

**RESULTS OF NRC STAFF AUDIT OF THE RE-INJECTION / MASS BALANCE ANALYSIS
HOMESTAKE MINING COMPANY OF CALIFORNIA, GRANTS RECLAMATION PROJECT
DOCKET NO: 040-08903; LICENSE NO: SUA-1471; ORDER NO: EA-16-114**

1.0 INTRODUCTION

By letter dated March 28, 2017,¹ the U.S. Nuclear Regulatory Commission (NRC) issued Confirmatory Order No. EA-16-114 (CO) to the Homestake Mining Company of California (HMC, the licensee) regarding violations that took place at the Grants Reclamation Project (GRP) site. The CO was issued following Alternative Dispute Resolution mediation between HMC and the NRC, which was the result of the issuance of five apparent violations documented in letter dated October 4, 2016.²

Section V of the CO includes 16 Conditions which require licensee implementation. Condition 8 of the CO requires the licensee to provide the following:

HMC will use the mass balance methodology described in its revised 2012 groundwater CAP [corrective action plan] submittal, incorporating the issues raised in the Requests for Additional Information provided by NRC (ADAMS Package No. [ML13360A224](#)), and adapting the methodology for the purpose of completing an analysis of the re-injection system's impact to the time estimate for completion of the groundwater CAP. The analysis will be completed within 120 days of issuance of this Confirmatory Order. No less than 30 days prior to its finalization of the re-injection analysis, HMC will discuss with NRC the methodology, data, and analysis. HMC will provide to NRC all discussion material at least 10 days prior to the discussion. NRC will perform an audit of the analysis, and provide in writing NRC audit results, including any recommended changes. HMC will incorporate NRC audit results in the actions described in Condition 5 of this section.

To comply with the Condition 8 of the CO, the licensee discussed their analysis in a public meeting with the NRC staff on June 26-27, 2017.³

By letter dated July 26, 2017, HMC submitted a report dated July 2017 entitled "Collection for the Re-Injection Mass Balance/Removal Analysis."⁴ The NRC staff audited HMC's July 26, 2017, report in a letter dated October 29, 2019,⁵ and provided three recommendations. In a letter dated September 18, 2020,⁶ HMC responded to NRC's recommendations. In a letter dated September 30, 2021,⁷ the NRC staff suspended review of HMC's September 18, 2020, letter regarding HMC's Condition 8 responses pending submission of HMC's proposed Alternate Concentration Limit (ACL) Application. During NRC staff inspection in February 2022,⁸ HMC requested that NRC staff reconsider its suspension of the Condition 8 audit and review HMC's September 18, 2020, Condition 8 response.

¹ Agencywide Document Access and Management System (ADAMS) Package Accession No. [ML17060A752](#).

² ADAMS Accession No. [ML16251A526](#).

³ ADAMS Accession No. [ML17212A028](#).

⁴ ADAMS Accession No. [ML17352B067](#).

⁵ ADAMS Accession No. [ML19221B533](#).

⁶ ADAMS Accession No. [ML20262H284](#).

⁷ ADAMS Accession No. [ML21270A024](#).

⁸ ADAMS Accession No. [ML22061A224](#).

2.0 NRC AUDIT RESULTS

The NRC staff reviewed HMC's September 18, 2020, letter and responses to NRC's three recommendations.

NRC Recommendation #1

Further clarity is needed concerning the effects of the clean water injection on contaminant concentrations measured for the control area and how HMC's mass balance analysis incorporates these potential dilution effects into the mass balance analysis.

NRC Staff Review of HMC Response to Recommendation #1

In their response, HMC provided additional information regarding the potential for dilution. HMC stated that the dilutive effects would be limited due to outward flow away from collection wells within the hydraulic control area. This information was requested based on the expectation of continuing groundwater corrective actions. Based, in part, on HMC's revised conceptual site model with long-term diffusive releases from low permeability layers, HMC has recently submitted an application for ACLs. NRC staff will review information related to clean water injection as part of HMC's updated modeling in the ACL application.

NRC Recommendation #2

The contribution of contaminants from both the contents of the LTP [large tailings pile] and the underlying partially saturated zone of alluvium to the control area is highly qualitative. Further clarity is needed on how this qualitative uncertainty is considered in the analysis of the mass balance in the control area.

NRC Staff Review of HMC Response to Recommendation #2:

In their response, HMC provided estimates of the uranium mass balance in the GRP system. HMC noted significant uncertainties in the uranium mass, especially in the estimation of uranium mass in the partially saturated zone between the base of the tailings and the alluvial aquifer and in the immobile pore space within the saturated alluvium. In HMC's revised groundwater CAP dated November 13, 2020,⁹ HMC cited the uranium mass in the immobile pore space (i.e., low permeability layers consisting of clays and silts) within the saturated alluvium as part of the reason why they believe that the groundwater at the GRP site cannot be restored to the groundwater protection standards. NRC staff will review the impact of the low permeability zones on groundwater restoration activities and the long-term performance of the GRP site during review of HMC's ACL application.

NRC Recommendation #3

The Reformulated Mixing Model (RMM) model had been rerun with data from 2000 to 2015 and a hard copy of the RMM model input and output was provided in the attachment to HMC's July 26, 2017, report. However, the NRC staff was not provided the electronic version of the model with electronic input and output files. These electronic files are needed for the NRC staff's independent review and verification of the satisfactory use of the model and modeled estimates.

⁹ ADAMS Package Accession No. [ML20358A192](#).

NRC Staff Review of HMC Response to Recommendation #3:

HMC discussed in their response that the RMM has been replaced by the Drain Down Model. HMC relied upon the Drain Down Model in their ACL application. NRC staff will review the updated model as part of the review of the ACL application.

As discussed in more detail below, understanding of the GRP treatment capacity has recently changed. This revised understanding of the treatment capacity affects NRC staff's review of Condition 8 of the CO.

In the meeting summary dated December 19, 2017, report ([ML17352B067](#)), HMC discussed their calculation that approximately 4,282 lbs. of uranium was transferred from L area to within the hydraulic control area during the collection for re-injection program. The re-injection area was located between the LTP and small tailings pile, as shown in Slide 4 from HMC's presentation in the meeting summary. In the same meeting summary, the NRC staff discussed their concern that this additional uranium mass re-injected into the groundwater could have resulted in additional remediation time. As documented in the meeting summary and the licensee's analysis in the July 2017 report, the licensee presented several lines of reasoning related to limited potential impacts to the remediation timeline, including:

- Limitations in the Reverse Osmosis (RO) treatment rate and evaporative capacity would have limited how much groundwater from within the hydraulic control area could have been treated. The licensee was collecting groundwater from L Area to limit plume migration. However, the groundwater concentrations in the L Area were a factor of 5 to 10 times less than the that of the hydraulic control area. Because of the limitation in treatment rates, the licensee would have had to have limited the treatment rate of the hydraulic control area groundwater to treat the L Area groundwater. This would have led to a reduction in the total amount of uranium removed from the GRP site groundwater.
- The re-injection of L Area contaminated groundwater facilitated the collection of higher-impacted groundwater within the hydraulic control area to be collected.

Accordingly, the licensee concluded that the timeframe for restoration due to re-injection of the groundwater from the L area would be largely unchanged.

In the meeting summary dated December 19, 2017, the NRC staff discussed that the licensee's "no action" alternative (i.e., not collecting groundwater from the L Area) was not an alternative, because the licensee was required to collect impacted groundwater from the L Area. The NRC staff further discussed that recent upgrades to the RO unit should have resulted in the RO system being able to process the L Area contaminated groundwater rather than it being re-injected.

A revised understanding of the licensee's treatment capacity has shown that the evaporative capacity of the GRP limits the treatment rate to between 700-800 gpm, depending on seasonal evaporation rates.^{10,11} In their presentation, the licensee stated that the collection for re-injection program operated at rates ranging from 25 gpm to 108 gpm through 2015. Based on an RO efficiency of approximately 75-percent, this groundwater flow rate would have resulted in

¹⁰ ADAMS Accession No. [ML21096A200](#)

¹¹ ADAMS Accession No. [ML21286A797](#)

approximately 6 to 27 additional gpm to the evaporation ponds. Because the licensee has operated at or close to the evaporative capacity of the site, the NRC staff determined that the licensee would not have had the evaporative capacity to treat this additional groundwater without reducing flow from within the hydraulic control area. Accordingly, the NRC staff agrees with the licensee's assessment that treatment of the L Area groundwater instead of some of the groundwater within the hydraulic control area would have resulted in less uranium being removed. Consequently, the timeframe for groundwater restoration would likely not have been extended due to the collection for re-injection program with the current evaporative capacity. NRC staff note that additional groundwater treatment at the GRP could be realized with additional evaporative capacity.

The NRC finds HMC's responses acceptable. This audit of HMC Condition 8 responses satisfies the NRC staff's portion of Condition 8 of the CO.