundwater flow within the alluvial and Chinle aquifers back toward collection wells located next to the tailing piles and across the Site. The contaminated groundwater flows to the collection wells where it is removed by pumping and then piped to the treatment facilities. The collected groundwater is treated by R.O. and zeolite filtration for reinjection into the aquifers at designated injection wells and infiltration trenches, and the residual brine water created from the treatment process is evaporated. The reinjected water is compliant with the NRC cleanup levels. Fresh water is also

pumped from the deeper SAG aquifer, as needed, to supplement the treated water used for the injection program.

The current NRC cleanup levels for groundwater are depicted in Table 2 for site-related chemicals of concern (COCs) and radionuclides of concern (ROCs). They are based partly on background levels determined by HMC for each of the contaminated aquifers. The cleanup levels based on background are significantly above federal drinking water and state groundwater standards. Separate cleanup levels are established for the alluvial aquifer and the Upper, Middle, and Lower Chinle bedrock aquifers. Because groundwater in each of the three Chinle aquifers consists of a mixing zone comprised of Chinle and alluvial groundwater and a non-mixing zone of only Chinle groundwater, cleanup levels have been established for the mixing zone and all three Chinle non-mixing zones. Figures C-5 through C-7 in Appendix C depict the locations of the mixing zone and non-mixing zone for each of the three Chinle aquifers and the wells used by HMC to calculate background.

Table 2: NRC 2006 Site Cleanup Levels – Groundwater

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

Notes:

a) Mixing zones occur in Chinle aquifers from the intrusion of alluvial groundwater into the Chinle aquifer at subcrop locations (*i.e.,* where the Chinle aquifer is in contact with the overlying alluvial aquifer). Alluvial groundwater typically has a much higher calcium concentration than the Chinle aquifers' groundwater. Therefore, mixing zone groundwater within the Chinle aquifers is characterized by an elevated calcium concentration. Areas of the Chinle aquifers where the water quality has not been affected by the intrusion of alluvial groundwater are referred to as the "non-mixing" zones.

b) Values based on site-specific groundwater background concentrations.

NR = groundwater protection standards not required for constituents in this zone.

mg/L = milligrams per liter

pCi/L = picocuries per liter

Source: Table 1-1 of the 2019 GCAP.

EPA will select CERCLA cleanup levels and remedial action objectives for groundwater as part of the CERCLA remedy selection process to be documented in a future ROD for OU1.

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

Documents that detail the response action decisions for OU2 include NRC License SUA-1471 and all amendments to the License, and a 1993 NRC-approved Decommissioning and Reclamation Plan.[12]

License SUA-1471 defines the following remedial objectives for OU2:

- Limit radon emissions from the tailing impoundments; and
- Remediate soil contamination that resulted from windblown tailing.

License SUA-1471 and an updated 2013 draft Decommissioning and Reclamation Plan define the following major components of the OU2 cleanup:

- 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 former mill site;
- Excavation of surface soil contaminated with windblown tailing and burial in the out slope of the LTP; and
- Construction of a final radon barrier on the two tailing piles to minimize radon emissions and reduce erosion.

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

EPA will select CERCLA cleanup levels and remedial action objectives as part of the CERCLA remedy selection process to be documented in a future ROD for OU2.

[12] A draft updated Decommissioning and Reclamation Plan was submitted to the NRC in 2013, but has not been approved.

OU1 and OU2 Activities Completed since the 2016 Five-Year Review

In addition to groundwater monitoring and operation and maintenance (O&M) activities completed for OU1 and reclamation and closure activities completed for OU2, the following other OU1 and OU2 activities have occurred since 2016:

Remedial Investigation Report as Part of CERCLA Equivalency Process for OU1 and OU2

HMC prepared the RI Report for OU1 and OU2 as part of the ongoing CERCLA RI/FS equivalency process. The RI Report is a compilation and summary of data and other information collected from previous investigations, decommissioning activities, reclamation, and groundwater corrective action performed over the years pursuant to NRC license conditions, NMED's groundwater discharge permitting program, and as directed by other regulatory authorities. This work is summarized in HMC's 2013 CERCLA Equivalency Package, which includes a compilation of the historical documents. HMC, in consultation with EPA, also performed additional work for site characterization and baseline risk assessments to fill gaps identified for completing the RI equivalency process. HMC documented this additional work in the RI Report that was approved by EPA in June 2020. The RI Report included the following:

- Site history, including mill operation history, decommissioning activities, groundwater restoration activities completed to date, and connection of Milan municipal drinking water supply distribution system to residences in neighboring subdivisions;
- Site characterization, including the hydrogeology of the alluvial, Chinle, and SAG aquifers, and HMC's assessment and supplemental investigation of background concentrations in the alluvial aquifer;
- Nature and extent of contamination, including an assessment of the remediation performed as part of decommissioning under UMTRCA and NRC License SUA-1471 requirements and whether it satisfies CERCLA and NCP requirements for protectiveness;
- Contaminant fate and transport;
- Risk analysis consisting of a baseline HHRA for the HMC Facility and the LTAs and a site-wide BERA; and
- Summary and conclusions on the nature and extent of contamination at the HMC Facility and LTAs, the baseline risk assessments, and EPA's supplemental HHRA-Subdivisions.

The RI Report also includes a discussion of the windblown contamination cleanup that was conducted in the late 1980s and early 1990s as part of the NRC-directed decommissioning activities. Remediation of windblown contamination in surface soil, primarily radium-226, within and outside of the NRC license boundary, was performed. UMTRCA standards for radium-226, specified in 10 CFR Part 40, Appendix A, Criterion 6, which conforms to EPA's environmental standards at 40 CFR Part 192, were used for the soil cleanup. The site-specific radium-226 standards were set at 10.5 pCi/g and 20.5 pCi/g for surface and subsurface soil, respectively.

Confirmatory sampling performed following the windblown soil remediation consisted of both field gamma readings and soil sampling and analysis. The soil sample results showed the cleanup met the UMTRCA standards. The mean radium-226 concentration in the soil was 2.95 pCi/g, and the 95 percent upper confidence level (UCL) using statistical testing was 3.5 pCi/g. Although the residual concentrations of radium-226 in soil were below the UMTRCA standards, an evaluation was made to determine if such concentrations were consistent with CERCLA and NCP requirements for protectiveness. A comparison of the residual radium-226 concentrations in the windblown remediation area was made to the cleanup levels used by EPA for the 2014 soil removal action at residential properties in the neighboring subdivisions. EPA selected a radium-226 cleanup level of 3.5 pCi/g, inclusive of background, for the removal action. The residual average radium-226 concentrations for the windblown area did not exceed the EPA's cleanup level established for the residential properties. As part of the risk assessment for the HMC Facility, HMC calculated the potential health risks within the windblown remediation area for a future trespasser scenario to be within EPA's acceptable excess lifetime cancer risk range. This risk range represents about one chance in ten thousand to one chance in a million of an individual getting cancer from exposure to contamination over a lifetime (referred to as 10^{-4} to 10^{-6}).

The RI Report also discusses HMC's evaluation of the LTAs as potential secondary source areas. Based on site data, there were no apparent groundwater impacts from historical irrigation activities using contaminated groundwater.

HMC Evaluation of Background Water Quality

In 2016, HMC elected to conduct an independent background study for groundwater at the Site after EPA had initiated its own reassessment of background and obtained the support of the U.S. Geological Survey (USGS). The USGS performed a study of the anomalous high concentrations of dissolved uranium at alluvial background monitoring well DD (discussed below). Well DD is a key location used in the calculation of the current Site background levels. HMC split groundwater samples collected by the USGS at well DD and other alluvial wells for independent analyses. HMC also drilled and cored soil boreholes for mineralogical analysis of core samples and performance of downhole borehole geophysics. HMC submitted a white paper to EPA and NMED documenting the results of the evaluation in 2018 and putting forth a conceptual site model (CSM) that describes local naturally occurring mineralogical sources of uranium as the source of the high uranium concentrations in groundwater at well DD.

HMC, in consultation with EPA and NMED, performed a supplemental background soil and groundwater investigation in 2018 and 2019 to expand on the work it completed in 2018 and to address EPA and NMED concerns with the study. The purpose of the supplemental investigation was to refine the CSM for natural uranium distribution and transport by identifying the mineralogical heterogeneity and hydraulic conductivity, as well as local variability of uranium concentrations, across the alluvial paleochannel upgradient of the LTP. Additional boreholes were drilled and cored as part of the study and laboratory batch-leach tests were performed on select core samples. HMC submitted a supplemental background report to EPA in August 2019. In the report, HMC concluded that the alluvial sediments contained leachable uranium. HMC also concluded that the groundwater samples from the monitoring wells used in the 2006 background study capture the natural variability and heterogeneity of the mineralogy of the alluvial sediments and represent the natural uranium concentration variations in alluvial

groundwater upgradient of the Site. The results of the supplemental investigation are presented in the 2020 RI Report.

HMC also performed a review of the 2006 statistical background study for groundwater. The review included an evaluation of the statistical methods used to calculate the existing background levels and recalculation of background using an independent software program consistent with up-to-date EPA guidance for comparison to the original calculations. HMC concluded that the previous statistical background assessment used to establish the current NRC-approved cleanup levels appears robust and the use of updated statistical methods to calculate background would result in only minor adjustments. HMC provided the results of this review to EPA and the other regulatory agencies in September 2019.

EPA and NMED Reassessment of Background Groundwater Quality

EPA and NMED began a reassessment of background in about 2014 at the request of BVDA and MASE, the two local community groups. USGS supported EPA in this effort and performed a study in 2016 focused on alluvial groundwater at several monitoring wells, include background monitoring well DD. The purpose of the study was to differentiate between anthropogenic and natural sources of uranium in groundwater by geochemical analysis. USGS published two papers in the Environmental Earth Sciences journal in 2019 that documented its findings. The results of the USGS study were inconclusive regarding the source of uranium in alluvial groundwater upgradient of the Site.

BVDA and MASE hired two consultants to review the background technical reports and other information prepared by the regulatory agencies, USGS, and HMC, and to perform an independent reassessment on background. In December 2019, EPA received technical papers by the BVDA and MASE consultants proposing new background levels for uranium and selenium in the alluvial aquifer. EPA and NMED met with BVDA, MASE, and their consultants in March 2020 to discuss the consultants' findings. At the meeting, NMED agreed to perform additional geochemical modeling and analysis of alluvial groundwater at the request of the two community groups.

NMED performed a background geochemical modeling study and released a report in September 2020. The purpose of the study was to determine the source of the groundwater and uranium at well DD. NMED and EPA received comments from HMC on the modeling report in October 2020, and an updated report was released by NMED in May 2021 that addressed several of HMC's technical concerns. NMED performed the modeling using the USGS computer software program PHREEQC.[13] NMED's report describes hydraulic and geochemical impacts to the alluvial aquifer upgradient (north) of the LTP that were likely caused by historical mine water discharges from legacy uranium mines. NMED describes a CSM where an estimated 125 billion gallons of mine water were discharged from legacy underground uranium mines that operated from the mid-1950s to early-1980s in the Ambrosia Lake valley to impact the San Mateo Creek drainage basin. The CSM includes the transport of mine-water discharges, as surface water flow, into the lower San Mateo Creek floodplain to infiltrate and recharge the alluvial aquifer. Graphs of constituent concentrations over time for alluvial monitoring wells located upgradient

[13] PHREEQC is a USGS reaction-transport modeling software program for groundwater and watershed systems. It is used for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations.

of the LTP, including well DD, are presented in the report. The graphs show transient (changing) conditions in dissolved concentrations of uranium, selenium, and other constituents. The transience or non-steady state conditions support NMED's model for the infiltration of mine-water discharges and the subsequent mixing with native alluvial groundwater. The report states that changing concentrations of the constituents in groundwater over time indicate that the aquifer system has not yet returned to steady state after the recharge event and are not representative of natural background water quality. The report also states that the results of the batch-leach tests conducted by HMC in 2018 and 2019 on core samples collected near well DD are inconclusive and do not demonstrate predominance of naturally occurring uranium leached from alluvial sediments. NMED concluded that the anomalously high concentrations of uranium and other constituents at well DD are likely the result of 1) mixing of native alluvial groundwater and mine-water discharges, and 2) vadose zone[14] leaching of constituents occurring with rising water table conditions caused by mine water recharge and the hydraulic damming at and near the LTP from tailing seepage and the groundwater restoration program operated by HMC at the Site for the past several decades.

EPA and NMED continue to reassess background for the alluvial and three Chinle aquifers at the Site and plan to perform updated statistical calculations of naturally-occurring background concentrations. The new background concentrations will inform the process for developing preliminary remediation goals (PRGs) as part of the ongoing CERCLA FS for OU1 and OU2.

Feasibility Study as part of CERCLA Equivalency Process for OU1 and OU2, and a Technical Impracticability Evaluation for Groundwater

HMC is performing the CERCLA FS in accordance with the 2020 ASAOC signed by EPA and HMC and a statement of work attached thereto. The work includes the initial development and screening of a range of remedial alternatives, followed by a detailed analysis on a limited number of viable alternatives that pass the screening step. Draft FS documents have been submitted by HMC in 2020 and are currently under review by EPA and NMED.

HMC is also performing an evaluation of the technical impracticability (TI) of groundwater restoration at the Site in accordance with the 2020 ASAOC. A draft TI Evaluation Report submitted by HMC in 2020 is currently under review by EPA and NMED. HMC has informed EPA and the other regulatory agencies that it believes it is technically impracticable to achieve groundwater ARARs, such as the current NRC cleanup levels or the more stringent State groundwater standards or federal MCLs. HMC has requested EPA consider invoking a TI waiver of such standards and selecting an alternative remedial strategy for protecting human health and the environment in future EPA decision-making pursuant to CERCLA Section 121(d)(4) and EPA guidance and policy.[15]

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[14] Vadose Zone is defined as the zone of unsaturated soils or sediments below ground surface and above the water table.

[15] Technical impracticability (TI) is one of several reasons specified in CERCLA and the NCP for EPA to waive an ARAR such as a federal drinking water standard or state groundwater standard. The NCP states that "EPA expects to return usable groundwaters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site" (40 CFR Section 300.430(a)(1)(iii)(F)). However, EPA recognizes

In October 2020, EPA's National Remedy Review Board (NRRB)[16] selected the ongoing CERCLA FS for review at the recommendation of EPA Region 6. The Site was selected due to complexities of site characteristics, environmental impacts, and ongoing groundwater restoration. The Board review team held a series of virtual meetings with Region 6 on March 25 and 26, 2021, to discuss the RI and various aspects of the ongoing FS. State and tribal stakeholders, as well as HMC and the two community groups (BVDA and MASE), were provided the opportunity to make verbal statements to the Board and to submit written statements on their expectations for the CERCLA remedy. NMED and the Pueblo of Acoma gave presentations to the Board review team in a separate state/tribal stakeholder meeting. HMC and BVDA/MASE also gave presentations to the Board review team in another separate meeting in which NMED and the Pueblo of Acoma were allowed to attend. The Pueblo of Laguna did not attend the stakeholder meeting. All of the stakeholders that participated in the NRRB process provided written statements to the Board. EPA Region 6 attended all stakeholder meetings. The Board review team submitted recommendations to Region 6 on June 15, 2021. Region 6 is currently reviewing the recommendations and will provide written responses to the Board review team in October 2021.

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that restoration to drinking water quality may not always be achievable due to the limitations of available remediation technologies. Therefore, EPA needs to evaluate whether groundwater restoration is feasible from an engineering perspective. Determination of TI will be made by EPA based on an evaluation of site-specific characteristics and remedy performance data. The TI evaluation generally includes the following components:

- Specific ARARs to which TI determinations are sought;
- Spatial area over which the TI decision will apply;
- Conceptual site model that describes the hydrogeology and the groundwater contaminants, sources, fate, and transport;
- An evaluation of the restoration potential of the site, including data and analyses that support any assertion that attainment of ARARs is technically impracticable from an engineering perspective;
- Estimates of costs of existing or proposed remedies; and
- Any additional information or analyses that EPA deems necessary for a TI evaluation.

In accordance with EPA guidance for evaluating TI for groundwater restoration (EPA Directive 9234.2-25), a TI evaluation should include a demonstration that no other remedial technologies or strategies would be capable of achieving groundwater restoration at a site. Furthermore, any demonstration that groundwater restoration is technically impracticable should be accompanied by a demonstration that contaminant sources have been, or will be, removed or treated where feasible. If EPA determines that a TI waiver of an ARAR is supported, based on a thorough review and analysis of the TI evaluation, EPA will invoke the waiver and select an alternative remedial strategy that is technical practicable, protective, and satisfies CERCLA and NCP requirements in a ROD. If a groundwater ARAR is waived at a Superfund site due to TI, EPA's general expectations include preventing further migration of the groundwater contaminant plume and preventing exposure to the contaminated groundwater. Where a Superfund ROD invokes a TI waiver, EPA must provide notice of its intent to waive the ARAR in the Proposed Plan and respond to any public, state, tribe, or other federal agency comments concerning the waiver. The Proposed Plan is released to the public for comment before issuance of a ROD.

[16] The NRRB is an EPA technical and policy review group made up of experienced members with both regional and headquarters perspectives in the CERCLA remedy selection process. The NRRB's primary mission is to ensure national consistency in remedy selection at selected sites and will assist the regions in operating in a nationally consistent manner in compliance with CERCLA, the NCP, and applicable agency guidance. A Board review team is comprised of key members of the NRRB that brings the appropriate experience for the type of site under review. The Board review team is positioned to provide support to the regions in developing a comprehensive suite of remedial alternatives that should be evaluated in the FS.

Update of Groundwater Corrective Action Program for NRC

HMC submitted an updated draft GCAP to the NRC in 2019. The draft GCAP provided a screening and evaluation of remedial technology options to identify a preferred groundwater restoration program that is generally consistent with CERCLA FS requirements. It also recommended a CAP based on such evaluation. Although the updated GCAP focuses on the current groundwater corrective action as the means for achieving the requirements of 10 CFR Part 40, Appendix A, Criterion 5,[17] HMC states in the GCAP that it believes the long-term groundwater corrective action will require approval of alternate concentration limits (ACLs) by the NRC that would be the subject of a subsequent license amendment application. The draft GCAP is currently under review by NRC. HMC has proposed submitting a draft ACL application to NRC in December 2021.

HMC Land Treatment Area Soil Sampling and Analysis

In 2017 and 2018, HMC completed comprehensive soil sampling and analysis at the LTAs as the Final Status Survey.[18] The objective was to evaluate whether contaminants of potential concern met the proposed criteria for unrestricted release from NRC License SUA-1471. Over 100 soil samples were collected and analyzed for selenium, uranium, and radium-226. Based on the results, HMC concluded that the criteria for unrestricted release from NRC License SUA-1471 had been met. To confirm these results, HMC funded a study by the Oak Ridge Institute for Science and Education, in 2018, to independently sample soil at the four LTAs. Results of the study were consistent with the Final Status Survey. They are summarized in the 2020 RI Report.

HMC San Andres/Glorieta Aquifer Investigation

In 2020 and 2021, HMC conducted an investigation of the SAG aquifer near the location where it is known to subcrop to the base of the Rio San Jose alluvial aquifer southwest of the HMC Facility. The purpose of the investigation was to characterize the physical and geochemical properties of the SAG aquifer and to evaluate the hydraulic connection[19] between the SAG aquifer and the overlying alluvial aquifer. The information was used to update the HMC CSM and groundwater flow and solute transport model at the Site. HMC drilled and cored two boreholes into the SAG formation and installed monitoring wells. Lithologic cores were analyzed to measure physical properties, including porosity. Borehole geophysical logging was also performed. HMC installed three alluvial piezometers to measure water levels in the alluvial aquifer near the SAG subcrop area. A draft report submitted to EPA and NMED in May 2021 is currently under review.

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[17] Criterion 5 of 10 CFR Part 40, Appendix A, incorporates basic groundwater protection standards imposed by EPA in 40 CFR 192, Subparts D and E, which are health and environmental standards for uranium and thorium mill tailing.

[18] The Final Status Survey is the measurements and sampling to describe the radiological conditions of a site following completion of decontamination activities in preparation for release. The objective of the survey is to show that residual radioactivity levels within the survey areas are less than the limits for unrestricted release.

[19] Hydraulic connectivity of two aquifers is a condition where permeable material in one aquifer is in contact with such material in another aquifer that allows for the free movement of groundwater from the one aquifer to the other under an hydraulic gradient.

Well Integrity Testing of San Andres-Glorieta Aquifer Monitoring and Water Supply Wells

HMC conducted well integrity tests at several SAG water supply wells and monitoring wells in 2015 and 2016 to investigate the source of elevated uranium concentrations. The results showed compromised casing integrity at well 928, corrosion of the casing in well 943 and other integrity concerns with the wells. This has allowed groundwater with higher uranium concentrations to enter these wells through the casings from the shallower alluvial and Chinle aquifers. Therefore, the higher uranium concentrations measured in these compromised wells do not appear to be sourced from the SAG aquifer. To address these issues, HMC installed replacement monitoring well 943M in December 2017 and abandoned well 943 in July 2018. HMC also drilled water supply replacement wells #1R Deep and #2R Deep in 2018 and abandoned monitoring well 928 in 2018 and water supply well #1 Deep in 2019. The water supply replacement wells #1R Deep and #2R Deep were drilled deeper into the SAG aquifer in 2021 to improve water production. SAG well integrity testing is a requirement of NMED Discharge Permit DP-200.

OU3 – Radon in Neighboring Subdivisions

Under a 1987 EPA administrative order on consent, HMC conducted an RI/FS specifically for radon and radon progeny[20] at the five residential subdivisions located south and southwest of the HMC Facility (Broadview Acres, Murray Acres, Felice Acres, Valle Verde, and Pleasant Valley Estates). Average annual radon levels in indoor air were found to exceed EPA's indoor air guidance action level of 4 picocuries per liter (pCi/L) for radon at eight residences, but there was no definitive correlation between the radon concentrations and the proximity of the homes to the HMC Facility. EPA selected a "no further action" alternative and documented the decision in the OU3 ROD, dated September 1989.

EPA performed additional investigations at and in the vicinity of the subdivisions to support a supplemental HHRA between 2010 and 2014. The investigations consisted of the following:

- Gamma Radiation Scanning: a walking gamma scan was performed at 90 properties in the five subdivisions and at 250 acres of HMC property between the evaporation ponds and the fence line (NRC license boundary) separating the HMC property and the subdivisions;
- Soil Sampling and Analysis: 640 surface soil samples were collected from residential properties, various locations on HMC property, and an area south of the residential properties to evaluate background soil conditions;
- Ambient and Indoor Air Sampling and Radon Analysis: 1500 air samples were collected during four sampling events over a period of one year at homes (indoors and outdoors) within the subdivisions, on HMC property, north of the LTP, and in Bluewater Village, the location EPA selected to represent background;
- Produce Sampling and Analysis: vegetables were collected from existing home gardens and sent to a laboratory for analysis; and

[20] Radon progeny are the radioactive elements produced from the decay of radon. The rate of radon decay is 3.8 days.

- Private Well Sampling: water samples were collect from existing private water wells in the subdivisions.

The purpose of the gamma scan was to investigate: 1) whether the spraying of contaminated water high into the air resulted in contaminants being deposited in the adjacent residential neighborhoods; and 2) whether heavy rains could have resulted in contaminants being carried from the tailing piles and evaporation ponds into the adjacent neighborhoods.

In 2012, EPA performed a removal action[21] to install radon mitigation systems at 12 residential properties where radon in indoor air exceeded the 4 pCi/L action level based on average annual sampling. EPA installed mitigation systems[22] in 11 homes; one homeowner declined the system installation. The source of high radon levels in these homes was not identified as there was no significant difference between annual indoor radon levels in the five subdivisions and background indoor radon levels at Bluewater Village.

EPA conducted a soil and debris removal action at residential properties in 2014. The soil action level established by EPA in a 2014 Action Memorandum for residential properties was 3.5 pCi/g of radium-226, inclusive of background.

EPA completed the HHRA-Subdivisions in December 2014. In performing the risk assessment, EPA evaluated two land use scenarios: residential and subsistence farming. The results showed a risk exceeding EPA's acceptable excess lifetime cancer risk range of 10^{-4} to 10^{-6} for elevated levels of radon in ambient (outdoor) air in the residential neighborhoods. Most of the risk was attributable to background concentrations of radon; however, some risk was determined to be site-related.

An NRC license condition requires HMC to monitor outdoor radon, air particulate levels, and direct gamma radiation at the NRC license boundary to ensure that conditions in the subdivisions do not significantly change before final site closure.

Status of Implementation

OU1 – Tailings Seepage Contamination of Groundwater Aquifers

Supplemental Drinking Water Supply to Residents

A 1983 settlement agreement between HMC and EPA required HMC to provide an alternate water supply to residences with contaminated private water wells in the neighboring subdivisions. The residences were connected to the Milan municipal water supply distribution system. The agreement also required HMC to

[21] A removal action under the EPA's Superfund program is a short-term response intended to stabilize or clean up an incident or site that poses a threat to public health or welfare.

[22] Radon mitigation systems are designed to reduce radon levels in the indoor air of a home or prevent radon from entering a home. The system which is used depends on the foundation design of the home. They generally consist of piping and an exhaust fan.

pay for residents' water usage for a period of 10 years. HMC completed the water supply connections in 1985 and paid for water use until the end of 1994. In late 2018, HMC restarted the water supply payment program for the subdivisions downgradient of the Site. Regulatory agencies did not require this action.

In January 2009, NMED and HMC entered into a Memorandum of Agreement for HMC to connect the remaining residences using private water wells within a designated area near the Site to Milan's municipal water supply distribution system. This work has been completed.

HMC conducts an annual land use survey to meet annual license condition reporting requirements under NRC License SUA-1471. This survey includes an assessment of the five residential subdivisions south and west of the HMC Facility. The assessment determines whether occupied dwellings are using water service from the Milan municipal water supply distribution system, rather than private wells, for potable water consumption. As of 2020, all residences in the subdivisions are connected to the public water supply. A Valle Verde resident, who had previously declined the offer for connection in previous years, agreed to connect in 2019. HMC connected the residence to the public water supply in 2020.

Groundwater Restoration Activities

HMC began groundwater restoration activities at the Site in 1977. At that time, groundwater contaminant plumes, defined primarily by selenium and uranium concentrations, extended from the LTP south and west into the residential areas. The initial program included a line of groundwater injection wells along the southern NRC license boundary, which is located between the LTP and the downgradient residences. The purpose of this line of wells was to create a hydraulic barrier that reversed the natural flow direction of the contaminated groundwater away from residences and back toward the tailing piles. Since that time, HMC has continually improved and expanded the scope and operation of this remediation system. Table C-1 in Appendix C summarizes the changes and improvements made to the groundwater restoration system over time. Groundwater cleanup at the Site is ongoing.

The current groundwater restoration program includes multiple components that are frequently adjusted based on evaluation of monitoring data. The components are a groundwater injection and collection system, a tailing toe drain system, a zeolite water treatment system on top of the LTP, an R.O. water treatment plant, two collection ponds, and three evaporation ponds (*see* Figure 2). Previously, the restoration program included tailing flushing and dewatering at the LTP to enhance source control. HMC discontinued the tailing flushing program in 2015. Operation of the tailing dewatering (pumping) wells was discontinued in 2017.

Treated water compliant with NRC cleanup levels and fresh water pumped from the SAG aquifer are currently injected into the alluvial aquifer and the Chinle bedrock aquifers to reverse the natural gradients and to flush contaminated groundwater toward collection wells. The collection wells are used to pump the contaminated groundwater from the aquifers. Groundwater pumped from wells located within the NRC license boundary is piped to the R.O. treatment plant; groundwater pumped from wells located outside of the NRC license boundary is piped to the zeolite treatment system or discharged into lined collection ponds or one of three lined evaporation ponds. Modifications to the injection and collection systems have been made as restoration has progressed, including discontinuing injection in some

downgradient alluvial wells and adding injection wells closer to the collection wells. Figure C-8 in Appendix C shows the current injection and collection systems.

Historically, contaminated groundwater collected from areas outside of the NRC license boundary was used for irrigation (a practice initially started in 2000 as a means for water disposal). Center pivot irrigation and flood irrigation systems were used. The irrigated areas are shown as four LTAs in Figure 2. NMED prohibited use of the irrigation systems with a renewal/modification of DP-200 and required groundwater treatment instead. Irrigation at the LTAs ended in 2012.

Water Treatment Systems

HMC operates the R.O. treatment plant and zeolite treatment systems at the Site. The R.O. treatment process includes lime clarification and microfiltration as pre-treatment to the R.O. treatment units. Sludge from the R.O. treatment process is discharged to the west collection pond. Brine water generated in the treatment process is discharged to the evaporation ponds. HMC completed significant upgrades to the R.O. treatment plant from 2015 through 2020 to expand the treatment capacity of the R.O. system. In 2015, equalization basins, an additional clarifier, and a microfiltration unit upgrade were added to the system. In addition, a Low-Pressure R.O. Unit was added. In 2016, a High-Pressure R.O. Unit was added to reduce the total brine stream from the R.O. plant to the evaporation ponds. In 2019, the existing microfiltration modules were replaced and additional modules were added.

The expanded and upgraded R.O. system has a theoretical design capacity to treat water at a rate of 1,200 gallons per minute (gpm). However, while these system improvements increased the theoretical design capacity flowrates up to 1,200 gpm, these "nameplate" rates were never expected to be sustainable as long-term treatment rates. The theoretical design capacity is the maximum output of a system operated continuously during a given period under optimal conditions. Theoretical design capacity does not account for down time from planned or unplanned maintenance, component underperformance/failure and other site-specific factors (*e.g.,* weather-related downtime). HMC estimates that the actual operational capacity of the R.O. system is approximately 600 gpm. The average treated water rate (input rate) at the R.O. plant from 2016 through 2020 was 436 gpm. The average R.O. product water recovery rate and brine generation rate (output rates) for the same period were approximately 329 gpm and 92 gpm, respectively. The brine water generated over the last five years represents about 28 percent of the total output from the R.O. treatment plant.

In addition to operating the R.O. treatment plant, HMC utilizes zeolite bed filtration technology to treat uranium-contaminated groundwater collected from wells located outside of the NRC license boundary. Such utilization has undergone significant change from 2015 through 2020. HMC evaluated the zeolites as an additional innovative, but unproven, alternative to address treatment of off-site, less impacted groundwater within a fairly small treatment system footprint. In 2016, HMC built a 1200 gpm full-scale zeolite water treatment plant on top of the LTP after pilot testing of 50 and 300 gpm systems indicated promise. Unfortunately, system operations from 2016 through 2018 demonstrated that overall efficiency was less than original system design expectations due to unforeseen physical limitations of the regeneration process. These limitations resulted in a much lower actual efficiency. In 2017, the regeneration process was redesigned. The redesign required a change to the effluent piping to allow for

independent operation of each of the trains for either treatment or regeneration. Currently, HMC estimates that the actual operational capacity of the zeolite treatment systems is approximately 200 gpm. However, unanticipated algae growth has become an increasingly significant problem in the zeolite treatment system, severely limiting efficient operation and requiring algae cleanout at a greater frequency than is required for regeneration. From 2016 to 2020, the zeolite treatment systems have been operated at a rate anywhere from zero to 200 gpm due to the ongoing algae issues. With a recent (July 2021) amendment to NRC License SUA-1471, HMC is now evaluating a copper sulfate additive to the zeolite treatment system to control algae growth. Additional operational issues include exposure of system components to the elements, weather delays (lightning, etc.), and overall difficulties in operating an innovative treatment system.

The combined operational water treatment capacity of the R.O. plant and zeolite treatment systems is approximately 800 gpm. Despite the challenges noted above, HMC operated the R.O. plant and zeolite treatment systems over the 2016 to 2020 timeframe at a combined average rate of 678 gpm. This has resulted in the removal of approximately 72,000 pounds of uranium from the aquifers during this time period. It is noted that the treatment rate of the R.O. system declined every year from a high of 584 gpm in 2016 to 314 gpm in 2019. This was partly the result of a reduction in treatment, beginning in 2018 and continuing through the spring of 2021, to reduce the total volume of brine water requiring evaporation. The reduction in brine water was necessary to dewater Evaporation Pond No. 1 to facilitate replacement of a damaged liner. However, the planned relining of the pond has been put on hold due to the COVID-19 pandemic. Currently, HMC is not draining down the brine water in the pond for liner replacement, but operating the pond at a lower water level due to the tears at the top of the liner. At this operating level, NRC estimates that the available evaporative capacity of Evaporation Pond No. 1 is only limiting the total evaporative capacity of system by about five percent.

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

HMC began demolition activities at the mill facility in 1992. Mill debris was deposited in the LTP or buried in pits in the mill area or south of the LTP. Prior to and following demolition of the mill facility, HMC removed soil contaminated by windblown tailings, ore storage and processing. HMC removed surface soil with windblown contamination from about 1,200 acres of land and disposed of most of the soil on the eastern side slope of the LTP. Significant quantities were also placed on the southern end of the STP and the apron of the LTP.

HMC placed cover materials on the former mill area, the LTP, and the STP as part of mill decommissioning efforts. At the former mill area, HMC backfilled excavated areas with clean alluvial soils. HMC also placed at least two feet of clean soil over the entire mill area.

HMC regraded and recontoured the surface of the LTP to improve long-term stability and drainage, and to prepare for final covering and closure. In 1994, HMC constructed a final radon barrier and erosion protection cover (rock cover) on the sides of the LTP, as well as an interim soil cover on its top. Since this initial placement, HMC has placed more soil cover on the LTP to fill depressions caused by

settlement, improve drainage, and address specific areas with elevated radon flux[23] measurements. In 1995, HMC constructed an interim one-foot soil cover on the part of the STP not covered by Evaporation Pond No. 1. The placement of final radon barriers on the STP and LTP is not planned to occur until groundwater restoration activities are completed, the facilities and equipment on top of the tailing piles are removed, and the wells on top of the piles are properly plugged and abandoned.

Following soil cleanup activities, HMC regraded drainage areas at the HMC Facility and established surface channels for drainage. These activities were completed by 1995. Mill decommissioning at the Site met applicable standards in 10 CFR Part 40, Appendix A, and applicable conditions of NRC License SUA-1471.

HMC conducted a pilot study at a portion of the LTP between December 2010 and May 2012 to evaluate the possibility of a rebound in contaminant concentrations once the tailing flushing program ended. Data from the study indicated that significant rebound was not expected. HMC ended the tailing flushing program in July 2015 and discontinued operation of the tailing dewatering wells in 2017.

HMC began plugging and abandonment of injection, collection, and monitoring wells on top of the LTP in 2018. The injection and collection wells were used for the tailing flushing program and tailing dewatering. The plugging and abandonment work was completed on July 23, 2021; a total of 641 wells were plugged and abandoned. Several monitoring wells selected by HMC, and concurred on by the regulatory agencies, will remain in place for continued monitoring of the tailing water within the pile and the underlying aquifers as part of the ongoing groundwater monitoring program.

OU3 – Radon in Neighboring Subdivisions

EPA conducted a removal action to install radon mitigation systems at 11 residences in the neighboring subdivisions in 2012. EPA also conducted a soil removal action at 16 residential properties to clean up radium-226 contamination and debris from two additional residential properties in 2014. The indoor air radon levels and the radium-226 contamination in soil and debris were not attributed to the Site, based on the assessment of background soil and indoor air concentrations.

EPA's 2014 HHRA-Subdivisions showed a risk exceeding EPA's acceptable excess lifetime cancer risk range of 10^{-4} to 10^{-6} for elevated levels of radon in ambient air in the residential neighborhoods. Some of this risk is attributable to the Site. Placement of the final radon barrier on top of the LTP and STP as part of reclamation and closure for OU2 are expected to reduce site-related radon concentrations in ambient air.

[23] Flux is defined as the rate of flow of fluids, particles, or energy across a given surface area.

Institutional Control Review

There are currently no institutional controls (ICs) established under CERCLA for this Site as no CERCLA remedies have been selected by EPA. The need for ICs will be considered by EPA as part of the development of remedial alternatives in the ongoing CERCLA FS for OU1 and OU2 and subsequent EPA decision-making on a CERCLA remedy. There are, however, proprietary and government controls that have been put in place or are planned by HMC and the State. Additionally, ICs will be put in place by the U.S. Department of Energy (DOE) once the Site is transitioned to its Office of Legacy Management (DOE-LM) to comply with UMTRCA requirements. Table 3 summarizes the ICs in place or planned for the Site, with additional OU-specific information below.

OU1 – Tailings Seepage Contamination of Groundwater Aquifers

In 2009, NMED issued a health advisory for private wells within the San Mateo Creek basin. The advisory cautions current and future owners and users of private wells that their well water could contain contaminant concentrations above federal drinking water standards. The NMED Health Advisory is considered to be an informational institutional control.

In May 2018, the New Mexico Office of the State Engineer (NM-OSE) issued a State Engineer Order (Order) restricting well drilling in the alluvial and Chinle aquifers within an area where groundwater is contaminated with uranium, selenium, combined radium-226 plus radium-228, molybdenum, chloride, nitrate, sulfate, and total dissolved solids (TDS) from historical uranium milling and mining activities. The Order protects human health and prevents interference with groundwater flow associated with ongoing remediation. The Order restricts the permitting and drilling of new wells, replacement wells, and supplemental wells, and restricts the permitting of any change to the point of diversion of any existing wells within the boundaries defined. This moratorium excludes permit applications that are submitted on behalf of NMED, or that may be required for remedial action and monitoring, and excludes areas within the NRC licensed boundaries for this Site and the DOE-LM's Bluewater Disposal Site.[24]

EPA will evaluate the need for these and any other ICs at OU1 as part of the ongoing development of remedial alternatives in the CERCLA FS for OU1 and OU2.

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

HMC currently restricts access within the NRC license boundary with a security fence and warning signs. The HMC Facility maintains security support services, security alarm systems and site entry controls. Once site reclamation, closure, and groundwater corrective action are complete, HMC will maintain the site controls until transfer of title to DOE-LM. Upon title transfer, DOE-LM will assume custody of and responsibility for the tailing disposal site and potentially other land within an established general NRC license boundary in perpetuity. Restrictions will need to be put in place to prevent disturbance of soil, waste, and any remedy components to prevent unacceptable future use and to prevent use of groundwater for potable purposes.

[24] The DOE Bluewater Disposal Site is a former uranium mill site located about 4 miles west-northwest of the HMC Facility. The site is under long-term surveillance and maintenance by the DOE Office of Legacy Management.

Table 3: **Summary of Planned or Implemented Institutional Controls**

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 Parcels	IC Objective	Title of IC Instrument Implemented or Planned (Date)
Groundwater, soil and waste within the NRC license boundary	Yes	No	Parcels within the NRC license boundary (see Figure 3)	To prevent disturbance of 11e.(2) byproduct material in soil and waste and any remedy components; to prevent unacceptable future use; and to prevent use of groundwater for potable purposes.	CERCLA OU1/OU2 FS to evaluate need for ICs UMTRCA requires HMC to transfer a part of the Site that includes the LTP and STP to DOE-LM for long-term surveillance and maintenance, which will limit public access in perpetuity.
LTAs outside the NRC license boundary	Unknown	No	Parcels within LTAs (see Figure 3)	To prohibit residential and agricultural use and to prohibit use of groundwater beneath the LTAs for drinking water.	CERCLA OU1/OU2 FS to evaluate need for ICs Restrictive covenants (proposed by HMC)[b]

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 Parcels	IC Objective	Title of IC Instrument Implemented or Planned (Date)
Groundwater outside the NRC license boundary	Yes	No	Parcels overlying the contaminant plumes (see Figure 3)	To caution current and future owners and users of private wells in the San Mateo Creek basin that their well water could contain contaminant concentrations above federal drinking water standards. To restrict well drilling in the alluvial and Chinle aquifers in an area where groundwater is impacted by historical uranium milling and mining activities.	CERCLA OU1/OU2 FS to evaluate need for ICs NMED Health Advisory (2009) NM-OSE Order for drilling moratorium (2018) HMC recording restrictive covenants on HMC property which restricts the use of domestic wells[c]

Notes:

a) EPA decision document(s) have not yet been issued for OU1 and OU2.

b) HMC has proposed IC for the LTAs, but the HHRA did not assess the potential risk for a residential or agricultural use for the LTAs, so the need for such an IC at the LTAs is unknown.

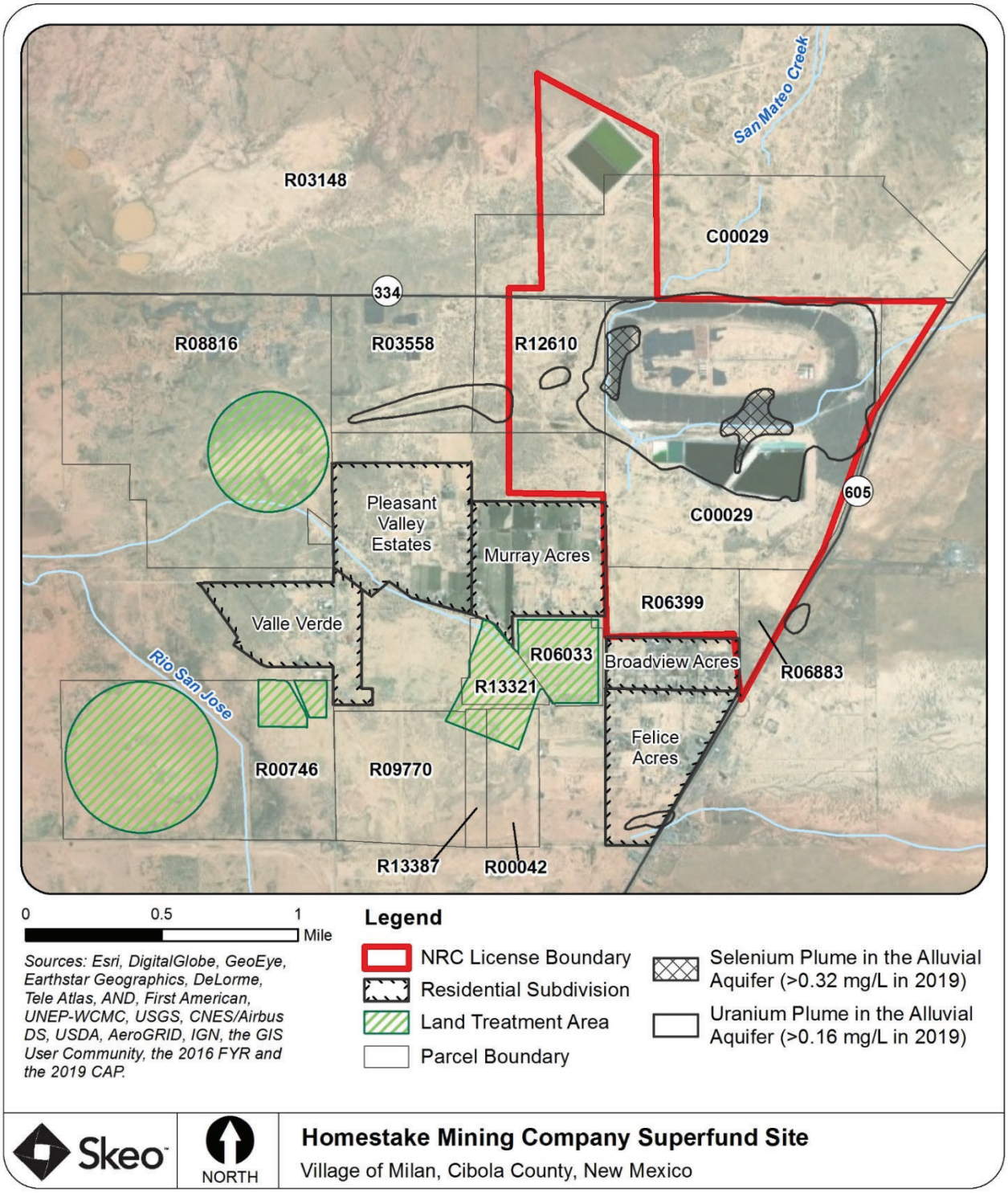
c) HMC is currently purchasing property outside of the NRC license boundary and recording restrictive covenants which restricts the use of domestic wells.

The 2020 RI Report noted that HMC was developing a Declaration of Restrictive Covenants, as a proprietary IC, that upon recording, will prohibit residential and agricultural use of the LTAs and use of groundwater beneath the LTAs for drinking water purposes. EPA will evaluate the need for this and any other ICs as part of the ongoing development of remedial alternatives in the CERCLA FS for OU1 and OU2.

OU3 – Radon in Neighboring Subdivisions

Decision documents did not require ICs for OU3 and, at this time, it is not expected that they are required for protectiveness. However, annual radon flux measurements and radon monitoring at the fence line of the NRC license boundary is required under NRC License SUA-1471.

Figure 3: Institutional Control Map



Disclaimer: This map and any boundary lines within the map are approximate and subject to change. The map is not a survey. The map is for informational purposes only regarding EPA's response actions at the Site.

Systems Operations/Operation and Maintenance

OU1 – Tailings Seepage Contamination of Groundwater Aquifers

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

- O&M and monitoring of the groundwater injection and collection wells and associated water conveyance piping;
- O&M of the R.O. treatment plant, zeolite treatment systems, collection ponds and evaporation ponds;
- Groundwater sampling and monitoring;
- Air monitoring; and
- Maintenance of air monitoring stations and groundwater monitoring wells.

HMC personnel are at the Site daily during the week doing O&M activities. Daily and weekly inspections verify the condition of the R.O. treatment plant and zeolite treatment systems components. HMC monitors the volume of groundwater collected and amount of contaminants removed as a part of O&M activities. Over 7 billion gallons of groundwater were extracted from the on-site collection system between 1978 and 2020. Over 1 billion gallons were extracted during the last five years (2016-2020). Additionally, more than 1.2 million pounds of uranium and 73,000 pounds of selenium have been removed from groundwater, with subsequent treatment by the R.O. treatment plant, since 1978. Over the last five years, approximately 72,000 pounds of uranium and 4,000 pounds of selenium have been removed. Table C-2 in Appendix C lists the total volume of groundwater collected and quantities of constituents removed by the site groundwater collection and tailings dewatering systems from 1978 to 2020.

O&M activities also include periodic monitoring of several hundred groundwater monitoring wells and continual O&M of dozens of collection and injection wells. The Data Review section of this FYR Report summarizes recent groundwater sampling results.

During ongoing O&M activities at the Site for this FYR period, HMC identified and reported the following two spills to the NRC, EPA and NMED:

- A release of non-impacted water from the "Y" injection wellfield occurred on December 20, 2019, as a result of a broken flowmeter caused by freezing temperatures. The spill, estimated to be between 50,000 and 72,000 gallons of injection water, affected an area of about 20,000 square feet. The entire wellfield, both collection and injection systems, and the zeolite system were shut down to complete the inspection. The systems are currently back up and running.
- A release of an estimated 216,000 gallons of contaminated groundwater from an off-site collection pipeline at collection well 490 occurred south of the NRC license boundary in a vacant lot owned by HMC. HMC discovered and stopped the accidental release on September 1, 2020.

The release is believed to have begun about six days earlier due to a check valve failure, combined with the fact that two manual valves had inadvertently been left in the open position prior to resumption of pumping off-site groundwater to the zeolite treatment facility.

None of the contaminated groundwater spilled in 2020 migrated outside of the boundaries of the vacant lot (beyond HMC property). HMC performed a gamma radiation survey and soil sampling to determine potential environmental or health impacts of the release. These response actions demonstrated that: 1) radiological impacts were not significant relative to the public radiation limits (dose limits) given in federal regulations at 10 CFR Part 20.1301; 2) incremental uranium concentrations in surface soils were insignificant and likely not distinguishable relative to background; and 3) the release impacted only property owned by HMC. Therefore, soil remediation was not deemed necessary by the regulatory agencies.

Alluvial groundwater beneath the HMC property where the 2020 spill occurred is already contaminated. If the spilled groundwater percolates downward to the water table, it would not further degrade the quality of the groundwater currently present in this area of the aquifer.

At the request of NMED, HMC also performed an incident investigation to identify additional corrective actions to prevent this type of incident occurring in the future, including updating standard operating procedures specific to the groundwater extraction and conveyance system for the zeolite filtration treatment operation. HMC submitted a Corrective Action Report to NMED in November 2020 that identified these and other preventative actions it would undertake. NMED approved the report in December 2020.

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

NRC License SUA-1471 conditions require that HMC conduct annual inspections of the tailing piles, pond dikes, and annual radon flux surveys for the tailing piles. The annual inspections include visual observations of the tops and out slopes of both tailing piles and dikes and the slopes and liners of the evaporation ponds. The inspections also include review of piezometer (depth of water) readings, tailing collection well and tailing drainage sump collection rates, leak detection monitoring records for two of the evaporation ponds (Evaporation Pond Nos. 2 and 3), settlement monitoring survey data, pond-level measurements, and other data. Annual reports submitted to NRC, EPA, and NMED document the results of the inspections and the radon flux surveys.

OU3 – Radon in Neighboring Subdivisions

There are no current long-term O&M activities for OU3. The radon mitigation systems installed in residential homes are robust and do not require regular O&M. Homeowners with mitigation systems are responsible for maintaining the systems and have been instructed to contact the installer for servicing any repairs beyond the warranty period.

III. PROGRESS SINCE THE PREVIOUS REVIEW

Table 4 includes the protectiveness determinations and statements from the 2016 FYR Report. Table 5 includes the recommendations from the 2016 FYR Report and the status of those recommendations.

Table 4: Protectiveness Determinations/Statements from the 2016 FYR Report[1]

OU #	Protectiveness Determination	Protectiveness Statement
OU1	Short-term Protective	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's 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.
OU2	Short-term Protective	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 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.
OU3	Protective	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	Short-term Protective	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.

[1] CERCLA protectiveness determinations and statements were made for the OU1 and OU2 UMTRCA remedies in the 2016 FYR. For this FYR, EPA has elected not to make any protectiveness determinations or statements for those UMTRCA remedies. EPA is only making protectiveness determinations and statements for CERCLA response actions and decisions, consistent with CERCLA, the NCP, and EPA FYR guidance (EPA 2001).

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Community Involvement and Site Interviews

EPA published a public notice in the *Cibola Citizen* newspaper on 9/30/2020 (Appendix D). The public notice stated that the FYR was underway and invited the public to submit any comments to EPA. The results of the review and the report will be made available at the Site's information repository, Grants Campus Library at New Mexico State University, located at 1500 Third Street, Grants, New Mexico 87020.

During this FYR process, interviews were conducted to document any perceived problems or successes with the remedy implemented to date. Interviews were conducted with the HMC Site Closure Manager, Governor of the Pueblo of Acoma and his staff, Water Rights Office Manager for the Pueblo of Laguna, Mayor of the Village of Milan, a community resident that is a member of BVDA, a former community resident that is a former member of BVDA, and a downstream community resident that is a member of MASE. The Cibola County manager was given the opportunity to be interviewed, but declined. All interviewees have granted their permission to use their names in the interview records. Appendix E includes the completed interview forms. The interviews are summarized below.

The HMC Site Closure Manager noted that substantial progress has been made over more than 40 years of groundwater corrective action and that all known available groundwater treatment technologies have been implemented or considered for use at the Site. The manager also noted that HMC has proposed a strategy for regulatory closure of the Site and protection of human health that includes ICs to prevent exposure to contamination, but not restoring the groundwater aquifers to drinking water quality. HMC is proposing TI as a reason for EPA to consider waiving groundwater standards in future EPA decision-making. The manager indicated that his company's cleanup efforts have had a positive effect on the community in that residences with contaminated water wells were connected to the Milan municipal water supply and their water bills were paid. He further indicated that properties were bought by HMC for value to allow residents to relocate if they chose to do so, and risks to human health were mitigated. The manager noted that HMC was not aware of any community concerns other than those raised by the community to EPA.

Pueblo of Acoma conveyed a severe and deep concern about the continued impact of contamination and that the length of time the cleanup has been ongoing is staggering. The Pueblo also noted that the idea of HMC seeking a TI waiver is troubling and seems like an attempt to walk away from the project. Pueblo of Acoma indicated that they had three major concerns: 1) groundwater contamination and the migration

Table 5: Status of Recommendations from the 2016 FYR Report

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
OU1, OU2	Although remediation is underway under NRC authority, there is no EPA ROD in place for OU1 and OU2.	Complete EPA reassessment of background groundwater and complete the CERCLA equivalency analysis, including issuance of a ROD for OU1 and OU2.	Ongoing	As part of a demonstration of CERCLA equivalency, EPA approved the OU1/OU2 RI Report in June 2020. An FS, TI evaluation, and background reassessment are underway. Following their completion, EPA, in consultation with the State and NRC, and after performing the public, tribal, and state participation process in remedy selection, will select and document a remedy for OU1 and OU2 in a ROD.	NA
OU1	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, 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 point-of-compliance wells to achieve contaminant of concern (COC) groundwater protection standards. Modeling did not predict COC concentrations for any other areas,	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.	Completed	HMC submitted an updated GCAP to the NRC for approval in 2019. The GCAP includes the results of more modeling efforts conducted in support of corrective action selection. The GCAP updates the timeframe for active remediation using the groundwater collection/injection systems. However, HMC notified EPA, NRC and NMED in 2019 that it does not believe that groundwater restoration to the current NRC cleanup levels, or federal MCLs and State groundwater standards, which are more stringent, can be achieved within a reasonable timeframe from an engineering perspective. HMC believes it is	12/18/2019

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
	including those areas outside the facility's licensed boundary.			technically impracticable to do so. HMC has requested that EPA consider invoking a TI waiver of these standards, as potential ARARs, in future EPA decision-making. HMC has also indicated to the NRC that it will apply for alternate abatement standards (ACLs) through a license amendment application. HMC has notified NMED that it will also request alternate abatement standards (AAS) through the New Mexico Water Quality Control Commission (WQCC) regulations.	
OU1	The source of the uranium exceedance in the SAG supply wells at the Site is unclear.	Investigate the source of the elevated uranium in the HMC supply wells to determine if pumping from the SAG wells is drawing site contamination into the deeper aquifer.	Completed	HMC conducted well integrity testing at SAG wells in 2015. The results found compromised integrity at well 928, corrosion in well 943 and other concerns with SAG wells. Due to integrity concerns, HMC installed replacement well 943M in December 2017 and abandoned well 943 in July 2018. HMC also drilled replacement wells #1R Deep and #2R Deep in 2018 and abandoned deep well 928 in 2018 and #1 Deep in 2019. The water supply replacement wells #1 Deep and #2 Deep were drilled deeper into the SAG aquifer in 2021 to improve water production.	3/1/2016

of the contaminant plume to impact the SAG aquifer; 2) the impact of contamination and the depletion of the SAG aquifer from pumping has the Pueblo worried about protecting its people's health and providing clean water to its people in the long-term; and (3) impacts on the Pueblo of Acoma cultural resources. It was noted that the SAG aquifer is one of the last remaining water supplies within the Rio San Jose drainage basin. Air quality and potential dust-related impacts from wind were also a health concern. The Governor indicated that there has generally been a lack of communication between the Pueblo and EPA from a government-to-government perspective. Tribal leadership changes from year to year and it is important that EPA recognize that and try to ensure ongoing communication. It is also important that EPA asks new tribal leadership about its preferred level of engagement as it will vary between different tribal leaders. The Governor also noted the Biden Administration's memorandum on tribal consultation and suggested that EPA organize a consultation to help tribal leaders gain a better understanding of the Superfund process in general. He recommended interagency collaboration.

Pueblo of Laguna noted that the project seems fairly ineffective as a cleanup, but moderately effective as a barrier to downstream contamination. They also noted that the tailing material should never have been allowed to remain without an impermeable barrier between it and the groundwater. Pueblo of Laguna recognize that they are further downstream to the Site than other stakeholders, but they are still concerned with groundwater contamination and a reduction of available water in the SAG aquifer (from Site pumping) that would contribute to the flow of the Rio San Jose. Another concern of the Pueblo was not requiring HMC to operate the water treatment plants at 100 percent of capacity, so it is not known how effective the remedy could be.

The Mayor of Milan is aware of the contamination to groundwater and the windblown contamination. He indicated that people living close to the Site and some ranchers with cattle do not get satisfactory answers to their questions. He noted that the public relations person at the HMC Facility does a good job in communicating with the public, but as far as Site operations goes, he does not believe the public or the Village are well informed. The Mayor recommended that HMC keep the Board of Trustees and his office informed on changes and construction at the Site so that the Village can keep the public informed.

The general sentiments of the two community residents and one former resident interviewed ranged from strong disappointment to anger over the progress made to clean up the Site. One resident noted that he spent half his lifetime waiting for the groundwater to be cleaned up. At the beginning, in 1978, the company indicated that the groundwater cleanup would not take long, but not much work was done until about 2000, and after that very little progress was made on the groundwater. The resident has the impression that HMC is looking to get out of the cleanup.

A former resident was very upset and claimed that the cleanup had been an abject failure. She stated that the community has lost its water and a way of life that cannot be regained. In addition, those living closest to the LTP were exposed to unsafe levels of airborne radon contamination for more than 30 years. She also conveyed a strong disappointment with the regulatory agencies and stated that no one listened to the community until they wrote letters and engaged politicians. When community members joined, raised money, and hired their own technical experts, they were no longer ignored. She stated that the Site destroyed the community and her dream of always living there and to have it for her grandchildren. She described it as a tragedy. She noted that nobody in the community cares anymore and all they want is to

get out. She also suggested that what needs to happen is for local elected officials to understand where their water comes from and how the Site could affect future water resources. She indicated that education and outreach for the communities and local officials is necessary if EPA wants informed community engagement.

The downstream community member discussed her overall concern with the ongoing remedy in significant detail. She stated that the "jumble" of remedies used at the Site have not been well managed or operated. She argued that HMC should never have conducted the tailing flushing program and that the tailing piles should have been dewatered and relocated away from the ancestral San Mateo Creek bed to a new site with a double liner and leak-detection system. She noted that BVDA previously recommended that the tailing material be relocated to a permanent regional repository to facilitate cleanup of the Site. BVDA proposed that the regional repository could also be used for tailing material near the Red Water Pond Road community (near Gallup) and the Mariano and Smith Lake communities, among others. She also noted that BVDA and MASE consistently asked EPA to reassess background water quality and challenged HMC's extensive use of the SAG aquifer in the groundwater cleanup effort. She indicated that there is a need for a long-overdue comprehensive health survey of community residents living around the Site, along with an epidemiological study, which should be included as an outcome in the EPA's next Five-Year Plan for the Grants Mining District. She made a general statement that the failure of the federal government to plan for and develop permanent waste disposal sites to contain and isolate uranium mine and mill waste is truly abysmal.

Overall, the community residents indicated that they were somewhat informed of Site activities by HMC and the regulatory agencies, but it could be better. One interviewee suggested that EPA or NRC should break down the substance of HMC's annual reports and explain it to the public, especially for local residents and downstream community members. She felt the reports are too complicated and long, and she doesn't have the time to try reading them.

None of the interviewees were aware of any complaints or incidents at the Site such as vandalism, trespassing, or emergency response by local authorities. However, one interviewee noted the spill of an estimated 216,000 gallons of contaminated groundwater at the zeolite groundwater collection and conveyance system in 2020 and an apparent violation to NRC License SUA-1471 that was cited in 2018 by NRC for use of water in the injection program that did not meet NRC's cleanup levels.

EPA will address the concerns related to community engagement and tribal government communication by implementing an updated Community Involvement Plan for the CERCLA process. The updated Plan will include additional outreach activities to improve the communities' and tribal leaderships' understanding of the CERCLA activities being performed at the Site.

Data Review

OU1 – Tailings Seepage Contamination of Groundwater Aquifers

The data reviewed for OU1 primarily consist of water chemistry analytical data and water-level data from monitoring, injection, and collection wells originally presented in HMC's 2016 and 2020 Annual

Monitoring Reports/Performance Reviews (annual reports). The current monitoring program consists of several hundred wells, most of which monitor the alluvial aquifer. The other wells in the program are in the Upper, Middle, and Lower Chinle aquifers, and the SAG aquifer. Sampling is conducted at least annually. Some wells are sampled more frequently.

Groundwater monitoring is used to characterize the hydraulic flow regimes of the aquifers and contaminant plumes, evaluate performance of the restoration activities, and demonstrate progress made in restoring groundwater to meet NRC cleanup levels. Uranium and selenium are the most widespread contaminants above NRC cleanup levels at the Site. Therefore, the groundwater monitoring data review focuses on uranium and selenium concentrations and distributions within each aquifer. Other key constituents currently detected above NRC cleanup levels beyond the footprints of the LTP and STP are sulfate, total dissolved solids, chloride and molybdenum. Contaminants and radionuclides such as nitrate, radium-226, radium-228, vanadium, and thorium-230 are generally only detected above NRC cleanup levels under or near the LTP. HMC's annual reports provide a complete discussion of all groundwater constituents.

Groundwater Flow

Figures F-1 through F-5 in Appendix F are groundwater elevation maps for 2020 showing groundwater flow direction in the alluvial, Chinle and SAG aquifers. Review of the maps shows that groundwater flow directions in the alluvial and Chinle aquifers have been altered by operations of the injection/collection systems. The groundwater gradients in the alluvial and Upper Chinle aquifers in targeted areas south of the LTP have been reversed, with groundwater flowing from injection wells toward the collection wells. The groundwater gradients in the two Middle Chinle aquifers (in two separate fault blocks) have also been altered to flow toward the collection wells. These operations are consistent with the designed performance objectives of the injection/collection systems.

Alluvial Aquifer – Plume Characterization

Figures F-6 through F-18 in Appendix F present plume maps showing the distribution of uranium and selenium in the alluvial aquifer in 2016 and 2020 and the injection/collection systems that are operated at various localities at the Site for groundwater restoration. Two maps from 2015 and 2017 are also presented because they show additional data points compared to the corresponding 2016 maps. These maps are provided for comparative purposes so that progress in the cleanup effort over the last five years can be observed. Plume maps from additional years, dating back to 1976, are included in HMC's annual reports.

The uranium plume maps presented herein for the alluvial aquifer depict the overall plume extent over the entire Site, as well as three areas of detail focused on the LTP and the downgradient edge of the plume along the western and eastern channels of the alluvial aquifer.[25] The uranium plume depicted on the maps (shown by green color) represent uranium concentrations above the 0.16 mg/L NRC cleanup level.

[25] South of the HMC Facility is a bedrock high that divides the alluvial sediments and groundwater flow into a western and eastern channel.

Figures F-6 and F-7 depict the site-wide uranium plume. These maps show a slight reduction in the overall extent of the uranium plume from 2016 to 2020, specifically along the downgradient edge of the plumes in the western and eastern channel, and near the east flank of the LTP. A comparison of the uranium plume maps for the western channel (Figure F-8) shows uranium concentrations have decreased at many of the monitoring wells within the western channel from 2016 to 2020, but concentrations have also increased in a few wells. North of Valle Verde and Pleasant Valley Estates subdivisions, the uranium concentrations ranged up to approximately 0.43 mg/L for 2016 and 2020. The injection and collection systems in operation for the western channel in 2016 and 2020 are presented on Figures F-9 and F-10 to show where actual injection and extraction of water is occurring. A comparison of the 2016 and 2020 uranium plume maps for the eastern channel (Figure F-11), located south of Felice Acres subdivision, shows uranium concentrations ranged up to 0.49 mg/L in 2016 and 0.58 mg/L in 2020. Figures F-12 and F-13 depict the injection/collection systems in operation for the eastern channel in 2016 and 2020.

Maps of uranium concentrations in the alluvial aquifer beneath the LTP for 2015 and 2020 are shown on Figure F-14. A comparison of these maps indicates that the uranium concentrations have remained very high over the last five years, but overall there appears to be a decrease in the concentrations. The maximum uranium concentration detected in 2015 was approximately 75 mg/L on the eastern side of the LTP. In 2020, the maximum uranium concentration was 56 mg/L for the same area. The concentrations beneath the LTP are approximately two orders of magnitude higher than the uranium concentrations in the western and eastern channels of the alluvial aquifer. Such high concentrations are due to tailing seepage from the LTP, which continues to be a source for alluvial groundwater contamination. The tailing flushing program was discontinued at the LTP in 2015. Since then, saturation has been draining out of the pile over the last five years, with some of the tailing seepage moving downward into the alluvial aquifer beneath the pile. This is discussed in further detail in the Data Review section for OU2, below. Figure F-15 depicts the currently operating injection/collection system in the area of the LTP and STP.

Figures F-16 and F-17 depict the 2016 and 2020 selenium plume maps for the alluvial aquifer. The selenium plume is shown in green and represents concentrations exceeding the 0.32 mg/L NRC cleanup level. The maps show the main selenium plume under the LTP has not changed significantly over the last five years. An isolated pocket of higher selenium concentrations is shown south of the STP along State Highway 605. Figure F-18 shows a detailed selenium plume map of the State Highway 605 area for 2017, along with a map of the injection/collection system for the area. Any contamination migrating south in this area of the alluvial aquifer would likely be intercepted by the line of collection wells along State Highway 605. This isolated selenium plume has decreased in areal extent from 2016 to 2020. Selenium concentrations in and near the residential neighborhoods southwest of the HMC Facility are below the NRC cleanup level of 0.32 mg/L for the alluvial aquifer.

A comparison of the selenium plume maps also shows that selenium concentrations have increased in the upgradient monitoring wells north of the LTP since 2016, with concentrations ranging up to 0.44 mg/L. These higher selenium concentrations to the north are part of a large selenium plume unrelated to the Site that is moving toward the Site. This plume is being investigated as part of an ongoing CERCLA groundwater RI/FS for a portion of the San Mateo Creek Basin, referred to as the Central Study Area.

The work is being performed by HMC and two other mining companies in accordance with a November 2019 EPA administrative order (CERCLA Docket No. 06-01-20).

Alluvial aquifer restoration continues to be needed at the Site as contaminants and radionuclides exceed the NRC cleanup levels. Uranium concentrations in alluvial groundwater beyond the area of the LTP and STP continue to exceed the NRC cleanup level of 0.16 mg/L. Selenium concentrations in alluvial groundwater beyond the tailing piles also exceed the NRC cleanup level of 0.32 mg/L. The injection/collection systems currently operating for the alluvial aquifer are shown on Figure C-5 in Appendix C.

Upper, Middle and Lower Chinle Aquifers – Plume Characterization

Figures F-19 through F-24 in Appendix F show the distribution of uranium in the Upper, Middle, and Lower Chinle aquifers in 2016 and 2020. The plume definitions shown on these maps are based on the NRC cleanup level for uranium (0.18 mg/L) in the mixing zone of all three Chinle aquifers, and the different NRC cleanup levels for the non-mixing zone in each aquifer (Upper Chinle – 0.09 mg/L; Middle Chinle – 0.07 mg/L; and Lower Chinle – 0.03 mg/L). The mixing zone for each of the three Chinle aquifers is depicted on Figures C-5 through C-7 in Appendix C.

The Upper Chinle uranium plume maps show the areal extent of the 2020 plume is similar to the extent of the 2016 plume under the LTP, but slightly smaller in the area of the Felice Acres and Broadview Acres subdivisions (Figure F-19). The maps also show the area of highest uranium concentrations (greater than 10 mg/L) beneath the LTP in 2020 is reduced compared to the highest concentrations in the 2016 plume.

The Middle Chinle uranium plume maps depicted on Figure F-20 for 2016 and 2020 show two separate plumes: the first is located west of the LTP and West Fault; the second is located in the area of the Felice Acres and Broadview Acres subdivisions and Thunderbird Lane. These plumes are in separate Middle Chinle aquifers that have been separated by the faults; the aquifers are not known to be in hydraulic communication with each other. Overall, the areal extents of the plumes appear to be slightly diminished in 2020 compared to 2016, with the greatest reduction in the area of Felice Acres subdivision and Thunderbird Lane. Figures F-21 and F-22 show an enlargement of the uranium plume map in the Felice Acres subdivision and Thunderbird Lane area for 2016, and a water-level elevation map for the same area for 2016. The injection and collection wells in operation are depicted on both maps. The water-level elevation map shows a cone of depression[26] of the water levels, which is caused by pumping at the collection wells. The cone of depression indicates that groundwater and the uranium plume are flowing toward the collection wells from every direction, hence effectuating hydraulic control and plume capture for that specific area of the aquifer. Figure F-23 depicts the same area of enlargement of the uranium plume for 2020, where a reduction in the size of the plume is apparent compared to the 2016 plume map. The reduction is a direct result of the injection and collection well operation.

[26] A cone of depression is the drawdown or lowering of the water levels (in unconfined aquifers) or pressure head (in confining aquifers) surrounding a pumping well, with the degree of drawdown diminishing as the distance from the pumping well increases.

Lower Chinle uranium plume maps for 2016 and 2020 are depicted on Figure F-24. A comparison of the two maps show a general decrease in the uranium plume magnitude over the last five years of operations.

Plume maps for selenium in the Chinle aquifers are not included due to the limited number of wells that had reported selenium concentrations above the cleanup level in 2020. Selenium concentrations, in 2020, were less than the cleanup level in all Upper Chinle wells, except for wells near the southern part of the LTP. None of the sampled subdivision wells contained selenium concentrations above the NRC cleanup level.

San Andres-Glorieta Aquifer Monitoring

The SAG aquifer and the alluvial aquifer are known to be hydraulically connected where they are in direct contact with each other in an area southwest of the HMC Facility. The area of hydraulic connectivity is downgradient to the area where the alluvial aquifer is impacted by Site contamination, based on the current cleanup levels established by NRC. The SAG aquifer is not known to be in direct contact with the Chinle aquifers at the Site and, therefore, it is not known to be in hydraulic communication with the Chinle aquifers.

The SAG aquifer has been used as a source for freshwater injection into the alluvial and Chinle aquifers at the Site. As a result, HMC established a monitoring program for the aquifer. During this FYR period, multiple SAG wells were abandoned because of well casing integrity issues and replacement wells were installed. HMC samples the SAG wells quarterly, semi-annually, or annually, depending on the well. Figure F-25 in Appendix F presents selenium, uranium, and other constituent concentrations in SAG wells from 2020. Figure F-25 also includes historical data from other wells that have since been abandoned or were not sampled in 2020 (*e.g.,* well 951).

Uranium concentrations were generally low in all SAG wells monitored in 2020, with the highest concentration of 0.032 mg/L detected in well 951. This concentration is slightly above the federal MCL of 0.03 mg/L for uranium. Selenium concentrations in the SAG aquifer vary from 0.004 mg/L in well 938 to 0.031 mg/L in well 907. These detected concentrations are below the federal MCL of 0.05 mg/L for selenium.

The 2020 RI Report noted that historical uranium milling operations at the DOE Bluewater Disposal Site released uranium to the SAG aquifer. The uranium concentrations detected at well 951, which was pumped for a number of years by HMC to supply SAG water for the injection program, may be the result of these releases.

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

This FYR considered data from annual inspections of the STP, LTP, pond dikes, slopes and evaporation ponds, and the radon flux surveys originally presented in the 2018, 2019, and 2020 annual reports. The 2016 FYR previously evaluated data from the tailings flushing program. Although this practice ended in July 2015, this FYR included a review of the tailing water quality and water-level changes in the LTP since cessation of the flushing program, as the LTP remains a source of tailing seepage to groundwater.

Condition of Tailing Piles and Evaporation Ponds

The 2018, 2019, and 2020 annual Engineer of Record (EOR) inspections of the tailing piles and evaporation ponds[27] found that they were in generally stable condition. Evidence of animal burrows, rilling[28] and a sinkhole were observed on the LTP. Rilling, significant slumps, and benching under the liner at Evaporation Pond No. 1 were observed at the STP. The annual EOR inspection reports, which are appended to the HMC annual reports, include recommendations for addressing these issues. The recommendations are primarily related to erosion control and drainage management. HMC submitted a design report to NRC for relining the aging evaporation pond in December 2018. HMC anticipated replacement of the liner in 2020, but this work was postponed due to the Covid-19 pandemic.

Radon Flux Measurements at Tailing Piles

Radon flux at the LTP and STP is measured by HMC as part of the annual review of the radiation protection program (As Low As Reasonably Achievable [ALARA] Audit).[29] The ALARA Audit includes radiological survey and sample data.

Average radon flux measurements for the LTP from 2016 through 2020, measured in picocuries per square meter per second (pCi/m^2/s), are as follows:

2016 – 21.7 pCi/m^2/s;
2017 – 46.6 pCi/m^2/s;
2018 – 51.3 pCi/m^2/s;
2019 – 35.4 pCi/m^2/s;
2020 – 22.5 pCi/m^2/s.

All of these measurements are above the 20 pCi/m^2/s limit specified at 10 CFR Part 40, Appendix A, Criterion 6. The 2018 annual EOR inspection noted that HMC requested a variance to the radon flux standard from NRC in 2017 since the existing groundwater treatment system and monitoring wells on top of the LTP prevent placement of a final radon barrier, and a dose assessment by modeling indicated that a variance would not result in exceedances of public dose limits. HMC performs such dose assessment by measuring radiation levels at the NRC license boundary and at monitoring locations representative of the nearest resident, and comparing those data to background monitoring stations to determine radiological levels sourcing from facilities and operations. NRC is currently conducting a review of this matter, and has indicated to HMC in June 2020 that corrective actions are not required until the NRC review is complete.

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[27] Annual Engineer of Record inspections are performed by HMC and it's contractor to inspect the stability and functionality of the tailing impoundments and evaporation ponds. The inspections are required by NRC Source Materials License SUA-1471, Condition 12, and NMED Discharge Permit DP-200, Condition 52i.

[28] Rilling is the forming of narrow, straight or sinuous channels or gullies by soil erosion.

[29] Annual ALARA Audits are required by NRC Source Materials License SUA-1471, Condition 42 and NRC Regulatory Guide 8.31.

The average radon flux measurements at the STP from 2016 through 2020 are as follows:

2016 – 7.9 pCi/m^2/s;
2017 – 3.5 pCi/m^2/s;
2018 – 12.7 pCi/m^2/s;
2019 – 10.5 pCi/m^2/s;
2020 – 4.6 pCi/m^2/s.

All of the average flux levels measured at the STP are below the radon flux limit of 20 pCi/m^2/s. Although the STP met the required standard, HMC placed about 6 inches of additional fill along the crest of the Evaporation Pond No. 1 east embankment in response to elevated radon flux measurements in this area.

The 2020 RI Report presents additional history of radon flux measurements at the LTP and STP, beginning in 2003.

Annual Radon Gas Monitoring

Radon gas concentrations in ambient air are monitored by HMC at nine locations on the HMC Facility and the perimeter of the NRC license boundary. Average annual radon concentrations measured at these nine locations for the years 2016 through 2020 are shown on Table 6. The locations of the monitoring stations are shown on Figure 4. Radon monitoring stations HMC4 and HMC5 are located along the NRC license boundary between the LTP and STP and the neighboring subdivisions to the southwest of the HMC Facility. Station HMC16 is the designated background radon monitoring station located northwest of the Facility.

The measured radon concentrations are used by HMC in calculating the total effective dose equivalent[30] (TEDE) of radiation to the nearest resident. HMC calculates the TEDE by adding the net doses from exposure to radon, inhalation of airborne particulates, and from direct gamma radiation. The TEDE at HMC4 and HMC5 is below the NRC standard of 100 millirems per year for public exposure, specified at 10 CFR Part 20.1301.

Table 6: Annual Average Radon Gas Concentrations

Location	Annual Average Radon Gas Concentration (pCi/L)				
	2016	2017	2018	2019	2020
HMC-1	0.91	0.73	0.80	0.70	0.83
HMC-1A	0.94	0.62	0.73	0.63	0.73
HMC-2	0.97	0.72	0.93	0.77	0.86
HMC-3	0.72	0.57	0.71	0.57	0.63
HMC-4	1.1	0.71	0.89	0.73	0.77
HMC-5	0.91	0.68	0.84	0.63	0.76
HMC-6	0.92	0.69	0.69	0.58	0.65

[30] Total effective dose equivalent is a radiation dose quantity defined by the NRC to monitor and control human exposure to ionizing radiation.

HMC-7	0.85	0.69	0.81	0.65	0.74
HMC-16	0.49	0.32	0.35	0.34	0.41

Source: HMC 2020 Annual Report

Tailing Water Monitoring

The tailing water monitoring program includes LTP wells, toe drains, and sumps to monitor tailing water quality and water-levels conditions. Figure F-26 in Appendix F is a water-level elevation map for 2020 showing the locations of these features and the area of saturation within the tailing material. The water-level contours define two mounds of tailing water. Figure F-27 in Appendix F includes a cross section through a portion of the LTP showing the location of the fine-grained tailing (slimes) within the interior of the pile and the coarse-grained tailing (sands) along the perimeter of the pile.[31] The zone of saturated tailing is depicted on the cross section at the base of the pile. A map of the cross-section location relative to the position of the LTP is included on Figure F-27.

Figure F-28 in Appendix F is a graph of the yearly quantity of tailing water and uranium removed from the LTP from 2000 to 2020. The graph shows a significant decrease in the quantities of water and uranium removed since the cessation of the tailing flushing program in 2015 and tailing dewatering (pumping) operations in 2018.

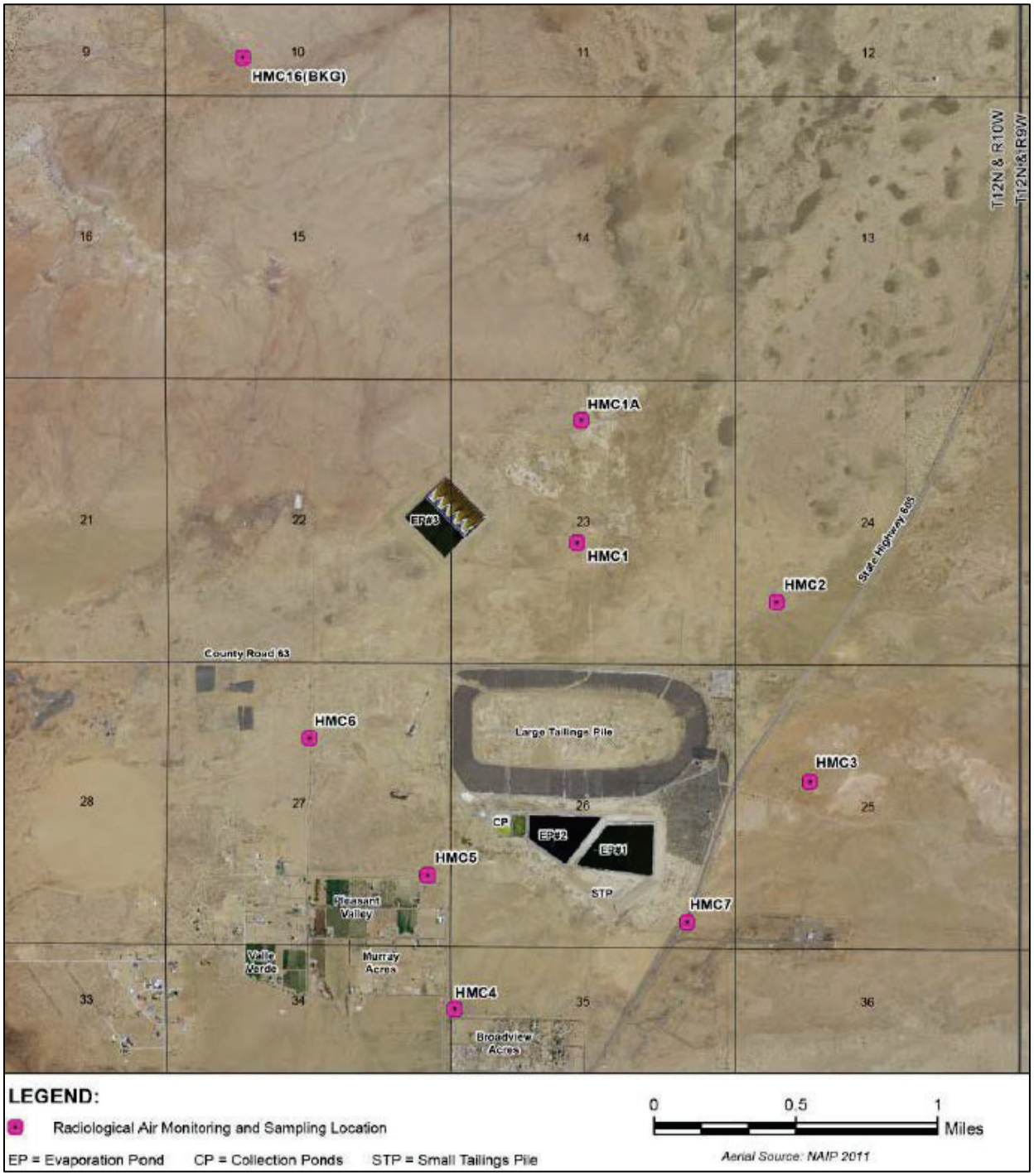
An overall decline in tailing water levels has been observed in the LTP since 2015, when the tailing flushing program was discontinued. Figure F-29 in Appendix F shows a graph of water-level changes for several tailing wells from 2009 to 2020. The graph depicts a dramatic decline in the water levels beginning in 2015. This decline represents the expected drain down of tailing water from the pile with the cessation of tailing flushing. The observed rate of the water-level decline is greatest in the first year or two after cessation of flushing and gradually slows to approximately 1-2 feet for the year 2020.

The largest water-level declines occur mostly along the central sand dike and the perimeter sand dike where the permeability of the tailing material is highest. In contrast, the two water-level mounds, depicted on Figure F-26, are present in the lower permeability slime areas east and west of the central sand dike. Each mound has a saturated thickness of approximately 50 feet. Because there has been no recent tailing flushing over the last few years, the changes in tailing water levels are almost entirely the result of water exchange between the slimes and sands and drainage from the pile. An analysis by HMC of the water volume change in the saturated tailing of the LTP indicates a reduction of approximately 7,356,000 gallons in 2020, which equates to a reduction of approximately 14 gpm. The total discharge from the toe drains during 2020 was approximately 5 gpm. Subtracting the toe drain discharge from the water volume change leaves about 9 gpm of the water volume change that was discharged from the LTP as seepage to groundwater. Taking into account infiltration of precipitation (estimated at 2 gpm), the effective seepage rate is approximately 11 gpm. This equates to approximately 5,765,760 gallons of

[31] HMC's method of tailing deposition using a cyclone resulted in the segregation of the fine-grained slimes with much lower permeability within the interior of the LTP and the coarse-grained sands with higher permeability along a central dike and on the perimeter of the LTP.

tailing seepage to groundwater per year. A detailed discussion of the water balance at the LTP is presented in HMC's 2020 annual report.

Figure 4 – Radiological Air Monitoring and Sampling Location Map



Source: HMC 2020 RI Report

Uranium is a key water quality indicator for tailing water. A series of uranium concentration maps are presented in the HMC 2020 annual report to show changes in uranium concentrations in tailing water over time, beginning in 2000 when the tailing flushing program was initiated. The uranium concentration maps for 2000, 2015, and 2020 are included in this FYR report for comparative purposes (*see* Figures F-30 and F-31 in Appendix F). These figures show a decline in uranium concentrations during the tailing flushing program.

In the HMC 2020 annual report, a series of graphs are presented of uranium, molybdenum, and selenium concentrations over time for select tailing wells at the LTP. The graphs show that the concentrations of these constituents in tailing water have stabilized after flushing ended. Several of these graphs are included in Appendix F of this FYR report. Figures F-32 and F-33 show two graphs for the sand tailing wells from 2004 to 2020 and 2016 to 2020. Figures F-34 and F-35 show two graphs for the slime tailing wells from 2006 to 2020 and 2016 to 2020. Figure F-36 depicts a map of the tailing well locations. The graphs show the concentrations of uranium, selenium, and molybdenum decreased significantly during active flushing of the LTP, but they have been relatively stable for many of the wells since discontinuation of the flushing program in 2015 and the tailing dewatering program in 2017, while some concentrations actually increased slightly. Although it was assumed that a rebound in contaminant concentrations could occur after the flushing program, HMC does not consider the recent increases to be significant, based on the water quality data collected.

OU3 – Radon in Neighboring Subdivisions

No new data have been collected from the neighboring subdivisions during this FYR period.

Site Inspection

Due to the COVID-19 pandemic, EPA did not conduct a site inspection for this FYR. However, EPA visited the Site in 2019 to review borehole geologic data obtain during the HMC supplemental background study and to tour the R.O. treatment plant, full-scale zeolite filtration system, and other areas of the HMC Facility. No issues related to protectiveness of the remedy were observed during the site visit. Appendix G includes photographs taken during the 2019 visit.

V. TECHNICAL ASSESSMENT

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

Question A Summary:

This FYR does not include a technical assessment for OU1 or OU2 because a CERCLA remedy has yet to be selected and documented in a ROD for those operable units. The current reclamation and closure activities and groundwater corrective action at OU1 and OU2 are conducted pursuant to UMTRCA, NRC License SUA-1471, and NMED Groundwater Discharge Permit DP-200. EPA will select a CERCLA

remedy for OU1 and OU2 following completion of the CERCLA RI/FS equivalency process and the formal public, tribal, and state participation processes for CERCLA remedy selection.

OU3 – Radon in Neighboring Subdivisions

There is no CERCLA remedy for OU3 because EPA selected "no further action" in the 1989 ROD. However, EPA conducted additional investigations in and near the neighboring subdivisions between 2010 and 2014 in response to community concerns. Data from the investigations were used to perform the supplemental HHRA-Subdivisions and to identify residences where removal actions to mitigate soil contamination and radon levels in indoor air were necessary to protect human health.

Although EPA's investigations found no significant difference between the annual indoor air radon levels at the five neighboring subdivisions and the background annual indoor air radon levels at Bluewater Village, EPA elected to install radon mitigation systems in 11 homes with radon levels above EPA's recommended action guideline of 4 pCi/L in 2012; one additional homeowner declined to have a mitigation system installed. The mitigation systems are reducing indoor air radon concentrations in these homes to levels below 4 pCi/L. Homeowners with radon mitigation systems have been instructed to contact the installer for servicing any repairs beyond the warranty period. Radon mitigation systems are known to operate without any maintenance problems for many years before the motor in the unit wears out.

EPA also conducted a removal action in 2014 to address radioactive contaminated soil at 16 residential properties and radioactive discrete material at two more residential properties. The removal action was successful in achieving the soil cleanup level of 3.5 pCi/g established by EPA for radium-226. EPA determined that the radiological contamination in the soil and debris was unrelated to the Site, but elected to conduct the removal action to protect human health.

EPA's HHRA-Subdivisions identified site-related risks, as well as background-related risks, for residential exposure to radionuclides (radon gas) in ambient air that exceeded EPA's acceptable excess lifetime cancer risk range of 10^{-4} to 10^{-6} and NMED's lifetime cancer threshold value of 10^{-5}.

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

<u>Question B Summary:</u>

As a CERCLA remedy has yet to be selected and documented in a ROD for OU1 and OU2, cleanup levels and remedial action objectives have yet to be defined by EPA under its CERCLA authority. Therefore, no response is provided to Question B for OU1 and OU2.

OU3 – Radon in Neighboring Subdivisions

EPA issued a "no further action" ROD for radon in 1989. However, after community members raised concerns about potential exposure to site contamination in 2009, EPA elected to conduct a field

investigation and perform a supplemental risk assessment for the subdivision. The HHRA-Subdivisions was completed in 2014. The risk assessment evaluated land-use exposure scenarios for the resident and subsistence farmer at the Valley Verde, Pleasant Valley Estates, Broadview Acres, Murray Acres, and Felice Acres subdivisions. The risk assessment identified chemicals and radionuclides of concern and the pathways and routes of exposure. It also quantitatively estimated the potential excess lifetime cancer and non-cancer risks. The HHRA-Subdivisions had the following findings:

- Indoor radon gas levels exceeded EPA's recommended 4 pCi/L action guideline at several homes within the five subdivisions. They were similar to levels measured at the indoor radon background location.
- Cancer risk to the current and future resident and subsistence farmer from exposure to radionuclides in ambient air is above EPA's acceptable excess lifetime cancer risk range of 10^{-4} to 10^{-6} and NMED's lifetime cancer risk threshold level of 10^{-5}. Most of the risk is attributable to background concentrations of radon. However, after factoring out background risks, the site-related risk is still above EPA's cancer risk range and NMED's cancer threshold level.
- Cancer risk to the current and future resident and subsistence farmer from exposure to radionuclides in soil is above EPA's acceptable cancer risk range of 10^{-4} to 10^{-6} and NMED's cancer threshold value of 10^{-5}. However, when risk attributable to background is factored out, cancer risks are within the EPA acceptable cancer risk range and slightly above NMED's cancer threshold value. Based on sample data, EPA determined that the soil contamination in the subdivisions was not attributable to the Site.
- Cancer risk to the current and future resident and subsistence farmer from exposure to radionuclides in untreated groundwater used for domestic purposes is above EPA's acceptable cancer risk range and NMED's cancer threshold value.

EPA conducted two separate removal actions to mitigate radon in indoor air and radium-226 in residential yard soils to protect human health. Neither of these impacts are associated with the Site and they will not be discussed further in response to Question B.

Risk Assessment Exposure Assumptions

The exposure assumptions used at the time of the 1989 ROD for "no further action" were updated in the 2014 HHRA-Subdivisions. A review of the updated assumptions show they are still valid. There are residents currently living in the five subdivisions. Some of these residents continue to consume homegrown produce from gardens, including squash, tomatoes, corn, and lettuce. Some residents continue to raise a few cattle on their properties for meat consumption. The cattle graze in pastures for most of the year and are fed hay that is bought during the two to three winter months. The pastures are irrigated from a community supply well screened in the SAG aquifer.

All residences within the subdivisions are connected to the Milan municipal water supply distribution system (as part of a response action for OU1). This response action was taken to abate risks from exposure to contaminants in groundwater. Although there is currently no known groundwater exposure pathway, EPA elected to assess the potential future risk to groundwater exposure for the resident and

subsistence farmer in the 2014 risk assessment because an assumption was made that a new resident might decide to install a water well and use it for drinking or other domestic purposes. There is a NM-OSE drilling prohibition to prevent the construction of new water wells. However, it is still possible that a future resident may install a water well in violation of the drilling prohibition.

Toxicity Data

A review of the toxicity data used for the 2014 HHRA-Subdivisions shows some values have changed since 2014, and there are new data for some chemicals and radionuclides when none were available in 2014. These data changes are described below. The complete results of the toxicity data review are presented in Tables H-1 through H-6 in Appendix H.

- Oral reference dose used for ingestion toxicity of uranium (total) changed from 3.0E-3 to 2.0E-4 milligrams per kilogram per day (mg/kg-day), a more stringent value for risk calculations.
- External Exposure Cancer Slope Factor for radium-228 + decay products changed from 1.2E-3 to 4.53E-6 (in units of risk/year per pCi/g), a less stringent value for risk calculations.
- Available new inhalation reference concentrations are:
    - Molybdenum – 2.0E-3 mg/m^3;
    - Vanadium – 1.0E-4 mg/m^3;
    - Uranium (total) – 4.0E-5 mg/m^3.

Updated EPA Rad PRG Calculator

A reassessment of the estimated cancer risks to the resident and subsistence farmer from exposure to radon in ambient air is needed to verify the results of the 2014 risk assessment. EPA uses a computerized mathematical model (electronic calculator) for conducting radiation risk assessments and developing PRGs for radionuclides at CERCLA sites (EPA OSRTI Directive 9200.4-40). The EPA's electronic calculator, known as the Rad PRG Calculator, was updated in October 2020. A new PRG output option, called peak PRG, was added to the Rad PRG Calculator and is now the default PRG option for use at CERCLA sites.[32] However, the Rad PRG Calculator approach for assuming that all potential radioactive progeny (decay products or daughters) are present at the same concentrations as the parent radionuclide (*i.e.,* secular equilibrium) may not be appropriate for the air medium at the Site. The reason is that several of the progeny are heavier radionuclides that will likely drop out of the air and not be transported far from their sources. These heavier progeny, specifically lead-210 and heavier radionuclides, should be removed from the calculation of total risk. Therefore, the risk calculations for various radionuclides in decay

[32] The peak PRG option calculates the activity of the parent radionuclide to be protective of the peak excess lifetime cancer risk for the entire chain of decay products (progeny or daughters) over time. For waste profiles that contain a refined radionuclide product with a relative long half-life, the progeny may present more excess lifetime cancer risk in the distant future than the parent in the present. By modeling the decay of the parent, with the ingrowth of all progeny, a protective peak PRG can be calculated and used to compare against current monitoring or sample data for the protection of future receptors. The benefits of using the peak PRG option are that future dates of peak excess lifetime cancer risk are known.

chains should be made separately and a "sum-of-the-fractions" approach used for determining total risk for radon in ambient air.

To summarize the response to Question B for OU3, the changes to the toxicity data used in the 2014 risk assessment and the new toxicity data that are available for risk assessment calculations could potentially change the results of the risk assessment for radon in ambient air at the subdivisions. Additionally, the use of the updated EPA Rad PRG Calculator and the sum-of-the-fractions approach for estimating risk from radon in ambient air could also change the results. An updated risk assessment for OU3 that specifically focuses on radon in ambient air would inform the ongoing CERCLA FS and remedy selection process for OU1 and OU2, which includes the reclamation and closure of the LTP as part of OU2. The LTP currently remains a source of radon flux without the final radon barrier placed on its top. Response actions to be taken under the NRC authority, such as placement of the final radon barrier on the top of the LTP, should reduce radon emissions coming off the LTP.

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

No other information has come to light that could call into question the protectiveness of the remedy.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations	
Issues and Recommendations Identified in the FYR:	
OU(s): OU3	**Issue Category: Other**
	Issue: EPA selected "no further action" in a 1989 a record of decision for radon contamination in neighboring subdivisions. From 2010 to 2014, EPA conducted additional investigations and performed a supplemental human health risk assessment for the subdivisions. A review of the toxicity data used in the 2014 risk assessment shows that not all of the data are still valid and that there is new toxicity information relevant to the risk assessment. Additionally, the computerized mathematic model (electronic calculator) used by EPA for conducting radiation risk assessments for radionuclides at CERCLA sites has been updated in October 2020. Furthermore, EPA has determined that the calculation of risk from exposure to radionuclides in ambient air should include separate calculations of risk for the lighter radionuclides in the decay chain and the use of a "sum-of-the-fractions" approach for determining total risk.
	Recommendation: Update the baseline human health risk assessment for radon in ambient air in the neighboring subdivisions using the current toxicity data and the updated EPA Rad PRG Calculator. For the update, include separate calculations for the various lighter radionuclides and use a "sum-of-the-fractions" approach for determining total risk. This updated risk assessment will inform the ongoing CERCLA feasibility study and remedy selection process for OU1 and

	OU2, including response actions for controlling site-related sources of radon contamination.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Yes	Yes	EPA		10/31/2022

OTHER FINDINGS

The following are recommendations that may improve site management but do not affect current and/or future protectiveness:

- The EPA Remedial Project Manager was unable to conduct a FYR site inspection due to travel restrictions related to COVID-19 and the last site visit was in 2019. When restrictions allow, EPA will visit the site to confirm current conditions.
- In order to improve community engagement and understanding of the CERCLA process for communities near the Site, an updated Community Involvement Plan that includes additional community outreach activities will be implemented.
- EPA will offer to meet with tribal governments at least annually to ensure newly elected tribal leadership is informed of the current status of site-related CERCLA activities.

VII. PROTECTIVENESS STATEMENTS

A CERCLA remedy has not yet been selected and documented in a ROD for OU1 and OU2; therefore, EPA will not be assessing the protectiveness of OU1 and OU2 in this FYR. As noted herein, EPA will select a CERCLA remedy for OU1 and OU2 in a ROD following completion of the CERCLA RI/FS equivalency process and the formal public, tribal, and state participation processes for CERCLA remedy selection. Protectiveness determinations for OU1 and OU2 will be made in future FYRs, as appropriate, following CERCLA remedy implementation. A protectiveness determination and statement are included for OU3 in this section.

Protectiveness Statement		
Operable Unit: OU3	*Protectiveness Determination:* Protectiveness Deferred	*Planned Addendum Completion Date:* 10/31/2022
Protectiveness Statement: A protectiveness determination for OU3 at the Homestake Mining Company Superfund site cannot be made at this time until further information is obtained. Further information will be obtained by updating the 2014 human health risk assessment for radon in the neighboring subdivisions using new toxicity data and EPA's updated electronic calculator for assessing risk from radionuclides. It is expected that this action will take approximately one year to complete, at which time a protectiveness determination will be made.		

Sitewide Protectiveness Statement	
Protectiveness Determination: Protectiveness Deferred	*Planned Addendum Completion Date:* 10/31/2022
Protectiveness Statement: A site-wide protectiveness determination of the remedy at the Homestake Mining Company Superfund site cannot be made at this time until further information is obtained. Further information will be obtained by updating the 2014 human health risk assessment for the neighboring subdivisions, primarily for radon in ambient air, using new toxicity data and EPA's updated electronic calculator for assessing risk from radionuclides. It is expected that this action will take approximately one year to complete, at which time a protectiveness determination will be made.	

VIII. NEXT REVIEW

The next FYR Report for the Homestake Mining Company Superfund site shall be completed five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

2015 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 2016.

2016 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 2017.

2017 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 2018.

2018 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 2019.

2019 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 2020.

2020 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 2021.

Administrative Settlement Agreement and Order on Consent for Feasibility Study. Homestake Mining Company Site, Cibola County, New Mexico. CERCLA Docket No. 06-03-20. August 12, 2020.

Comprehensive Five-Year Review Guidance. Prepared by U.S. EPA. EPA 540-R-01-007. June 2001.

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

Differentiating Anthropogenic and Natural Sources of Uranium by Geochemical Fingerprinting of Groundwater at the Homestake Uranium Mill, Milan, New Mexico, USA. By Johanna M. Blake, Philip Harte and Kent Becher, USGS. Published online in Environmental Earth Sciences; 78:234. June 29, 2019.

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

Draft Groundwater Corrective Action Program, Homestake Mining Company of California, Grants Reclamation Project. Prepared by HMC. December 2019.

Evaluation of Water Quality in Regard to Site Background Standards at the Grants Reclamation Project. Prepared by Arcadis U.S., Inc. September 2018.

Final Remedial Investigation Report, Homestake Mining Company Superfund Site, Operable Unit 1: Tailings Seepage Contamination of Groundwater Aquifers, Operable Unit 2: Long-term Tailings Stabilization, Surface Reclamation and Site Closure. Prepared by HDR. March 30, 2020.

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

Fourth Five-Year Review Report for Homestake Mining Company Superfund Site, Cibola County, New Mexico. Prepared by USEPA Region 6. September 2016.

Geochemical Conceptual Site Model and Batch-Equilibrium Modeling of Groundwater at Monitoring Well DD, Homestake National Priorities List Site, New Mexico. Prepared by Pat Longmire, New Mexico Environment Department. May 2021.

Grants Reclamation Project, 2015 San Andres Well Integrity Testing. Prepared by Hydro-Engineering, L.L.C. for Homestake Mining Company. December 2015.

Grants Reclamation Project, 1st Quarter 2016 San Andres Well Integrity Testing. Prepared by Hydro-Engineering, LLC. March 2016.

Homestake Mining Company, Grants Reclamation Project, License Source Materials License SUA-1471, Docket Number 40-8903; NMED Discharge Permit DP-200: 7-Day Notification of Unauthorized Discharge from Injection Wellfield. Prepared by Homestake Mining Company of California. December 2019.

Homestake Mining Company, Grants Reclamation Project, License Source Materials License SUA-1471, Docket Number 40-8903; NMED Discharge Permit DP-200: NMED 15-Day/NRC 30-Day Corrective Action Report for Unauthorized Discharge from Off-site Well. Prepared by Homestake Mining Company of California. September 2020.

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.

Review of 2006 Background Evaluation Completed by Homestake Mining Company of California (HMC), Environmental Resources Group, and Hydro-Engineering for the HMC Grants Reclamation Project, Grants, New Mexico. Prepared by Arcadis, U.S., Inc. September 2019.

San Andres Well 943M Completion Report. Prepared by Homestake Mining Company of California. January 2018.

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

Supplemental Background Soil and Groundwater Investigation Report, Grants Reclamation Project, Cibola County, New Mexico. Prepared by Arcadis. April 2019.

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 CHRONOLOGY

Table B-1: Site Chronology

Event	Date
Uranium mill operations began at the Homestake Mining Company of California (HMC) Facility Atomic Energy Commission began regulatory authority of operations at the HMC Facility under License SUA-708	1958
Regulatory authority of uranium mill operations was granted to the New Mexico Environmental Improvement Board	1974
A state of New Mexico (State) and EPA study identified selenium contamination in groundwater near the HMC Facility	1975
The State 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 affected residents	1976
HMC began groundwater restoration activities at the Site	1977
EPA listed the Site on the NPL EPA and HMC signed a settlement agreement, requiring HMC to pay for an extension of the Milan municipal water supply distribution system to four residential subdivisions, and to pay for the water service for 10 years	1983
The State approved a groundwater discharge plan (Operable Unit 01 or OU1)	1984
HMC constructed the west and east collection ponds in support of water treatment operations	1985
HMC installed the extension of the Milan municipal water supply distribution system to Broadview Acres, Felice Areas, Murray Acres and Pleasant Valley Estates subdivisions (OU1)	1986
The State returned regulatory authority of the HMC Facility to the U.S. Nuclear Regulatory Commission (NRC) The NRC granted the facility License SUA-1471	1986
EPA issued an Administrative Order on Consent to HMC to conduct an RI/FS for the radon OU (OU3) HMC began the Remedial Investigation/Feasibility Study (RI/FS)	1987
HMC finished the OU3 RI/FS EPA issued a “no further action” ROD for OU3 HMC submitted an updated Corrective Action Plan (CAP) for groundwater remediation to the NRC (OU1)	1989
Uranium milling operations at the HMC Facility ended HMC constructed evaporation pond 1 to assist in dewatering the Large Tailing Pile (LTP)	1990
HMC began reclamation activities to clean up soils and decommission the mill HMC submitted a reclamation plan to the NRC	1992-1993
EPA and the NRC signed a Memorandum of Understanding detailing each agency’s responsibility and authority at the Site	1993
HMC completed demolition of the mill and surface reclamation activities (OU2) HMC constructed evaporation pond 2 and completed installation of an interim soil cover on the Small Tailing Pile (STP)	1995
HMC began freshwater injections in Upper Chinle well CW13 (OU1)	1996
The NRC approved the soil cleanup and mill reclamation (OU2) HMC added Reverse Osmosis (RO) water treatment to the groundwater restoration program (OU1)	1999
HMC began the flushing program for the LTP (OU2) and use of land treatment areas (LTAs)	2000
EPA issued Site’s first Five-Year Review (FYR) Report	2001
HMC added a second RO unit to the treatment plant to increase RO treatment capacity from 300 gallons per minute (gpm) to 600 gpm (OU1)	2002

Event	Date
New Mexico Environment Department (NMED) sampled residential wells in nearby subdivisions based on recommendations from the Bluewater Valley Downstream Alliance (BVDA) (OU1)	2005
EPA issued Site's second FYR Report HMC submitted an updated CAP to the NRC The NRC, EPA and NMED agreed on contaminants of potential concern (COPCs) and radionuclides of potential concern (ROPCs) and cleanup levels in groundwater	2006
EPA completed the Remedy System Evaluation, a broad evaluation that considered remedy goals, the conceptual site model, aboveground and subsurface performance, and site closure strategy	2008
NMED issued a health advisory to limit groundwater exposure NMED and HMC reached a Memorandum of Agreement for HMC to provide additional water service to residents The Agency for Toxic Substances and Disease Registry issued a Health Consultation Report NMED approved discharge plan DP-725 and evaporation pond 3	2009
EPA began a multimedia sampling effort in support of the human health risk assessment HMC constructed evaporation pond 3 north of the LTP	2010
EPA issued Site's third FYR Report	2011
EPA issued an Administrative Order on Consent to HMC HMC submitted an updated CAP to the NRC, EPA and NMED for review and approval (OU1) EPA installed radon mitigation systems at 10 residential properties, with one property owner whose residence was eligible for a system refusing mitigation efforts (OU3)	2012
HMC submitted a revised Decommissioning and Reclamation Plan to the NRC for review and approval (OU2) HMC submitted to EPA the report CERCLA Equivalency of Investigation and Remediation Efforts at the Homestake Mining Company of California Uranium Facility	2013
EPA conducted a soil/debris removal action at 18 residential properties (OU3) EPA completed a human health risk assessment (HHRA) for subdivisions (OU3) EPA initiated background reassessment for groundwater at the request of BVDA and Multicultural Alliance for a Safe Environment (MASE) EPA and NMED agreed to sample 40 private wells at the request of BVDA and MASE NMED performed private well sampling	2014
HMC completed updates to the RO treatment plant EPA engaged the U.S. Geological Survey (USGS) to conduct a groundwater background study	2015
EPA issued Site's fourth FYR Report Full-scale zeolite water treatment began USGS initiated groundwater background study HMC split groundwater samples with USGS and performed an independent background study	2016
HMC submitted white paper to EPA entitled "Evaluation of Water Quality in Regard to Site Background Standards at the Grants Reclamation Project HMC submitted a revised groundwater CAP (GCAP) to the NRC for approval	2018
HMC completed a Supplemental Background Assessment Report USGS published two papers on groundwater background study BVDA/MASE requested historical groundwater data be provided to two consultants, Dr. Tom Myers (Hydrologist) and Dr. Ann Maest (Geochemist) EPA received technical papers from Dr. Myers and Dr. Maest proposing new selenium and uranium background concentrations for groundwater	2019
Dr. Myers and Dr. Maest presented their papers to EPA and NMED and requested the agencies initiate a new background geochemistry study	2020

Event	Date
NMED conducted a PHREEQC geochemical modeling study on alluvial groundwater quality at well DD based on the BVDA/MASE request and released a modeling report EPA approved the OU1 and OU2 RI Report, prepared by HMC EPA and HMC entered into an Administrative Settlement Agreement and Order on Consent (ASAOC) for Feasibility Study (FS) HMC submitted revised draft Alternatives Development and Screening Technical Memorandum as initial phase of FS HMC submitted a draft Technical Impracticability Evaluation Report in accordance with ASAOC HMC submitted a draft FS Report in accordance with ASAOC EPA selected Site for the EPA's National Remedy Review Board (NRRB) to evaluate the CERCLA feasibility study HMC submitted written comments on NMED modeling report	
NRRB conducted a meeting with EPA Region 6; State, Acoma Pueblo, HMC, and BVDA/MASE made oral presentations to the Board and submitted written statements Laguna Pueblo also submitted written statements to the NRRB NMED released an updated geochemical modeling report NRRB submitted recommendations to EPA Region 6 on FS process and remedial alternatives being considered in the FS	2021

APPENDIX C – GROUNDWATER RESTORATION PROGRAM SUPPORTING DOCUMENTATION

Table C-1: Summary of Changes to the Groundwater Restoration System

Year(s)	Activity
1977 to 1983	Installation of multiple hydraulic containment and collection wells in the alluvial aquifer
1984	Initiation of hydraulic containment of the Upper Chinle aquifer
1990	Construction of evaporation pond 1 within the footprint of the STP to assist in the dewatering of the LTP and to hold water pumped from collection wells Installation of additional hydraulic containment and collection wells in the alluvial aquifer
1992	Installation of toe drains around the tailings
1993 to 2000	Revisions to the corrective action and monitoring well networks, including well installations and well abandonments
1996	Use of evaporation pond 2 began
1999	Addition of the RO treatment unit for extracted groundwater Use of treated water from the RO unit for hydraulic containment of the alluvial aquifer began
2000	Initiation of irrigation of 270 acres as LTAs to manage extracted groundwater
2002	Addition of 60 acres to the LTAs RO treatment plant capacity increased from 300 gpm (one unit) to 600 gpm (two units)
2002 to 2009	Revisions to the corrective action and monitoring well networks
2004 to 2005	Addition of 64 acres to the LTAs
2010	Construction and use of evaporation pond 3 began
2012	Use of LTAs ended The 300-gpm zeolite pilot treatment began
2015	Expansion of the RO treatment plant to 1,200-gpm capacity, with updates including addition of a 600-gpm low pressure skid, a 250-gpm high-pressure skid and two microfiltration skids to replace the existing sand filters
2016	Addition and startup of a 1,200-gpm zeolite treatment system for off-site groundwater
2017	Operation of LTP tailing dewatering wells was discontinued

Table C-2: Quantities of Constituents Collected On Site

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

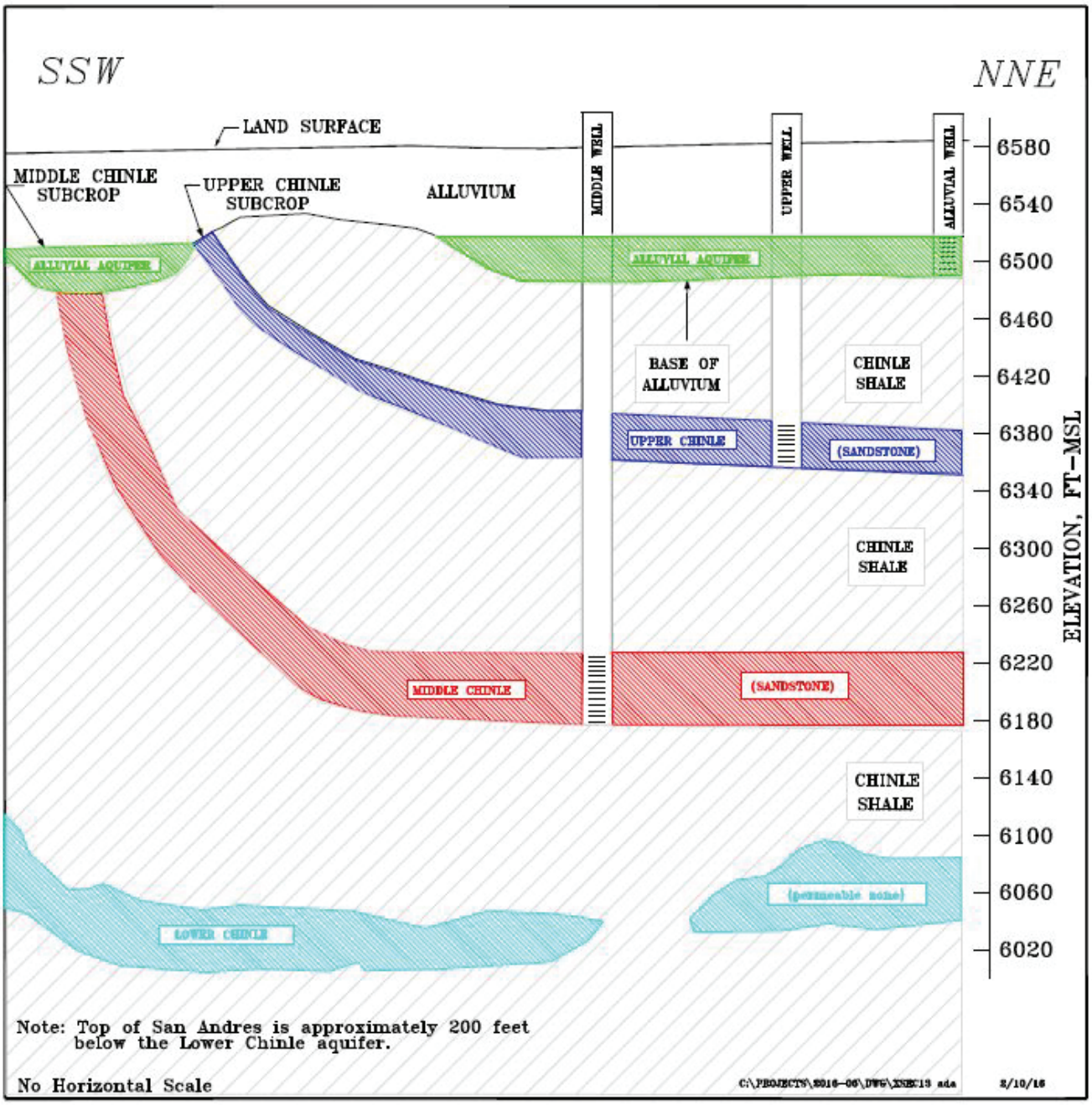
Table C-2: Quantities of Constituents Collected On Site (continued)

YEAR	SOURCE	TOTAL VOLUME PUMPED (GAL)	SULFATE (SO4) CONC. AMT. (MG/L)	(LB)	URANIUM (U) CONC. AMT. (MG/L)	(LB)	MOLYBDENUM (MO) CONC. AMT. (MG/L)	(LB)	SELENIUM (SE) CONC. AMT. (MG/L)	(LB)
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	1958	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
2015	G.W.	109360371	3100	2829437	10.8	9857	14.1	12869	0.83	758
2015	TOE	10222310	5252	448076	20.7	1766	41.2	3515	0.30	26
2015	TAILS	8644000	2891	208565	8.2	592	28.0	2020	0.11	8
2016	G.W.	312653024	2590	6758352	8.2	21397	14.5	37836	0.45	1174
2016	TOE	7553090	4756	299809	17.2	1085	36.7	2310	0.15	9
2016	TAILS	2678400	2891	64625	8.2	183	28.0	626	0.11	2
2017	G.W.	261047358	2104	4583987	10.5	22876	17.1	37256	0.66	1438
2017	TOE	5455170	3305	150473	13.9	633	26.9	1225	0.21	10
2017	TAILS	674300	4918	27677	14.7	83	32.5	183	0.70	4
2018	G.W.	229336854	1460	2794506	3.8	7235	5.5	10566	0.28	542
2018	TOE	4530130	4708	178002	17.5	662	36.6	1384	0.27	10
2019	G.W.	170189842	2185	3103584	7.3	10369	13.4	19033	0.49	696
2019	TOE	3024380	4959	125172	15.4	389	42.4	1070	0.20	5
2020	G.W.	156370198	2500	3262664	8.3	10858	14.3	18662	0.45	587
2020	TOE	2152800	4952	88974	16.1	289	39.7	713	0.52	9
SUM G.W.		6,229,283,043		188,668,296		1,074,329		1,321,322		68,134
SUM TOE		416,794,911		29,790,427		125,674		266,885		4,885
SUM TAILS		493,302,302		20,155,515		76,460		211,831		725
COMBINED SUM		7,139,380,256		238,614,238		1,276,463		1,800,037		73,743

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

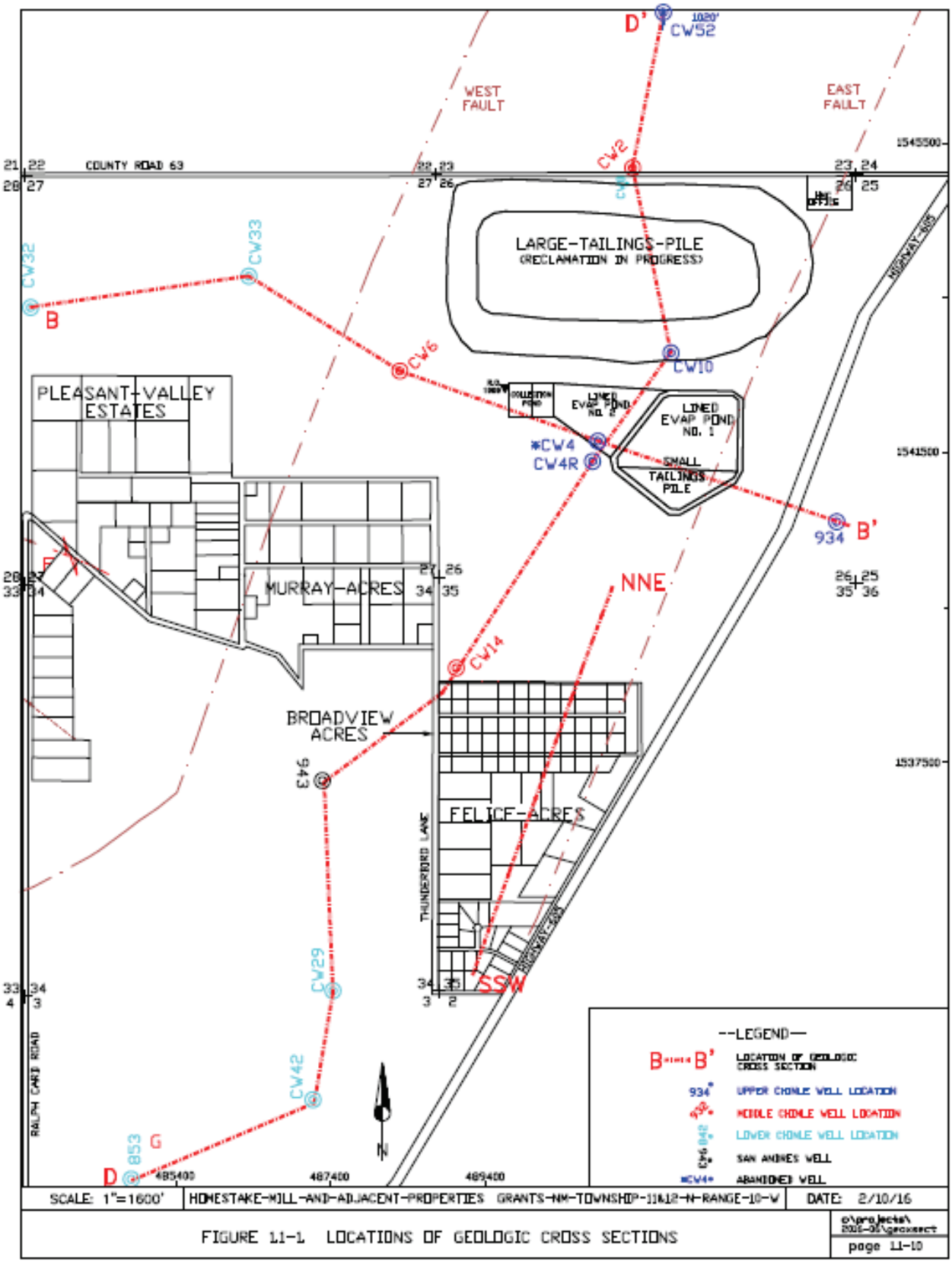
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-1: Generalized Geological Cross Section



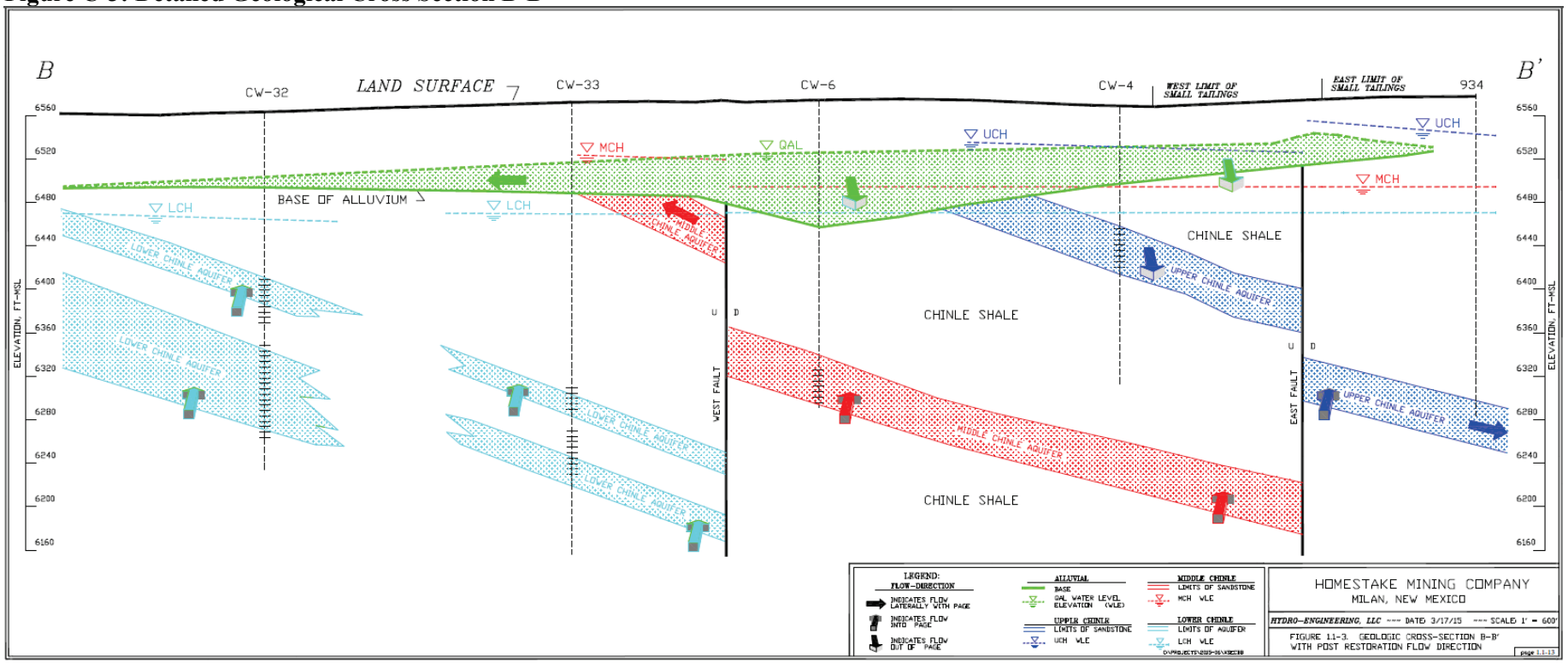
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-2: Location of Detailed Geologic Cross Sections



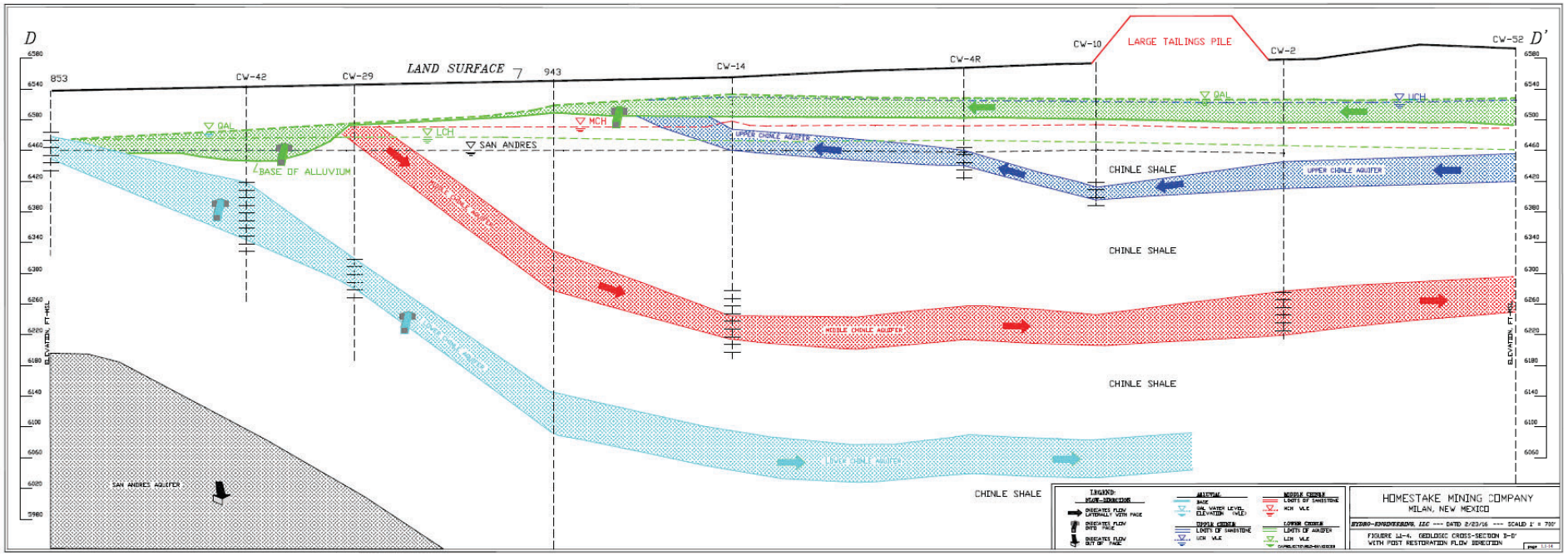
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-3: Detailed Geological Cross Section B-B'



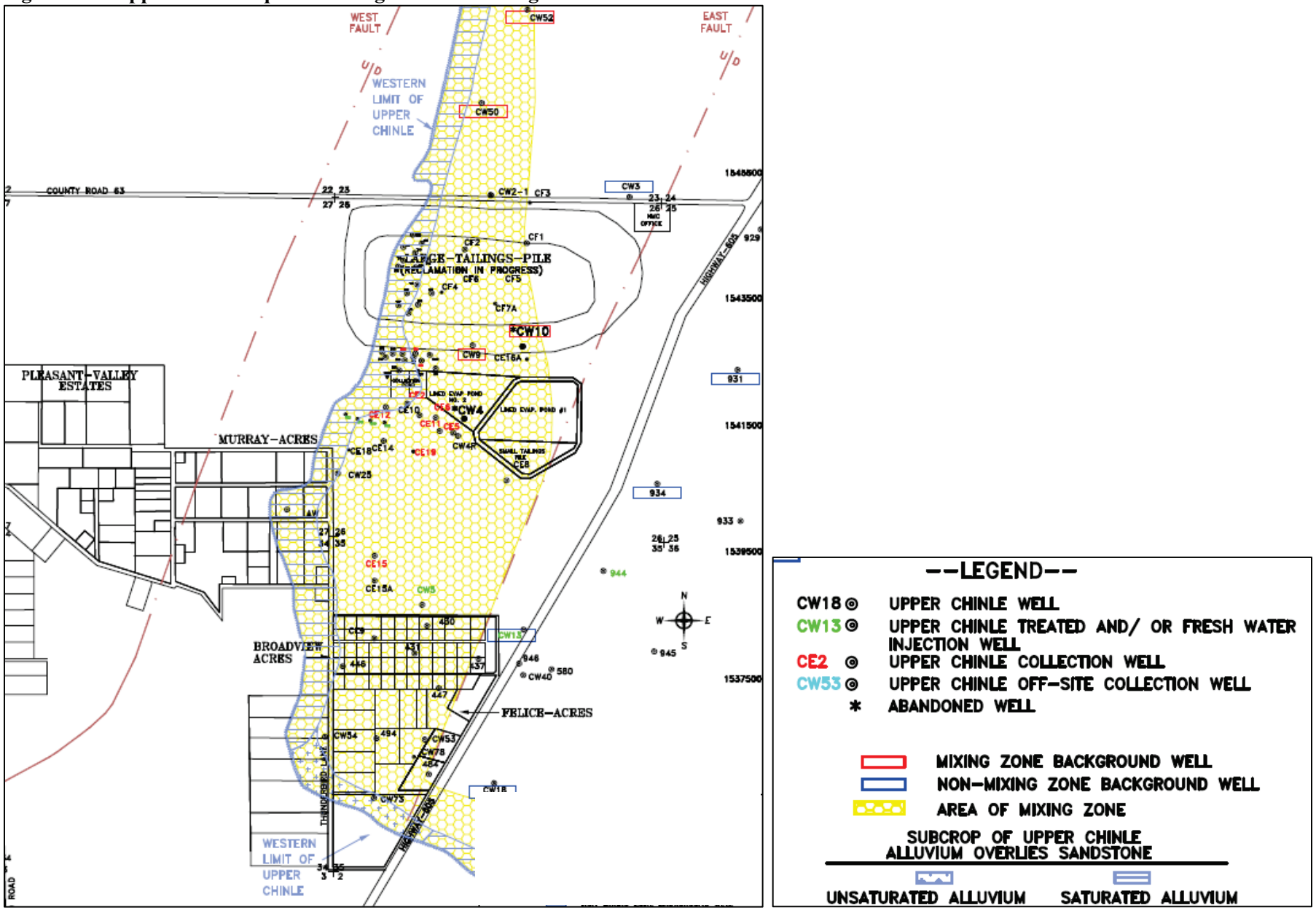
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-4: Detailed Geological Cross Section D-D'



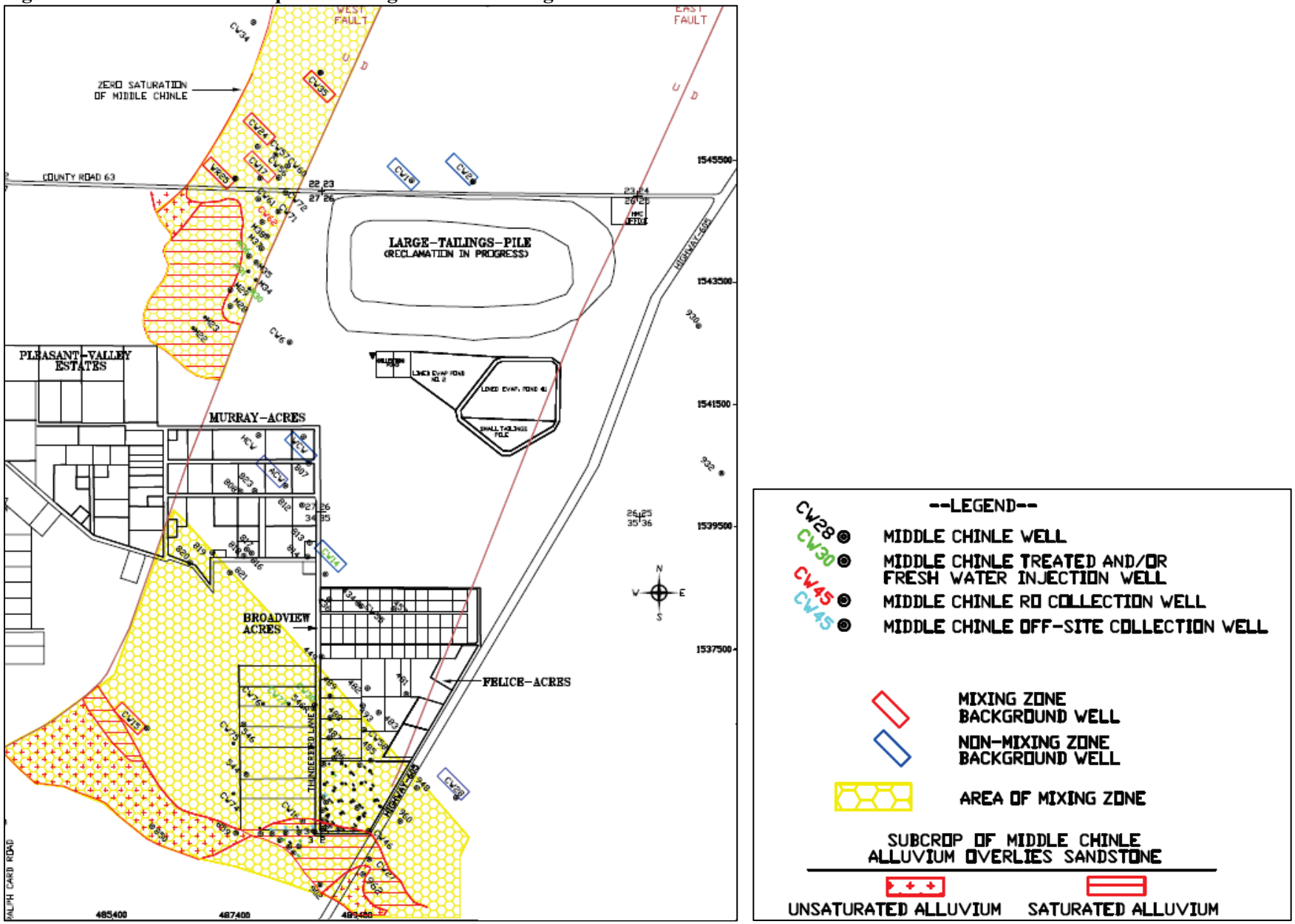
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-5: Upper Chinle Aquifer Mixing Zone and Background Wells



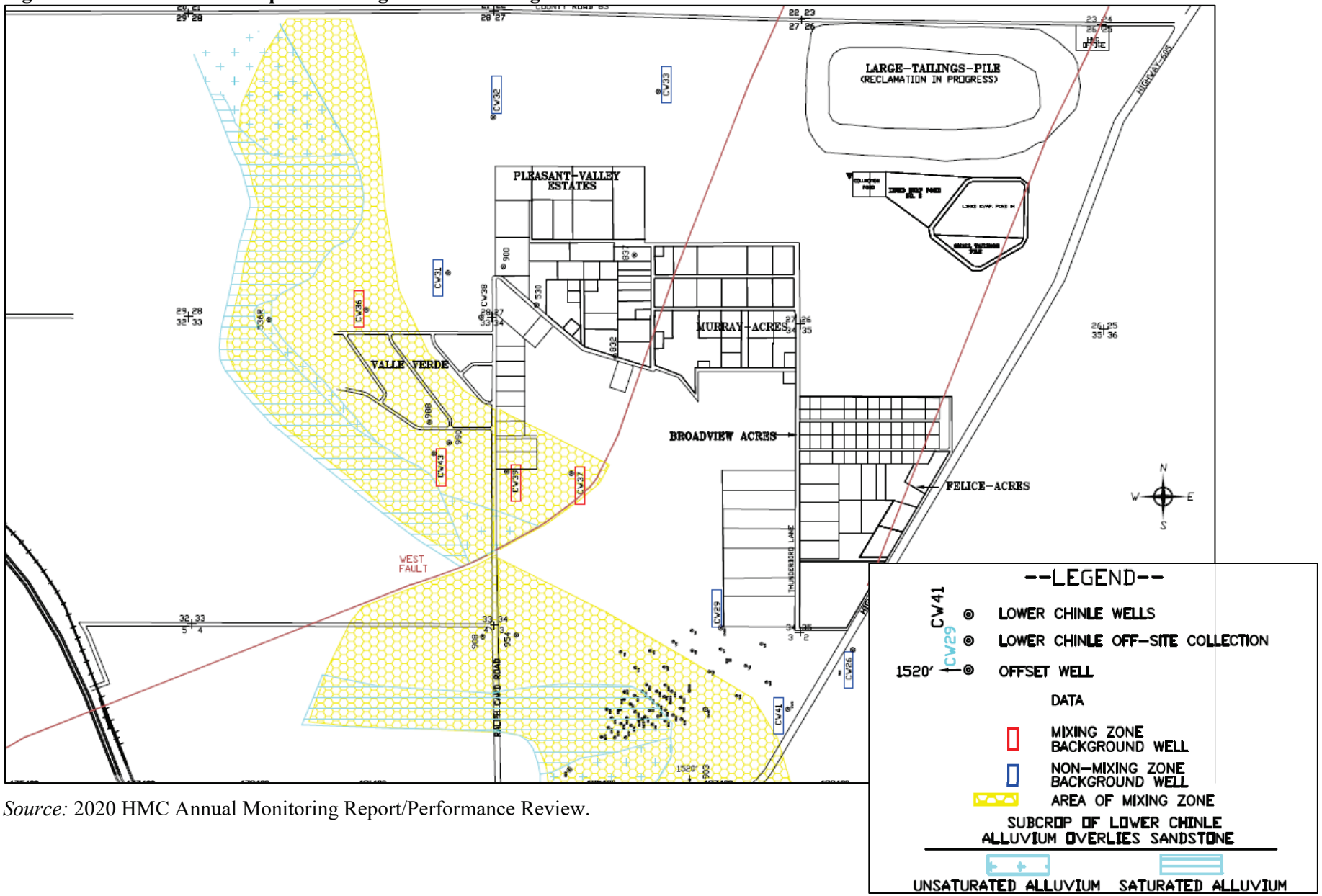
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-6: Middle Chinle Aquifer Mixing Zone and Background Wells



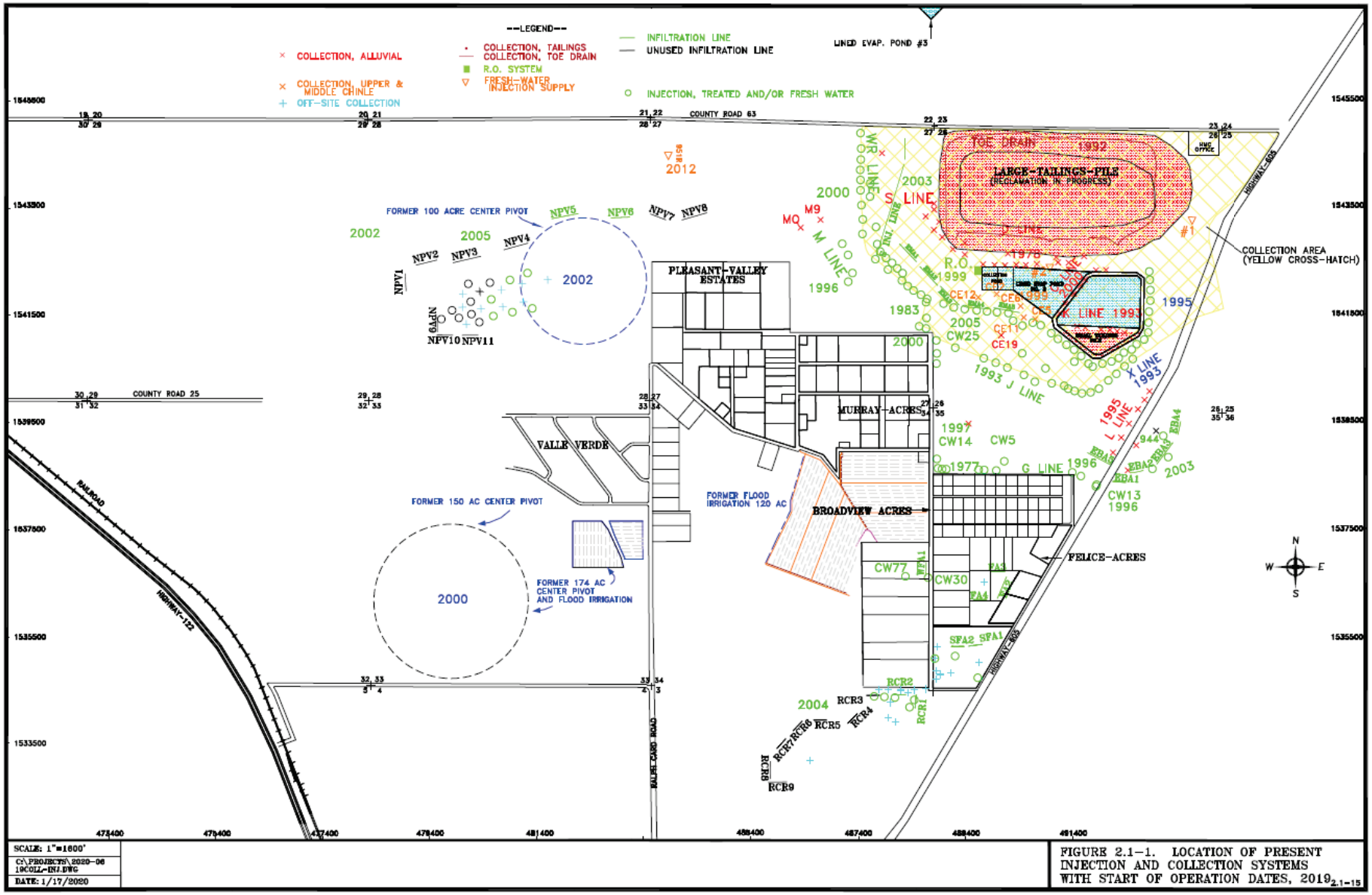
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-7: Middle Chinle Aquifer Mixing Zone and Background Wells



Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure C-8: Location of Present Injection and Collection Systems



Source: 2019 Annual Monitoring Report/Performance Review.

APPENDIX D – PUBLIC NOTICE

PUBLIC NOTICE
HOMESTAKE MINING COMPANY SUPERFUND SITE

U. S. EPA, Region 6 Initiates
Fifth Five-Year Review of Site Remedy
September 2020

The U.S. Environmental Protection Agency Region 6 (EPA), in coordination with the New Mexico Environment Department, will be conducting the fifth five-year review of remedy implementation and performance at the Homestake Mining Company Superfund site (Site) in Milan, Cibola County, New Mexico. The Site is a former uranium mill and tailing disposal facility that includes a large and small tailings impoundment and contaminated portions of the underlying groundwater aquifers that extend into neighboring subdivisions. Current groundwater remedial actions include source control, plume control, evaporation, and water treatment.

The five-year review will determine if the ongoing remedy remains protective of human health and the environment. The five-year review is scheduled for completion in September 2021.

A report of the results of the review will be made available to the public at the following EPA Internet address and the local information repository:

http://www.epa.gov/superfund/homestake-mining

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

Site status updates are also available on the Internet. All media inquiries should be directed to the EPA Press Office at (214) 665-2200.

For more information about the Site, contact:

Mark Purcell
Remedial Project Manager
U.S. Environmental Protection Agency, Region 6
(214) 665-6707
or 1-800-533-3508 (toll-free)
or by email at purcell.mark@epa.gov

Adam Weece
Community Involvement Coordinator
U.S. Environmental Protection Agency, Region 6
(214) 665-2264
or 1-800-533-3508 (toll-free)
or by email at weece.adam@epa.gov

9/30

AVISO PÚBLICO
SITIO SUPERFUND HOMESTAKE MINING COMPANY

La Región 6 de la Agencia de Protección Ambiental de los Estados Unidos Inicia La Quinta Revisión de Cinco Años del Remedio
Septiembre de 2020

La Región 6 de la Agencia de Protección Ambiental de los Estados Unidos (EPA, por sus siglas en inglés), en coordinación con el Departamento de Medio Ambiente de Nuevo México, llevará a cabo la quinta revisión de cinco años de la implementación y el desempeño del plan de limpieza del sitio Superfund Homestake Mining Company (Sitio) en Milán, Condado de Cibola, Nuevo México. El Sitio es un antiguo molino de uranio y una instalación de almacenamiento de relaves que incluye un depósito de relaves grandes y pequeños tanto como porciones contaminadas de los acuíferos subterráneos subyacentes que se extienden a las subdivisiones vecinas. Las acciones correctivas actuales para las aguas subterráneas incluyen el control de la fuente de contaminación, el control del penacho de aguas subterráneas contaminadas, la evaporación y el tratamiento de las aguas subterráneas.

La revisión de cinco años determinará si el remedio en curso sigue protegiendo la salud humana y el medio ambiente. La revisión de cinco años está prevista para septiembre de 2021.

El informe se pondrá a disposición del público en la siguiente dirección de Internet de la EPA y en el repositorio local de información:

http://www.epa.gov/superfund/homestake-mining

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

Actualizaciones del estado del sitio Superfund están disponibles en la dirección de Internet de la EPA. Todas las preguntas de los medios deben dirigirse a la Oficina de la Prensa de la EPA al (214) 665-2200.

Para obtener más información sobre el sitio, contacte a:

Mark Purcell
Gerente de Proyecto de Limpieza
Región 6 de la EPA de los EE. UU.
(214) 665-6707
o 1-800-533-3508 (número gratuito)
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Adam Weece
Coordinador de Participación Comunitaria
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APPENDIX E – INTERVIEW FORMS

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #: NMD007860935**	
Subject: Fifth Five-Year Review	**Time:**	**Date: 06/18/21**
Type: Teleconference **Location of Visit: NA**		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** **Remedial Project Manager**	**Organization:** **EPA Region 6**

Individual Contacted:

Name: Mr. Brad R. Bingham	**Title: Closure Manager**	**Organization: HMC**

Telephone No: 505-290-8019 **Fax No:** **E-Mail Address: bbingham@barrick.com**	**Street Address: 560 Anaconda Road, Route 605 Milan, NM 87021**

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

Homestake, in cooperation with EPA, NRC, and NMED, has made substantial progress at the site.

- Over more than 40 years of groundwater remediation, Homestake has removed 1 million pounds of uranium and spent more than $230,000,000.
- Homestake has progressively used essentially all available groundwater treatment strategies, including containment measures, evaporation, and pump and treat. From RO, zeolite, and ion exchange to phosphate, bioremediation, not to mention its treatability studies on options not actually implemented, Homestake has either used or evaluated all applicable technologies.

After multiple investigations and years of remediation, we now have clear understanding of the site and the path forward.

- The site is in a position to move toward closure, and Homestake has proposed a strategy that will allow for regulatory closure and protection of human health and the environment, which includes granting a technical impracticability waiver to waive groundwater ARARs and a belt and suspenders approach to institutional controls.

Question 2: What effects have the site operations had on the surrounding community?

Homestake's continued commitment to the site and progress made have had positive effects on the surrounding community:

- Connected residents to municipal water and paid for their water

- Purchased property for value that would allow residents to relocate if they would like to
- Mitigated risk to human health and the environment
- Reduced the footprint of the groundwater plume

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

We are not aware of any concerns other than those that have already been raised by the community to EPA.

- As previously discussed, we are aware of the concern regarding GW treatment rate/capacity: Reasons for the misconception include nameplate capacities, aquifer geochemical properties, and the lack of understanding of the overall remediation treatment system(s) limitations. Regardless of our treatment capacity, back diffusion from fine-grained materials within the aquifer will continue to impact the mobile domain resulting in loss of a natural resource through extraction and evaporation without discernable improvement in groundwater quality. HMC is committed to continue treatment at a maximum sustainable rate for the site as we progress through the ACL application and TI Waiver processes.

- More importantly, even if system capacity could be increased, that will not overcome the fact that it is technical impracticability to remediate GW. ICs and a TI waiver would still be needed, resulting in the application of the same remedy.
    - Even assuming that the mobile domain could be completely remediated, back diffusion from the nearby geologic features and continued seepage from the LTP would generate a new plume with the same characteristics.
    - Increased treatment capacity, as referenced above, will not result in improved groundwater quality. The solution is placing institutional measures that protect human, health and the environment.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

No.

Question 5: Do you feel well informed about the Site's activities and progress?

- Yes.
- Homestake welcomes the cooperative relationship with EPA, NRC, and NMED that allows for open communication to achieve the agencies' and Homestake's collective goal to protect human health and the environment.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

- Just want to reiterate that HMC is committed to maintaining active communication and continued transparency with all stakeholders, including regulatory agencies, local communities, local officials, NGOs, and other interested parties.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #:** NMD007860935	
Subject: Fifth Five-Year Review	**Time:** 9 am mountain	**Date:** 4/21/21
Type: Teleconference **Location of Visit:** Not applicable (NA)		

Contact Made By:

Name:	**Title:**	**Organization:**
• Mark Purcell • LaDonna Turner	Remedial Project Manager (RPM)	EPA Region 6

Individual Contacted:

Name(s):	**Title(s):**	**Organization:**
• Brian Vallo, Governor of the Pueblo of Acoma • Aaron M. Sims, legal counsel • Donna Martinez, Environment Coordinator for the Acoma Department of Natural Resources (ADNR) • Franklin Martinez, ADNR Director	See names for associated titles	Pueblo of Acoma
Telephone No: NA **Fax No:** NA **E-Mail Address:** fmartinez@poamail.org	**Street Address:** NA	

Summary of Conversation

EPA: The RPM began with a brief introduction of the Homestake site (the Site). Under the Superfund law and regulations, EPA is required to conduct a review of an ongoing remedy every five years. The purpose of the review is to make sure that the remedy remains protective. While the cleanup is ongoing, EPA needs to assess the remedy to determine if it remains protective of human health and the environment. After the review is over, EPA will present the findings of the review in a report. The report is not a decision document, but it includes issues and recommendations to ensure protectiveness in the short or long term. An important part of the five-year review is interviews with Site stakeholders. A form with the interview questions was sent previously to the Pueblo of Acoma. EPA will take notes during the interview and fill out the form. EPA will then send the filled out form to the Pueblo of Acoma to review and modify as needed. The form can identify the individuals interviewed by name, or identities can remain anonymous. The Pueblo of Acoma representatives should let EPA know how they would like to be identified.

The Homestake site is a former milling operation and tailings disposal facility. Today the mill has been demolished and reclaimed. There are two tailings impoundments that remain. Tailings are a byproduct material from the milling process. One of two piles is quite large and can be seen from the adjacent

highway.

Homestake has been cleaning up groundwater since 1977. The Site is regulated by the Nuclear Regulatory Commission (NRC) and the New Mexico Environment Department (NMED) in addition to EPA. NRC has been the lead federal agency through a Memorandum of Understanding with EPA. NMED has authority through a groundwater discharge permit.

Governor Vallo: Governor Vallo noted that the Pueblo of Acoma submitted written comments concerning the Site and a multitude of issues during the EPA's National Remedy Review Board (NRRB) meeting on March 25, 2021. The Pueblo of Acoma also had the opportunity to provide oral statements on the concerns. Governor Vallo stated that he appreciates the overview of the Site, and he is interested in learning how these interviews will impact the report and future decision-making with the Agency and its Superfund program. He would also appreciate the opportunity to review the Pueblo of Acoma's responses to the six interview questions, as recorded by EPA, prior to EPA releasing the Five-Year Review report.

EPA: The RPM clarified that the NRRB process, including the meeting held on March 25th, is different from the five-year review; however, the Pueblo's concerns may be the same. The NRRB is a board of 9 to 10 people from EPA, and includes technical experts, policy experts, attorneys, etc. Following the March 25th meeting, the board has six weeks to provide recommendations regarding the Superfund process Region 6 is conducting at the Site. The NRRB process is ongoing.

Ms. Martinez: Ms. Martinez asked how long the Pueblo of Acoma would have to review the interview narrative and noted that at least two weeks would be helpful.

EPA: The RPM responded that a few weeks is fine, and EPA can be flexible with the turnaround. The RPM also described the internal review process for the five-year review report. EPA would likely have a draft of the interview narrative ready for review in a few weeks. The Pueblo of Acoma can review and revise the narrative as necessary.

Question 1: What is your overall impression of the project? (general sentiment)

Mr. Sims: From the Pueblo of Acoma's perspective, the general sentiment is that there is severe and deep concern about the continued impact of the contamination and the effects from mining within the basin. He noted that the length of time the cleanup project has been going on is staggering (it is the fifth five-year review).

He noted that the idea of Homestake seeking a technical impracticability (TI) waiver is troubling as it seems like an attempt to walk away from the project. Doing so could leave contamination and potential contamination for the surrounding community to deal with in perpetuity.

He noted that there are three major concerns of impact. The first concern is the groundwater contamination, migration of the plume and potential impacts to the San Andres-Glorieta (SAG) aquifer. The SAG aquifer, on the western side, is a primary source of water and recharge for many of the water sources used by the Pueblo of Acoma. Mr. Sims noted that the Pueblo of Acoma's presentation to the NRRB showed the hydrology in the area and how those systems are connected.

He noted that mining and dewatering of aquifers in the basins have devastated the natural hydrologic system. With the impacts of contamination as well as the depletion of the SAG aquifer and overlying aquifers, the Pueblo of Acoma is concerned about how it will protect its people in the long-term and how it will provide water for its people in the long-term. The possibility that the federal agencies are

considering Homestake's TI waiver, and prospects for Homestake to walk away from its responsibility for cleanup, is concerning to the Pueblo of Acoma and inappropriate.

The Pueblo of Acoma is also concerned about impacts on Acoma cultural resources, because of mining throughout the San Mateo basin by Homestake and other mining companies. The Acoma have lived in the area for hundreds, maybe thousands of years. There are cultural resources both identified and unidentified that have been impacted and may continue to be impacted by mining activities and the continued presence of contaminants such as the tailing piles. The impacts limit Acoma cultural practitioners from accessing these areas due to safety concerns.

Mr. Sims then summarized the broad concerns of cultural impact, health impact and resource impact. These impacts are all deeply concerning to the Pueblo of Acoma due to the prospect that cleanup may be discontinued following the TI analysis.

Mr. Martinez: Mr. Martinez noted that the water office's biggest concern is water quality. If the contaminated plume continues to migrate, there are concerns for Acoma and neighboring towns such as Milan, Grants, Laguna, etc. The concern is to protect the limited water that is available.

Ms. Martinez: Ms. Martinez noted that overall, impacts to cultural use and impacts to human health have always been a concern with the upstream contamination. The Acoma consume products they grow. A main concern is consumption of products that may be impacted by that contamination. There have been so many incidences of cancer in the community and there are questions about whether they are related to the contamination. Ms. Martinez also noted that the contamination has been there for years, and she wondered when the Acoma will see more impacts to their lands and streams. She noted that remediating the contamination will be beneficial to everyone – communities upstream and downstream.

Question 2: What effects have the site operations had on the surrounding community?

Mr. Sims: Mr. Sims noted that pumping from Homestake and other mines in the area has impacted availability of water sources to the Pueblo of Acoma. He noted impacts to springs that contribute to river flows of the Rio San Jose, which is a primary surface water source that flows through the Pueblo of Acoma. Depletion of water has been so severe that springs that feed the river, one of which is close to Milan – Ojo del Gallo – has completely gone dry and no longer contributes to the Rio San Jose. The Acoma use that water for irrigation, as a means of supporting themselves and as a cultural practice.

Mr. Sims noted that decades of mining have resulted in significant declines in water availability to the Pueblo. This is also a subject of ongoing litigation about water rights (United States vs. Kerr-McGee as an example) with Pueblo of Laguna and others.

With depletion of the water supply, the Pueblo is looking at how they can continue to provide water for agricultural uses, domestic uses and industrial uses. The SAG aquifer west is one of the last remaining water supplies for the Rio San Jose basin and the Homestake plume is contaminating it. Other aquifers in the area have been investigated as possible water sources, but natural contamination (such as total dissolved solids) makes them unreasonable to develop as a water source.

Mr. Martinez: Mr. Martinez also added that dust from the Homestake facility, which is significant on a windy day, is also a concern for the surrounding community.

Governor Vallo: Governor Vallo noted that there are concerns not only for exposure to dangerous chemicals in the dust (with added concern for tailings remaining onsite), but there are concerns to

cultural resources in the area. Mount Taylor is a traditional cultural property. The lands adjacent to the traditional cultural boundaries are full of cultural resources, including pilgrimage trails, archaeological remnants, springs, shrines, etc. Some of these areas are accessed by cultural leaders as well as non-tribal technical experts, and there is concern about the safety of those individuals in those environments, from dust and other contamination.

Ms. Martinez: Ms. Martinez noted the potential long-term financial impacts of the contamination, including the possibility that the Pueblo may need to treat water for agricultural or human consumption in the future. Air quality and potential impacts from wind was also a concern.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Governor Vallo: Governor Vallo reiterated his previous concerns regarding tribal and community members working on cultural resource management issues and projects. Governor Vallo also noted that the Pueblo of Acoma does not have an ongoing public outreach initiative keeping community apprised of the Superfund site. He stated that it would be helpful if there is a greater effort to maintain a level of communication via written documentation, social media or other virtual outlets to provide information to the community. This outreach should continue beyond the project term because the Site will continue to be an ongoing concern for the Acoma. He was unaware of availability of resources for this outreach, but requested the Agency consider providing those resources to develop a program if one does not already exist.

Ms. Martinez: Ms. Martinez noted that they do get limited funding from EPA but they are limited on what they can spend on Superfund. She reiterated that money should not be an issue when it comes to health. She stated that if there are other resources out there, the Pueblo of Acoma would like to work with them to develop continued education for its communities.

Ms. Martinez noted that another community concern is the incidence of cancer among past uranium workers, not only in the Acoma community but other communities. She also mentioned the impacts on quality of life to others in the uranium industry, and to those not qualified for the uranium impact fund.

Mr. Sims: Mr. Sims noted that a general community concern is also the availability of water, as addressed in previous responses.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

The Pueblo of Acoma representatives were not aware of any complaints, incidents or activities at the Site.

Question 5: Do you feel well informed about the Site's activities and progress?

Governor Vallo: Governor Vallo indicated that although the project has been ongoing for some time, he located very little documentation sent to tribal leadership. While more information might be provided to the environment office, from a government-to-government standpoint, there has not been a lot of communication between tribal government and the Agency. Tribal leadership changes from year

to year, so it is important that the Agency recognize that and try to ensure there is ongoing communication. It is also important for the Agency to ask tribal leadership about preferred level of engagement, as some prefer limited interaction while others prefer more frequent interaction.

Ms. Martinez: Ms. Martinez also indicated that communication has been limited to correspondence with the RPM and Ms. LaDonna Turner. Most communication has been in the past year.

Mr. Sims: Mr. Sims noted that most information seems to be shared when there is a big decision to be made. Regular communication and updates are more infrequent.

Governor Vallo: Governor Vallo noted the Biden administration's memorandum on tribal consultation to strengthen relations with tribes. He asked if EPA would be organizing a consultation because of the memorandum. He suggested EPA organize a consultation to help tribal leaders gain a better understanding of Superfund reporting, communication, and the process in general, and to help EPA understand the needs of tribes during such projects. He recommended interagency collaboration.

EPA: EPA responded that it was not aware of the Region's response to the memorandum but would follow up internally with the Region.

Ms. Martinez: Ms. Martinez noted that the Pueblo of Acoma is working on a Region 6 transition document with the National Tribal Operations (NTO) committee that will be presented to EPA headquarters. She noted that this document might also be a way to address EPA headquarters.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

Governor Vallo: Governor Vallo stated that he would encourage site management plans and operation plans take into consideration concerns of communities, including Acoma. He noted that there should be more solid means of communication among Acoma's environment office, water office and the tribal government directly so that they are aware of issues, such as trespassing, vandalism, etc., as they arise. He encouraged a commitment to establishing a more robust level of communication at the site and local level.

Mr. Sims: Mr. Sims stated that it would be helpful if EPA better explain how analyses prepared by Homestake, such as the TI evaluation, are evaluated by the Agency. He questioned whether technical experts conduct an independent evaluation of the work completed by Homestake.

EPA: The RPM clarified that Homestake prepares an annual report that describes site operations, results from those operations, groundwater quality monitoring and other data. The report includes plume maps, graphs of contaminant concentrations in wells, etc. The reports are prepared for the NRC and the state, and EPA receives a copy. EPA uploads the reports to the Homestake site profile page on EPA's website. EPA recently received the 2020 annual report and will upload to the EPA webpage shortly. These reports provide an overview of all cleanup activities at the Site.

EPA also noted that EPA is currently conducting its review of Homestake's draft TI evaluation report. EPA provides oversight and checks all the details of the report to ensure they are technically sound. An EPA contractor is conducting an analysis of the modeling effort. NMED also has experienced groundwater modelers conducting a detailed analysis of the work as well.

The RPM noted that EPA and NMED have also been reassessing natural background concentrations in groundwater upgradient of the site. Currently, background levels determined by Homestake in 2006 are used as the cleanup standards established by the NRC for constituents such as uranium and selenium. These standards are much higher than federal drinking water standards. Once this reassessment is completed, EPA will select groundwater cleanup levels as part of a Superfund remedy decision. The groundwater cleanup levels to be selected will likely be different than the cleanup standards established by the NRC.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #: NMD007860935**	
Subject: Fifth Five-Year Review	**Time:**	**Date:**
Type: Teleconference **Location of Visit: NA**		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** **Remedial Project Manager**	**Organization:** **EPA Region 6**

Individual Contacted:

Name: Mr. Adam Ringia	**Title: Water Rights Office Manager**	**Organization: Pueblo of Laguna**

Telephone No: -505-235-5023 **Fax No: -** **E-Mail Address: ringiaa@pol-nsn.gov**	**Street Address:** 22 Bay Tree Road, Building A, Room 208 Kawaik'a Center Paraje, NM 87007

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

In general, the project seems fairly ineffective as a clean-up, but moderately effective as a barrier to downstream contamination. The Homestake mill tailings should never have been allowed to remain in situ without an impermeable barrier between it and the groundwater. The current "remediation" effort, has apparently never been implemented to the extent envisioned by the EPA or as described by Homestake. Possibly as a result, the efforts have not had a more permanent effect, however, the water withdrawals have at least (apparently) helped to prevent the infiltration of toxic chemicals and radionuclides into the aquifers providing the domestic water supply to the local communities.

Question 2: What effects have the site operations had on the surrounding community?

Laguna is a way downstream, so is less effected by the operations, however, we are certainly concerned about the contamination of those same aquifers, as well as the reduction in available water from that aquifer (that is used in the remediation efforts) that would contribute to the flow of the Rio San Jose. The actual site is an eyesore, and almost certainly detracts from the desire of the local community to be in that area, impairs any ability to use the land, and reminds people of the costs of uranium mining.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Yes, this site has been active for some time and has sparked the creation of a number of activist groups, who have been vocal opponents of both uranium impacts, as well as the effectiveness of the cleanup. They have indicated that the company has appeared to attempt to circumvent remediation strategies, irrigate with contaminated water, not fixed wells, failed to continue to provide free water when remediation continued beyond the expected timeframe, failed to fully operate equipment, not invested appropriately in cleanup efforts, and ruined their community in general.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

I am not aware of any – the local residents would be a better source here.

Question 5: Do you feel well informed about the Site's activities and progress?

We could be, the information is there, and in general the EPA has been quite proactive about providing updates and opportunities to ask questions. Depending on time, prioritization and staffing availability Laguna has participated when it could.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

The primary question is why the site managers have been permitted to run their equipment at far less than the proposed levels, giving us an inability to know how effective those agreed upon strategies could be. Running a 20% operation does not necessarily give a good representation of what a 100% operation could do.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #: NMD007860935**	
Subject: Fifth Five-Year Review	**Time:** 1200	**Date:** 4/12/2021
Type: Teleconference **Location of Visit: NA**		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** **Remedial Project Manager**	**Organization:** **EPA Region 6**

Individual Contacted:

Name: Mr. /Ms. Felix O Gonzales	**Title:** Mayor	**Organization:** V.O.M.

Telephone No: 285-6694 **Fax No:** **E-Mail Address:**	**Street Address:** 623 Uranium St Milan, New Mex.

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

On water Contamination— ground Contamination wells that are Capped. Flying Dirt. wind Blown Contamination.

Question 2: What effects have the site operations had on the surrounding community?

People who Live close to Homestake don't get answers to their Satisfaction. Some Ranchers That have Cattle.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Same as Question 1-2

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

not aware

Question 5: Do you feel well informed about the Site's activities and progress?

Joann Martoney is good on public Relations – as far as operations go we are not well informed.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

Homestake – can keep the Board of Trustees – and myself – (mayor) Sarah (manager.) informed on Changes and on Construction at the site – so we can inform the Community.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #: NMD007860935**	
Subject: Fifth Five-Year Review	**Time:** 12:05	**Date:** 4-12-21
Type: Teleconference **Location of Visit: NA**		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** **Remedial Project Manager**	**Organization:** **EPA Region 6**

Individual Contacted:

Name: Mr. /Ms. Vivian Brumbelow	**Title:** Mayor-Pro Tem	**Organization:** Village of Milan
Telephone No: **Fax No:** **E-Mail Address:**	**Street Address:**	

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

I feel Homestake is doing a good job on clean up.
We haven't got a lot of concerns from residents that the Village has to address.

Question 2: What effects have the site operations had on the surrounding community?

Have more community meetings because we would be able to inform public.
This is located in the Country, this involves more citizens than just the Village.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

Soil concern - Wind blowing soil - is it contaminated

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Not any we are aware.

Question 5: Do you feel well informed about the Site's activities and progress?

JoAnn Martinez tries to answer any questions the Village has, but there are some things she cannot answer.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

Keep Mayor, Manager and Trustees informed more often.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #:** NMD007860935	
Subject: Fifth Five-Year Review	**Time:** 2:20 PM MST	**Date:** 04/06/21
Type: Teleconference **Location of Visit:** Not applicable (NA)		
Contact Made By:		
Name: Mr. Mark Purcell	**Title:** Remedial Project Manager	**Organization:** EPA Region 6
Individual Contacted:		
Name: Mr. Larry Carver	**Title:** NA	**Organization:** Resident
Telephone No: **Fax No:** **E-Mail Address:** carveroil@qwestoffice.net	**Street Address:** NA	

Summary of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

The whole project since it started back in 1975/76 has been rather slow. We started out in 1975/76 and everyone was jumping in. Homestake brought out Dr. Love to test locals for selenium poisoning (taking fingernail and hair samples). In 1976, Paul Price, Homestake general manager, held a meeting with residents from Murray Acres to discuss putting in a temporary municipal irrigation system; however, that was the last positive meeting we had with Homestake. Paul Price was transferred to Arizona and Homestake brought in a new general manager, John Parker. Edward Kennedy was an environmental expert on Homestake's staff who argued that no contamination left the Homestake property. Further, the Homestake attorneys – Mr. Kraut and Mr. Nixon – just seemed to toe the line.

We had hundreds of meetings from 1978 to 2000. The general consensus was that groundwater would be cleaned up to drinking water standards. At the time the uranium standard was 5 parts per million (ppm), but it was subsequently dropped to 1 to 2 ppm, and now it is at 0.03 ppm. Homestake's groundwater model showed that it will take 200 years to cleanup to those standards. Now Homestake is saying that it will never reach the cleanup levels. What was supposed to be a short remedy did not turn out that way. We had hoped in the past that the system would work, but my recollection is from 1978 to 2000 it was show and tell, but nothing happened. Homestake collapsed the mill and covered it. They put all of it on the eastside of the site because the prevailing wind is from the west. Homestake also cleaned up the soil, about to a 1-foot depth.

When they brought in Al Cox as the site manager in 2000, that was the first time we had seen real action with the groundwater collection and injection systems that would clean things up. From 2000 to present, they have done a lot of work. But overall, I've spent half my lifetime waiting for this problem to be cleaned up. Over the years, a lot of solutions have been offered, but not a lot of progress has been made. A few of us are still living here, but of the 130 acres of the Murray Acres subdivision, only about 50 acres of land were not sold to Homestake. Most people have sold their property to Homestake. I get the impression that Homestake has made a deal with the NRC and it is looking to get

out of cleaning the groundwater to the current uranium cleanup standard of 0.16 ppm by applying for an Alternate Concentration Limit with the NRC. I have heard rumors that they want a great deal of the property west, through the railroad and part of Milan. I read the first EPA five-year review report and talked to Nate Patel (local environmental consultant who used to work for ARCO and worked on the Anaconda site) who helped write the second five-year review report. The review reports have a lot of technical stuff. It says they need to put institutional controls on the drinking water wells to prevent their use, which is fine if we can be provided with drinking water that meets standards.

Question 2: What effects have the site operations had on the surrounding community?

Back in the 1970s and 1980s, uranium was still a big business. We had people in the nearby communities and subdivisions that worked for Homestake at the time. Every time there was a problem or big push from the locals to deal with the contamination, it caused a lot of friction with Homestake employees. Homestake employees did not want to place the blame on Homestake because they were interested in keeping their jobs. Around 1984, we [as a group of Murray Acres residents as well as some folks from surrounding subdivisions] hired Jim Tellus, an attorney, to help us file a suit against Homestake for property damages (at the time, we did not know that he was a good friend of one of the Homestake attorneys). Our attorney filed the suit and Homestake settled out. While we received a settlement for the damages, the community members who were not a part of the lawsuit were also compensated for damages. However, they received more money than those involved in the lawsuit. Essentially, Homestake paid their employees for property damages at a higher rate than what was agreed upon in our [group of Murray Acres residents and some others] legal settlement. This created a lot of friction between neighbors and was seen as an effort to punish the others in the lawsuit.

In 1985 Santa Fe Resources constructed a coal plant because a lot of coal was found when digging for uranium. A coal mine was established at the Lee Ranch. Toby Michaels was a developer and bought a farm, then sold the water rights to the coal-fired power plant (now Tri-State Power Plant).

The uranium companies – Homestake, Kerr McGee, etc. – were very good at giving local students jobs. I ended up working for all of them at different points. In spring 1961, rather than go to Kerr McGee, I got a job working at Homestake while I was a student at New Mexico State. At the time, I worked about 48 hours a week in the office writing up local purchase orders and things like that. On the weekends, I would work on the tailings pile. At that time, the milling solution was pumped out to a little pond. A ten-inch pipeline surrounded the brim. The pipeline had lots of two-inch diameter holes with wooden pegs and every hour you pulled out 40 plugs. I worked six months during the summer on the labor team and worked on the pile itself. That is how I know that the 21 million tons of tailings that are currently within the pile contain about 15% uranium. United Nuclear sold its interest in the facility when the tailing spill occurred at its Church Rock uranium mill.

I was surprised throughout 1975 to 2000 that Homestake did very little for the cleanup. I guess I had more faith in them. Paul Price, the site manager, transferred out and John Parker came in. The groundwater collection/injection system sounded good at first, but then we learned that all it did was shift the groundwater location and made a big plume to the west side of the pile.

There have also been changes to the water levels in the groundwater aquifers. Saturation has been built up in the alluvium. The static water level in my private alluvial well used to be at a depth of 50 to 60 feet below the ground surface, but in 1999 the static water level was at a depth of 39 feet. The San Andres-Glorieta (SAG) aquifer provides water for the irrigation well and the static water level was around a depth of 110 feet, but the power plant's constant pumping has lowered the static water level about 30 feet so that it is at a depth of 140 feet today. We discovered a leak in the irrigation well casing in 1995. We hired a well logging company from Wilcox, Arizona to come out and log our well.

Wilcox specialized in putting swage patches in irrigation wells. We also invited Mr. Cox and Homestake's engineer. The well pump was at a depth of 175 feet. When they logged our irrigation well, they found a hole in the casing at 172 feet that was bringing in sand and gravel. It was also pulling in contaminated water from the alluvium and two Chinle aquifers above. They put in a 20-foot swage patch (of wavy galvanized tin) in the well which stopped the sand and gravel from entering, but it did not stop the influence from the overlying contaminated alluvial and Chinle aquifers. We were able to use it to irrigate, but there was an uptick in radionuclides.

In 2004 or 2005, there was a proposition to line the well or drill a replacement, but Homestake never volunteered. After Homestake had purchased a few properties in Murray Acres, they volunteered to drill a replacement well (at around $200,000). Homestake drilled the B5R replacement well in 2006 to a depth of 600 feet. Replacement well B5R was about 100 feet from the original irrigation well. We have been using B5R ever since. The static water level in the new well is at a depth of 140 feet and the well pump is at a depth of 200 feet.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

It was unusual for Homestake to purchase properties in Murray Acres. Jesse Toepfer was former military and worked as Homestake's site closure manager for about two years (2014-2015), then a new site closure manager, Tom Wolford, was hired. Tom Wolford leased the Murray Acres property to Larry Grider for growing alfalfa and hay. Homestake had started farming alfalfa and hay in the area using center pivot irrigation and flood irrigation practices. This land irrigation was done to dispose of contaminated groundwater Homestake collected at the site because they did not have enough treatment capacity for the water. The reason Tom Wolford leased the property to Larry Grider was also to dispose of this extra collection water. I heard a rumor that when they would have to test the hay, Larry Grider would go out and get hay from somewhere else to test. Whether there is truth to that, I don't know. Larry Grider used some of the alfalfa and sold some of it for feed. There is a question of what happens with the animals that eat the alfalfa and hay that has been irrigated with collection water, especially since they are being sold in interstate commerce, which is probably why the hay had to be tested, but eventually they shut off the water and the farming stopped. I believe the Natural Resources Conservation Service (NRCS) or Nuclear Regulatory Commission shut down the disposal of the collection water in that manner. After they shut off the collection water supply, Larry Grider grazed the land, but it became a dust bowl with no vegetation. Then there was an issue with the sand blowing all over. I think Larry would have preferred to continue growing alfalfa to prevent the sand from blowing in the wind.

Tom Wolford hired someone to talk to the NRCS to determine what kind of seed to plant, but the field had an infestation of prairie dogs. Before they could reseed, they had to exterminate the prairie dogs, which they did. However, once they planted the seed, they did not irrigate or fertilize so the seeds all blew away. Tom apparently remarked, "We can tell them we tried."

In New Mexico it isn't against the law to have blowing sand unless you are deliberately doing so. I think it would probably be better to use the collection water to establish a wind break than have nothing.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Nothing that I know of. They have people who run security at the site all the time; never heard of

anyone having any troubles with trespassing. The site is fenced with metal t-posts and five-strand barbed wire; the mill is fenced on the north, west and south sides. State Highway 605 intersects a portion of the site.

Question 5: Do you feel well informed about the Site's activities and progress?

Pretty well, I have tried to keep up with the last 40 years. There has been a lot of turnover in Homestake site managers since John Parker left. When Tom Wolford left, we were told the next manager would sign a three-year contract. David Pierce came in and signed a three-year contract. He had some remediation experience, but was let go after a year and a half. Daniel Lattin is Homestake's new site closure program manager, but he is in located in Nevada; Brad Bingham, who is Homestake's environmental manager, now seems to be the on-site manager.

Follow-up question: Do you feel well informed by EPA, NRC and the regulatory agencies?

Yes and no. In the 1970s and 1980s, we had periodic meetings and were brought up to date, although we never had any input. Biggest concern is that they would not try Milton Head's idea for moving the tailings through pipelines back to Ambrosia Lake, which would have eliminated future problems. There is good shale in the Ambrosia Lake area for which to dispose the tailings on. I remember one meeting, the NRC representative said they would kill more people moving the tailings than leaving them in place. I disagree, because it is less than 20 miles and you can use a slurry to move the tailings through the pipe. In Caliente, NM, coal is slurried 200 miles to a power plant, so we should be able to do the same thing with the tailings and it would be safer than moving it by truck. There was no real discussion around moving it though, just expectation that it would stay there. Milton Head also recommended digging a trench, putting in a liner/barrier, and burying the tailings. We know that in other locations, tailings were moved because of their proximity to surface water. Homestake covered the sides of the tailing piles. When they tore the mill building down, rather than giving the yellow cake to Kerr McGee to deal with, they just buried it.

Looking at the ARCO project (DOE Bluewater Disposal Site), Mrs. Bernadette Tsosie said DOE is monitoring the site but they have no funds for the cleanup. What are the local people supposed to do when the groundwater contamination starts to migrate 20 years from now? What about the next generations? We can hope the hydrologist is correct and it won't migrate to the SAG aquifer.

Follow-up question: Do you think over the past 8 to 10 years the agencies have been better about keeping you informed?

Yes, we have been kept informed, but we haven't seen much progress. Seems like NRC has made a deal with Homestake to walk away from this project without having to meet the cleanup standards. The agencies talk to us and explain, but I haven't heard a scenario where the problem is actually taken care of.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

Follow-up question: Is there anything EPA can do going forward with community outreach (in other words, how EPA informs the community)?

The only major question I have is: what if a person does not sell to Homestake/DOE, what do we do for clean drinking water? Does DOE have the wherewithal to claim imminent domain? The village of

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #:** NMD007860935	
Subject: Fifth Five-Year Review	**Time:** 1:00 PM MST	**Date:** 04/01/2021
Type: Teleconference **Location of Visit:** Not applicable (NA)		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** Remedial Project Manager	**Organization:** EPA Region 6

Individual Contacted:

Name: Candace Head-Dylla. Ph.D.	**Title:** Former Resident	**Organization:** Former Blue Water Valley Downstream Alliance (BVDA) Member

Telephone No: 505-401-4349 **Fax No:** **E-Mail Address:** cheaddylla@gmail.com	**Street Address:** NA

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

The Homestake Barrick Gold site has been an abject failure, which EPA, NMED, and NRC would have walked away from long ago had community members not kept writing letters and engaging politicians to force at least a modicum of attention to be paid to the injustice of this environmental disaster. In the early years, community efforts to bring obvious deficits in remediation to the attention of regulators were relegated to the dustbin because we could not afford competent technical expertise. When community members joined with other affected communities, raised money, and hired skilled technical experts, we were no longer ignored, but by then the incompetence of regulators had resulted in the community's loss of wells, water, and a way of life that could not be regained. In addition, those living closest to the large tailings pile were exposed to unsafe levels of airborne radon contamination for more than 30 years.

An autopsy of the failures at this site would be most informative if the EPA actually cared about the environment, safety of citizens, or the site. Unfortunately, EPA and other environmental regulators probably begin their careers with admirable aims, but the political cycles and compromises necessary to maintain a job, let alone rise in this organization, precludes those responsible for the site from acting responsibly and in ways that would actually solve environmental problems.

It is unfortunate to see today's EPA leadership speak about environmental justice and juxtapose that

with the actual experiences of our community, which had legitimate ideas and solutions and were fully engaged, but no one listened to them and now it is too late. Unless the community has money to hire experts, and probably even then, Superfund sites across the nation languish from inattention and lack of political will to solve the problems. The only thing that moved our site forward—for a brief period of time--was a combination of political pressure (from Senator Heinrich's office and Katy Richardson) and expert comments that could not be easily ignored, as well as the change of leadership in EPA Region 6 (Regional Administrator Ron Curry). Unfortunately, by this time too much damage had been done and the process was too far gone.

This site would be a great case study to look back and consider why and how regulators failed the community. In another community with more resources, things might have gone better. But here, with Barrick Gold (the parent company to Homestake) involved, they were "a god who could not be touched" politically. For example, I cannot understand why there is no remedy for groundwater—no ROD for groundwater after more than 30 years of failed remediation.

Throughout the process, community members never knew what was going on behind closed doors. That is a huge problem. We know Barrick Gold has meetings with Senator Heinrich every few months and this has been true since Domenici's days. Maybe they just shoot the breeze or maybe they make deals. The community is left out. Regulators meet with lawmakers and RPs and there is no record of those meetings—no way for community members to know what is happening outside the community meetings and no way for them to be part of these informal processes. If you step back, I think you, Mark, would agree this site is a huge failure—yet you seem sincere about your commitment to health and the environment, so what went wrong?

My husband and I built our home on our own. We saved our money to buy the land. My dad, husband, and I shoveled out the crawlspace and laid the blocks, built every wall, hammered every nail together. We thought we would always live in that home and have it for our grandkids. It was a thriving community at that time and folks irrigated beautiful green pastures. It was such a peaceful, soft and wonderful place to live. It was truly a joy. But, because a greedy company named Homestake/Barrick Gold believed its mission gave it permission to destroy that community in pursuit of its "fiduciary responsibility" to stockholders and because politicians such as Domenici, Bingaman, and others needed that company's money, and because regulators failed—that is all gone. The dream is gone. The community is gone, and it a direct result of what Homestake/Barrick Gold did and what regulators and politicians allowed them to do.

I understand that Mark, Sai, and many others begin their jobs with best intentions. But some are just there for the job. Even those with good intentions know they are limited and some boats cannot be rocked. The community is then caught in the middle and the work on the ground does not get done. This Superfund site destroyed our community. Now if I get a twinge of pain or any illness, I just immediately think of cancer because of the site. I am a freak about not having any extra x-rays and checking the basement regularly for radon because I know my family and I have been so exposed because of the site. And I do this with every family member—all of us who lived on that site. That could have been avoided if the company and regulators had addressed the ambient radon and effectively remediated the site. The future health of people who lived so many years near this site is a real question and one that has never been considered by regulators or politicians—another aspect just ignored.

Now that the community is destroyed, there is no one there to keep fighting. MASE (Multicultural Alliance for a Safe Environment) is doing what it can. It is finally well-funded, but cannot fight every front and has other groups with the same level of need. And MASE is not the same as having local community stakeholders. Homestake/Barrick Gold has done such a good job of co-opting and exploiting the local political scene and the community is so desperate for mining jobs with no

imagination, no clue how to create a different economic base, it has bowed to Homestake/Barrick Gold. Local politicians do not even question where their water comes from and where water will come from in the future. They are not educated about water resources and, worse, are deliberately kept ignorant. In this way, local people who welcomed the mining would be at meetings to show support for Homestake/Barrick Gold and even provide a platform for Homestake/Barrick Gold to espouse lies. That is a tragedy. Particularly because regulators know what is actually happening, but use these uninformed people as cover for their inaction or ineffective action.

Question 2: What effects have the site operations had on the surrounding community?

See above. Basically, we lost everything we held dear, including our health. In the informal community survey we did, there were a number of deaths adjacent to the site and a greater than normal rate of thyroid problems and cancer throughout the community, with the greater number and most severe cases closest to the large tailings pile. No one cared. We were not epidemiologists. Our information was ignored except for one front page Albuquerque Journal article that featured our "death map." It was all quickly brushed aside because we were not experts—even though the illnesses and deaths were simply facts.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details.

I am aware of 40 years-worth of community concerns. I have a room full of boxes documenting our concerns and efforts to engage regulators for effective oversight.

At this point there is nobody in the community who cares anymore. They all just want to get out. They want to sell and get out because they understand at this point that there may be an opportunity to recoup at least some of what was lost in property values due to the site and they are equally certain that there is no political will to solve the problem.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

Oh no, there were no problems from our community. We followed all laws and rules. We very politely allowed Homestake/Barrick Gold to take our community and our health, aided and abetted by the EPA, NMED, and NRC. We are very law abiding and thought that regulators would protect us. We were wrong.

Question 5: Do you feel well informed about the Site's activities and progress?

Staying informed at this point would just be salt in a wound. I try not to think about this site anymore because to keep thinking about it would make me crazy. My family and I thankfully all had full time jobs, so my mom and I then did the BVDA/MASE work after long hours at our regular jobs. Trying to keep up for almost 30 years was exhausting. At one point we also had to fight a medical waste incinerator in the community, which took two years. I put so much into it over the years, but now I ignore it because it would otherwise just be too ridiculously painful. EPA will do whatever the powers that be decide is politically convenient—communities and the environment really do not matter as every action can and will be rationalized and justified so the regulators and politicians can sleep at night.

In the past, around the time Mark came back on, it did improve some. It has to do with who is in the leadership positions. We used to tell the NRC to please not come to the community because they were so rude and demeaning to us and people felt great animosity towards them. I felt that changed when Mathew Meyer came on board. Then, suddenly we were well informed, and NRC then was much better than EPA. We had monthly calls with the NRC, which were very useful in letting the community know what was happening and for the community to share its concerns. This had never happened with the EPA. The regulators can make a difference if they find the political will to do so.

Doing all of this outside of our paid work was difficult. I'm not sure how helpful the TAG (Technical Assistance Grant) was. We appreciated the TAG and TASC (Technical Assistance Services for Communities) assistance, and maybe if we had received better technical advice and help, it would have been more successful. We never received adequate technical assistance until we started paying for it ourselves. Working class people struggle to get and use grants. Sure, it is good thing, but I thought the monthly meetings with NRC were more helpful than the TAG or TASC support.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

We have no idea how EPA works or the current political landscape within EPA, but if community involvement is helpful in pushing cleanups, then the thing that needs to happen at this site is for local elected officials to understand where their water comes from and how this Superfund site could impinge on future water resources. Right now, you could go to any elected official in the area and none (except Christine Lowry – Cibola County Commissioner; also a MASE member) would have a clue where their water comes from or where the community hopes water will come from in the future. They have no clue how this site could impact those resources. I do not know how this is allowed to happen. The Village of Milan does not understand their water resources. They are ignorant regarding how this site could affect the entire area in the future. But officials have been purposefully kept in the dark because their ignorance has kept them supporting the big mining company, which, if threatened, becomes a threat to state and federal politicians. So, the game has been to just pretend that the community is a bunch of troublemakers and the regulators and politicians have it all under control. Future generations will come to understand that the whole thing was a farce at their expense.

I do not know what government agency might be interested in doing the education and outreach, but it is necessary if EPA wants informed community engagement. The few community people who could do this type of education are old, and also just want out. Making the larger community aware where their water comes from and what the risks are would be useful. But currently, no one cares because they do not see how it is important.

I have survived my engagement in this process by becoming bitter, cynical, and sarcastic. That is not really who I am, so I have to be finished with this now. No more comments, no more contact, please.

Milan signed an agreement to furnish water, but people are concerned that DOE can come in and condemn the property.

INTERVIEW RECORD

Site Name: Homestake Mining Company Superfund Site	**EPA ID #: NMD007860935**	
Subject: Fifth Five-Year Review	**Time:**	**Date:**
Type: Teleconference **Location of Visit: NA**		

Contact Made By:

Name: Mr. Mark Purcell	**Title:** **Remedial Project Manager**	**Organization:** **EPA Region 6**

Individual Contacted:

Name: L. Watchempino, downstream community resident	**Title: NA**	**Organization:** Multicultural Alliance for a Safe Environment (MASE)

Telephone No: **Fax No:** **E-Mail Address:** 5000wave@gmail.com	**Street Address:**

Summary Of Conversation

Question 1: What is your overall impression of the project? (general sentiment)

Which project? Flushing to extract contaminants and maintain hydraulic barrier; unauthorized land application of excess contaminated water; injection/extraction of groundwater in several aquifers without accounting for movement between aquifers; Reverse Osmosis (RO); zeolite treatment (both treatments operating below capacity); use of the San Andres-Glorieta, or SAG, aquifer to flush the large tailings pile (LTP), create a hydraulic barrier, and to dilute water before land application and before/after RO treatment. None of these projects has successfully contained the sources of groundwater contamination. Instead, they have spread contaminants throughout the San Mateo Creek Basin, prolonging the need for remediation.

The jumble of remedies used at the site has not been well managed or operated in accordance with a comprehensive remedial plan. The 2008 ACOE evaluation of remedies (RSE) and 2010 Supplement cited Homestake's management of injection/extraction rates, along with recommendations to end Homestake's flushing and land application projects that were likely to spread contamination and prolong the need for remediation.

Homestake's LTP should have been dewatered and lined to limit the release of contaminants. Flushing the tailings created saturated conditions and re-mobilized the uranium in pore spaces as they were flushed out of the pile. Now that flushing has been terminated, we can expect a long-term rebound of seepage from the LTP that must be captured and treated to assure that the seepage does not push existing contaminant plumes further off-site into community water supplies.

The only Institutional Control that can protect us from this threat is to remove the tailings, or contaminant sources, out of the San Mateo Creek Basin. We are agricultural communities that need good clean water to survive into the future, and to maintain our cultural traditions. We understand that we can do neither without clean water to nourish our bodies and sustain our homelands.

Not much has changed in the way of managing uranium mill waste since UNC's massive tailings impoundment breached near Churchrock, NM in 1979, sending 1,100 tons of radioactive uranium mill tailings and 94,000,000 gallons of radioactive wastewater downstream into the Rio Puerco for at least 80 miles. After the spill, unmonitored contaminants eventually reached the community of Sanders, AZ, which is now experiencing water quality impacts in its community drinking water wells.

Question 2: What effects have the site operations had on the surrounding community?

The surrounding community has been subjected to ongoing radon emissions from Homestake's uranium mill tailings into air, soil and groundwater since 1958 when mill operations began. Radon emissions from the site must continue to be managed in perpetuity for the health and safety of all surrounding communities. Radon monitor stations are needed around the site at different locations and elevations, as prevailing winds often shift. Who will take responsibility for future emissions and releases to nearby residents or to downstream communities in the event of a tailings breach?

An EPA, NM Health Advisory for community wells was issued in 2009, but what about residents that used the water from these wells for domestic and agriculture purposes prior to the health advisory?

EPA's 2014 Human Health Risk Assessment underscores the need for a long-overdue comprehensive health survey of community residents around the Homestake Superfund site, along with an epidemiological study, which should be included as an outcome in EPA's next Five-Year Plan for the Grants Mining District. A large number of community residents have experienced a greater number of health maladies than those living in other areas (cancer, asthma, severe migraines, gall bladder diseases, and thyroid diseases). Many residents have died. Families have experienced intense stress knowing that their children's health will be compromised by living in a hazardous environment, but they are unable to sell their homes due to depressed property values.

Overuse and contamination of the SAG aquifer by Homestake's high-production pumping wells of questionable integrity has undermined community confidence in SAG aquifer water quality. Milan Well #4 directly downstream of the Homestake Superfund site should be monitored for radionuclides, sulfates, and TDS on an annual basis to assure the downstream municipalities that their drinking water sources in the SAG aquifer have not been impaired by Homestake's remedial operations.

EPA's attempt to characterize the SAG aquifer subcrop at this late date is likely to grandfather in over half a century of uranium development impacts within the San Mateo Creek Basin.

Question 3: Are you aware of any community concerns regarding the site or its operation and administration? If so, please give details

In 2012, MASE advocated for a better approach to plume control by utilizing source controls to collect all discharges at the source, thereby minimizing infiltration to groundwater.
MASE Comments to US NRC on Homestake's Revised Updated Corrective Action Plan (October 31, 2012); EPA 2005 Draft Hardrock Mine Cleanup Guide; Global Acid Rock Drainage Guide (GARD 2012)

The Bluewater Valley Downstream Alliance (BVDA) initially recommended that Homestake's mill tailings be relocated to a permanent regional repository to facilitate cleanup of the site. Removal of the sources of contamination would also protect residents from radon levels which elevated the acceptable cancer risk 2-3 times at the site boundary, according to **EPA's 2014 Human Health Risk Assessment**. A regional repository that is double-lined with leak detection protections could also help to isolate similar radioactive byproduct source material near the Red Water Pond Road Community and the Mariano and Smith Lake Communities, among others.

In addition, MASE and BVDA have consistently asked EPA to reassess background water quality at the site. EPA never investigated background water quality prior to 2006, or issued a Record of Decision for groundwater at this site, even after agreeing to alternate Ground Water Protection Standards for Homestake's groundwater remediation. Nor has the NRC approved a groundwater Corrective Action Plan for the Homestake site since 1989.

The SAG aquifer has been heavily used by Homestake to push tailings seepage back on-site for treatment, then again before RO treatment. and again before treated RO water is re-injected into the alluvial aquifer and Chinle (Upper and Middle) aquifers. Homestake's use of the SAG aquifer before and after RO treatment amounts to dilution, prohibited by NRC license SUA-1471 and NMED's discharge permit DP-200.

Because the SAG aquifer is the only clean water source available for domestic use in the San Mateo Creek Basin and provides an alternative water supply for community residents around the Homestake site, MASE and BVDA have challenged Homestake's extensive use of this freshwater source in its remedial operations.

MASE repeatedly questioned Homestake's assertions that the SAG aquifer was not impacted by its remedial operations during a 2014 public hearing on the renewal of Homestake's discharge permit DP-200. Homestake's rationale for upholding the integrity of its active SAG wells during the 2014 DP-200 renewal hearing was consistent water quality results that comply with the site standards for injection. Nevertheless, Condition 21of DP-200 required Homestake to perform a well integrity evaluation of its seven SAG wells. Several of those wells were finally plugged and abandoned, but Deep Well 2, which is compromised, is still being used by Homestake, despite the availability of replacement wells Deep 2R and Deep 1R.

It should also be noted that the SAG aquifer is an unimpacted source of water that remains subject to the Clean Water Act and must comply with the Safe Drinking Water Act when used as a public water supply.

Homestake made a similar argument for SAG well 943 in 2018, that its faulty well 943 would not have been able to affect water quality in the SAG when it was being pumped continuously until 2017. But the NRC is not certain that pumping during operations was sufficient to capture all of the seepage from the overlying aquifers, or that uranium concentrations in the overlying aquifers was high enough to result in the uranium exceedances observed in well 943 during a recent pump test. NRC has suggested a pump test on Well 943M to verify that contamination is not occurring around Well 943M. NRC also recommends additional well integrity evaluations for other SAG wells that have not been previously tested.
US NRC January 23, 2020 Review of *Homestake's Proposed Adjustment in Groundwater Monitoring of the SAG Aquifer near Well 943*

Additionally, when uranium concentrations in Homestake Well 951 became elevated, it was converted to a monitoring well. But Homestake's use of both 951 and 951R should be discontinued, as both are located within the Bluewater site SAG aquifer uranium plume. The SAG plume is approximately 2

miles north of Milan Well #4, which could be influenced by pumping from Homestake Wells 951 and 951R.
DOE's 2020 Legacy Management Report: *Evaluating the Influence of High-Production Pumping Wells on Impacted Groundwater at the Bluewater, New Mexico Disposal Site*

MASE therefore recommends that ALL of Homestake's wells be subjected to integrity testing so that they can be properly abandoned and plugged. Faulty wells should not be used for remediation or monitoring. A well abandonment schedule be developed and followed. Many hundreds of Homestake's wells are currently inactive. A plan for the retirement of Homestake's injection lines should also be developed.

Furthermore, while MASE has consistently raised the threat to the SAG aquifer from Homestake high-production wells, EPA is just now characterizing the SAG subcrop southeast of the Homestake site, after decades of SAG aquifer use by Homestake. Baseline water quality data for the SAG subcrop should have been collected before Homestake's intensive use of the SAG aquifer in its remedial activities.

Our communities are very concerned that Homestake will prematurely shut down its expanded RO and zeolite treatment systems and extensive injection/extraction well network just when they are needed most to treat contaminant plumes that have migrated beyond the site. Now it appears that a fifth aquifer, the SAG aquifer, has been impacted by Homestake's faulty well maintenance and remedial operations, which would take the last remaining clean aquifer from our communities and future generations.

Our communities will suffer immeasurably if Homestake is allowed to end treatment after causing such profound damages near the headwaters of the Rio San Jose basin, damages that have permeated every viable aquifer within the San Mateo Creek sub-basin.

EPA, DOE, NRC, and the state regulators should have acted together to forestall the migration of contaminant plumes that are moving from upgradient sites in the Ambrosia Lake mining district and from the Bluewater Disposal Site with more stringent cleanup standards at each site, rather than agreeing to alternate concentration limits (ACLs) for constituents of concern. MASE and BVDA adamantly oppose the conversion of the Homestake Superfund site into another permanent disposal site for radioactive materials that will continue to pollute our watershed and river basin for hundreds of years.

BVDA has long advocated for a site-wide EIS by EPA to enlarge the scope of Homestake's uranium milling impacts to include: 1) remedial system operation impacts to the SAG aquifer; 2) cumulative human health impacts from contaminated air, soil and water impacts over 44 years of remediation attempts that spread, rather than contained, contaminant sources; 3) basin-wide ecological impacts; 4) off-site contamination plumes from all sources in the San Mateo Creek Basin; and 5) the expanded use of the former mill site as a permanent tailings disposal site.

Question 4: Are you aware of any complaints, incidents or activities at the Site such as vandalism, trespassing, or emergency response from local authorities? If so, please provide details.

An unauthorized release of impacted water was discharged from off-site Well 490 around September 2020, as Homestake's zeolite treatment system was being reactivated. The zeolite system had been out of operation since November 2019. Since then, the system has undergone additional operational down time due to membranes clogged with algae. The RO system has been operating at 300 gpm, or close to 30% capacity for the past 2 years.

In 2018, Homestake was cited for several "apparent violations" of its NRC license relating to its use of water that did not meet the site's NRC approved groundwater protection standards (GWPS). Homestake sprayed water that exceeded those standards on irrigated plots as part of a land application project. Homestake also failed to comply with its license reporting requirements for monthly sample collection at the RO plant and injected RO treated water that exceeded the site GWPS on numerous occasions. Homestake admitted that it failed to promote a culture of safety at the project site and needed to implement procedures to ensure public safety and compliance with its NRC license conditions. Homestake needs to implement staff training programs that prioritize compliance and safety over production goals and cost reduction.

2018 Homestake Self-Assessment Report

Homestake failed to keep adequate records to demonstrate license compliance and discouraged the reporting of safety lapses and procedural violations. Inadequate oversight and staff accountability resulted in a failure to identify corrective actions and the need for additional resources to elevate safety over competing expediency and cost reduction goals. For example, in 2014 Homestake proposed to inject "high-concentration" injectate above NRC GWPS in Table 3 of discharge permit DP-200.

More recently, Homestake piped "compliant" water to 2 landowners for off-site irrigation that did not meet state water quality standards.

Emergency responders must be warned of the dangers before responding to any unplanned releases from the site in the future. Only trained hazmat responders should be allowed to enter the site. What precautionary measures will be taken to assure the safety of first responders in the event of climate-induced releases of hazardous materials? Who will pay for such contingencies after the site is decommissioned?

Who will maintain institutional controls at the site for as long as the site remains hazardous?

Question 5: Do you feel well informed about the Site's activities and progress?

I am somewhat informed because I participate in monthly community calls with the NRC and community updates with EPA Region 6, but I don't have the time or ability to read Homestake's massive annual reports. It's too bad that EPA or NRC doesn't attempt to break down the substance of Homestake's annual reports for the public, especially for local residents and downstream community members like myself.

EPA produced some updates for the community in 2014 and 2015 to document the timeline for its RI/FS functional equivalency process, and the issuance of a ROD for OU1.

However, EPA's 1989 issuance of an ROD for OU3 required further evaluation by EPA to assure that current air and soil quality data supports the protectiveness of the OU3 remedy, following EPA's 2014 Human Health Risk Assessment.

EPA's determination of protectiveness has not been reported to the communities, depriving community members of the information they need to assure their own health and safety.

Question 6: Do you have any comments, questions, or recommendations regarding the Site's management or operation?

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EPA's inordinate delay in conducting the CERCLA mandated RI/FS (remedial investigation and feasibility study) for the Homestake Superfund site means that current remedial activities were undertaken prior to characterization of the tailings piles and surrounding hydrologic conditions, foreclosing an informed evaluation of remedies based on the best available science.

Characterization of background water and air quality generally takes place during a Remedial Investigation. EPA's delay in completing a hydrological characterization of all impacted aquifers, including a nearby SAG aquifer subcrop directly connected to the alluvial aquifer beneath the Homestake site, has increased the risk that contamination of the SAG aquifer has gone undetected for some time. In this case, a provisional ROD for radon emissions was issued in 1989 and Ground Water Protection Standards were approved by all site regulators in 2006.

Another reason that functional equivalency for a Remedial Investigation cannot be attained by Homestake is that EPA has not yet adopted guiding ARARs for the Homestake Superfund site under CERCLA.

ARARs (applicable or relevant and appropriate requirements) are required to attain a proper measure of cleanup and to control further releases during remediation. Public involvement in the development of ARARs is necessary to assure that cleanup standards and the remedy(ies) selected are protective of our health and our environment. EPA must also complete its reassessment of background groundwater quality and investigate the source of elevated uranium in Homestake SAG aquifer supply wells in order for the remedy to be protective in the long term.

EPA Fourth Five-Year Review for HMC Superfund Site (2016)

Following the adoption of ARARs and reassessment of background groundwater, EPA must fully evaluate all remedial options, including removal of the source material, to achieve long-term protectiveness of human health and the environment.

Further investigation to determine how Homestake's use of faulty SAG aquifer wells like Deep Well #2, Well 951 and Well 943 have impacted contaminant transport in the SAG aquifer is needed. Surface water impacts to San Mateo Creek and the Rio San Jose should also be investigated, and Homestake's modeling of groundwater flow and contaminant transport should be verified against historical data.

Homestake should attempt to verify its seepage rate model as well. Until the models are verified, we cannot have confidence in their predictions of future flow and transport conditions, or predicted seepage rates from the large tailings pile.

MASE Comments on the Grants Reclamation Project, Updated 2012 HMC CAP by George Rice, October 30, 2012

It's a shame that EPA, NRC, and state regulators (OSE, NMED) haven't looked into these issues, but have tended to defer to HMC's assumed knowledge of what they were doing, allowing damages to the regional hydrology to be compounded.

Additional comments:

An unstated assumption that leaving toxic mountains of untreated mill waste to leach into regional groundwater supplies can be protective of our health or environment is not warranted and is contrary to CERCLA law. Conversion of the former mill site into a permanent disposal site for untreated mill tailings must be evaluated as an inadequate remedy.

The permanent disposal of Homestake's unlined uranium mill tailings next to the headwaters of San Mateo Creek, a critical watershed and groundwater basin, where other plumes are converging cannot achieve long-term protectiveness of regional groundwater supplies. In addition, the large tailings pile (LTP) is situated on the ancestral San Mateo Creek, which acts as a preferential flow path for contaminated seepage from the unlined tailings to be transported downstream into the shallow aquifers feeding the SAG aquifer and larger Rio San Jose Basin.

The failure of the United States to plan for and develop permanent waste disposal sites to contain and isolate uranium mine and mill waste is truly abysmal and could lead to climate-induced disasters from

severe weather events, such as the damage to the Homestake's tailings piles caused by storms in July 2010. More recent events like the winter storms that wreaked havoc in Texas earlier this year and the heat waves that led to wildfires in California, with subsequent flooding and mudslides in burned out forested areas have created disaster after disaster.

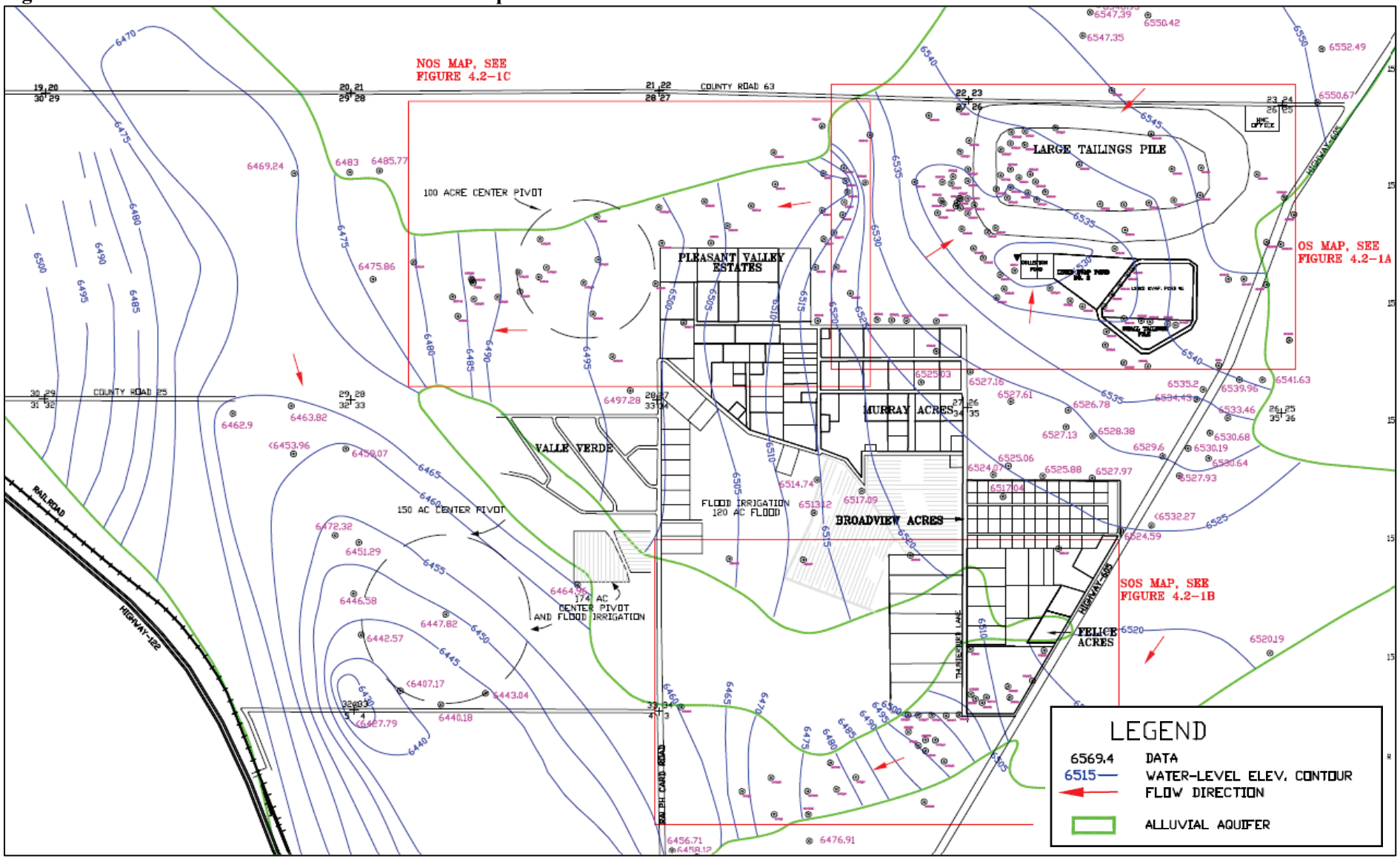
While it may be tempting for the regulators to pretend that capping the unlined tailings piles is a remedy that can achieve long-term protectiveness for our communities, it will result in a severe breach of EPA's duty to protect our health and our ecosystems. Long-term protectiveness at the Homestake site will not be achieved until the massive tailings waste piles are completely contained and isolated from our regional groundwater sources and off-site plumes are captured and treated.

Homestake-Barrick Gold should be required to seek another license for the permanent disposal of radioactive materials onsite, and the enlargement of its licensed boundary to include all the property it has annexed. What is Homestake's plan for all the homes and facilities they have acquired? How will they be managed and how will Institutional Controls be maintained? For as long as the waste emits radiation and seeps into underlying aquifers, our communities remain at risk of continued exposure. Even now, the liner on Evaporation Pond 1 has been stretched beyond its useful life because synthetic liners have an average life span of 25 years.

My recommendation is for Homestake to dewater the tailings piles, so that the tailings can be moved away from the ancestral San Mateo Creek bed onto double-lined ponds with leak-detection systems that are then encapsulated to prevent the infiltration of water into the tailings and radon releases from the tailings. This option would still require Homestake to capture contaminants in off-site plumes using treated water and its massive injection/extraction well network, followed by treatment in RO and zeolite systems that have been optimized to operate at full capacity . The mill facility and equipment that were buried in the tailings should be transported to a licensed disposal site.

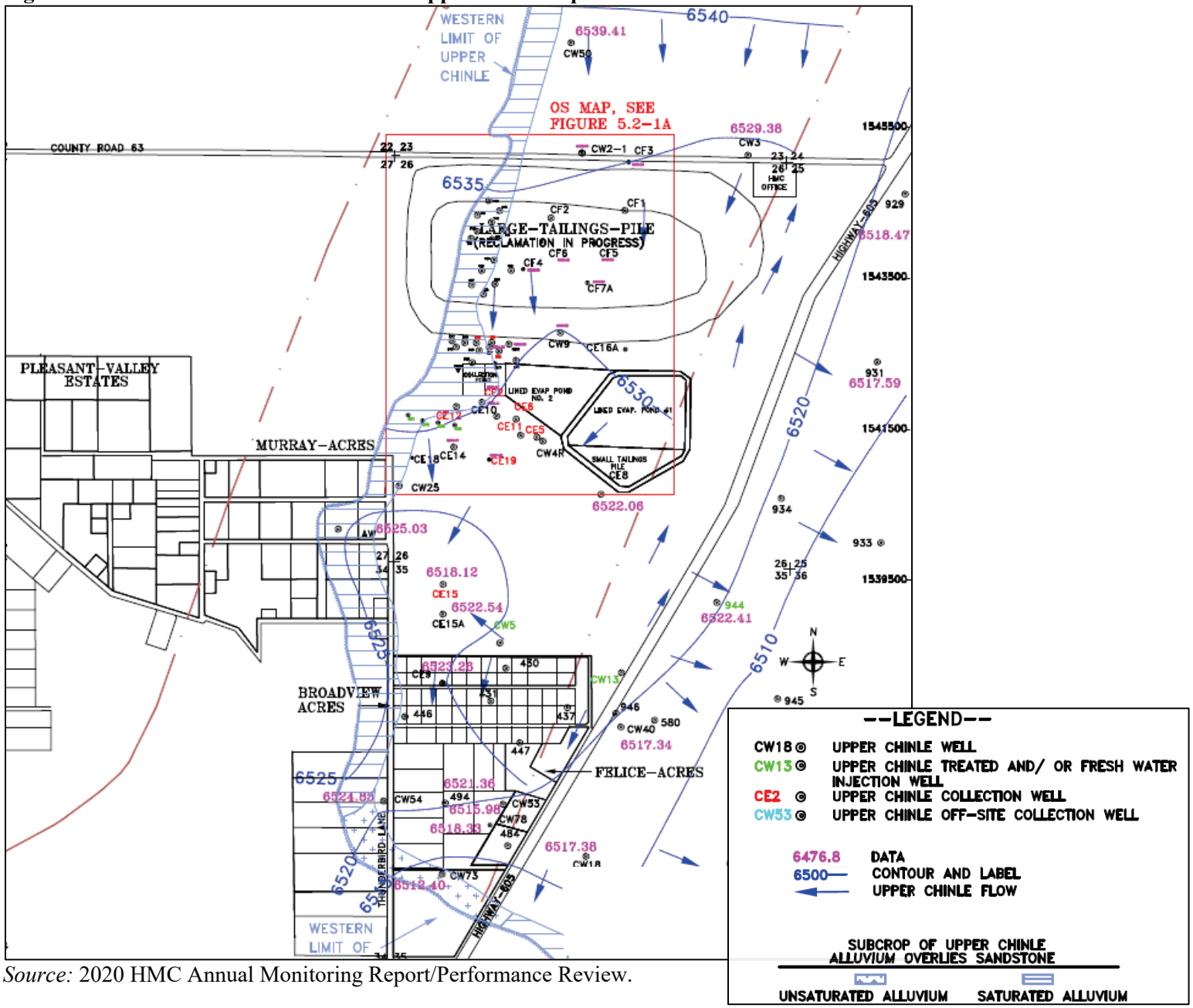
APPENDIX F – DATA REVIEW SUPPORTING DOCUMENTATION

Figure F-1: Water-Level Elevations of the Alluvial Aquifer – 2020



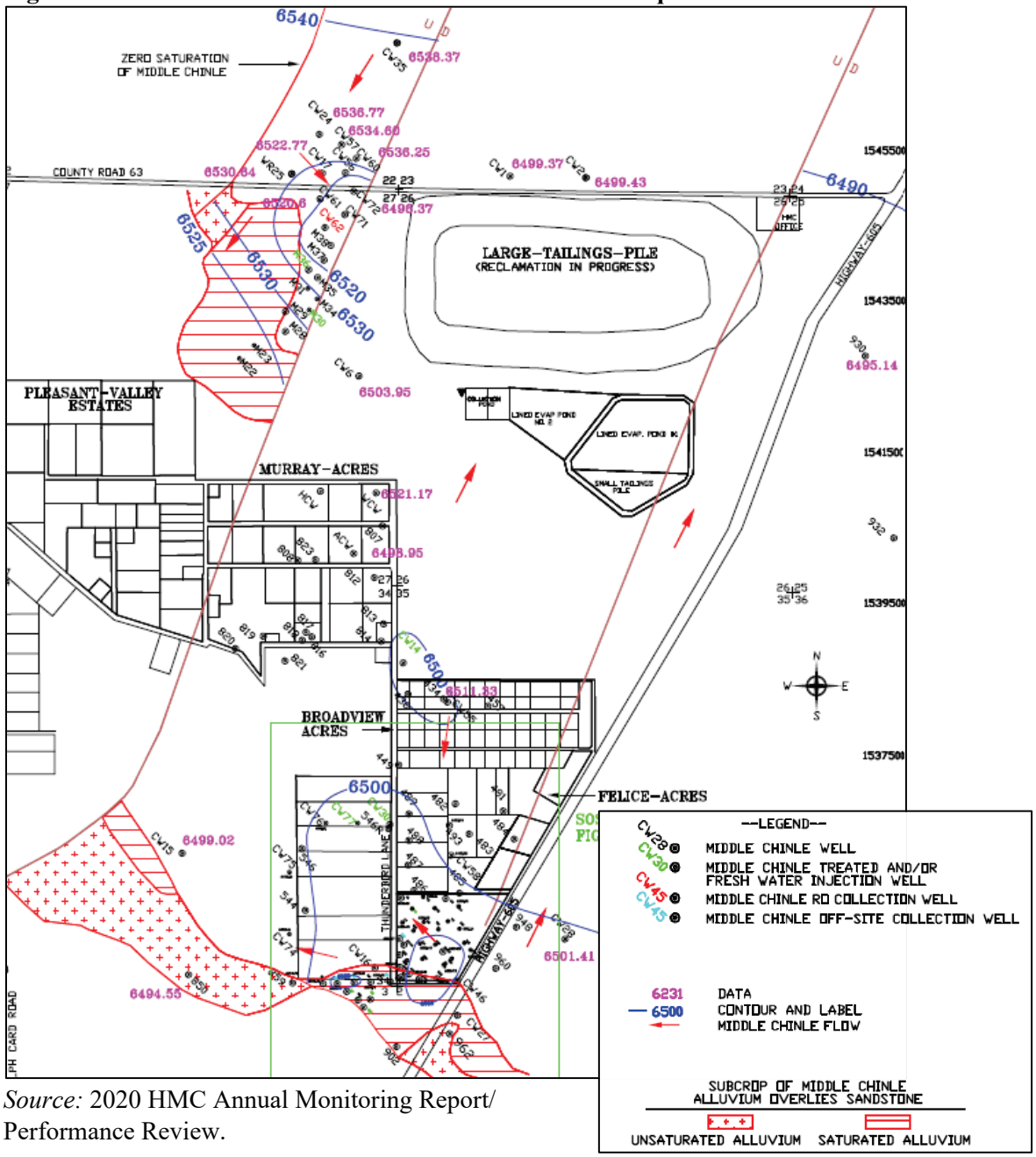
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-2: Water Level Elevations of the Upper Chinle Aquifer – 2020



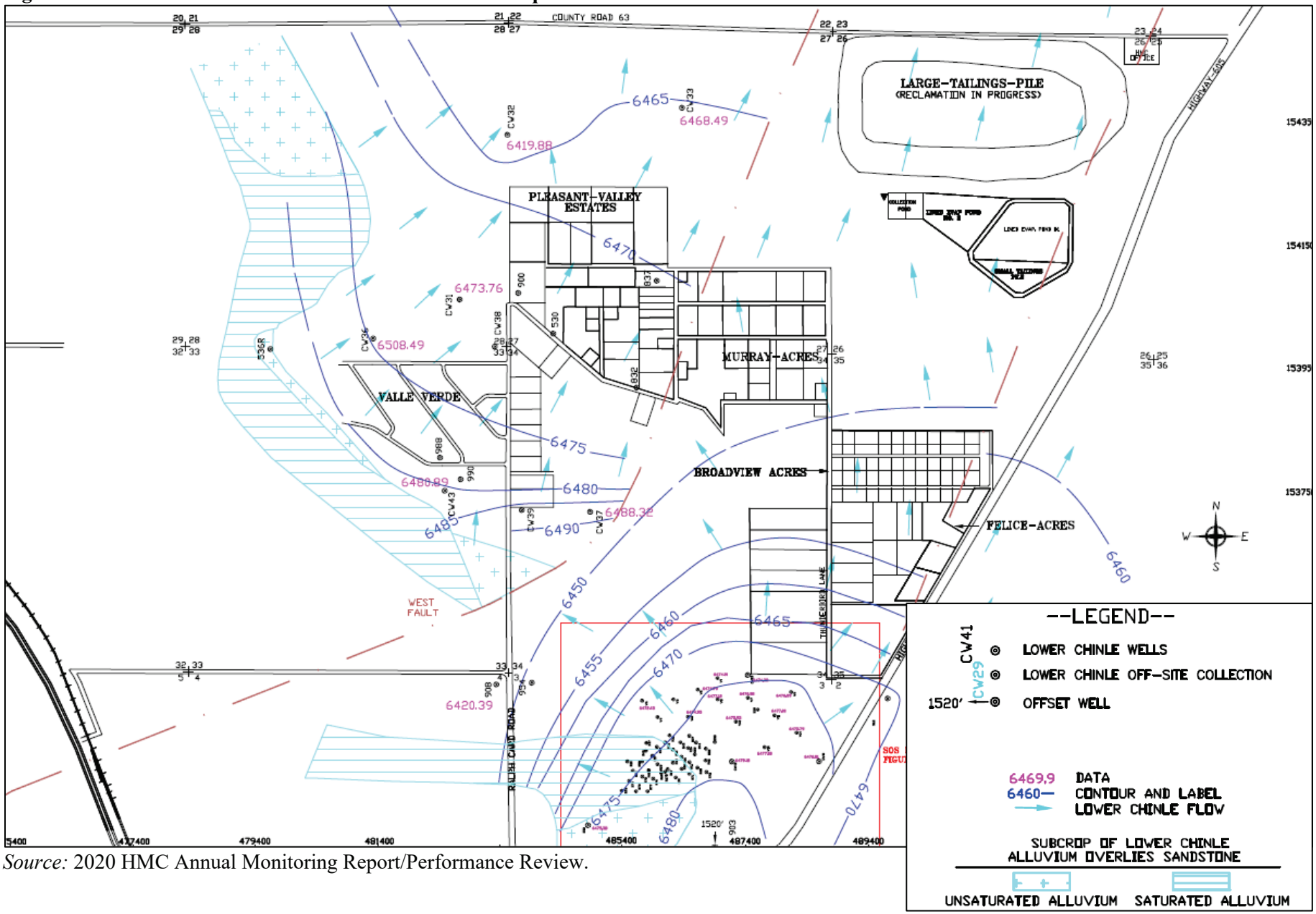
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-3: Water Level Elevations of the Middle Chinle Aquifer – 2020



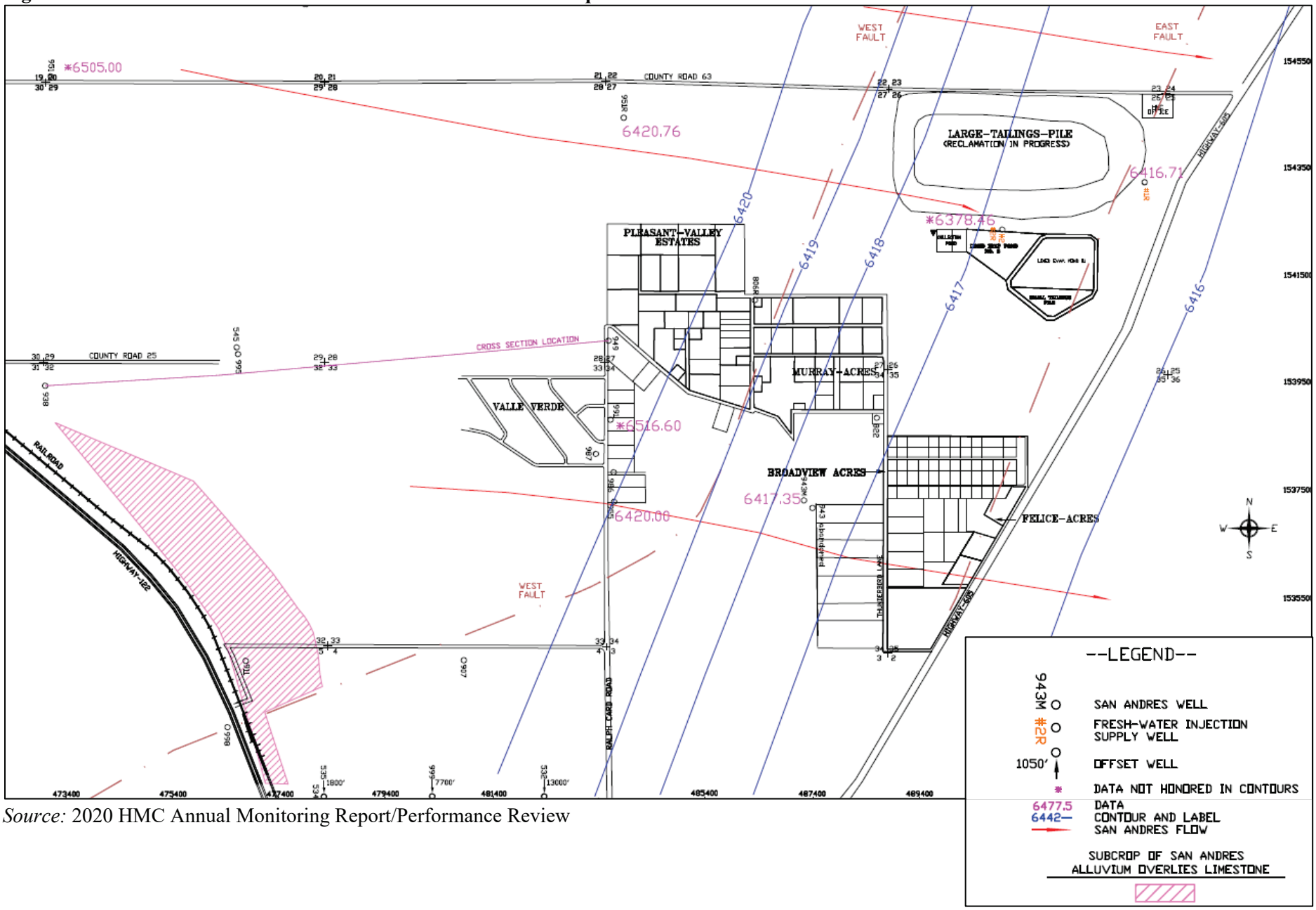
Source: 2020 HMC Annual Monitoring Report/ Performance Review.

Figure F-4: Water Level Elevations of the Lower Chinle Aquifer – 2020



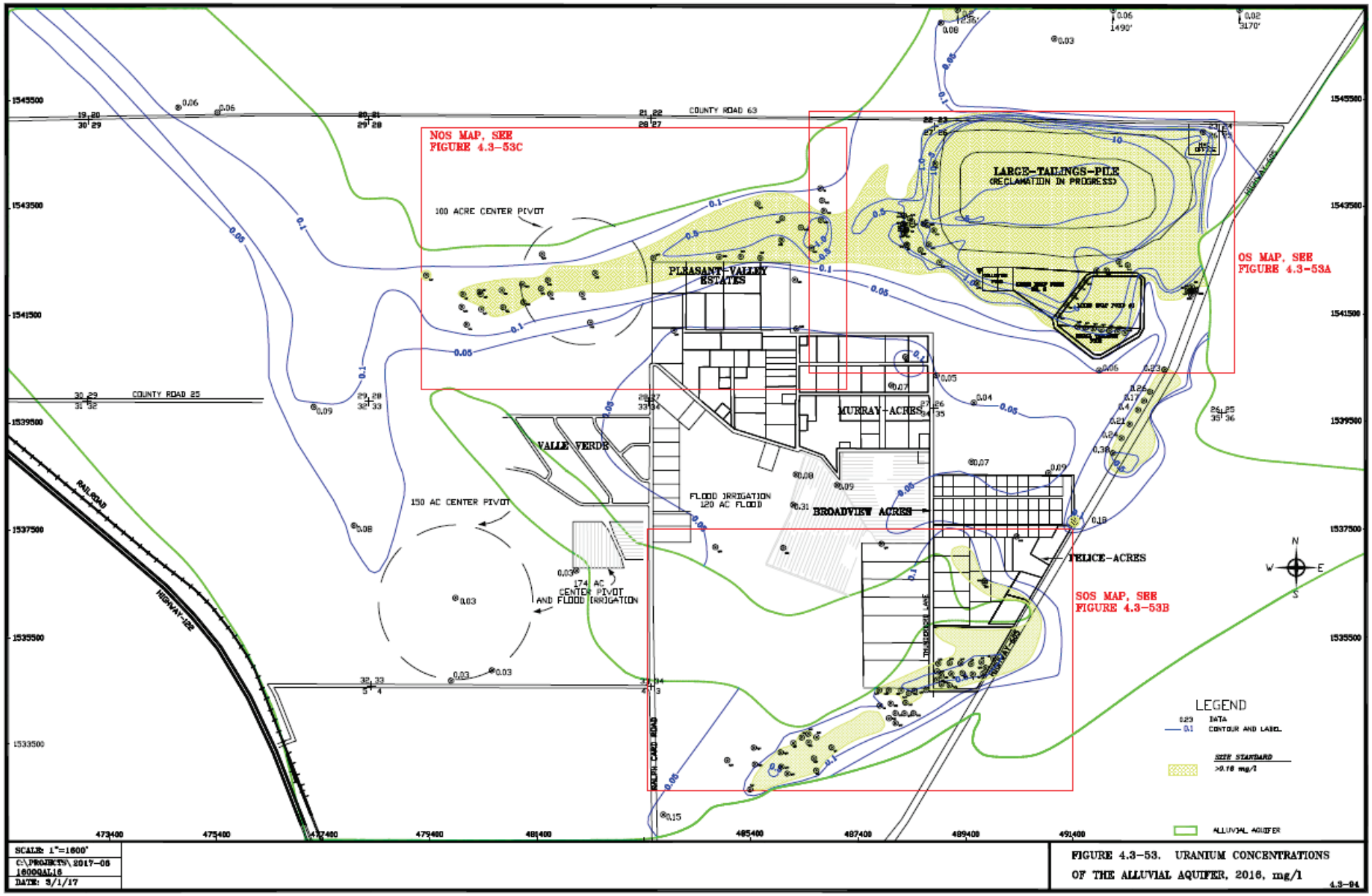
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-5: Water Level Elevations of the San Andres–Glorieta Aquifer – 2020



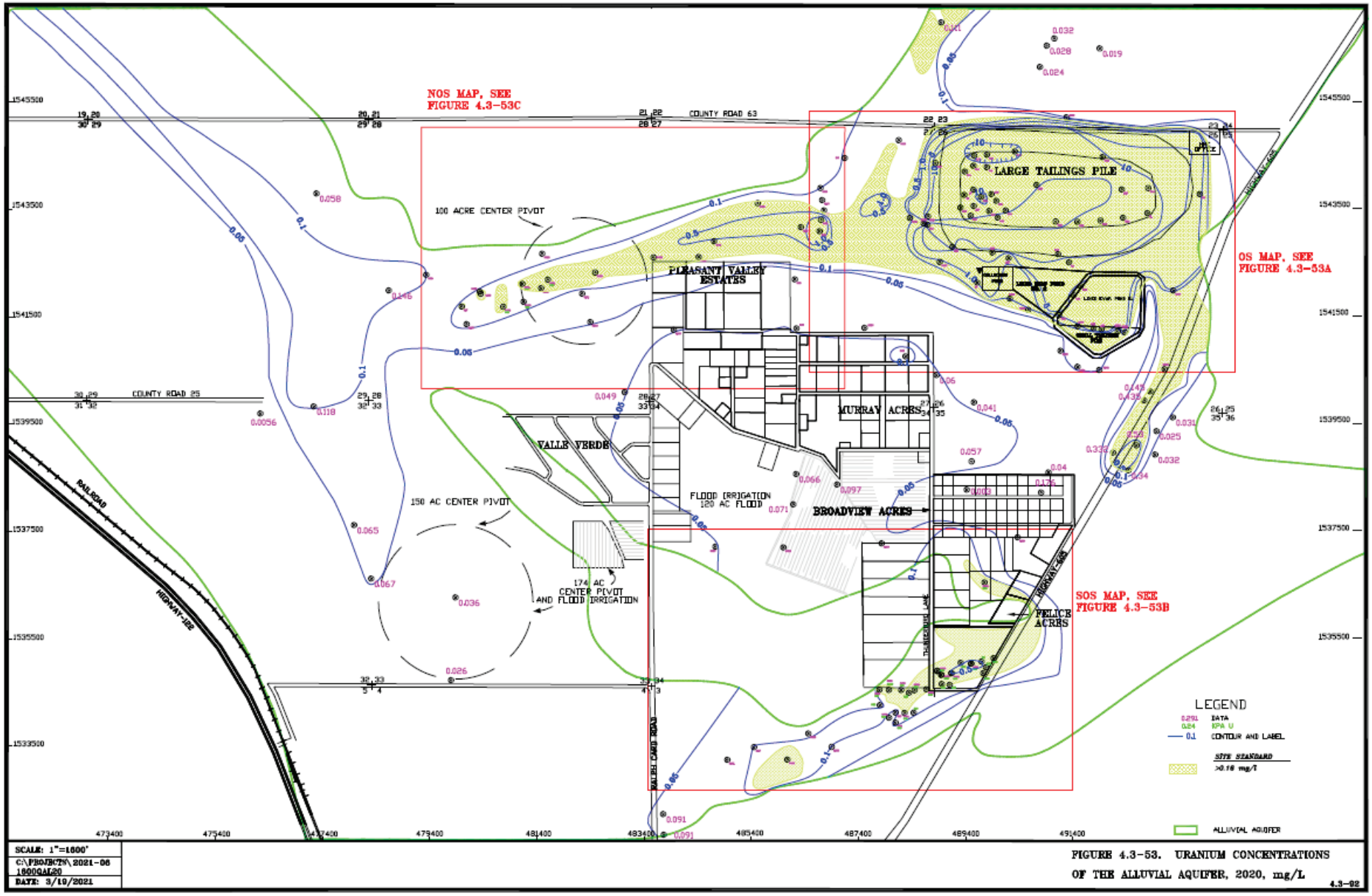
Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-6: 2016 Alluvial Aquifer Uranium Plume Map



Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-7: 2020 Alluvial Aquifer Uranium Plume Map



Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-8: 2016 and 2020 Alluvial Aquifer Uranium Plume Maps – Downgradient Plume Area in West Channel

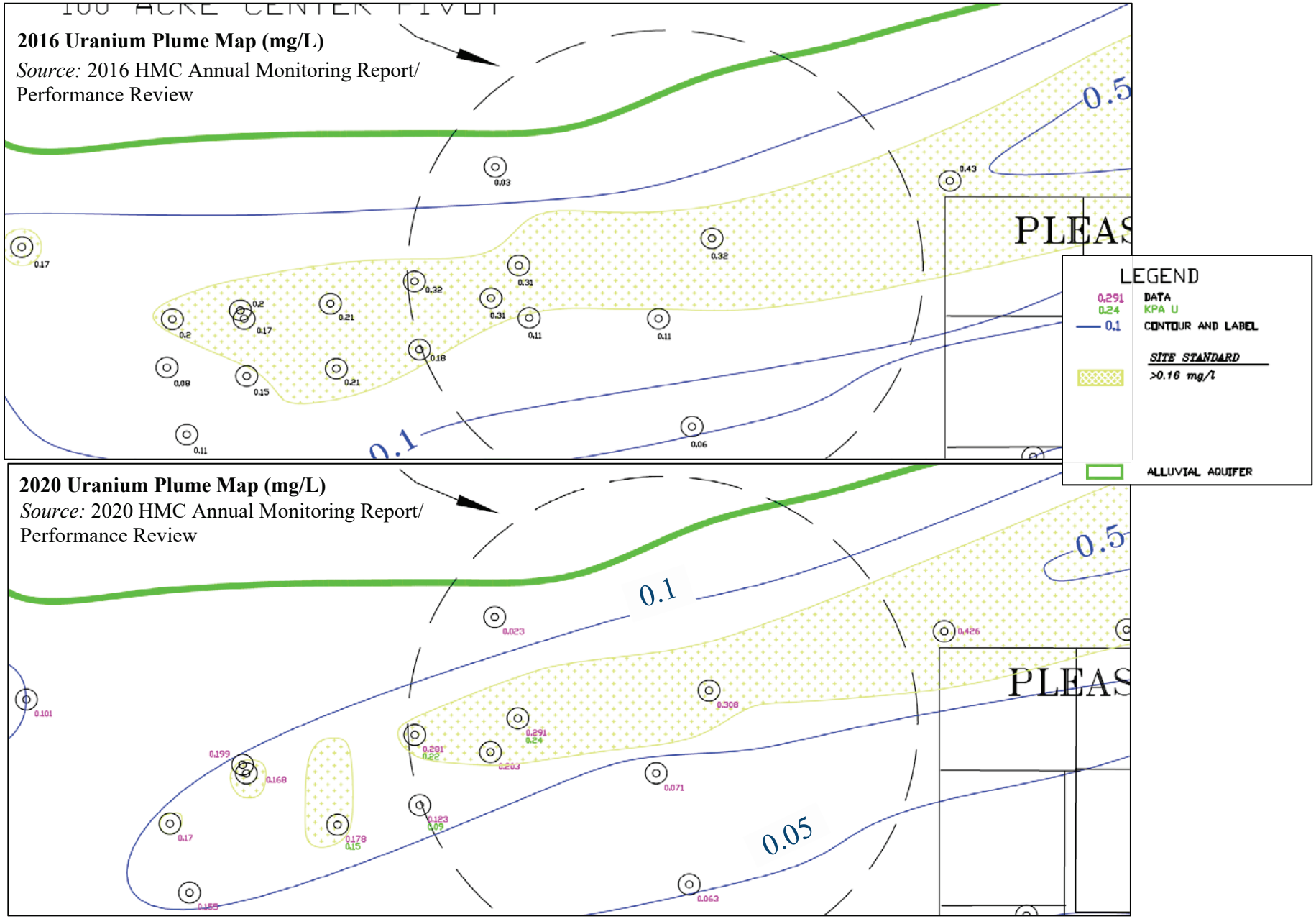
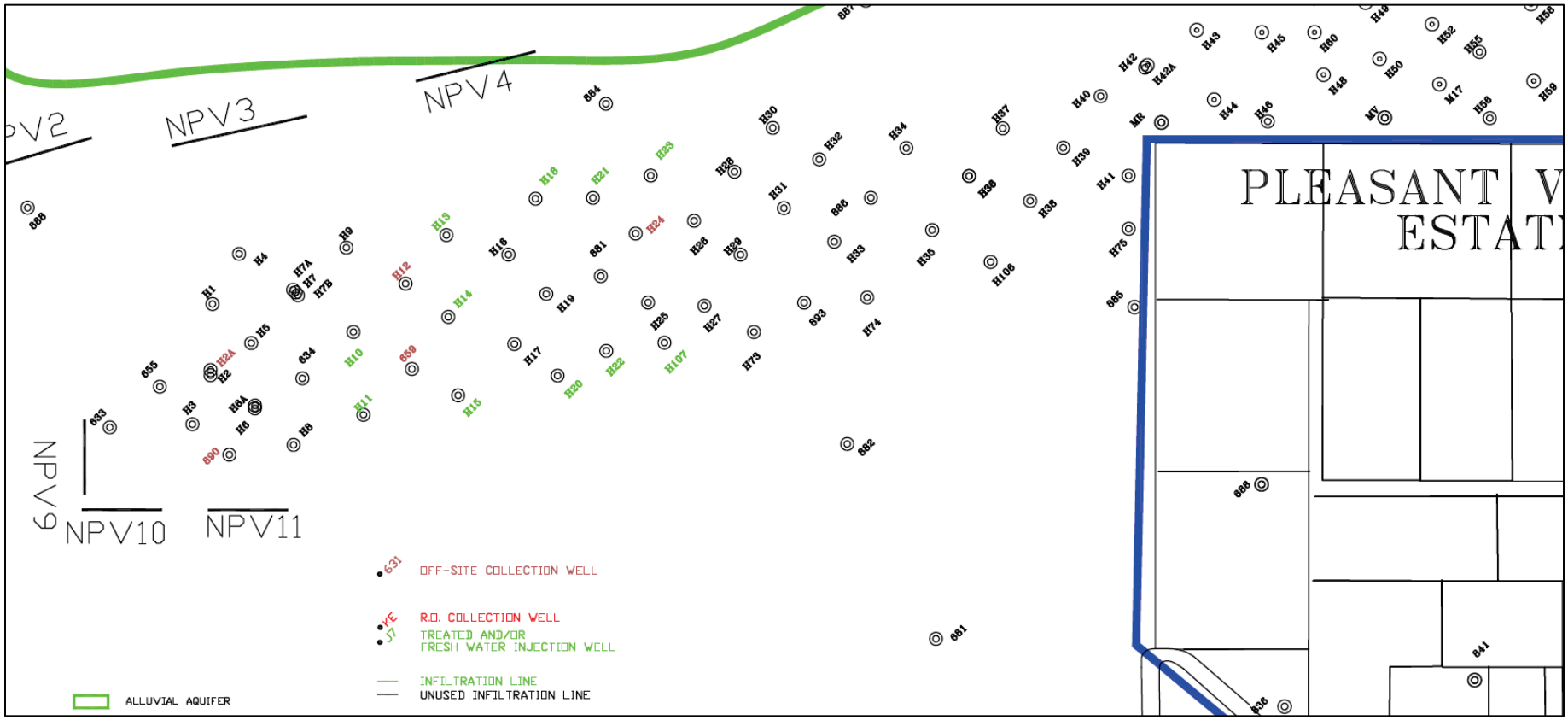
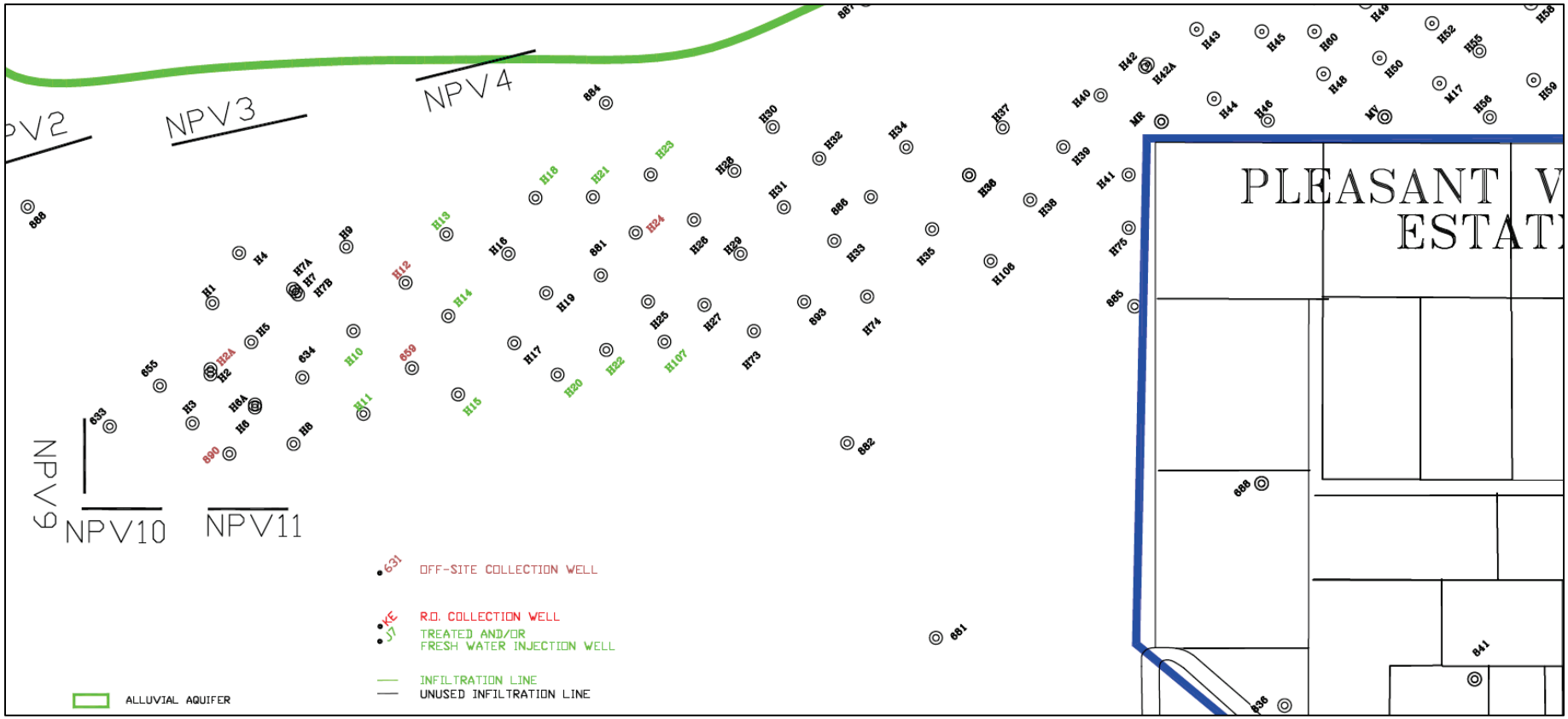


Figure F-9: 2016 Alluvial Aquifer Injection and Collection System – West Channel



Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-10: 2020 Alluvial Aquifer Injection and Collection System – West Channel



Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-11: 2016 and 2020 Alluvial Aquifer Uranium Plume Maps – Downgradient Plume Area in East Channel

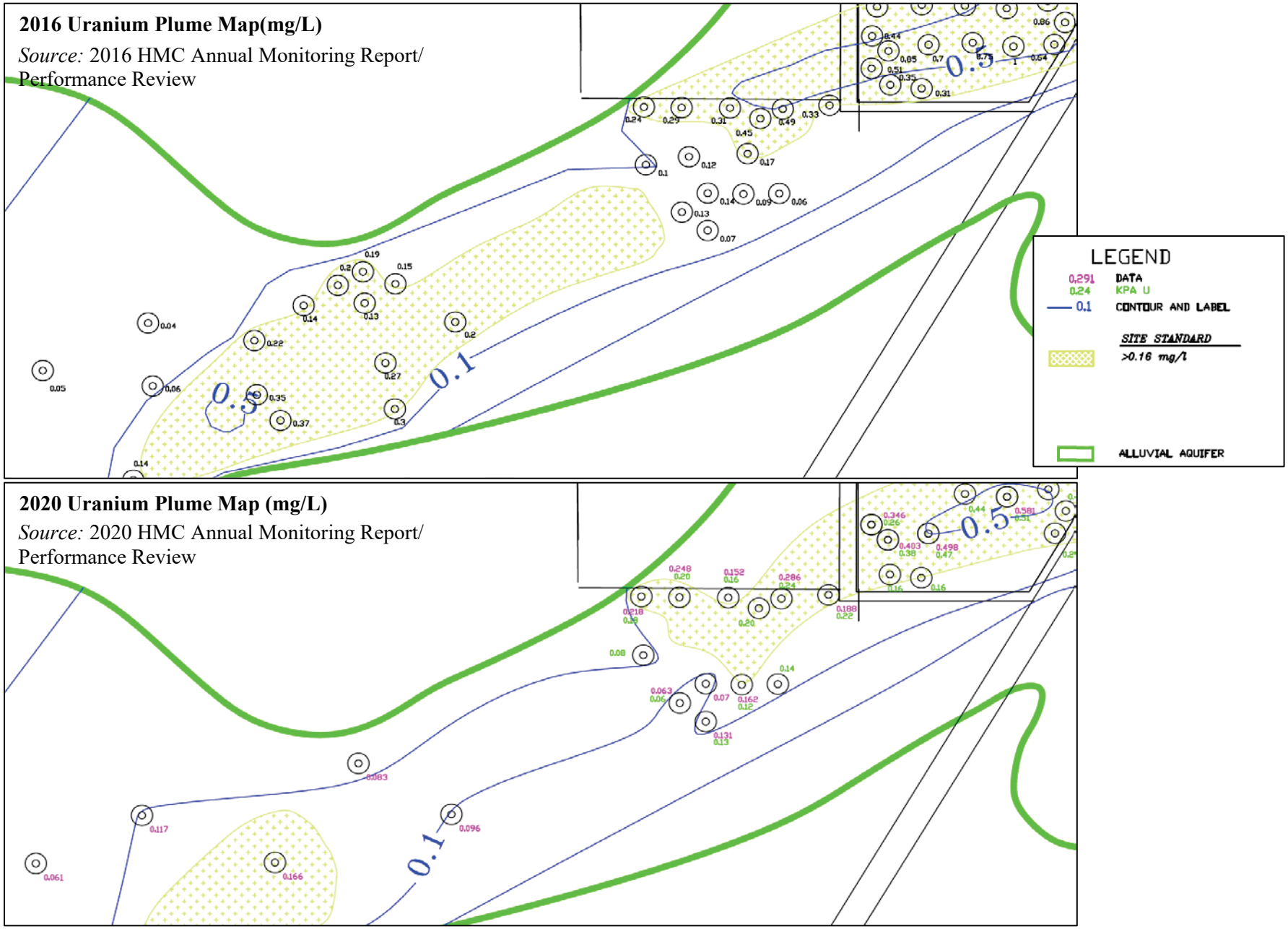
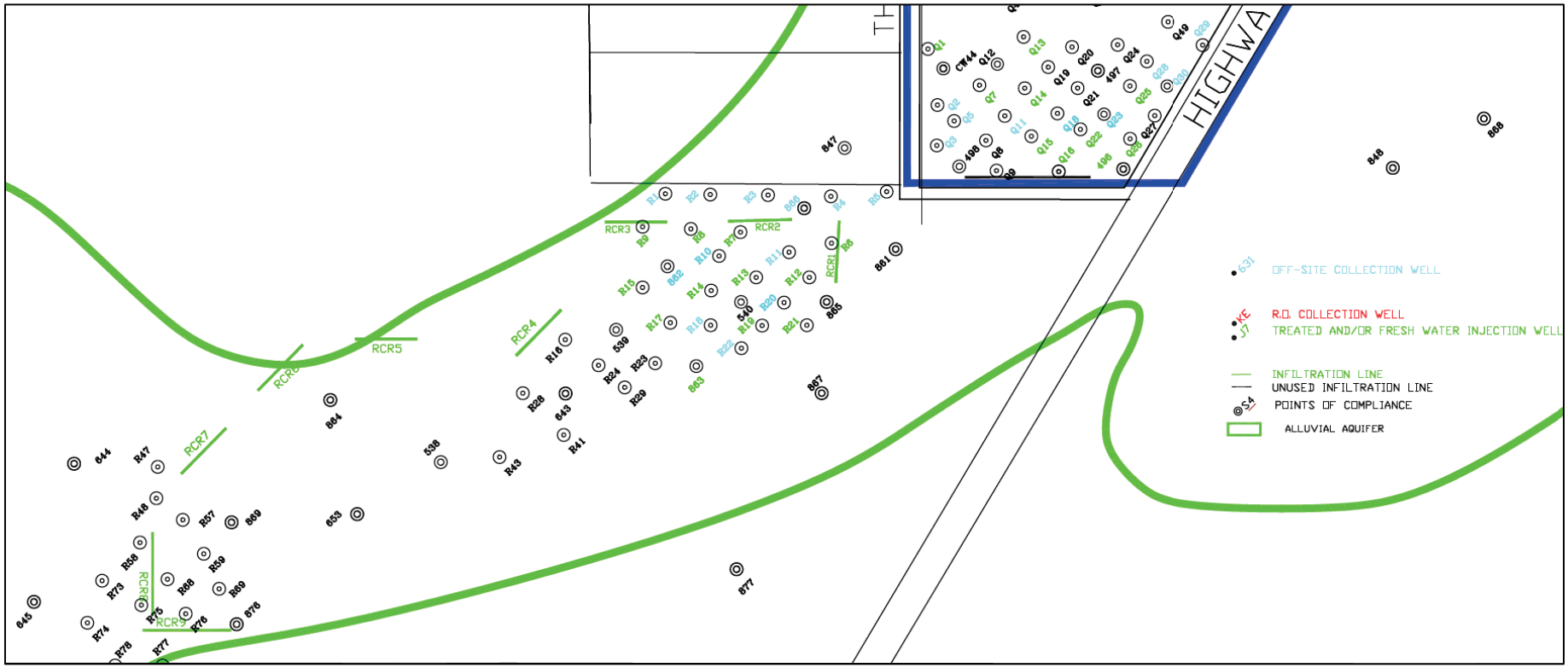
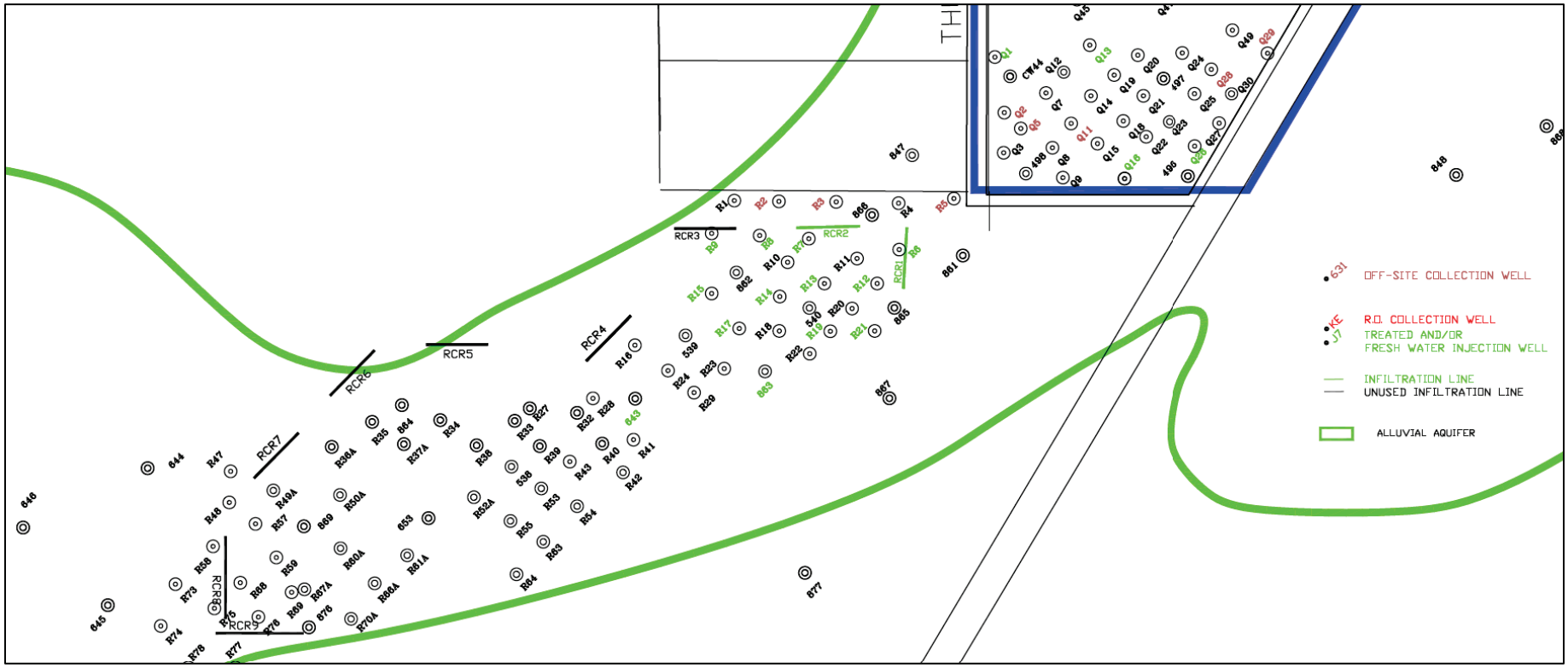


Figure F-12: 2016 Alluvial Aquifer Injection and Collection System – East Channel



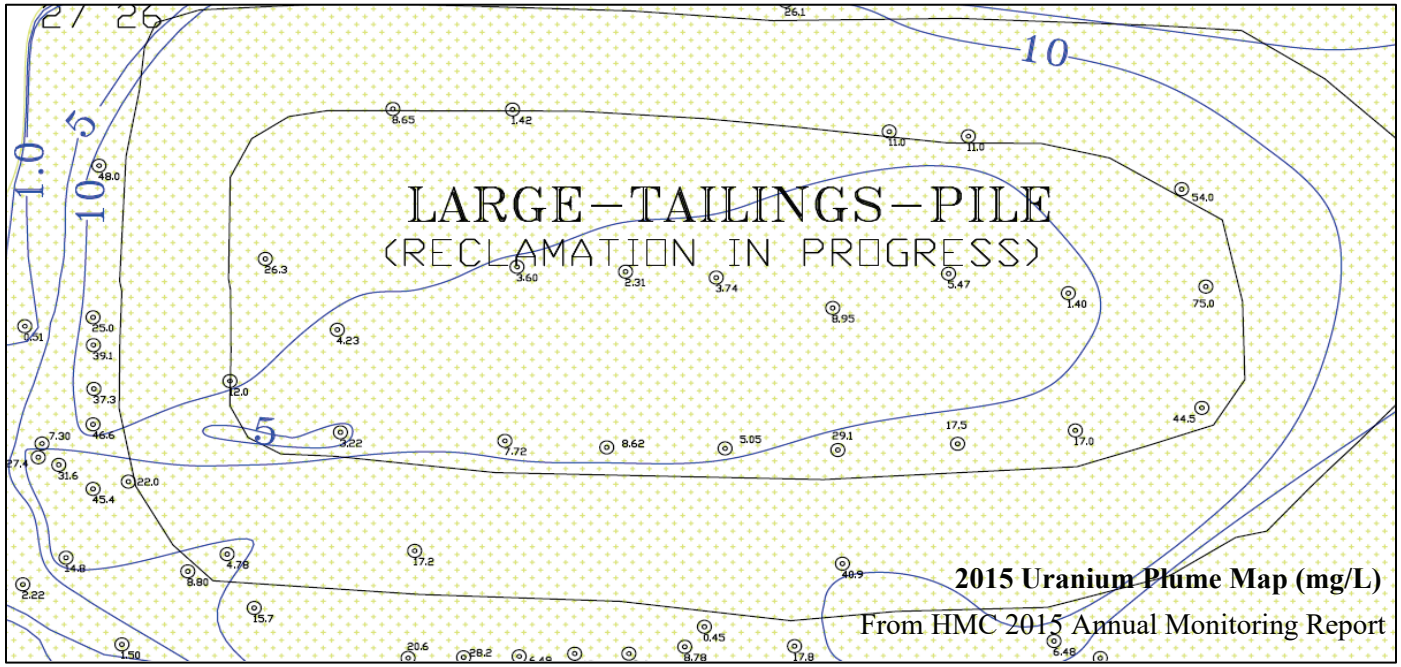
Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-13: 2020 Alluvial Aquifer Injection and Collection System – East Channel

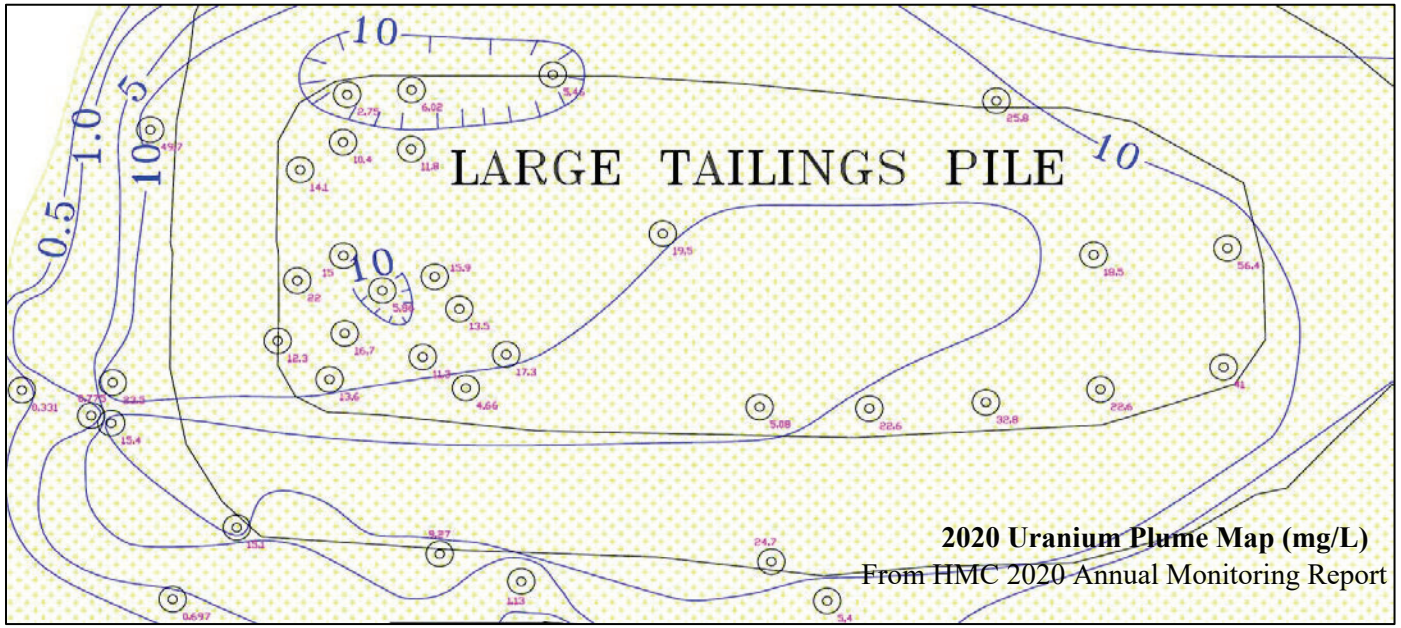


Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-14: 2015 and 2020 Alluvial Aquifer Uranium Plume Maps – Large Tailing Pile



2015 Uranium Plume Map (mg/L)
From HMC 2015 Annual Monitoring Report



2020 Uranium Plume Map (mg/L)
From HMC 2020 Annual Monitoring Report

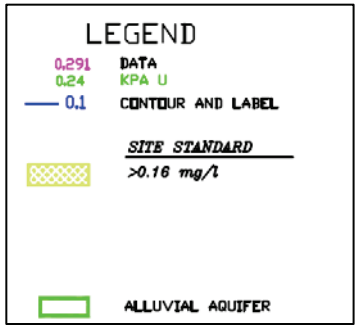
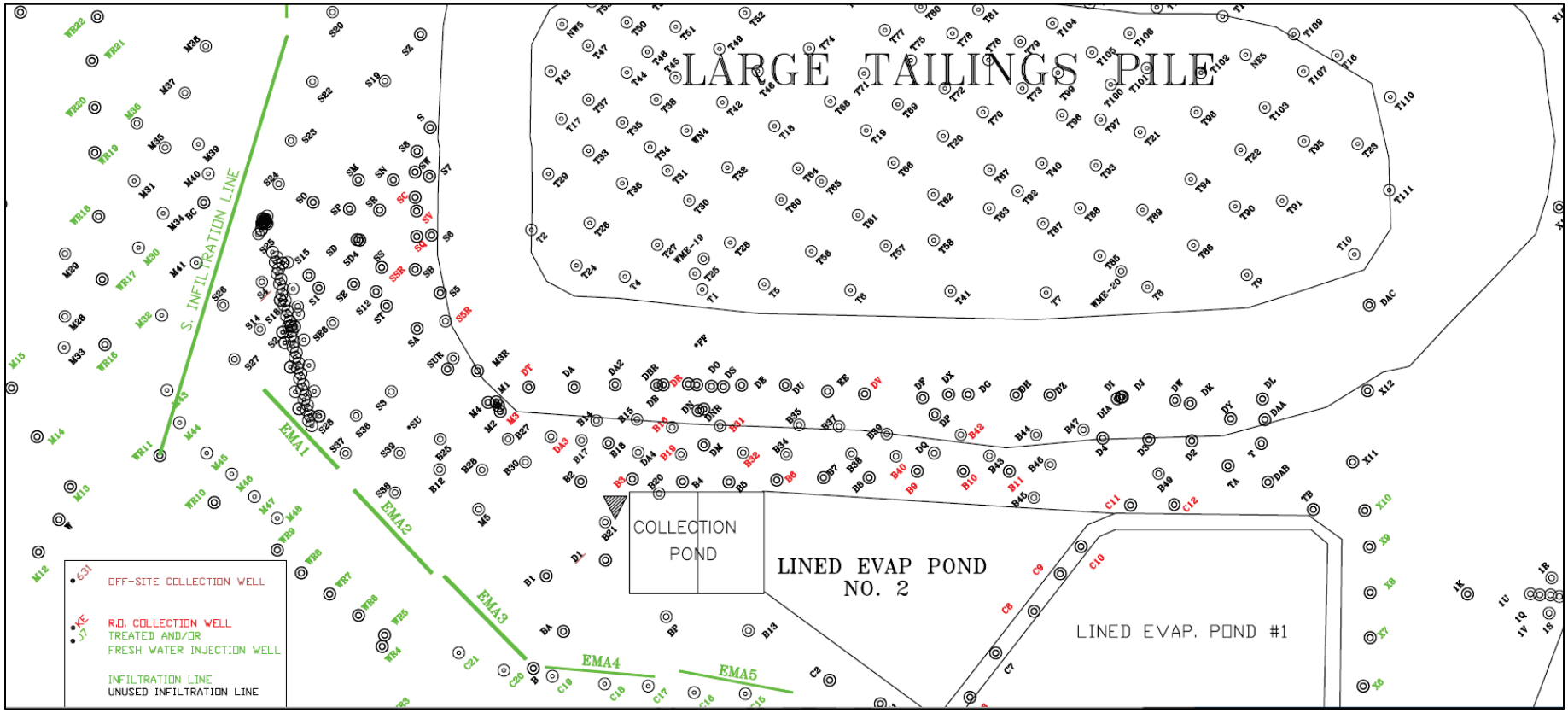
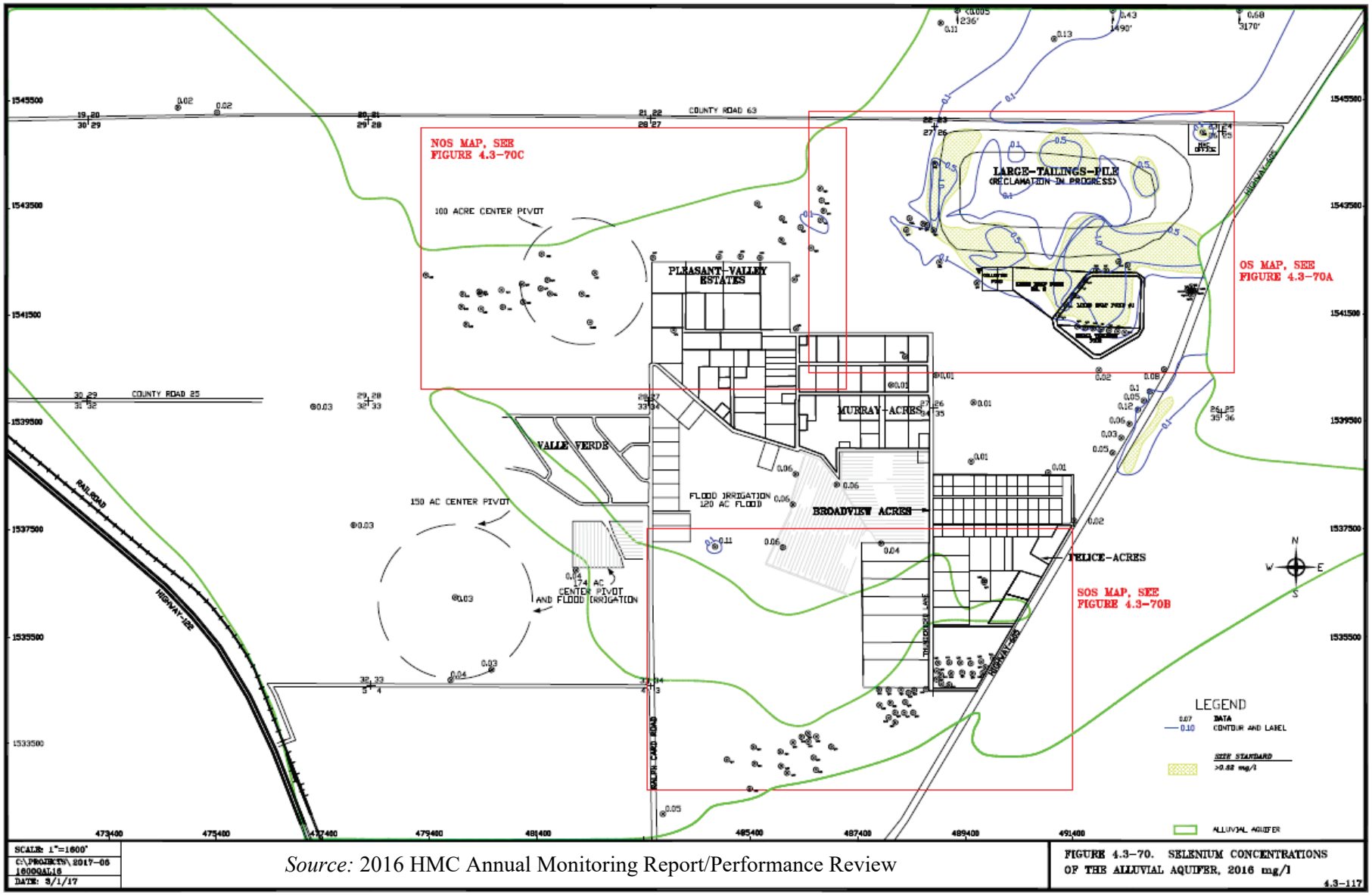


Figure F-15: 2020 Alluvial Aquifer Injection and Collection System – Large Tailing Pile



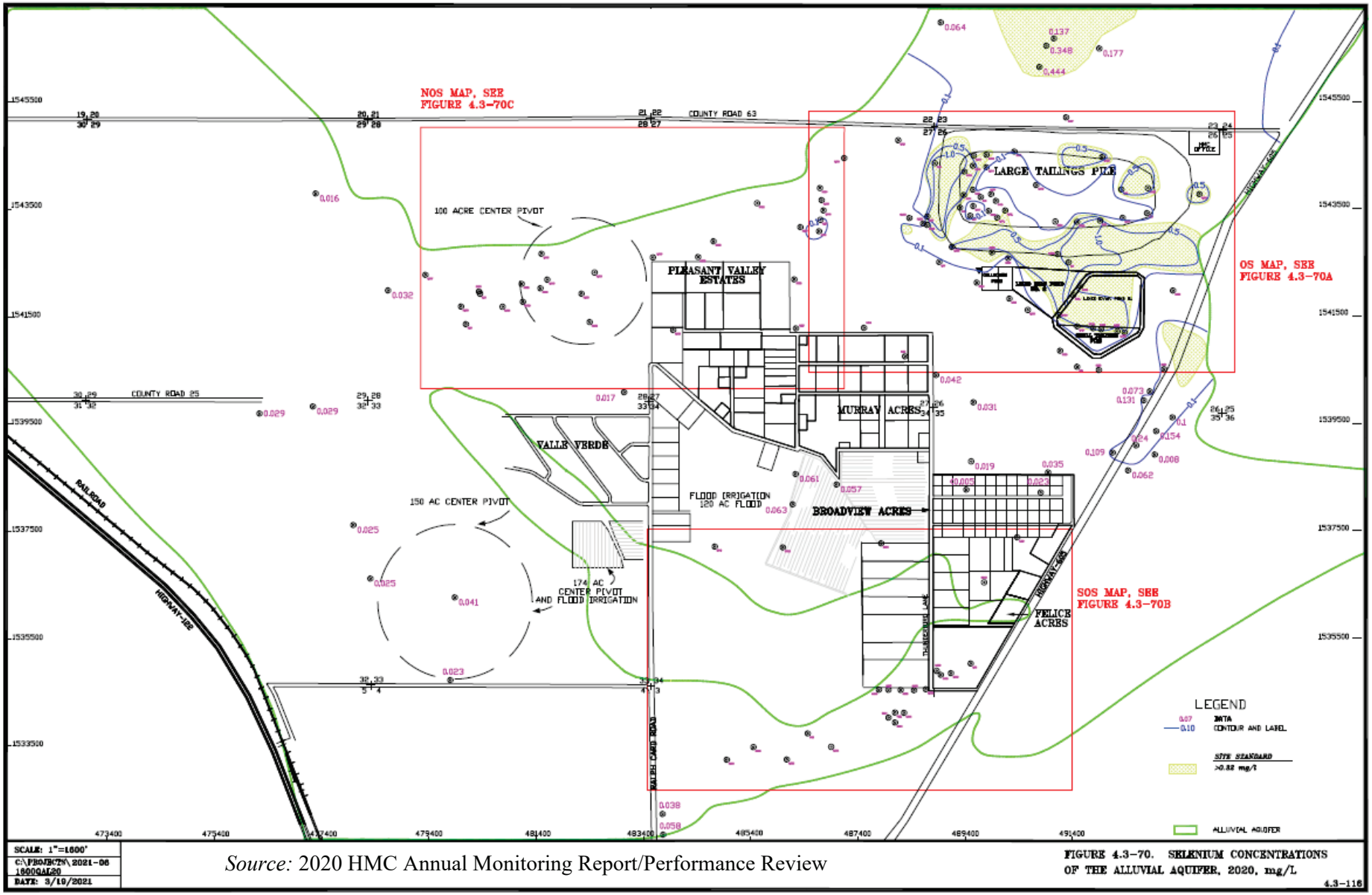
Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-16: 2016 Alluvial Aquifer Selenium Plume Map



Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-17: 2020 Alluvial Aquifer Selenium Plume Map

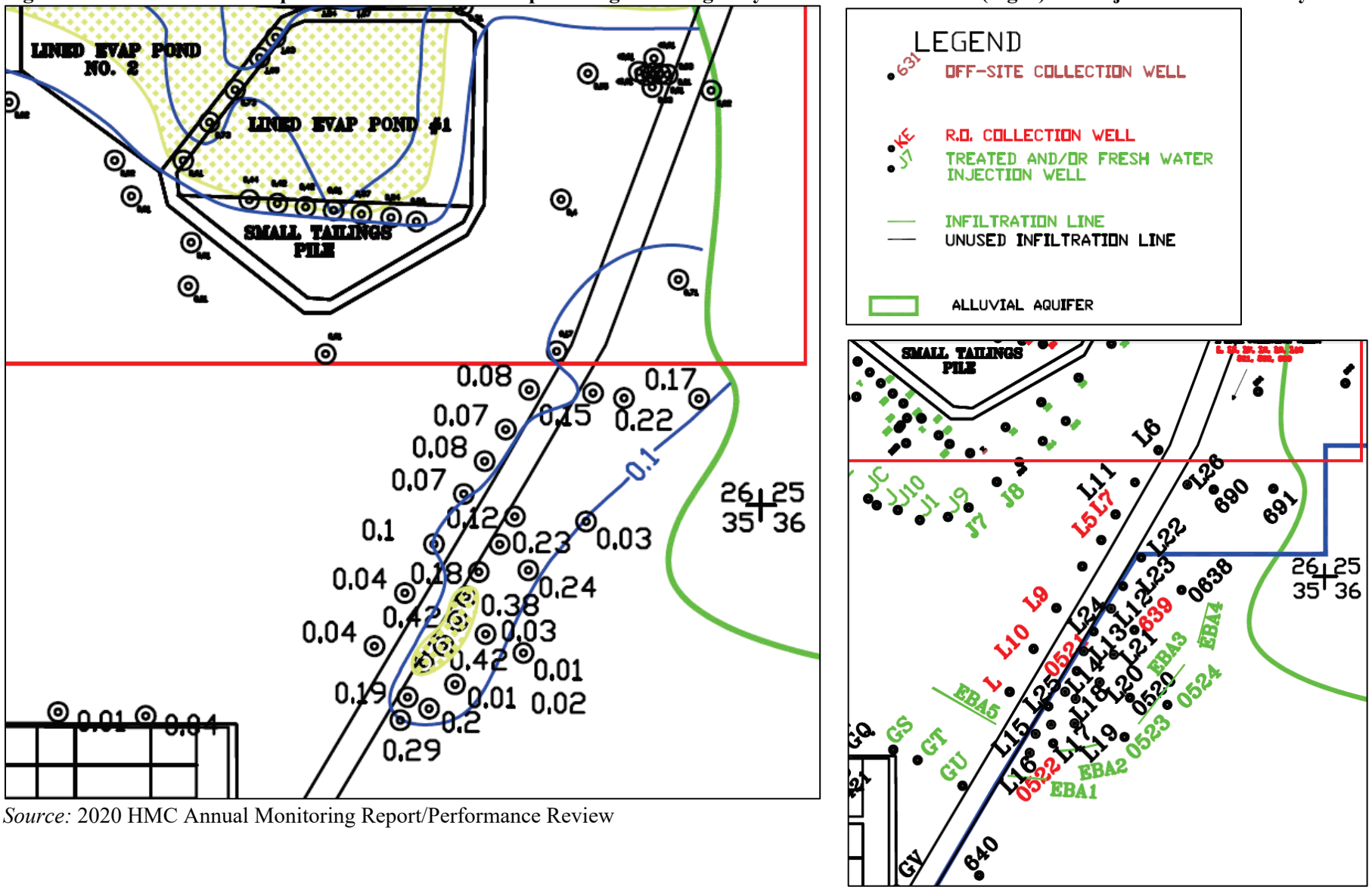


Source: 2020 HMC Annual Monitoring Report/Performance Review

FIGURE 4.3-70. SELENIUM CONCENTRATIONS OF THE ALLUVIAL AQUIFER, 2020, mg/L

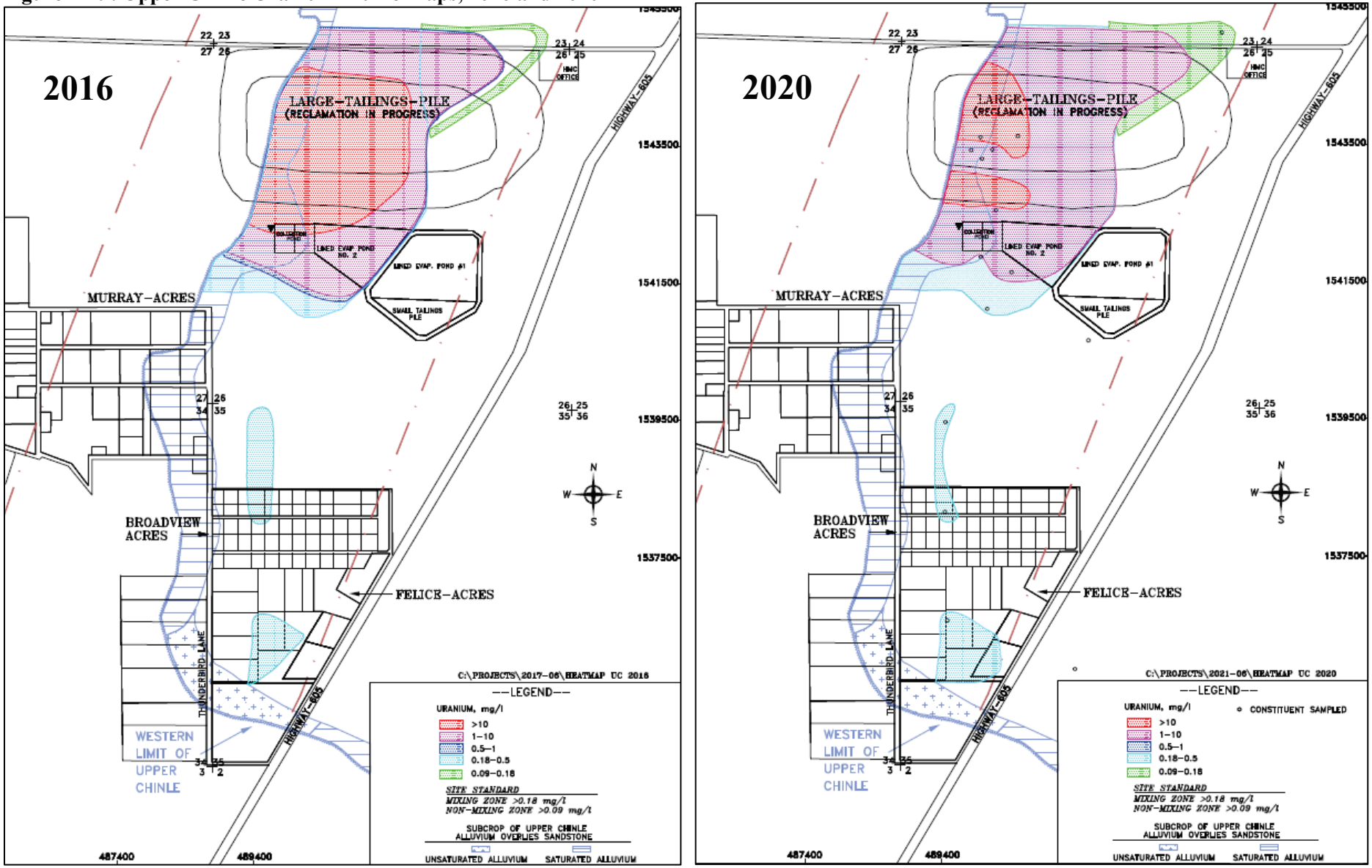
4.3-116

Figure F-18: 2017 Alluvial Aquifer Selenium Plume Map – Along State Highway 605 and South of STP (mg/L) and Injection/Collection System



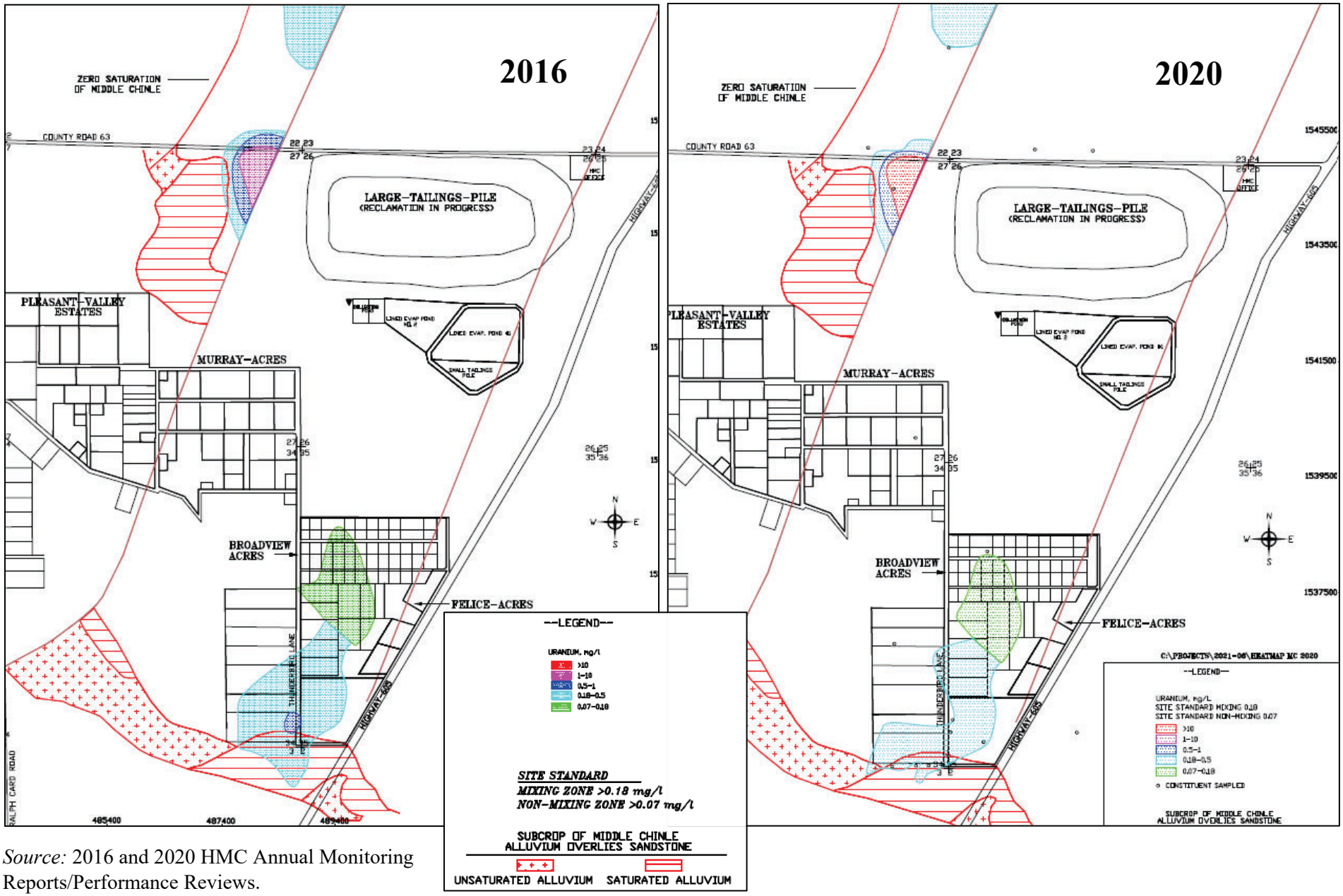
Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-19: Upper Chinle Uranium Plume Maps, 2016 and 2020



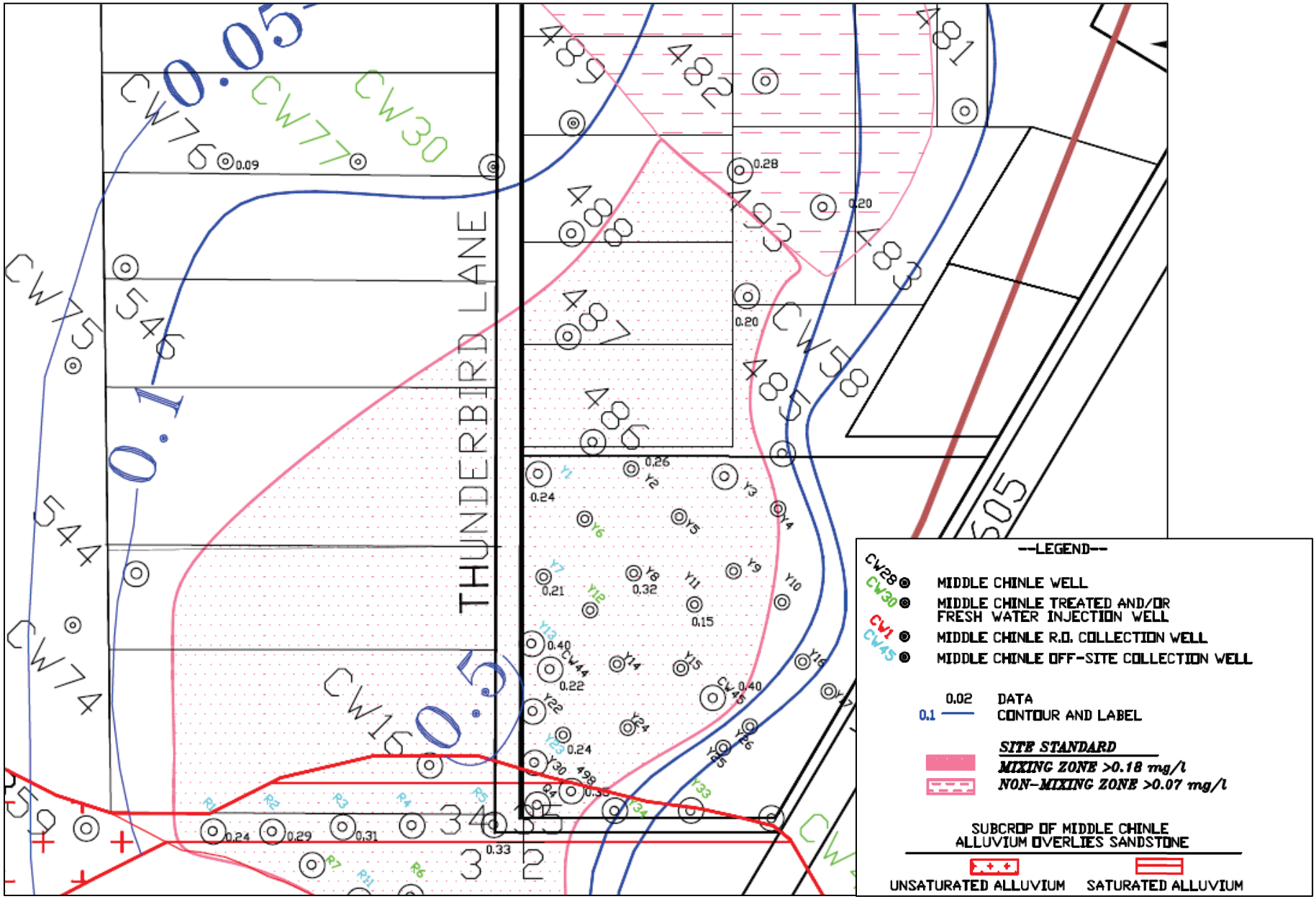
Source: 2016 and 2020 HMC Annual Monitoring Reports/Performance Reviews.

Figure F-20: Middle Chinle Uranium Plume Maps, 2016 and 2020



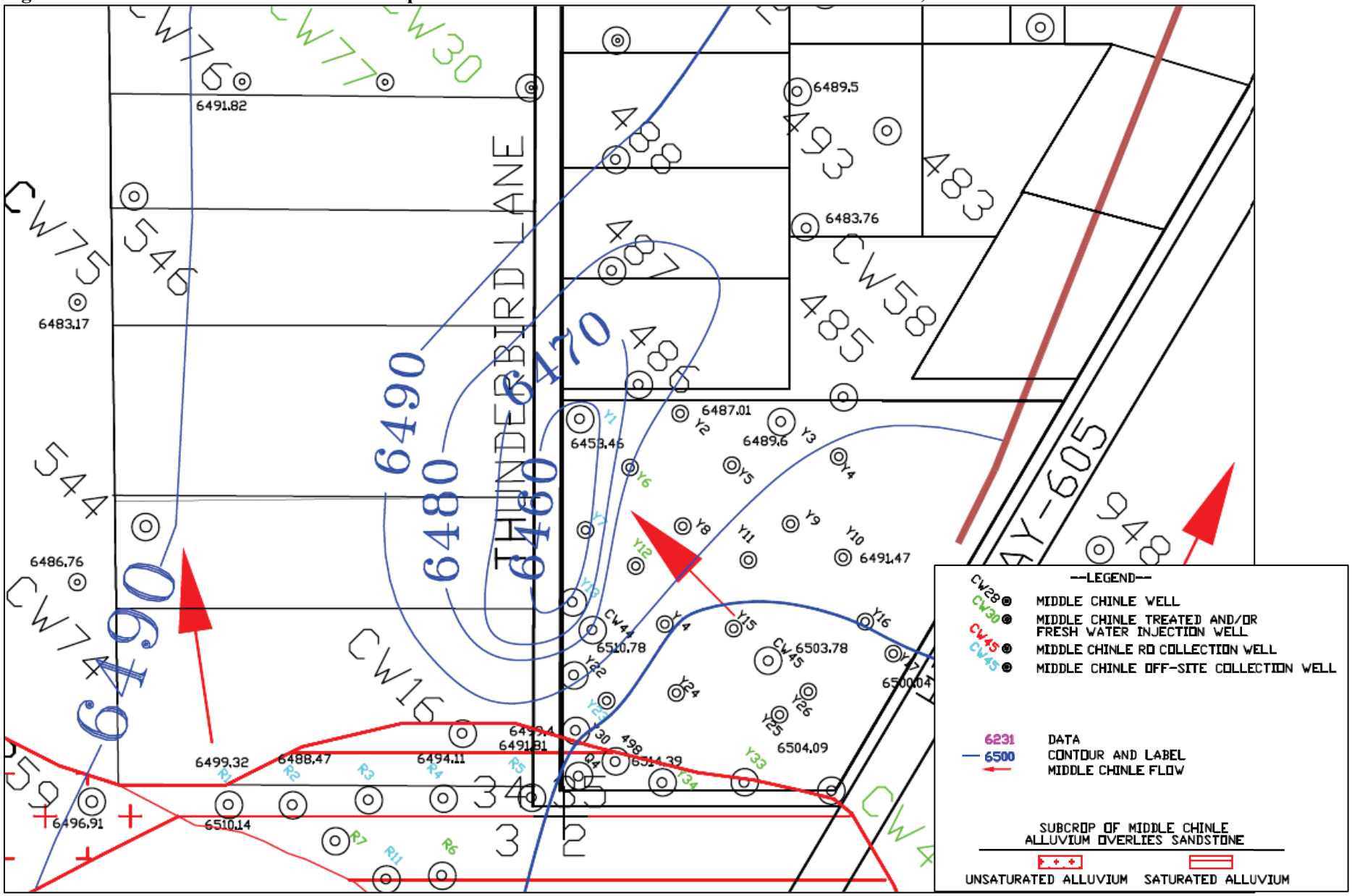
Source: 2016 and 2020 HMC Annual Monitoring Reports/Performance Reviews.

Figure F-21: Middle Chinle Uranium Plume Map for Felice Acres Subdivision – Thunderbird Lane Area, 2016



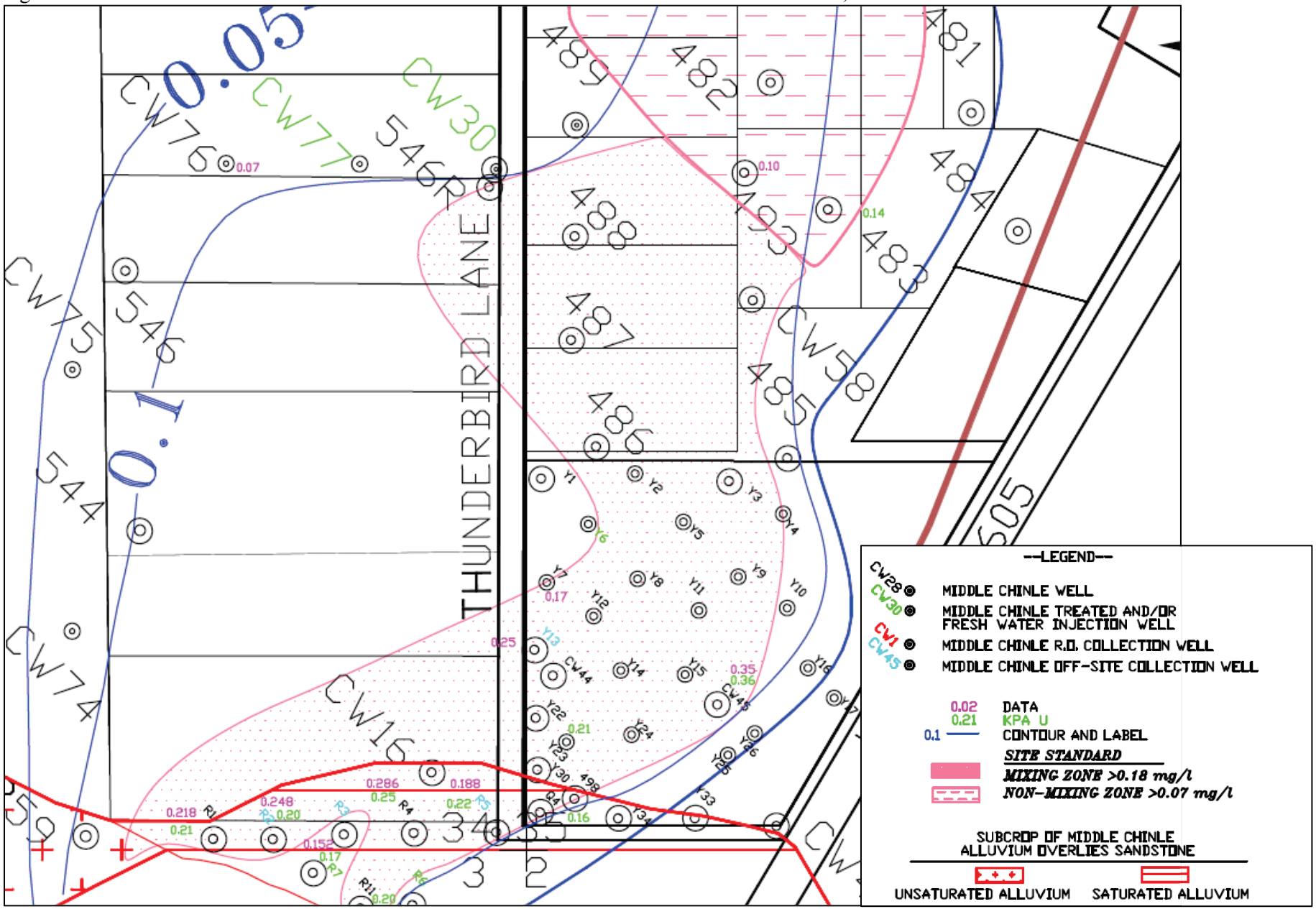
Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-22: Middle Chinle Water-Level Map for Felice Acres Subdivision – Thunderbird Lane Area, 2016



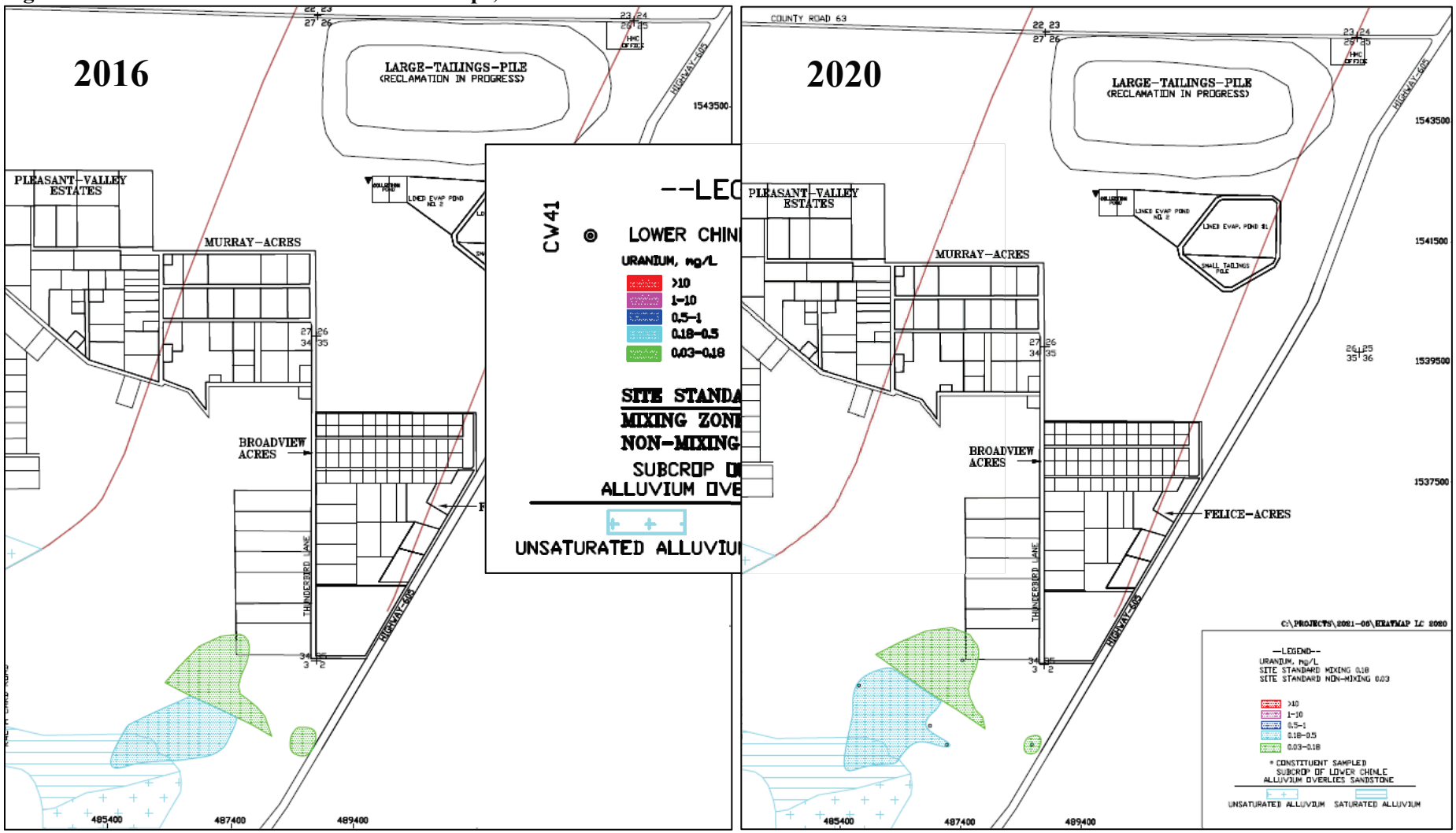
Source: 2016 HMC Annual Monitoring Report/Performance Review

Figure F-23: Middle Chinle Uranium Plume for Felice Acres Subdivision – Thunderbird Lane Area, 2020



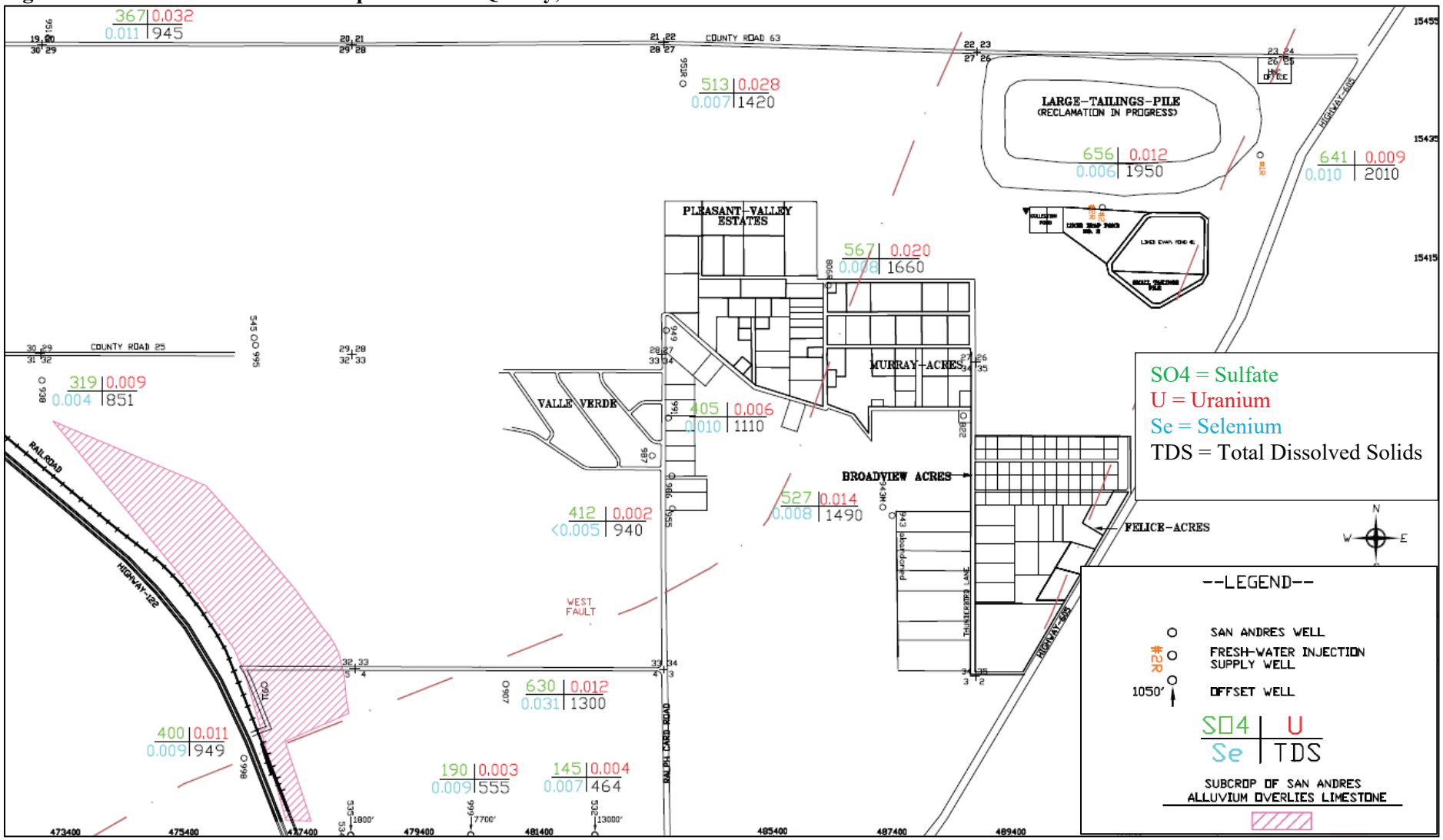
Source: 2020 HMC Annual Monitoring Report/Performance Review

Figure F-24: Lower Chinle Uranium Plume Maps, 2016 and 2020



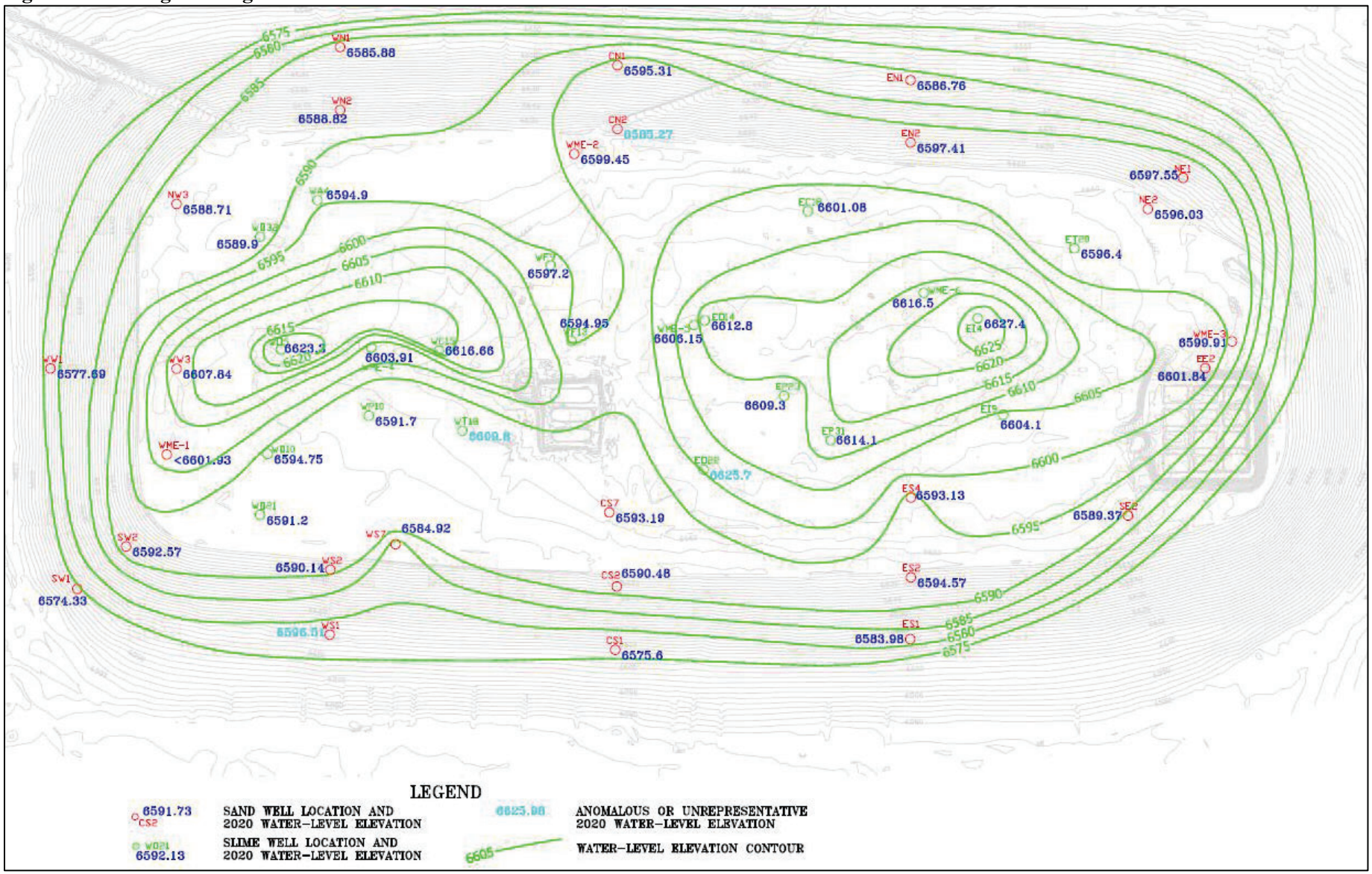
Source: 2016 and 2020 HMC Annual Monitoring Reports/Performance Reviews.

Figure F-25: San Andres-Glorieta Aquifer Water Quality, 2020



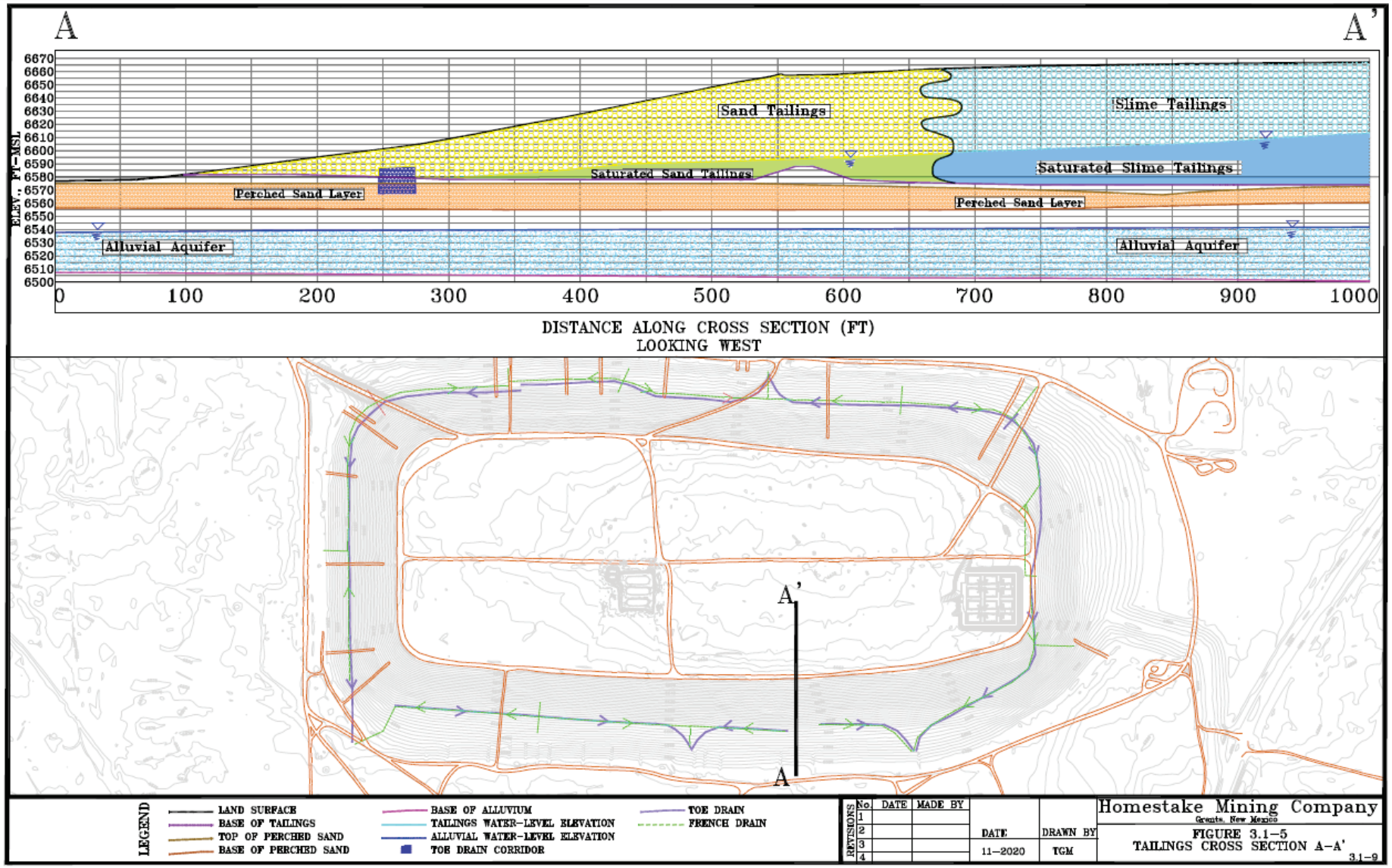
Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-26: Large Tailing Pile Well Locations and Water-Level Elevations 2020



Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-27: Large Tailing Pile Cross Section Depicting Tailing Saturation 2020



Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-28: Yearly Quantity of Tailing Water and Uranium Removed from the LTP – 2000 to 2020

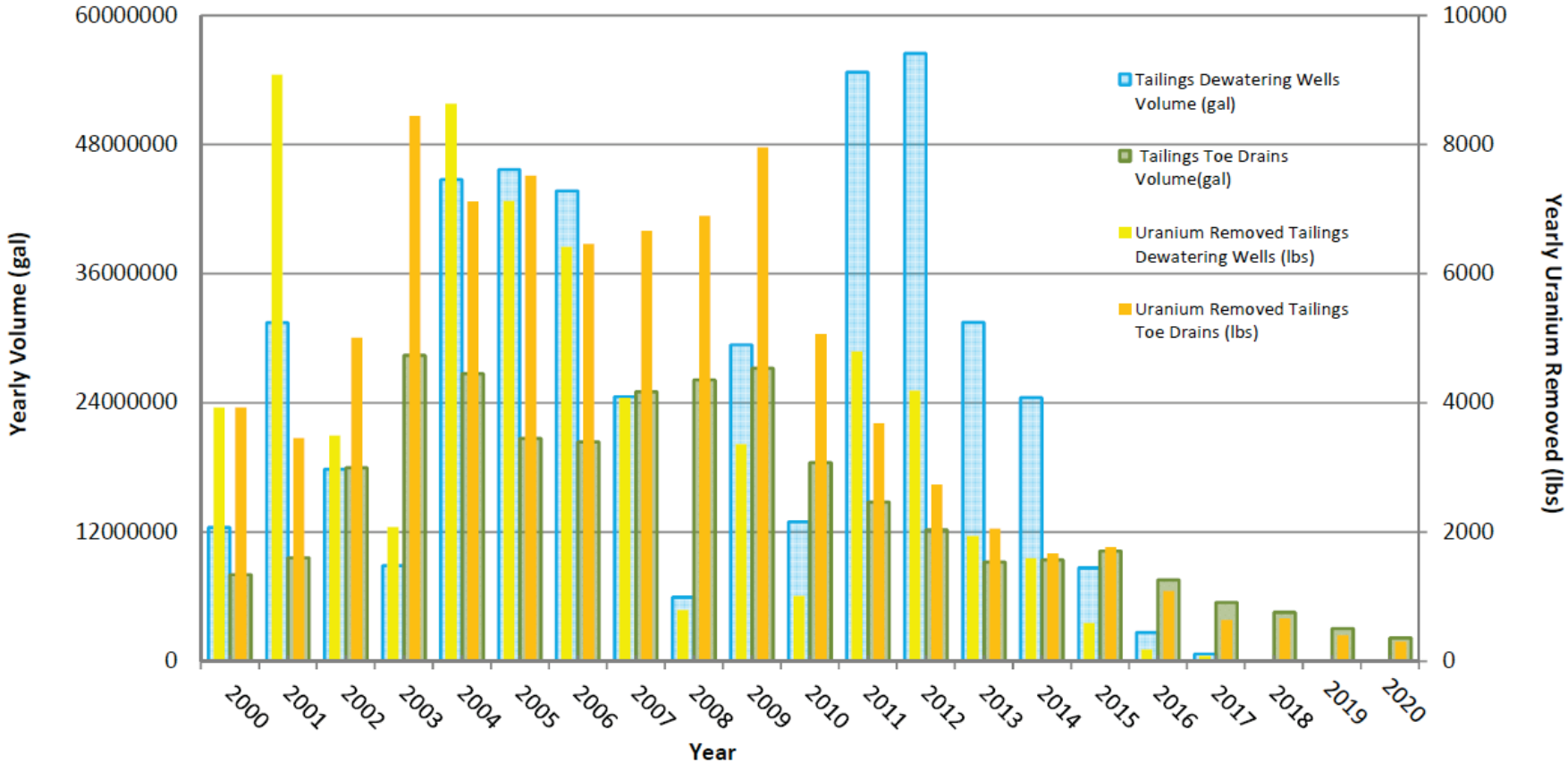


Figure 3.1-4. Yearly Quantity of Tailings Water and Uranium Removed

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-29: Large Tailing Pile – Water-Level Elevation Changes for Tailing Wells 2009-2020

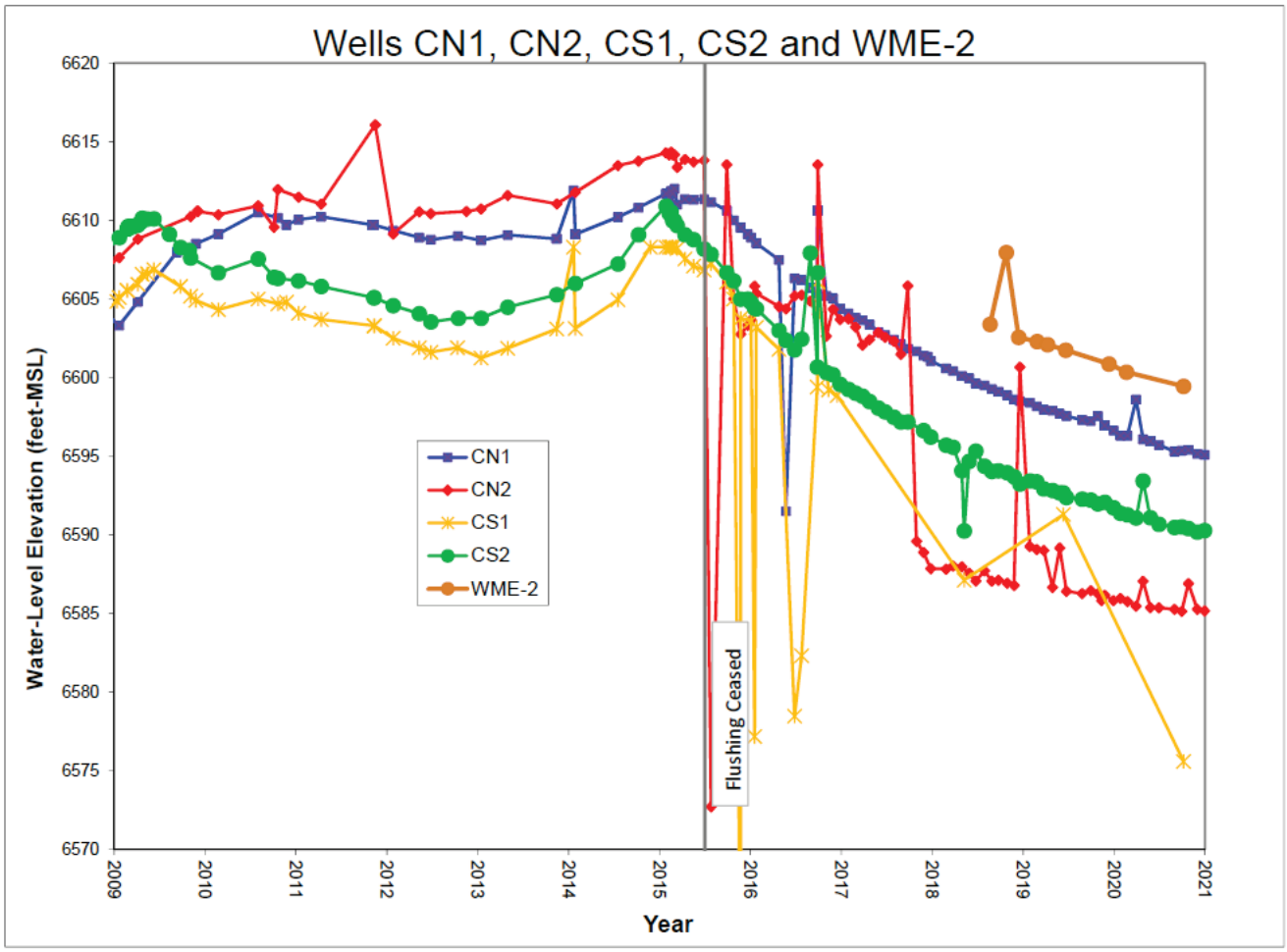


Figure 3.2-2. Water-Level Elevation ForTailings Wells CN1, CN2, CS1, CS2 and WME-2

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-30: Large Tailing Pile – Tailing Uranium Concentrations in 2000

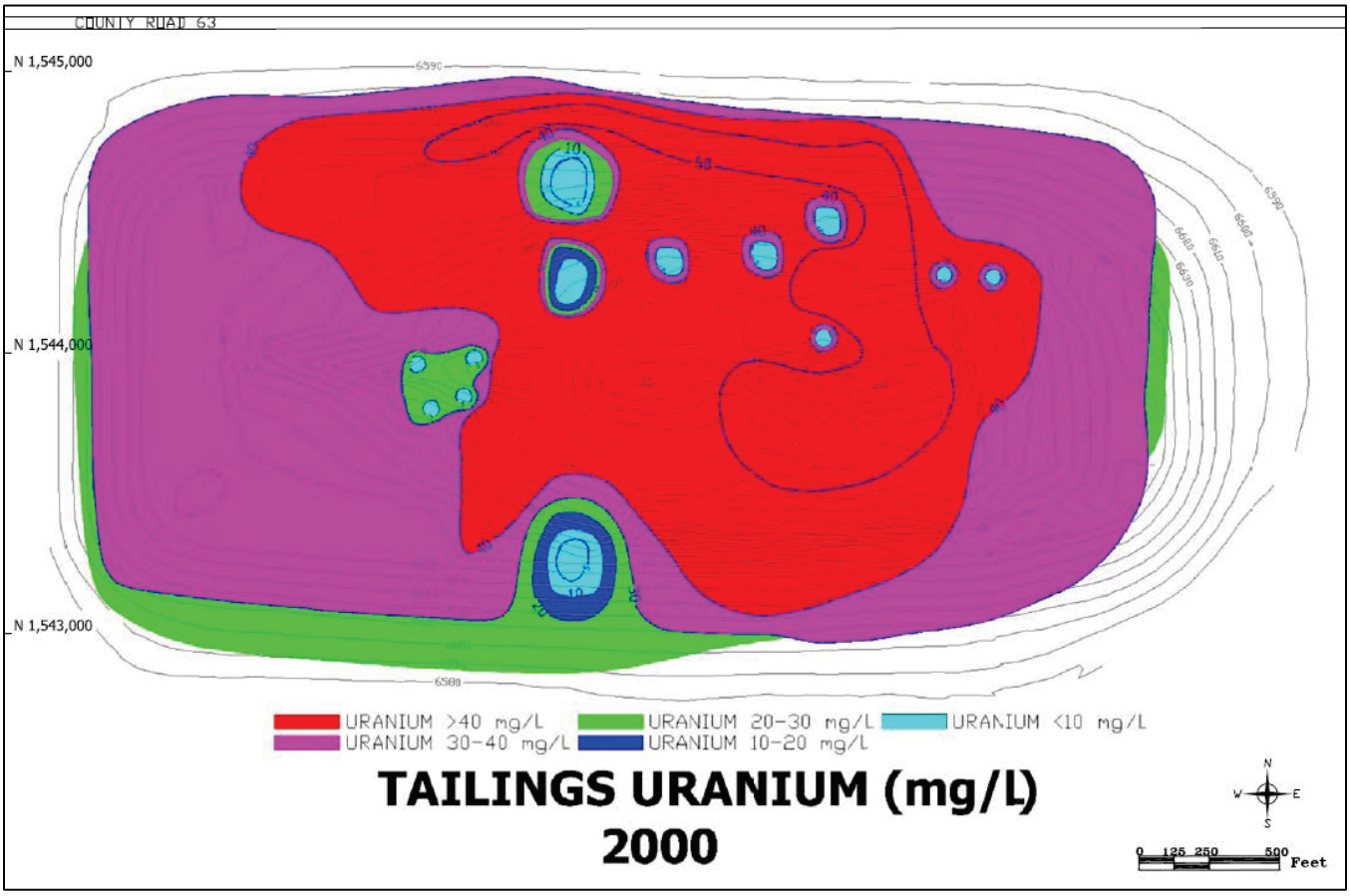
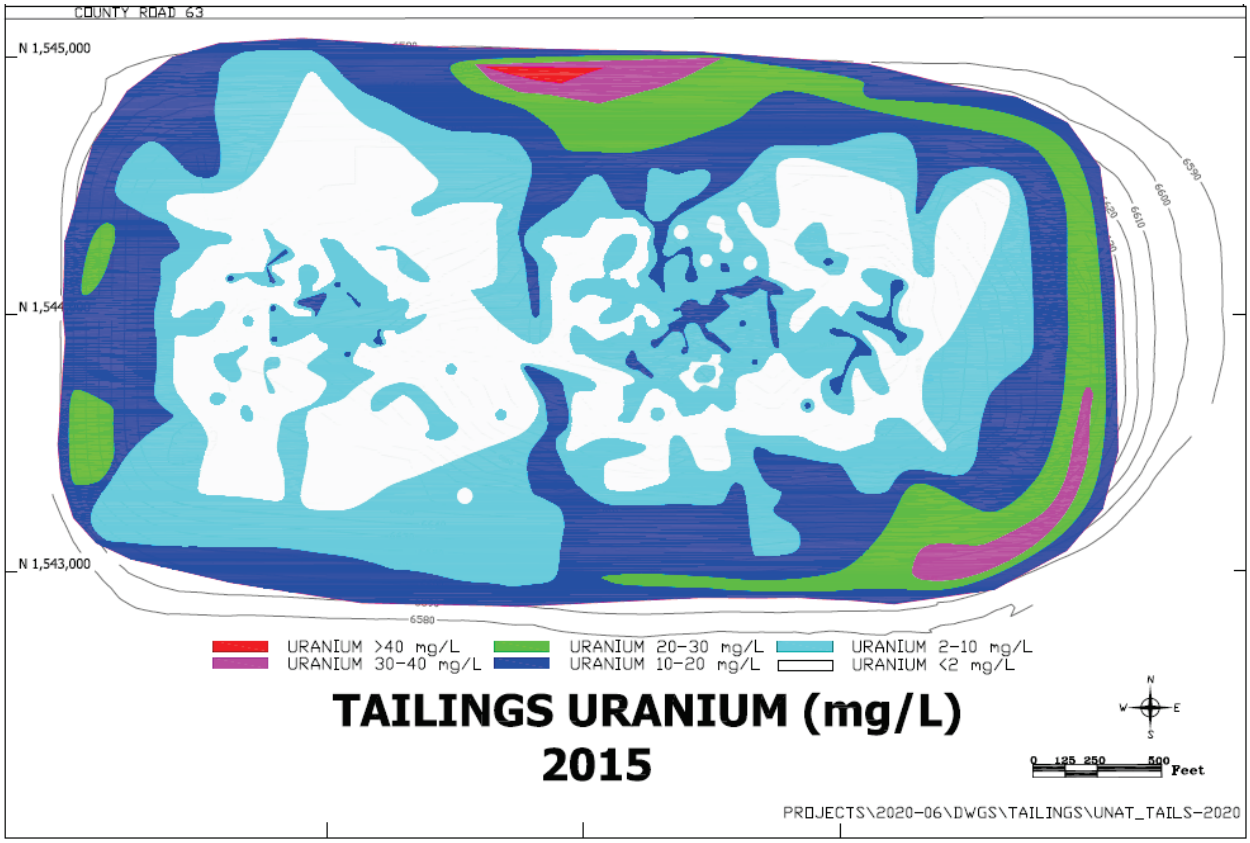
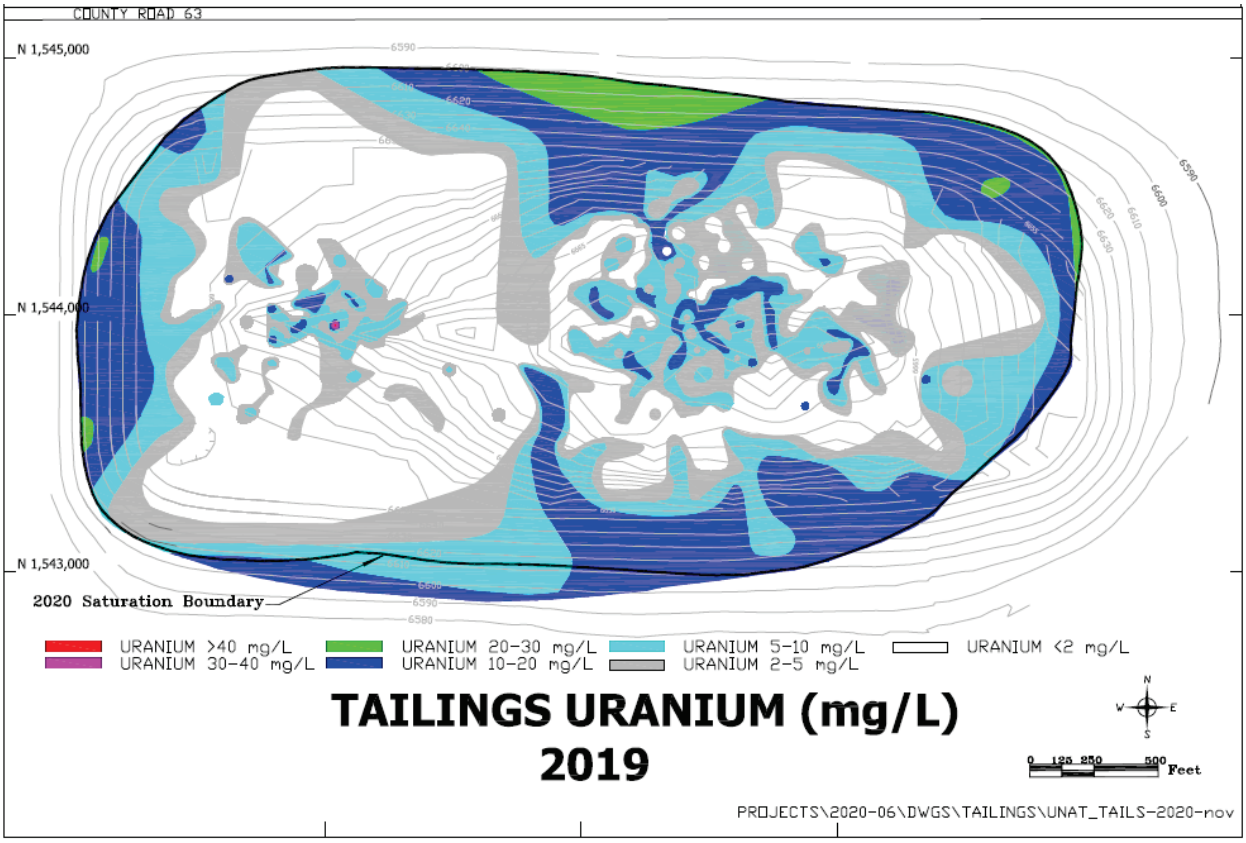


Figure F-31: Large Tailing Pile – Tailing Uranium Concentrations in 2015 and 2019





Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-32: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Sand Tailing Wells at Large Tailing Pile 2004-2020

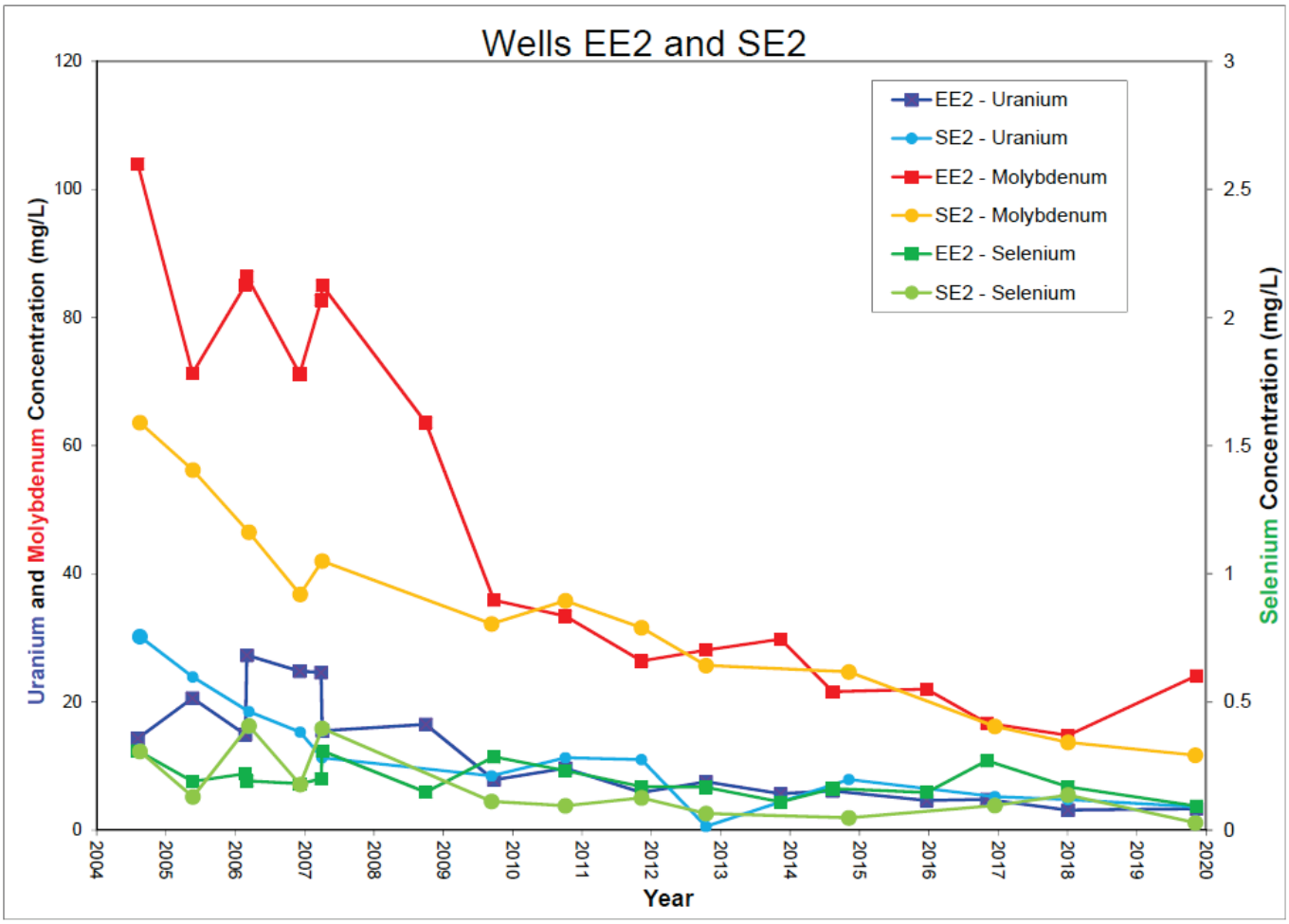


Figure 3.3-8. Uranium, Molybdenum and Selenium Concentrations for Sand Tailings Wells EE2 and SE2

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-33: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Sand Tailing Wells at Large Tailing Pile 2016-2020

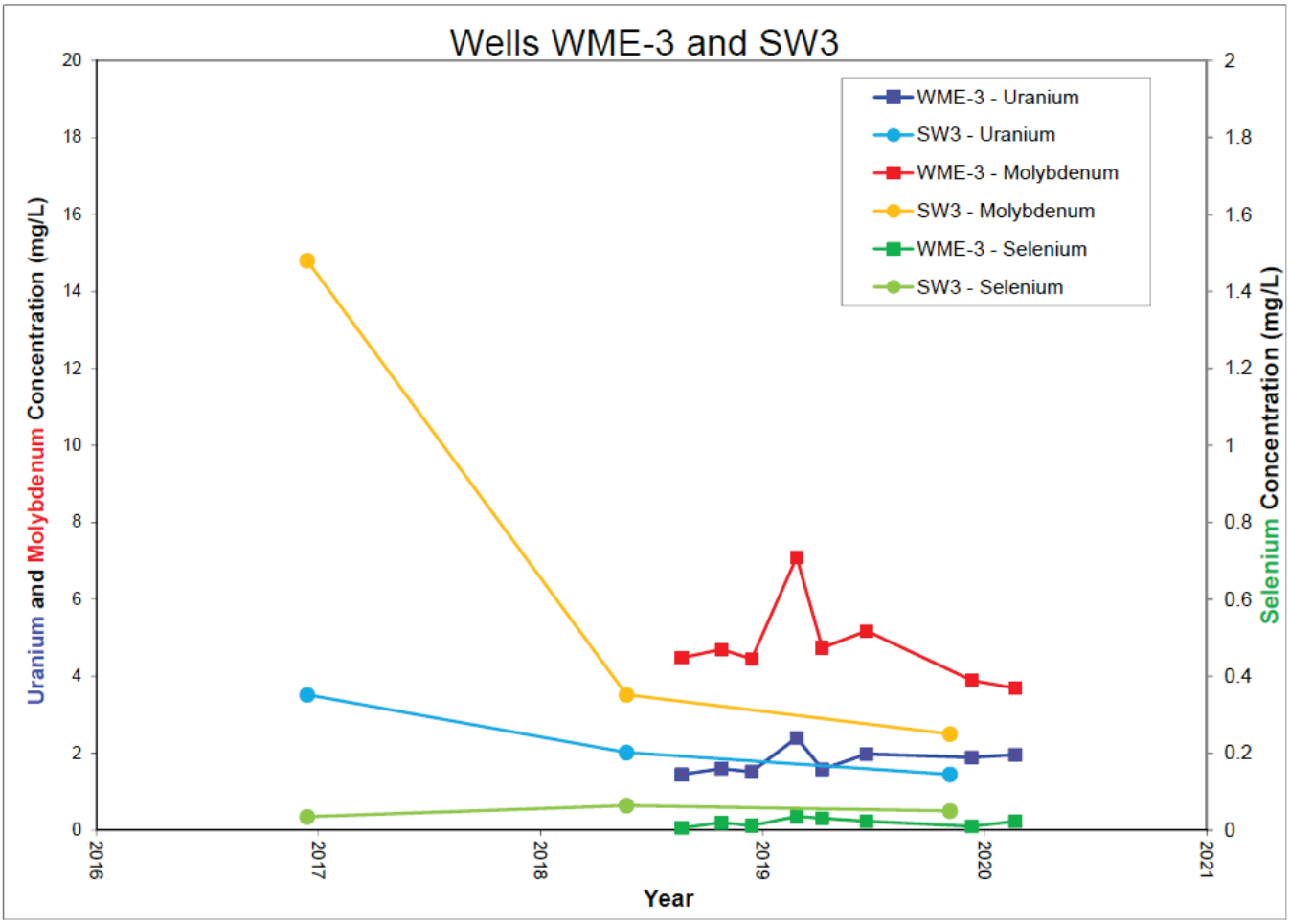


Figure 3.3-10. Uranium, Molybdenum and Selenium Concentrations for Sand Tailings Wells WME-3 and SW3

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-34: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Slime Tailing Wells at Large Tailing Pile 2006-2020

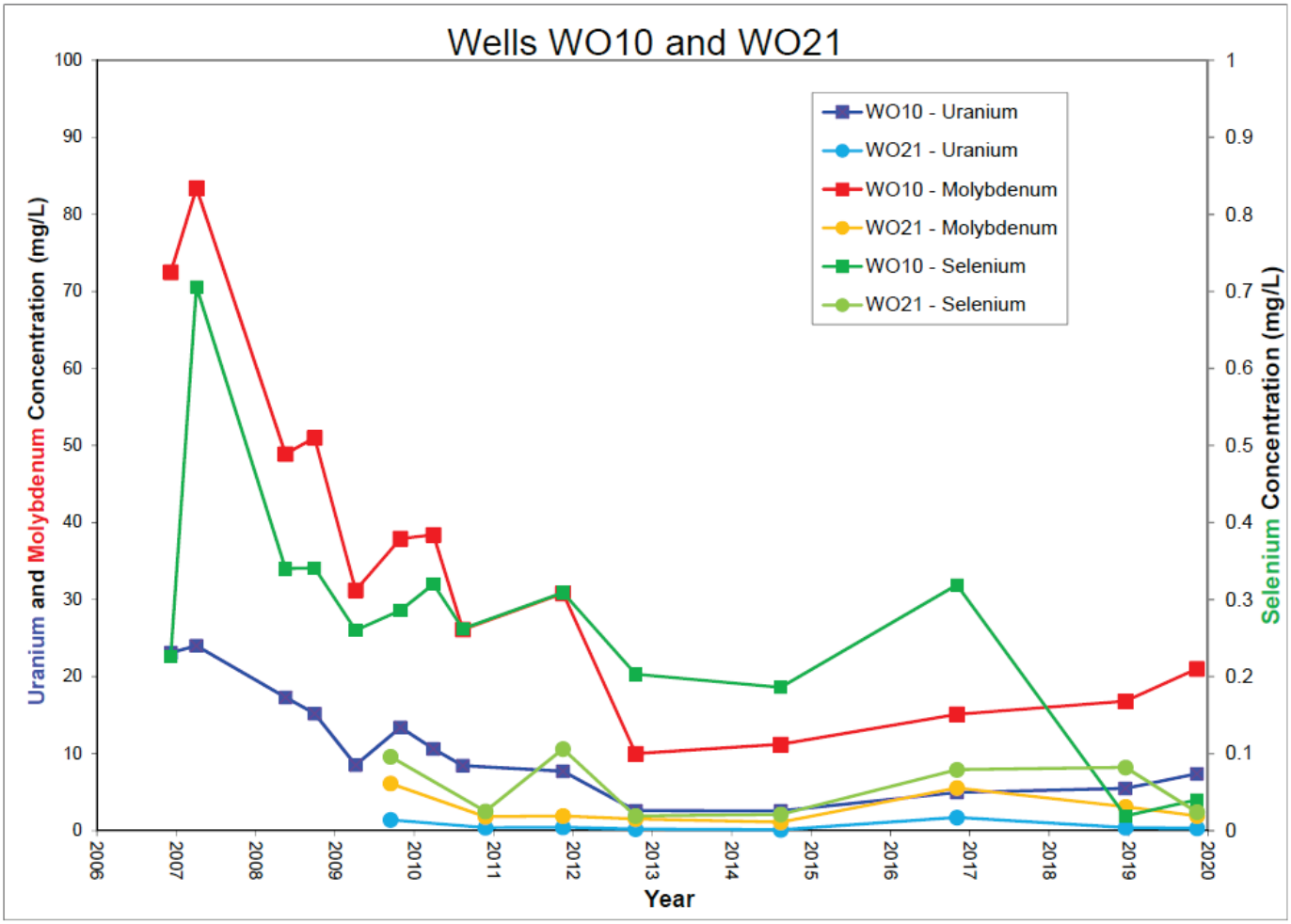


Figure 3.3-13. Uranium, Molybdenum and Selenium Concentrations for Slime Tailings Wells WO10 and WO21

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-35: Graph of Uranium, Molybdenum, and Selenium Concentration Changes Over Time in Slime Tailing Wells at Large Tailing Pile 2016-2020

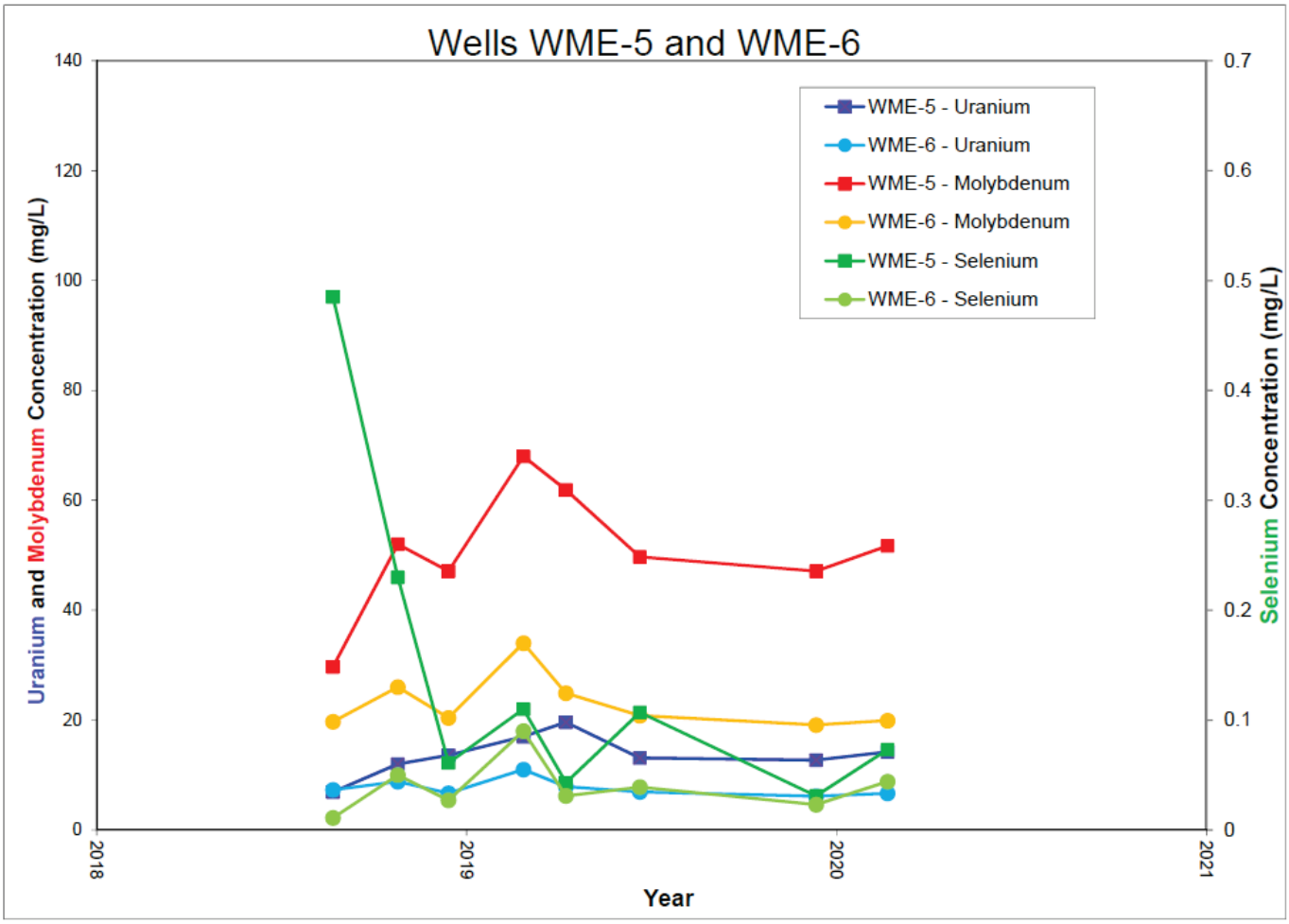


Figure 3.3-15. Uranium, Molybdenum and Selenium Concentrations for Slime Tailings Wells WME-5 and WME-6

Source: 2020 HMC Annual Monitoring Report/Performance Review.

Figure F-36: Tailing Monitoring Wells in 2020

Source: 2020 HMC Annual Monitoring Report/Performance Review.

APPENDIX G – 2019 SITE VISIT PHOTOGRAPHS

Collection ponds with RO treatment plant and LTP in the background, looking northwest

Evaporation pond 1

Evaporation pond 2 with sprayers

RO treatment plant storage tanks

Top of RO storage tanks with LTP in the background

RO treatment plant interior

RO treatment plant interior

Collection ponds looking east from the RO treatment plant

Zeolite filtration system on top of the LTP

Zeolite treatment system tanks on top of the LTP

Zeolite treatment system

APPENDIX H – TOXICITY DATA EVALUATION FOR 2014 HHRA

Table H-1: Oral Cancer Toxicity Value Review (Soil Ingestion)

Radionuclide/Chemical of Potential Concern[a]	Oral Cancer Slope Factor (Soil Ingestion)					
	Value Used in 2014 Risk Assessment[b]		2021 Value		Units	Change
	Value	Source	Value	Source		
Arsenic	1.50E+00	IRIS	1.5E+00	IRIS[c]	$(mg/kg\text{-}day)^{-1}$	no change
Radium-226 +D	7.30E-10	HEAST	7.30E-10	HEAST[d]	risk/pCi	no change
Radium-228 +D	2.29E-09	HEAST	2.29E-09	HEAST[d]	risk/pCi	no change
Thorium-230	2.02E-10	HEAST	2.02E-10	HEAST[d]	risk/pCi	no change
Uranium-234	1.58E-10	HEAST	1.58E-10	HEAST[d]	risk/pCi	no change
Uranium-238 +D	2.10E-10	HEAST	2.10E-10	HEAST[d]	risk/pCi	no change

Notes:
a) Risk from decay products (+D) included as appropriate.
b) Source: December 2014 Human Health Risk Assessment, Appendix A, Table 6.1
c) Source: May 2021 EPA Regional Screening Levels tables, accessed 7/28/2021 at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
d) Source: EPA Radionuclide Table (formerly HEAST Table 4), accessed 7/28/2021 at https://www.epa.gov/radiation/radionuclide-table-radionuclide-carcinogenicity-slope-factors
$(mg/kg\text{-}day)^{-1}$ = per milligram per kilogram per day
risk/pCi = risk per picocurie
-- = toxicity data not available
IRIS = Integrated Risk Information System
HEAST = Health Effects Assessment Summary Tables

Table H-2: Oral Cancer Toxicity Value Review (Food Ingestion)

Radionuclide of Potential Concern[a]	Oral Cancer Slope Factor (Food Ingestion)					
	Value Used in 2014 Risk Assessment[b]		2021 Value[c]		Units	Change
	Value	Source	Value	Source		
Radium-226 +D	5.15E-10	HEAST	5.15E-10	HEAST	risk/pCi	no change
Radium-228 +D	1.43E-09	HEAST	1.43E-09	HEAST	risk/pCi	no change
Thorium-230	1.19E-10	HEAST	1.19E-10	HEAST	risk/pCi	no change
Uranium-234	9.55E-11	HEAST	9.55E-11	HEAST	risk/pCi	no change
Uranium-238 +D	1.21E-10	HEAST	1.21E-10	HEAST	risk/pCi	no change

Notes:
a) Risk from decay products (+D) included as appropriate.
b) Source: December 2014 Human Health Risk Assessment, Appendix A, Table 6.3
c) Source: EPA Radionuclide Table (formerly HEAST Table 4), accessed 7/28/2021 at https://www.epa.gov/radiation/radionuclide-table-radionuclide-carcinogenicity-slope-factors
risk/pCi = risk per picocurie
HEAST = Health Effects Assessment Summary Tables

Table H-3: Inhalation Cancer Toxicity Value Review

Radionuclide/Chemical of Potential Concern[a]	Inhalation Cancer Slope Factor					
	Value Used in 2014 Risk Assessment[b]		2021 Value		Units	Change
	Value	Source	Value	Source		
Lead-210	2.77E-09	HEAST	2.77E-09	HEAST[c]	risk/pCi	no change
Radium-226 +D	1.16E-08	HEAST	1.16E-08	HEAST[c]	risk/pCi	no change
Radium-228 +D	5.23E-09	HEAST	5.23E-09	HEAST[c]	risk/pCi	no change
Thorium-230	2.85E-08	HEAST	2.85E-08	HEAST[c]	risk/pCi	no change
Uranium-234	1.14E-08	HEAST	1.14E-08	HEAST[c]	risk/pCi	no change
Uranium-238 +D	9.35E-09	HEAST	9.35E-09	HEAST[c]	risk/pCi	no change
Arsenic	4.30E-03	IRIS	4.3E-03	IRIS[d]	per µg/m³	no change
Radon gas	1.80E-11	HEAST	--		risk/pCi	no value
Radon-222 (Rn-222 +D)	1.80E-11	HEAST	1.80E-11	HEAST[c]	risk/pCi	no change
Thoron (Rn-220)[e]	--	HEAST	--	HEAST[c]	risk/pCi	no change

Notes:

a) Risk from decay products (+D) included as appropriate.
b) Source: December 2014 Human Health Risk Assessment, Appendix A, Table 6.2
c) Source: EPA Radionuclide Table (formerly HEAST Table 4), accessed 7/28/2021 at https://www.epa.gov/radiation/radionuclide-table-radionuclide-carcinogenicity-slope-factors
d) Source: May 2021 EPA Regional Screening Levels tables, accessed 7/28/2021 at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
e) Thoron gas an isotope of Radon gas (Rn-220)

-- = toxicity data not available
risk/pCi = risk per picocurie
µg/m³ = microgram per cubic meter
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System

Table H-4: External Exposure (Radiation) Cancer Toxicity Value Review

Radionuclide of Potential Concern[a]	Cancer Slope Factor (External Exposure)					
	Value Used in 2014 Risk Assessment[b]		2021 Value[c]		Units	Change
	Value	Source	Value	Source		
Lead-210	1.4E-09	HEAST	1.41E-09	HEAST	risk/yr per pCi/g	no change
Radium-226 +D	7.87E-09	HEAST	--		risk/yr per pCi/m³	--[d]
	8.49E-06	HEAST	8.49E-06	HEAST	risk/yr per pCi/g	no change
Radium-228 +D	1.2E-05	HEAST	4.53E-06	HEAST	risk/yr per pCi/g	less stringent
Thorium-230	1.31E-12	HEAST	--		risk/yr per pCi/m³	--[d]
	8.19E-10	HEAST	8.19E-10	HEAST	risk/yr per pCi/g	no change
Uranium-234	2.5E-10	HEAST	2.52E-10	HEAST	risk/yr per pCi/g	no change
Uranium-238 +D	1.22E-10	HEAST	--		risk/yr per pCi/m³	--[d]
	1.14E-07	HEAST	1.14E-07	HEAST	risk/yr per pCi/g	no change
Radon gas	7.85E-09	HEAST	--		risk/yr per pCi/m³	--[d]
	8.48E-06	HEAST	--		risk/yr per pCi/g	no value
Radon-222 (Rn-222 +D)	7.85E-09	HEAST	--		risk/yr per pCi/m³	--[d]
	8.48E-06	HEAST	--		risk/yr per pCi/g	no value
Thoron (Rn-220)[e]	1.61E-12	HEAST	--		risk/yr per pCi/m³	--[d]
	1.71E-09	HEAST	1.70E-09	HEAST	risk/yr per pCi/g	no change

Notes:

a) Risk from decay products (+D) included as appropriate.
b) Source: December 2014 Human Health Risk Assessment, Appendix A, Tables 6.4 and 6.5
c) Source: EPA Radionuclide Table (formerly HEAST Table 4), accessed 7/28/2021 at https://www.epa.gov/radiation/radionuclide-table-radionuclide-carcinogenicity-slope-factors
d) EPA Radionuclide Table presents external exposure cancer slope factors using units of "risk per year per picocurie per gram" (not using units of "risk per year per picocurie per cubic meter")
e) Thoron gas an isotope of Radon gas (Rn-220)

-- = toxicity data not available
risk/yr per pCi/g = risk per year per picocurie per gram
risk/yr per pCi/m³ = risk per year per picocurie per cubic meter
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System

Table H-5: Non-Cancer Ingestion Toxicity Value Review

Chemical of Potential Concern	Reference Dose				
	Value Used in 2014 Risk Assessment[a]	2021 Value[b]		Units	Change
		Value	Source		
Arsenic	3.00E-04	3.0E-04	IRIS	mg/kg-day	no change
Lead	--	--		mg/kg-day	no change
Molybdenum	5.00E-03	5.0E-03	IRIS	mg/kg-day	no change
Selenium	5.00E-03	5.0E-03	IRIS	mg/kg-day	no change
Vanadium	5.04E-03	5.0E-03	IRIS[c]	mg/kg-day	no change
Uranium. Total	3.0E-03	2.0E-04	ATSDR	mg/kg-day	more stringent

Notes:

a) Source: December 2014 Human Health Risk Assessment, Appendix A, Table 7.1.7

b) Source: May 2021 EPA Regional Screening Levels tables, accessed 7/28/2021 at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables +

c) The RSLs User's Guide states that "The oral RfD toxicity value for Vanadium, used in this website, is derived from the IRIS oral RfD for Vanadium Pentoxide by factoring out the molecular weight (MW) of the oxide ion. Vanadium Pentoxide (V_2O_5) has a molecular weight of 181.88. The two atoms of Vanadium contribute 56% of the MW. Vanadium Pentoxide's oral RfD of 9E-03 mg/kg-day multiplied by 56% gives a Vanadium oral RfD of 5.04E-03 mg/kg-day."

-- = toxicity data not available

(mg/kg-day) = milligram per kilogram per day

IRIS = Integrated Risk Information System

ATSDR = Agency for Toxic Substances and Disease Registry

Table H-6: Non-Cancer Inhalation Toxicity Value Review

Chemical of Potential Concern	Reference Concentration				
	Value Used in 2014 Risk Assessment[a]	2021 Value[b]		Units	Change
		Value	Source		
Arsenic	1.50E-05	1.5E-05	CalEPA	mg/m³	no change
Lead	--	--		mg/m³	no change
Molybdenum	--	2.0E-03	ATSDR	mg/m³	new value
Selenium	2.00E-02	2.0E-02	CalEPA	mg/m³	no change
Vanadium	--	1.0E-04	ATSDR	mg/m³	new value
Uranium. Total	--	4.0E-05	ATSDR	mg/m³	new value

Notes:

a) Source: December 2014 Human Health Risk Assessment, Appendix A, Table 7.1.7

b) Source: May 2021 EPA Regional Screening Levels tables, accessed 7/28/2021 at https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

-- = toxicity data not available

mg/m³ = milligrams per cubic meter

CalEPA = California Environmental Protection Agency

ATSDR = Agency for Toxic Substances and Disease Registry