



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
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October 15, 2021

MEMORANDUM

SUBJECT: Region 6 Responses to National Remedy Review Board Recommendations for the Homestake Mining Company Superfund Site – Feasibility Study

FROM:

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TO: Christine Poore, Chair, on behalf of the Board Review Team
National Remedy Review Board

PURPOSE:

The U.S. Environmental Protection Agency (EPA), Region 6, has completed its review of the recommendations and advisory considerations submitted by the National Remedy Review Board (NRRB or Board) Review Team on June 15, 2021, for the feasibility study and other activities being conducted at the Homestake Mining Company (HMC) Superfund Site pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This memorandum documents the Region's responses to the Board Review Team's recommendations and advisory considerations.

Each of the Board Review Team's recommendations and advisory considerations are restated herein, followed by the Region 6 responses (shown in italics). A List of Abbreviations and Acronyms is provided at the end of the responses.

RESPONSES TO BOARD REVIEW TEAM RECOMMENDATIONS:

1. Current Tailings and Treatment Operations

As stated earlier, the HMC Site includes two unlined tailings piles. Based on the information provided to the Board, the flanks of the large tailings pile (LTP) have a permanent radon cover, but the top of the LTP has an interim cover. Despite the partial cover, it is the Board's understanding that radon exfiltration from the large pile at the site may currently exceed UMTRCA standards. Additionally, the zeolite filtration system sits

atop the uncovered portion of the LTP. Based on the information provided to the Board, there are two large scale water treatment systems operating at the site: a RO system and a zeolite filtration system. It's the Board's understanding that neither system has operated at full capacity, though the reasons for reduced operations were unclear. The RO system has operated at nearly half capacity and the zeolite filtration system has operated at nearly one third capacity. Despite the limited capacity, it was indicated that approximately 100 pounds of uranium was recovered.

Recommendations:

- a. The Board recommends that the Region assess the challenges that prevented the treatment systems from operating at full capacity. Based on the information provided to the Board, the current water treatment systems, operating at full capacity, may be inadequate to treat the current seepage from the piles at the site. It was unclear to the Board if this is due to the current limited treatment capacity or if it was due to a high seepage rate. Understanding and resolving the challenges associated with limited system operations may improve treatment capacity, thereby reducing seepage. Additionally, improvements to the treatment systems may improve the recovery of uranium, in effect resulting in secondary recovery of the uranium (i.e., resource recovery/reprocessing).

Region 6 Response: HMC completed significant upgrades to the RO treatment plant from 2015 through 2020 to expand the treatment capacity of the RO system. The expanded and upgraded RO system has a theoretical design capacity to treat water at a rate of 1200 gallons per minute (gpm). However, while these system improvements increased the theoretical design capacity flowrates up to 1200 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 RO system is approximately 600 gpm. The average treated water rate (input rate) at the RO plant since 2016 was 471 gpm. The average RO 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 RO plant.

In addition to operating the RO treatment plant, HMC utilizes zeolite¹ bed filtration technology to treat uranium-contaminated groundwater collected from wells located outside of the NRC license boundary. Such utilization has undergone significant change over the last five years. HMC initially 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.² 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 trains³ 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. HMC is now evaluating a copper sulfate additive to the zeolite treatment system to control algae growth. Additional operational issues have included exposure of system components to the elements, weather delays, and overall difficulties in operating an innovative treatment system.

¹ Zeolites are naturally occurring and porous aluminosilicate clay minerals with a negative ionic charge and strong adsorption and cation exchange properties. Such properties make zeolite an excellent filtration medium for the removal of pollutants, such as uranium, from waste water. Their microcrystalline structure or framework is very open and contains channels, which lead to cavities where cations (atoms or groups of atoms with a positive charge), such as sodium, may reside to balance out the negative charge of the zeolites. These residing cations can be replaced or exchanged within the structure by other cations under the right conditions. The amount of a cation that can be exchanged by another cation is referred to as the cation exchange capacity. Zeolites have very high cation exchange capacities. Additionally, because cation exchange capacity is pH-dependent, the residing cations can be stripped out or removed from the zeolite exchange sites using an acidic solution. This frees up most of the exchange sites for adsorption by other cations, such as uranium. HMC developed a proprietary process through treatability testing and pilot study for using zeolite as a filtration medium for uranium adsorption. The process includes soaking the zeolite beds in an acid solution to strip the residing cations from the zeolite cation exchange sites, thus maximizing the zeolite's ability to adsorb uranium cations onto those exchange sites that were vacated by the stripped cations.

² Once zeolite cation exchange sites become fully loaded, the zeolite loses its ability to adsorb additional uranium and other cations and has to be regenerated. Regeneration is a process to strip away cations with an acidic wash to free up the cation exchange sites for additional uranium adsorption. The acidic wash is followed by two fresh water rinses to remove the majority of the acidic wash.

³ A treatment or regeneration train is a combination of different methods or components implemented in sequence or concurrently to achieve best performance results.

The combined operational water treatment capacity of the RO and zeolite filtration systems is approximately 800 gpm. Despite the challenges noted above, HMC operated these systems over the last five years 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 operating rate of the RO system declined every year from a high of 584 gpm in 2016 to 314 gpm in 2019. This was partly due to the operation issues discussed above, but also the result of a reduction in treatment to reduce the total volume of brine water requiring evaporation. The reduction in treatment began in 2018 and continued through the spring of 2021. The reduction in brine water was necessary to dewater one of the three evaporation ponds 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, it is estimated that the available evaporative capacity of the pond is only limiting the total evaporative capacity of system by about five percent.

The current and future anticipated rates of seepage from the LTP is significantly less than that of the treatment systems influent rate. Based upon the draindown model presented in the groundwater modeling report in support of HMC's 2020 draft Technical Impracticability Evaluation Report, the estimated seepage from the LTP has been less than the 100 gpm average since 2016. Anticipated seepage is expected to asymptotically approach the long-term infiltration rate of 0.6 gpm. In comparison, the RO system has treated an average of 471 gpm since 2016. In terms of uranium mass balance, the LTP has seeped approximately 11,000 pounds of uranium since 2016, while the RO plant has removed about 72,000 pounds over the same period.

- b. Should the tailings piles remain in place, the site will likely have to comply with UMTRCA cover standards that address radon emissions. Based on the information provided to the Board, it was unclear if the tailings piles are fenced off from the public. If there is not a complete fence line enclosing the Source Materials License boundary, the Board recommends the implementation of engineering and institutional controls (i.e., fencing and signage) to minimize access to the uncovered portion of the LTP until a final remedy is constructed. This should prevent the public from accessing the large pile until a final remedy is constructed.

Region 6 Response: The U.S. Nuclear Regulatory Commission (NRC) Source Material License SUA-1471 (License SUA-1471) boundary is completely fenced off with 4-strand and 5-strand barbwire fencing with proper signage, "Caution, Radioactive Material",

that prevents or limits access to the HMC facility by the public. In addition, the perimeter of the NRC license boundary is regularly patrolled by site personnel and maintenance of the perimeter fence and/or replacement of signage is performed as necessary. Upon completion of NRC annual on-site inspections, fencing and signage compliance is referenced in its inspection reports.

2. Technical Impracticability Waiver

The Site Information Package included a “Development and Screening of Remedial Alternatives Technical Memorandum” that discussed Technical Impracticability (TI), as a potential remedial component. The selection of a TI waiver is the acknowledgement that the applicable or relevant and appropriate regulation (ARAR) is waived due to “technical impracticability from an engineering perspective.”⁴ The NCP Preamble states that TI determinations should be based on “...engineering feasibility and reliability, with costs generally not a major factor unless compliance would be inordinately costly.”⁵ This determination is based on contaminant properties, subsurface conditions and appropriate remedial technologies evaluation. The TI zone should be as minimal as appropriate and can be multiple zones.⁶ The TI zone may not necessarily encapsulate the whole groundwater plume and should include source control as part of the Alternate Remedial Strategy. The Alternate Remedial Strategy is essential to controlling the contribution from the source to the groundwater.⁷

Recommendations:

- a. In assessing the appropriateness of a TI waiver, the conclusion that it is not possible from an engineering perspective to restore groundwater to its beneficial use is based upon the factors identified in Section 1.1 of the 1993 Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration (TI Guidance). Additionally, as stated on page 2 of the TI Guidance, “Failure to achieve desired cleanup standards resulting from inadequate system design or operation is not considered by EPA to be a sufficient justification for a determination of technical impracticability of ground-water cleanup.” Recommendation No. 1.a supports the assessment of current system design and operation. Should the Region pursue a TI waiver component, the Board recommends that the Regional Site Team work closely with their Regional TI

⁴ Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. September 1993. (Page 9) <https://semspub.epa.gov/work/HQ/175387.pdf>

⁵ See NCP Preamble, 55 FR 8748, March 8, 1990.

⁶ Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. September 1993. (Section 4.4.2) <https://semspub.epa.gov/work/HQ/175387.pdf>

⁷ Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration. September 1993. (Section 5.0) <https://semspub.epa.gov/work/HQ/175387.pdf>

representative, and the Headquarters TI point of contact, currently Dave Bartenfelder, in developing the TI evaluation package.

Region 6 Response: Agreed. Region 6 has already had meetings with HMC to discuss TI and the draft TI Evaluation Report, dated November 2020. The Regional TI representative and Headquarters TI point of contact participated in those meetings. The Region will continue to involve the regional representative and Headquarters TI point of contact, as appropriate.

- b. Should a TI waiver be supported and a component of the preferred alternative, the Board recommends the TI zone be appropriately sized based on the site characterization and analysis. Per Section 4.4.2 of the TI Guidance, the potential TI zone should be “limited to as small an area as possible, given the circumstances of the site.” Generally, the TI Zone is based on current site conditions rather than projected modeling results. The TI zone can be modified (expanded/contracted) if conditions change in the future and can be justified (e.g., discovery of new sources), per Section 6.2 of the 1993 TI Guidance.

Region 6 Response: Agreed. HMC has used both site conditions and modeling to support its proposed TI zone, which is large enough to encompass the full extent of the contaminant plumes where they are projected to migrate from the tailing piles over a period of years in modeling scenarios. The Region is currently reviewing the HMC’s draft TI Evaluation Report, so no decision has been made on the merits of TI at the Site, including the merits of the proposed TI zone, to support a TI waiver of groundwater standards.

- c. The information provided to the Board highlighted the complexity of the hydrogeologic setting. The Board recommends additional geochemical and hydrogeologic modeling (e.g., EPA-Office of Research and Development (ORD) or United States Geological Survey (USGS)) to better understand the subsurface conceptual site model behavior. The Board further recommends the Region assess, and if appropriate, augment the current modeling with those models conducted by the NMED. A more refined conceptual site model of the geochemical hydrogeologic conditions should better support the remedy development and selection process.

Region 6 Response: The Region agrees that the geochemical modeling performed by the New Mexico Environment Department (NMED) on background is important to understand natural background groundwater quality at the Site and will utilize it to further define the conceptual site model and inform the ongoing CERCLA feasibility study.

The Region has previously sought and received support from ORD scientists and the USGS for the Site over the years, specifically as part of the Region's reassessment of background water quality. The ORD scientists reviewed a supplemental background study performed by HMC in 2018 and provided comments to the Region. USGS conducted an independent background study on behalf of Region 6 in 2016 that resulted in the publication of two journal papers in 2019.⁸ At this time, the Region does not plan to request geochemical or hydrogeological modeling from ORD or the USGS. It is noted that the Region is also receiving technical support from the EPA Headquarters Optimization Team contractor to review HMC's draft feasibility study and draft TI evaluation reports, including all modeling performed as part of those efforts. The contractor has put together a team of experts in geochemistry and hydrogeology to perform the reviews. If additional expertise is needed beyond this level of support, the Region will consider additional ORD or USGS support.

3. Background Groundwater and Soil

The information provided to the Board included a discussion of historical mining activities in the San Mateo Creek Basin. This area of New Mexico has historically been a viable source of uranium with over 80 legacy mines and several milling operations. Some of these mines were "wet" mines, meaning that mine waters had to be pumped from the mine to allow access for mining activities. Based on the information provided to the Board, groundwater impacted by these activities may be flowing downgradient through the basin. If this is the case, uranium levels in groundwater may be elevated due to the presence and practices of upgradient mine sites.

Recommendation:

The Board recommends the Region refine the background investigation for uranium, radium and thorium with additional monitoring wells to identify background in this complex geologic setting and influenced by up-gradient mine discharges (approximately 125 billion gallons). The geochemical report developed by New Mexico is a good resource, and additional sampling and analysis might augment the report analysis to benefit the site understanding. To support this effort, the Region should consider the option to identify an

⁸ Harte PT, Blake JM, Thomas J, Becher K (2019) Identifying natural and anthropogenic variability of uranium at the well scale, Homestake Superfund site, near Milan, New Mexico, USA. Environmental Earth Sciences. <https://doi.org/10.1007/s12665-019-8049-y>

Blake JM, Harte P, Becher K (2019) Differentiating anthropogenic and natural sources of uranium by geochemical fingerprinting of groundwater at the Homestake uranium mill, Milan, New Mexico, USA. Environmental Earth Sciences. <https://doi.org/10.1007/s12665-019-8385-y>

unimpacted area in the surrounding environment to identify naturally occurring soil background concentrations of uranium, radium, and thorium. The Board also recommends reaching out to Matt Jefferson (OSRTI/Technology Innovation and Field Services Division), Dave Kappelman (OSRTI/Environmental Response Team), and Felicia Barnett (ORD; Site Characterization & Monitoring Technical Support Center Director).

Region 6 Response: The work to identify an unimpacted area in the surrounding environment is already ongoing. Region 6 and three mining companies, including HMC, (hereinafter the Working Group) signed an Administrative Settlement Agreement and Order on Consent in November 2019 for the Working Group to perform a CERCLA groundwater remedial investigation and feasibility study (RI/FS) for a portion of the San Mateo Creek Basin north of the Site, referred to as the Central Study Area. Part of this RI/FS includes a geophysical seismic survey for locating optimal drilling locations to collect soil/sediment samples for laboratory column leach tests and the installation of monitoring wells for groundwater samples. One objective of the remedial investigation will be to determine natural background groundwater quality (in an unimpacted area) based on the column leach tests and groundwater sample data.

Since some of the alluvial background monitoring wells included in the NMED geochemical study are located within the Central Study Area RI/FS boundary, these areas of study overlap. Therefore, it will be important to compare the findings of both studies to better understand the overall quality of native groundwater within the alluvial aquifer system of the lower San Mateo Creek Basin as well as those areas where groundwater continues to be impacted by the historical mine-water discharges.

Region 6 will consider the other EPA sources of technical support recommended by the Board should it be necessary to do so.

4. Principal Threat Waste

The LTP covers about 234 acres and contains approximately 21 million tons of tailing material and the STP covers about 40 acres and contains approximately 1.2 million tons of mill tailings, with both tailing piles being unlined. Of great concern is the ongoing release of contaminants from the LTP and STP to the groundwater due to these piles being unlined. The Site Information Package identifies the LTP and STP as the primary sources of contamination in the groundwater, soil and air at the site. The contaminants of concern (COCs) in groundwater are uranium, selenium, radium-226, radium-228, thorium-230, molybdenum, sulfate, chloride, nitrate and total dissolved solids. The maximum concentrations of COCs detected in groundwater were detected in the alluvial groundwater directly beneath or near the LTP. In addition to the COCs' mobility as evidenced by the

leaching of uranium and other contaminants to groundwater, the toxic tailings pose risks to future receptors. For example, in the revised risk assessment presentation for the Board, the future composite worker's total cancer risk is estimated at 2E-02, which exceeds the acceptable risk range by two orders of magnitude (approximately a factor of 100).

Recommendations:

- a. The Site Information Package states that no principal threat waste has been identified. However, there are significant amounts of mill tailings present at the site that may be highly toxic and mobile, as evidenced by the site data. The Board recommends the Region give further consideration as to whether the mill tailings present at the site constitute principal threat waste (PTW) as discussed in OSWER Directive No. 9380.3-06FS, November 1991, *A Guide to Principal Threat and Low Level Threat Wastes* (Principal Threat Waste Guidance and OSWER Directive 9355.0-69, August 1997, *Rules of Thumb for Superfund Remedy Selection* at page 11).

Region 6 Response: In accordance with EPA Guidance (OWSER Directive 9380.3-06FS; OSWER Directive 9355.0-69), Principal Threat Wastes are defined as follows:

“Principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner and/or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No “threshold level” of toxicity/risk has been established to equate to “principal threat.” However, where toxicity and mobility of source material combine to pose a potential risk of 10^{-3} or greater, generally treatment alternatives should be considered.”

In evaluating whether the uranium mill tailings, as source material, constitute a principal threat waste, the Region assessed the two components of the definition separately:

- i. *Are the uranium mill tailings considered highly toxic or highly mobile and generally cannot be contained in a reliable manner?*

Uranium mill tailing material is considered a highly toxic source material for groundwater, soil, and air contamination, but can be contained in a reliable manner through engineering controls such as an engineered disposal cell and

radon barrier and erosion protective layer. Such engineering controls are used by the U.S. Department of Energy and the NRC at Title I and Title II Uranium Mill Tailing Radioactive Control Act (UMTRCA) sites pursuant to UMTRCA regulations at 40 CFR Part 192 and 10 CFR Part 40, Appendix A.

- ii. *Do the uranium mill tailing present a significant risk to human health or the environment where they pose a potential excess lifetime cancer risk of one chance in one thousand (10^{-3}) or greater?*

The baseline human health risk assessment performed by HMC for the facility showed the potential excess lifetime cancer risk for a future composite worker to be one chance in fifty ($2E-02$ or 2×10^{-2}), which is two orders of magnitude higher than the upper bound of EPA's acceptable lifetime cancer risk range of one chance in ten thousand (10^{-4}). The cancer risk to the future composite worker is primarily from exposure to radionuclides in air. Tailing material presenting such a high risk level from the air pathway would likely constitute a principal threat waste as defined in EPA guidance. However, Region 6 considers the risk estimate to be too high. HMC utilized the EPA Rad-PRG Calculator to perform the risk calculations for radionuclides. The calculator assumes that the parent and all potential radioactive progeny (decay products or daughters) are present in the medium and at constant concentrations (i.e., secular equilibrium). Region 6 considers these calculations to be inappropriate for the air medium because the heavier radionuclides would likely drop out of the air before being transported far from the source. A better approach would be to remove the heavier progeny of the decay chain, specifically lead-210 and the heavier isotopes, from the calculations and use a "sum-of-the-fractions" approach for the lighter radionuclides to calculate total risk for ambient air.

Region 6 identified this issue in the CERCLA Fifth Five-Year Review Report for the Site, which was completed in September 2021. In the report, the Region recommended the "sum-of-the-fraction" approach for the lighter radionuclides to calculate risk for air in the neighboring subdivisions. The Region is currently working with Stuart Walker, Superfund Remedial Program's National Radiation Expert, OLEM/OSRTI/ARD/SPB; Brian Littleton and David Strunkel, Office of Radiation and Indoor Air, Radiation Protection Division; and Frederick Dolislager, Oak Ridge National Laboratory, to model the concentrations of radon and other lighter radionuclides coming off the large and small tailing piles in ambient air. EPA's CAP88-PC radiation risk assessment software is being used in the modeling effort. Once this work is completed, the Region will recalculate the risk of radionuclides in air at the neighboring subdivisions. The

Region will also discuss with HMC the revisions that are needed to the baseline human health risk assessment for the future composite worker and other receptors at the HMC facility and the Land Treatment Areas. The updated risk calculations will inform the ongoing CERCLA feasibility study.

At this time, Region 6 does not plan to identify the uranium mill tailing material as principal threat waste. The tailing can be reliably contained, and the Region's expectation is that the total cancer risk to the future composite worker at the Site will decrease once the risk is recalculated. However, if updated risk calculations continue to show a significant risk to the future composite worker (i.e., above 10^{-3}), Region 6 will reassess the principal threat waste determination.

It is noted that the Region will include an assessment of risk from direct exposure to tailing material for a potential future commercial/industrial land use scenario to address one of the Board's recommendations (see Region 6 Response to Recommendation 6.a, below); however, the Region does not consider such an exposure assumption to be realistic. Such risk is anticipated to be very high and may exceed the 10^{-3} risk level specified in the EPA guidance on principal threat waste.

Lastly, treatment options for the tailing material (e.g., cement solidification/stabilization, chemical solidification/stabilization, and thermal vitrification) are being considered in the ongoing feasibility study.

- b. If the Region determines that portions of the mill tailing are principal threat waste, as the Region further develops or considers the range of alternatives for the Site, it should consider the Principal Threat Waste Guidance, the statutory preference for treatment or resource recovery to the maximum extent practicable in CERCLA section 121(b), and the NCP's expectations for treatment of principal threats posed by the Site, wherever practicable.

Region 6 Response: *No response necessary.*

5. Risk Analysis

Recommendations:

- a. Consideration of Land Use Restrictions in Risk Analysis – Based on the information provided to the Board, there may be portions of the Site that lie outside of the tailing

piles boundaries for which Institutional Controls (ICs) have already been established to restrict land use. Consideration should be given as to whether the ICs should be established as a part of the CERCLA remedial action in those areas. The Board recommends the Region update the risk assessment to assess if unacceptable risk under one or more unrestricted exposure scenarios exist, of if uncertainties in predicting reasonably anticipated future land use exist. This information may inform the need for including ICs as part of the CERCLA remedial action despite the current land use restrictions. OSWER Directive 9355.0-30, which is titled "*Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*" may serve as a resource for this assessment. For example, the second paragraph on page 3 states: "*This cumulative site baseline risk ... should not assume that institutional controls or fences will account for risk reduction.*" Further discussion is provided in the sections titled "*Risk Consideration in Risk Management Decision*" and "*Risks Warranting Remedial Action*" on pages 4-6. In order to demonstrate that an IC is necessary to ensure protectiveness of human health and the environment as part of a CERCLA remedial action, (i.e., selected as part of the remedy in the Record of Decision (ROD)), risks should be estimated and documented for exposure scenarios without consideration of current or proposed land use restrictions.

Region 6 Response: Agreed. HMC has recorded a Declaration of Restrictive Covenant for the Land Treatment Areas that restricts residential land use and other uses. However, such land uses were never assessed in the HMC baseline human health risk assessment for the Land Treatment Areas, which are located outside of the NRC license boundary. An assumption was made during performance of the risk assessment that any future residential or agricultural land use for the Land Treatment Areas would likely present an unacceptable risk, which was the reason for recording the Restrictive Covenant. Region 6 will work with HMC to update the risk assessment to include the future residential land use scenario at the Land Treatment Areas. The update will inform the ongoing feasibility study as to the need for the Restrictive Covenant in a CERCLA remedy.

- b. Large Tailing Pile and Small Tailing Pile – A conclusion presented in the Revised Risk Assessment Presentation noted that although there are excess cancer risks from soil and air for a composite worker, the risks are associated with soil and air concentrations that are below soil and air ARARs. As discussed in OSWER Directive 9200.4-23, which is titled "*Clarification of the Role of Applicable or Relevant and Appropriate Requirements in Establishing Preliminary Remediation Goals under CERCLA,*" "EPA's policy of generally establishing PRGs [Preliminary Remediation Goals] based on ARARs in the absence of multiple pathways or contaminants, is based on the assumption that individual ARARs will be protective. For example, the NCP expressly

authorizes consideration of the cumulative risk range in setting PRGs where attainment of ARARs would result in a cumulative risk in excess of 10^{-4} due to multiple contaminants or pathways (40 CFR Part 300.430(e)(2)(I)(D)).” This may be relevant to the radon exfiltration noted in Recommendation 1.b. Additionally, because the future composite worker evaluated in the risk assessment is exposed via the inhalation, submersion, ingestion, dermal contact, and gamma radiation pathways to multiple contaminants and is estimated to receive a total cancer risk outside the CERCLA risk range, an evaluation to determine whether ARARs are sufficiently protective should be completed. If not, PRGs should be established in accordance with CERCLA and EPA guidance, including OSWER Directive 9200.4-23, which includes consultation with Headquarters contacts, currently Robin Anderson for OSRTI and Charles Openchowski for the Office of General Counsel.

Region 6 Response: The Region is well aware of the issues raised in this Recommendation on whether UMTRCA standards and regulations, as potential ARARs, are sufficiently protective of human health and the environment under CERCLA. The Region will continue to assess such sufficiency of the potential UMTRCA ARARs, including radon emission standards, during the CERCLA feasibility study and remedy selection process. As discussed in the Region’s response to Recommendation 4.a (Principal Threat Waste), above, the most significant risk estimated for the future composite worker is from radionuclides in ambient air, based on the baseline human health risk assessment for the HMC facility and Land Treatment Areas. Region 6 identified an issue in the September 2021 Fifth Five-Year Review Report regarding risk calculations for radon in ambient air using the EPA Rad-PRG calculator and will be discussing with HMC the revisions that are needed to the baseline human health risk assessment to address this issue.

6. Remedial Action Objectives

Based on the information provided to the Board, the NRC is the lead agency for byproduct material disposal area reclamation and closure, but tailing closure is part of OU2. The “*Development and Screening of Remedial Alternatives Technical Memorandum, HOMESTAKE MINING COMPANY SUPERFUND SITE*” lists in table 7-1 the various ARARs and TBC criteria for the Site. The listed ARARs include 10 CFR Part 40, Appendix A, Criterion 6, as well as 40 CFR Part 192, Subparts A, C, and D, which include various requirements for the design of the controls for residual radioactive material.

Recommendations:

a. These required controls pertain to more than just the emanation of radon. For example, 10 CFR Part 40, Appendix A, Criterion 6 (1) states “*In disposing of waste byproduct material, licensees shall place an earthen cover (or approved alternative) over tailings or wastes at the end of milling operations and shall close the waste disposal area in accordance with a design which provides reasonable assurance of control of radiological hazards to (i) be effective for 1,000 years, to the extent reasonably achievable, and, in any case, for at least 200 years...*” (underlined for emphasis). Although NRC is the lead for closure of the tailing piles [sic.], a CERCLA remedial action (among other things) must ensure protectiveness of human health and the environment, consistent with the NCP and existing EPA CERCLA guidance; at this Site, that includes a cover to prevent exposure to contaminants of concern and to protect groundwater. Given that the radiological hazards from the tailing are expected to include exposure to external gamma radiation, ingestion, and inhalation of the various radiological contaminants of concern, the Board recommends the Region include an analysis of the risk related to the tailing piles material and, as appropriate, develop additional RAOs to achieve protectiveness of human health and the environment as required by CERCLA. Examples of RAOs that may be appropriate for OU2 tailing piles include:

- i. Prevent direct contact to contaminated media (including waste material, stormwater, sediments, leachate and groundwater) located on or emanating from the tailing piles.
- ii. Limit inhalation and external radiation exposure from contaminated media (including waste material, fill, leachate, and emissions) located on or emanating from the tailing piles to within the acceptable risk range (10^{-4} to 10^{-6} cancer risk or a HI of less than 1 for non-carcinogenic risk).
- iii. Prevent migration of contaminants to groundwater above levels protective for the beneficial use of groundwater and reasonably anticipated use of surface water.

Region 6 Response: Region 6 does not consider a future land use scenario where actual exposure to uranium mill tailing material would occur to be a realistic exposure assumption. Nevertheless, the Region will perform the risk calculations on the tailing material assuming a commercial/industrial future land use scenario. Historical analytical data exists on the tailing slimes and sands that can be used in the calculations. It is expected that the calculations will show a very high risk due to exposure to the tailing material. If there is a risk for a future commercial/industrial land use scenario, then it can be assumed that there would be a risk for a future

residential land use scenario as well. This information will inform the ongoing CERCLA feasibility study.

Region 6 generally agrees with the examples of remedial action objectives provided by the Board for the OU2 tailing piles. These, or similar objectives, will be added to the remedial action objectives being developed as part of the ongoing CERCLA feasibility study.

- b. The Board also notes that guidance should be considered pertaining to the groundwater protection standards in 40 CFR Part 192. The Board recommends the Region refer to “Use of Uranium Drinking Water Standards Under 40 CFR Part 141 and 40 CFR Part 192 as Remediation Goals for Groundwater at CERCLA Sites”⁹ to support the approach for determining groundwater protection standards.

Region 6 Response: The Region will continue to take this and other relevant guidances, as well as state discharge permits and other requirements, into account in identifying groundwater protection standards as potential ARARs.

7. Coordination with NRC and DOE

As stated in the site description above, the overlapping regulatory requirements of UMTRCA Title II and CERCLA present unique challenges to developing a remedial approach for the site that satisfies the legal and technical requirements of both statutes. This issue is particularly relevant in at least two specific instances, identifying ARARs/PRGs/RAOs and site deletion. For example, taking a site off the NPL may have implications for the UMTRCA site closure and transfer process including long-term maintenance and care under the DOE Legacy Management Program. EPA has not established policy and guidance that address future EPA, NRC and DOE overlapping regulatory requirements.

As noted earlier, Homestake is one of four NPL sites subject to NRC regulations regarding closure and EPA oversight of CERCLA cleanup actions. The four sites are located in two EPA regions and are in varying stages of the Superfund cleanup process. Additionally, the Office of Mountains, Deserts, and Plains (OMDP), established in 2020, focuses on hardrock mining NPL sites in the western portion of the United States. It is the Board’s understanding that while each Region works directly with NRC and DOE for their respective site(s), there may be an intra-agency workgroup focused on this unique cadre of sites.

⁹ <https://semspub.epa.gov/work/06/619832.pdf>

Recommendations:

a. Coordination that affects remedy selection including ARARs/PRGs/RAOs

i. Inter-Agency Coordination

1. The Board recommends that, as part of the feasibility study, the Region clearly enumerate the underlying basis (e.g., UMTRCA ARARs related to closure; Safe Drinking Water Act Maximum Contamination Levels for groundwater remediation) for cleanup criteria for each impacted environmental medium. The Board notes that CERCLA's requirements ensure protectiveness of human health and the environment will need to be met for NPL deletion purposes.

Region 6 Response: Agreed.

2. The Board further recommends that the Region clarify with the NRC the criteria for identifying areas for potential transfer into the DOE Legacy Management Program. Clarity from NRC/DOE on what are their criteria for accepting these areas may help inform the selection of appropriate treatment technologies when selecting a CERCLA remedy.

Region 6 Response: Agreed. The Region has been communicating and coordinating with NRC and DOE on all UMTRCA and CERCLA activities at the Site. This will be an important consideration for EPA's future decision-making and, ultimately, NPL deletion and transfer to DOE's Legacy Management Program.

3. It is EPA's concern that DOE may not accept an NPL site into its Legacy Management Program due to the expenses associated with the potential need for additional work. Since the HMC Site is on the NPL, EPA may be requested to delete the site prior to site transfer. If this is the case, EPA will need to conduct a formal notice and comment rulemaking in order to delete this site. As part of that formal rulemaking process, EPA will need to include data and information in the rulemaking docket to support the deletion process. In particular, the NCP provides that deleting a site from the NPL can occur when there is no further federal or PRP-lead response needed at that site (e.g., because CERCLA protectiveness of human health and the environment has been achieved). While EPA can acknowledge and take into account the work being done pursuant to the NRC license

process, various aspects of that process (e.g., prior calculation of background concentrations in groundwater, development of alternative concentration limits) do not appear to be consistent with the CERCLA program guidance. That potential gap may be significant at a point when the Agency undertakes an NPL deletion rulemaking process in the future, especially with regard to the no further federal or PRP-lead response needed requirement. It also may be significant if NRC concludes its license process and DOE refuses to accept the site into its Legacy Management Program due to the potential need for additional response actions (e.g., for groundwater) to ensure protectiveness of human health and the environment. Therefore, the Board recommends that the site's administrative record file, including the RI/FS and other documentation used to support the remedy development and selection process, fully address how the approach to various aspects of the cleanup at this site are being undertaken consistent with CERCLA, the NCP and existing EPA CERCLA guidance. For example, the administrative record file should explain how the approach for calculating the soil and groundwater background concentrations, the use of MCLs and UMTRCA groundwater standards for uranium in developing PRGs, RAOs, and cleanup levels, the point of compliance for attaining groundwater ARARs and consideration of a technical impracticability waiver, is consistent with the NCP preamble and various guidance documents, such as the Role of Background guidance, the RI/FS guidance, Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites guidance, Remediation Goals for Radioactively Contaminated CERCLA Sites Using the Benchmark Dose Cleanup Criteria in 10 CFR Part 40, Appendix A, I, Criterion 6(6), the 2009 Summary of Key Existing Ground Water guidance, Use of Uranium Drinking Water Standards under 40 CFR Part 141 and 40 CFR Part 192 as Remediation Goals for Groundwater at CERCLA sites guidance, and the TI waiver guidance.

Region 6 Response: Agreed. The evaluation and documentation of consistency with the NCP and EPA guidance in the determination of background, the development of preliminary remediation goals, remedial action objectives and preliminary ARARs, and the evaluation of TI is ongoing and will continue through the CERCLA feasibility study and future Region 6 decision-making process. Region 6 will continue to generate materials for inclusion in the administrative record file contemporaneously with ongoing evaluation and decision-making.

ii. EPA Coordination

1. The Board recommends the Region coordinate within Region 6 and with Regions 8 and 9, as well as with OMDP and OSRTI, where appropriate. Additionally, there is a multi-agency team that is actively working to establish operations and maintenance (O&M) expectations and team may be positioned to provide valuable feedback.

Region 6 Response: Agreed.

8. Suite of Remedial Alternatives

The HMC Site is unique in that the site is currently subject to interim reclamation/remedial components. As discussed earlier, while the flanks of the large tailing pile have a radon barrier, the top of the pile has only an interim cover that may not protect to UMTRCA standards. Without a permanent cover, there may be current human health exposures and rain may penetrate, resulting in ongoing source migration from the tailing pile (seepage) to groundwater. The groundwater at Homestake is currently subject to containment through pumping clean water from the San Andres/Glorieta (SAG) aquifer and injecting it into the alluvial aquifer to create a groundwater mound. The Region provided a Remedial Alternative Technical Memorandum for the site as part of the site information package. The tailing remedial alternative considered included on-site remediation and tailing closure; and removal and off-site disposal (outside of the San Mateo Creek Basin and Milan) of the tailing piles. The remedial alternatives considered for groundwater included long-term monitoring and ICs; groundwater containment and removal; groundwater containment, removal, and in-situ treatment; and groundwater restoration via containment and removal; and technical impracticability.

Recommendations:

- a. In addition to the current remedial technologies, the Board recommends that the Region assess a wider selection of remedial alternatives, including source control actions, before conducting the detailed alternatives analysis. The Region may want to consider the Board's recommendations on RAOs when assessing remedial alternatives for source control and/or protection of drinking water. Below are a few recommended options for consideration that could be used alone or in combination to expand the suite of alternatives:

Region 6 Response: Agreed. Region 6 will expand the range of remedial alternatives to be evaluated in the development and screening of remedial alternatives phase of the

feasibility study prior to performing the detailed analysis of alternatives. The Region will also include additional remedial action objectives to address source control and protection of groundwater, as discussed in the Region's response to Recommendation No. 6.a, above. Overall, the Region considers all of the options recommended by the Board to have merit for consideration in the ongoing CERCLA feasibility study. Individual responses are provided below for each of the Board's recommended options.

- i. Given the importance of the SAG aquifer to local communities, the Board recommends the Region consider utilizing pumping and treating the alluvial aquifer to prevent migration rather than creating a hydraulic mound. The remediated water from the treatment systems could be reinjected to the alluvial, Chinle, or SAG aquifers, depending on the level to which it is treated. This would allow for containment while preventing the use of clean water to create a mound in the contaminated alluvial aquifer. Additionally, this approach would minimize the use of the SAG aquifer for remedial purposes, reserving it for domestic use.

Region 6 Response: The Region agrees that minimizing or eliminating the use of SAG groundwater in the groundwater corrective action would be desirable. The groundwater corrective action is primarily a pump and treat system designed to remove contaminant mass by extracting (pumping) contaminated groundwater from the alluvial and Chinle aquifers and then treating the contaminated groundwater and reinjecting it back into the aquifers to create an hydraulic barrier (hydraulic mound) that locally reverses the groundwater flow direction back to the pumping wells. Approximately 300 gpm of groundwater is pumped from the SAG aquifer as a supplemental water supply in the injection process to maintain the necessary hydraulic gradients. The Region will consider a groundwater pump and treat alternative that excludes the supplemental SAG groundwater usage in the CERCLA feasibility study.

- ii. Should the current hydraulic barrier be considered as a remedial alternative, the Region should consider evaluating the hydraulic head, similar to the analysis performed upgradient, to better understand the influence of the ceased LTP flushing operation on downgradient migration.

Region 6 Response: Agreed. The Region continues to evaluate hydraulic flow regimes and plume migration in response to the injection and collection well operations for each of the impacted aquifers. This includes analysis of groundwater elevation maps and contaminant concentration trend graphs that HMC provides in the annual reports. The Region also continues to evaluate the

impact that tailing flushing cessation has had on the aquifer systems through such analysis and the ongoing monitoring of tailing water levels and chemistry and the performance of water balance calculations for estimating the amount of tailing liquids that continues to seep into groundwater as the tailing pile saturation drains down following cessation of tailing flushing.

- iii. As noted in Recommendation No. 1.a, assessing the challenges facing the RO and zeolite treatment systems may improve current operations, but this information may also be valuable to inform optimization opportunities moving forward.

Region 6 Response: Agreed. The challenges in operating the reverse osmosis and zeolite treatment systems are discussed in the Region's response to Recommendation No. 1.a, above, as well as the ongoing efforts by HMC to improve the efficacy and the effectiveness of the treatment operations. The Region will continue to evaluate optimization opportunities going forward.

- iv. It was stated that a permeable reactive barrier (PRB) may be utilized as a contingency alternative. The Board recommends that the Region consider the use of a PRB in the current suite of alternatives rather than only as a contingency. Similar to pump and treat, a PRB may be an option to replacing the current hydraulic mound.

Region 6 Response: Agreed.

- v. In terms of waste disposal, the HMC Site is one of many mines and mills in the San Mateo Creek Basin, some of which the Homestake Mining Company is responsible for. The Board recommends that the Region consider the use of a regional waste disposal facility or consolidation at another DOE facility, that may result in cost efficiencies over the long-term.

Region 6 Response: One of the remedial alternatives considered in the initial development and screening of remedial alternatives phase of the feasibility study was the removal and disposal of the tailing material into a new disposal cell that would be constructed and lined. Although the use of a regional waste disposal facility was not originally considered as a disposal option with this alternative, the Region agrees with the Board and will consider it in the feasibility study going forward. However, the Region anticipates significant challenges with the effectiveness, implementability, and short-term protectiveness of such an option.

The permitting of a regional waste disposal facility would likely be a significant challenge as well.

Region 6 will discuss with DOE the Board's recommendation for using another DOE tailing disposal facility within the San Mateo Creek Basin for the HMC tailing material, but anticipates that there would be significant technical and regulatory challenges raised by the DOE Office of Legacy Management for such an option to be viable.

- vi. In addition to the closure of the LTP and STP, the Region may consider alternative on-site source control options such as a lined cell adjacent to the current cell. If the material is moved to a lined cell, the primary source of contamination to groundwater (seepage) would be substantially reduced, if not eliminated. This approach has been used at another Superfund site in Region 10.

Region 6 Response: Agreed. The Region will add this on-site source control option to the range of alternatives to be developed and screened in the feasibility study. It is noted that HMC is redesigning the final barrier cover for the large tailing pile as a combination evapotranspiration (ET) and radon barrier cover. HMC plans to submit this ET cover design to NRC in December 2021. An ET cover system would minimize the percolation of precipitation through the tailing material and its seepage to groundwater.

- vii. Should the Region consider alternatives that maintain the LTP and STP, the Region may also consider solidifying the base of the tailing piles through injections. This may create a less permeable surface at the base of the landfill that would limit source migration/seepage to groundwater much like a liner.

Region 6 Response: Agreed. Cement solidification/stabilization of the entire tailing piles was considered in the development and screening phase of the feasibility study, but it was not retained for the detailed analysis of alternatives because of issues with effectiveness, implementability and high capital costs. The solidification/stabilization of only the base of the piles may minimize some of these issues. Again, as noted in the previous response, an ET cover system would minimize tailing seepage to groundwater.

- viii. Should the tailing material remain onsite, the Board recommends the Region work with NRC and DOE to design a cap that meets their requirements while preventing infiltration into the tailing.

Region 6 Response: Agreed. The Region will include an ET/radon barrier cover system for the tailing piles as an option in the development and screening of alternatives phase of the feasibility study. As stated above, HMC is currently redesigning the final radon barrier cover for the Site to include an ET cover component for preventing the percolation of precipitation through the tailing material. The concept of using an ET cover system on tailing waste, in addition to a radon barrier, as required by UMTRCA regulations, is currently being evaluated by the DOE Office of Legacy Management in an ET cover pilot study at the Grand Junction, Colorado, Disposal Site. DOE determined that ecological and soil-forming processes are changing the engineering properties of rock-armored disposal cell covers. The rock rip-rap creates a favorable habitat for vegetative growth. The Grand Junction pilot study will assess whether ET can prevent percolation if natural vegetative growth is allowed or enhanced.

- ix. Based on the information provided to the Board, the UMTRCA radon emission standards are above the CERCLA human health risk range for unlimited use and unrestricted exposure. As a result, the Board recommends that, should the Region select a remedial alternative that includes on-site waste management, the Region consider alternatives that utilize institutional controls and fencing to limit access to the piles to reduce exposures.

Region 6 Response: Agreed.

9. Climate Change

As noted on EPA's Climate Change website,¹⁰ understanding and addressing climate change is critical to EPA's mission to protect human health and the environment. With regards to the Superfund program, it's important to consider the impact of severe weather events, potential flooding, changes in rain patterns and temperature changes into remedy selection and design. It may be necessary to incorporate elements of climate resilience, especially for sites subject to groundwater contamination and/or material being left in place, such as the HMC Site.

Recommendation:

- a. The Board recommends that the Region, when evaluating remedial alternatives, consider the potential impacts of climate change that may negatively affect the

¹⁰ <https://www.epa.gov/climate-change>

protectiveness of alternatives. The June 2014 OLEM Climate Change Adaptation Implementation Plan¹¹ (Implementation Plan) discusses potential program vulnerabilities to climate change. Per Table 1 in the Implementation Plan, such vulnerabilities may include: design and placement of storage facilities to accommodate climate change impacts, changing climate conditions may impact continued remedy effectiveness, current assumptions regarding protectiveness of remediation and containment methods may not reflect changing climate impacts, or conducting periodic evaluations of implemented remedies, including changes to frequency and intensity that may impact remedy effectiveness. Examples of vulnerabilities that may be applicable to Homestake include: evapotranspirative covers may be less effective in areas with stronger drought/rain cycles, the depth to groundwater may be affected by climate change, or a site's O&M needs may change based on more extreme weather events.

Region 6 Response: Agreed. It is noted that UMTRCA requirements for site closure and license termination at 10 CFR Part 40, Appendix A, which are preliminary ARARs for a future CERCLA response action at the Site, require that the tailing pile cover systems and protective measures for groundwater be effective for a minimum of 200 years and, to the extent reasonably achievable, up to 1,000 years.

10. Environmental Justice

Based on the information provided to the Board, two downgradient tribes, the Pueblo of Acoma and the Pueblo of Laguna, as well as the cities of Milan and Grants are dependent upon the SAG aquifer for drinking water. These vulnerable communities may be disproportionately impacted by the HMC Site. Impacts to the SAG aquifer may create environmental justice (EJ) concerns for tribal communities, as they cannot move their homelands, and the tribes' relationship to the resource includes cultural as well as public health considerations.

Recommendations:

- a. Based on the presentations made by the Region and other stakeholders, the Board recommends the Region address the potentially disproportionate impact of site-related contamination and potential EJ concerns related to cleanup approaches. In particular, policies articulated in Section 1 of Executive Order 13990 (e.g., using science to improve public health, protect the environment, ensure access to clean water, consideration of impacts on EJ and low income communities) and public statements made by the Administrator since the issuance of that Order, as well as long-standing

¹¹ <https://www.epa.gov/sites/production/files/2018-08/documents/oswer-climate-change-adaptation-plan.pdf>

Agency EJ guidance, offer a framework that can inform policy considerations in evaluating alternatives for limiting exposure to highly toxic/carcinogenic and mobile constituents of concern (radionuclides). Given the evolving priorities related to environmental justice (EJ), the Board recommends the site team engage with Region 6's designated EJ coordinator and OSRTI's EJ coordinator, currently Lavar Thomas, to address potential EJ concerns.

Region 6 Response: Agreed. The Region's EJ staff are actively working on all EJ designated sites, including the HMC Site, that are located within the Region and engage with the site teams on a regular basis. The site team will request the EJ Coordinator, currently Ms. Debra Tellez, to contact Mr. Thomas to discuss the evolving priorities related to EJ and how such priorities can best be met during the ongoing CERCLA feasibility study and remedy selection process.

- b. Given the impact to two tribes, the Board recommends that the Region ensure adequate tribal consultation with regard to resources that may be negatively impacted by site-related contamination and potential response action alternatives.

Region 6 Response: Agreed. The Region completed the fifth five-year review of response actions for the Site in September 2021. Part of that review was an interview process with key stakeholder on their perceptions of the cleanup and the identification of any issues or concerns they may have regarding the Site. Interviews were conducted with the Pueblo of Acoma and the Pueblo of Laguna. One of the concerns raised by the Pueblo of Acoma was the need for adequate tribal consultation, especially since their government officials change every year. The Region documented this and other issues raised by the tribes in the Fifth Five-Year Review Report. As noted in the Recommendations Section of the Report, the Region will offer to meet with the tribal governments at least once a year. The Region will also update its site community involvement plan to include additional community outreach activities to ensure that the tribes are well informed about CERCLA response actions at the Site.

ADVISORY CONSIDERATIONS

Advisory considerations are Board Review Team suggestions that are meant to support the Regional Site Team in moving forward, but do not necessarily rise to the level of recommendations. Please take these comments under consideration as the RI is finalized and the FS is initiated.

1. Utilize Lessons Learned from Other Sites

As noted earlier, there are over 80 legacy uranium mines and four former uranium mill facilities that operated in the San Mateo basin, including the HMC Site. Some of these, such as Bluewater, have already undergone some remedial/reclamation activity. Similarly, other NPL sites also subject to UMTRCA Title II may be further in the remedy selection process. It might be helpful for the Region to learn more about those sites to determine if there are any lessons learned that may inform the HMC Site. Those site lessons may provide useful information and approaches for addressing inter-agency coordination, groundwater management and other related issues as the Region moves forward with remedy selection at this site.

Region 6 Response: The Region is very familiar with the over 80 legacy uranium mines and the three other former uranium mill facilities (DOE Bluewater Disposal Facility, Rio Algom Mining Company Ambrosia Lake Facility, and the DOE Ambrosial Lake Disposal Facility) that are located in the San Mateo Creek Basin. The Region's Superfund Program removal and remedial activities have included surface and groundwater investigations throughout the basin. The Region's multi-phased groundwater investigation for the basin, completed in 2018, included an evaluation of all the uranium mills' groundwater impacts and reclamation histories. Additionally, because the DOE Bluewater Disposal Facility is located in close proximity to the HMC Site and its groundwater contaminant plumes in the alluvial and SAG aquifers extend to the western boundary of the HMC Site, with the Bluewater alluvial plume likely having commingled with the HMC Site alluvial plume, the Region works closely with DOE, NRC, and NMED on all Bluewater activities. Lessons have been learned from the Bluewater site, including the importance of adequately characterizing the full extent of groundwater contamination prior to transferring the site to the DOE Legacy Management Program. The Region recognizes that the HMC Site groundwater characteristics are very complex, with the proximity of Bluewater contamination to the west and the upgradient contamination in the alluvial aquifer to the north, most likely caused from the historic mine-water discharges at legacy uranium wet mines in the upper part of the San Mateo Creek Basin. The Region has spent the last seven years reassessing these complex groundwater geochemical and hydrological conditions to characterize background and delineate the extent of groundwater impacts caused by the HMC Site. The Region will continue with this important work to inform the ongoing CERCLA feasibility study and remedy selection process. The Region also recognizes, and is constantly reminded in ongoing stakeholder communications, of the importance of the groundwater resources to the state, tribes and communities, especially the regional SAG aquifer. The Region's future decision-making for a CERCLA remedy the will take into consideration the concerns of these and all other stakeholders in protecting these resources, consistent with CERCLA, the NCP, and EPA policy.

Finally, the Region has experience working on another NPL site within its jurisdiction that is a Title II UMTRCA site; the United Nuclear Corporation Church Rock uranium mill site, located near Gallup, New Mexico. This site also presents unique challenges and lessons learned for remediation, reclamation, and interagency coordination for the eventual transfer to the DOE Legacy Management Program. For other sites located outside of the Region's jurisdiction that are both UMTRCA Title II sites and NPL sites, the Region plans to take every opportunity to learn about the remediation and reclamation of those sites going forward.

**REGION 6 RESPONSES TO NATIONAL REMEDY REVIEW BOARD
RECOMMENDATIONS
HOMESTAKE MINING COMPANY SUPERFUND SITE
CIBOLA COUNTY, NEW MEXICO**

LIST OF ABBREVIATIONS AND ACRONYMS

Agency	U.S. Environmental Protection Agency
ARAR	Applicable or relevant and appropriate requirement
ARD	EPA Air Radiation Division
Board	National Remedy Review Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COCs	Contaminants of Concern
DOE	U.S. Department of Energy
EJ	Environmental Justice
EPA	U.S. Environmental Protection Agency
ET	Evapotranspiration
FS	Feasibility Study
gpm	Gallons per minute
Headquarters	U.S. Environmental Protection Agency, Washington, D.C. Office
HI	Hazard Index
HMC	Homestake Mining Company of California
HQ	U.S. Environmental Protection Agency, Washington, D.C. Office
ICs	Institutional Controls
LTP	Large Tailing Pile
MCLs	Safe Drinking Water Act Maximum Contaminant Levels
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NMED	New Mexico Environment Department
NPL	National Priorities List of Superfund Sites
NRC	U.S. Nuclear Regulatory Commission
NRRB	National Remedy Review Board
O&M	Operation and Maintenance
OLEM	EPA Office of Land and Emergency Management
OMDP	EPA Office of Mountains, Deserts, and Plains
ORD	EPA Office of Research and Development
OSRTI	EPA Office of Superfund Remedial Technology and Innovation
OSWER	EPA Office of Solid Waste and Emergency Response
OU2	Operable Unit 2
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goals

PRP	Potentially Responsible Party
PTW	Principal Threat Waste
Rad	Radiological
Region	U.S. Environmental Protection Agency – Region 6
RAOs	Remedial Action Objectives
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RO	Reverse Osmosis
ROD	Record of Decision
SAG	San Andres Glorieta
Site	Homestake Mining Company of California Superfund Site
SPB	EPA Science Policy Branch of the Air Radiation Division
STP	Small Tailing Pile
TBC	To be considered
TI	Technical Impracticability
UMTRCA	Uranium Mill Tailings Radiation Control Act
USGS	U.S. Geological Survey