Multicultural Alliance for a Safe Environment
www.masecoallition.org
PO Box 4524 Albuquerque NM 87196 fax:505-262-1864

October 31, 2012

Attn: Document Control Desk
c/o Mr. John Buckley, Mail Stop T-8F5
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Via email to: John.Buckely@nrc.gov

RE: Multicultural Alliance for a Safe Environment ("MASE") comments on the Revised Updated Corrective Action Plan (2012) for the Homestake Mining Company ("HMC") in Milan, New Mexico, License No. SUA-1471, Docket No. 40-8903

Dear Mr. Buckley:

Attached for filing please find MASE's comments on the Revised Updated Corrective Action Plan (2012) for the Homestake Mine Company (d/b/a Barrick Gold) in Milan, New Mexico, referenced above. We appreciate the opportunity to have our comments considered as part of the United States Nuclear Regulatory Commission's deliberative process on the HMC submission of a license amendment incorporating its updated, revised Corrective Action Plan for the former uranium mill site in Milan, New Mexico.

MASE and its members continue to be very concerned that a comprehensive Environmental Impact Study ("EIS") has never been conducted for this site. Given the proximity of residences to the site, known issues with uranium contamination of water resources and radon contamination that led the United States Environmental Protection Agency ("EPA") to undertake remediation to numerous residences near the site, conducting an comprehensive EIS for the site and adjacent communities is necessary, particularly at this stage of the process leading into a final Reclamation Plan for the facility.

We look forward to continued participation in this process and having your agency's and the applicants responses to our comments.

Sincerely,

Nadine Padilla,
Coordinator of MASE

Enc/As described above

COMMENTS OF THE MULTICULTURAL ALLIANCE FOR A SAFE ENVIRONMENT (MASE) TO THE STAFF OF THE UNITED STATES NUCLEAR REGULATORY COMMISSION (NRC) ON THE HOMESTAKE/BARRICK GOLD (HMC) URANIUM MILL SUPERFUND SITE UPDATED REVISED CORRECTIVE ACTION PROGRAM (CAP)

MASE's comments consist of three parts presented in four attachments to its comments below. The attachments consist of reviews and comments on the CAP and notes on the extent to which the CAP addresses the NRC Staff's Requests for Additional Information (RAIs) on the original "revised" CAP (December 2006) that HMC never directly answered. Attachment One was prepared for MASE by a professional engineer, James Kuipers. Attachment Two was prepared for MASE by a professional hydrologist, George Rice. Their curricula vitae are included as Attachments Three and Four. Below are MASE's general comments.

Comments

1. The CAP fails to address the continuing radiological issues caused by radon emissions from the mill site that were presented to the United States Environmental Protection Agency and the NRC in a May 2010 TASC report on radon level prepared by Chris Shuey of Southwest Research and Information Center (SRIC). Mr. Shuey's report showed that HMC is using unsupported assumptions to demonstrate compliance with the NRC's 100-mrem-year rule. Fenceline levels of Rn were shown to be consistently elevated over background. Mr. Shuey asserted that this demonstrated that HMC was out of compliance based upon the data and dose calculations. Although EPA has authorized preparation of a forthcoming risk assessment that will include measuring Rn at background sites and indoors and outdoors in the neighborhoods adjacent to the HMC site, the CAP does not address this issue in terms of on-site Rn emissions.

2. Significant data gaps exist for the drainage of the San Mateo Creek and Rio San Jose and their connection to the regional aquifers at the Homestake Superfund site. Any conclusions in the CAP which rely upon this questionable or non-existent data to project the limits of the extent of groundwater contamination to the boundaries of the Homestake Superfund site within the San Mateo Creek drainage are suspect. Therefore, to the extent the CAP relies such projections, MASE requests that the NRC require HMC to supplement the CAP by conducting studies to develop accurate data points upon which it would be reasonable to make such projections.

3. Financial assurance for the site, as required under Criterion 9 of 10 CFR Part 40 Appendix A, is not sufficient to cover closure of the site when the on-going costs of

groundwater remediation are taken into account. The CAP should not be approved until HMC demonstrates that there is sufficient financial assurance for closure including all necessary and on-going site remediation costs.

4. As noted in MASE's cover letter, highlighted by the comments of James Kuipers at 7-8 discussing risk assessment, and supported by the DOE protocols for dealing with uranium mill tailings disposition. These have been described as follows:

> The environmental and human health risk assessment will determine ecological and human receptors for each potential exposure pathway, identify contaminants for each pathway, and compare contaminant concentrations in media to appropriate benchmarks and to toxicity data to estimate risk.

S.R. Metzler. US DOE, IAEA-TECDOC-1403, *The Long Term Stabilization of Uranium Mill Tailings,* Annex XIII, 297-309 (2004). This description of an appropriate risk assessment is more similar to an Environmental Impact Study (EIS) than an Environmental Assessment. No EIS has been done for the HMC uranium mill site. The CAP should not be approved until an EIS and proper risk assessment are completed for the site.

5. The March 2012 version of the HMC CAP fails to identify water quality data for the area affected by Homestake operations in the neighborhoods down gradient of the tailings piles. This deficiency in the 2012 CAP is striking as it demonstrates HMC's failure to respond to a specific questions about background water quality in the neighborhoods and other early water quality data raised in NRC 2010 "Request for Additional Information" (RAI) addressing deficiencies in the 2006 HMC CAP. The 210 NRC RAI, at RAI 4, specifically requested HMC provide water quality data for the residential areas in the 1960s and 1970s, along with Atomic Energy Commission (AEC)-required groundwater monitoring data from the site gathered in the 1950s identified by HMC.

6. MASE along with its coalition partner Bluewater Valley Downstream Alliance (BVDA) take the positions that (1) based upon the U.S. Army Corps of Engineers (ACE) report that forms an Appendix to the RSE for the HMC site, flushing is not working, is spreading contamination in the groundwater, and should be stopped; (2) neither the ACE Appendix or HMC have considered removing the large tailings pile to a prepared, geologically appropriate repository within the vicinity or even on nearby property that HMC owns. The NRC should require, as part of the CAP, that HMC request the ACE to reevaluate its findings based upon study of sites within the near vicinity to HMC and on HMC's property. Removal of the large tailings pile will remove the primary source of contamination of the site, the adjacent communities, and the groundwater.

Technical Review of

Grants Reclamation Project
Updated Corrective Action Program (CAP)
NRC Radioactive Material License SUA-1471
Homestake Mining Company of California, March 2012

By
James R. Kuipers, P.E.
Kuipers & Associates LLC

For
Multicultural Alliance for a Safe Environment (MASE)

October 29, 2012

Background

The following comments are based on a technical review of the Grants Reclamation Project Updated Corrective Action Program (CAP) or other documents as referenced. The comments have been developed on behalf of the Multicultural Alliance for a Safe Environment (MASE) and are intended to address key issues of public safety, existing remedy protectiveness, proper processes for development of effective reclamation and closure/remediation measures, protection of public financial liability, and public participation.

The comments are based on the reviewer's extensive professional expertise together with regulations, guidance and scientific references as noted in these comments. The reviewer has more than 30 years professional experience in the mining and environmental fields and is knowledgeable in mine development, operations, reclamation and closure, water management and treatment, and financial assurance. The reviewer has provided technical expertise as a contractor to numerous county, state, federal and tribal governments including the EPA and New Mexico Environment Department, including development of EPA guidance for hardrock mine cleanup. The reviewer has been involved in a primary capacity at numerous federal Superfund sites either as a remedial contractor, or agency or public (TAG) technical advisor including at Chevron Questa in NM and Butte Silver Bow, Anaconda Smelter, Milltown Reservoir, Zortman and Landusky, and Beal Mountain in MT. From 2006 to 2012 the reviewer provided technical assistance to Anaconda-Deer Lodge County, MT in development of an institutional controls program together with review of the existing (1996) RI/FS and ROD. In addition to the development of a model institutional controls program for mining Superfund sites the work led to the discovery of significant additional contamination resulting in a determination by the EPA that the remedy was not protective and promoted a new RI/FS to be conducted resulting in the recent issuance of a revised Proposed Plan for cleanup of community soils and other residential areas.

In developing these comments the reviewer has focused on consistency of the proposed remedy with New Mexico Environment Department (NMED) and EPA regulations and other requirements together with recognized viable "best practices" for hardrock mine reclamation and closure.

Consistency with Superfund Expectations

The Grants site was originally added to the National Priorities List (NPL) in 1983, establishing it as a Superfund site and therefore subject to the National Contingency Plan (NCP) and Remedial Investigation /Feasibility Study (RI/FS) Process. The reviewer therefore assumed that the information provided for the site, as well as the site history, would at a minimum provide some similarity to typical Superfund protocols for site characterization, data collection and availability, risk assessment, alternatives analysis, feasibility evaluations, and determination of proposed plans and implementation follow-up. Instead, the CAP describes activities which have been conducted since 1977 as part of a corrective action plan to address contamination discovered at that time, prior to the site being added to the NPL. While some modifications have been made to the CAP during that time, the site has clearly not undergone a comprehensive evaluation and determination as to the best methods for remediation and ultimate final closure as one would expect given the sites Superfund status.

As noted by EPA[1] "As a practical matter, to the extent that questions about the effect of Homestake's closure activities on areas outside those covered by the license are not sufficiently addressed and documented in real time, EPA will be compelled to revisit them in the context of compiling the record for deletion, whether in the form of an Expanded Site Investigation, a full Remedial Investigation, or some other NCP-mandated investigation to build the record necessary to support site deletion."

Based on our review of the available information as contained by the CAP and supporting documents, a full RI/FS should be performed by EPA for the site. As noted by the CAP (p. 1-10), deletion would require that:

- The responsible party under CERCLA or other designated party(s) has implemented all appropriate response actions required.
- All appropriate fund-financed response under CERCLA has been implemented, and no further response action by the responsible party is appropriate.
- The Remedial Investigation (RI) has shown that the release poses no significant threat to public health or the environment; therefore, taking of remedial measures is not appropriate.

In our professional opinion:

- It is highly likely that significant additional response actions will be necessary at this site beyond those described in the CAP.
- The existing remedial actions described in the CAP are not appropriate because they are inconsistent with recognized best practice and agency approaches at other similar sites as discussed further in our comments.
- In addition EPA and NMED ARARs must be considered which the present actions described in the CAP do not adequately address.
- It is also highly likely, based on the site characteristics and similarities to other hardrock mining sites, that long-term maintenance and monitoring will be required to protect any final remedy together with long-term water management and treatment activities.
- Although long-term funding might be addressed by financial assurance, unless a mechanism that can assure funding in perpetuity, versus the standard of 30-100 years can be demonstrated, funding for the site, particularly if it becomes a DOE property (p. XX), will eventually fall to the public domain.

1 Coleman 2011. Letter from Samuel Coleman, EPA to Larry Camper, NRC dated July 08, 2011 Re: Homestake Mining Company Superfund Site, Grants, New Mexico.

Unless an new and thorough remedial investigation is performed showing no threat to public health or the environment, it is improbable that this site will meet the criteria for delisting within the next 25 years, if ever, particularly if the present remedy proposed in the CAP is not significantly altered. Given the contaminants of concern and their likely geochemical nature and concentrations in the source material there is a high likelihood of rebound and long-term seepage for some time (50+ years) following closure. Given the numerous pathways which could lead to human exposures via groundwater, it is highly unlikely that a RI, provided it is properly conducted, will find no threat to public health or the environment at this site.

It is our opinion that additional supplemental RI data in terms of site characterization (source characterization including geochemical leaching characteristics, draindown, and seepage predictions, hydrological characterization, human health risk assessment) will be required for EPA to adequately address the site in accordance with NCP requirements. It is further our opinion that EPA should require a complete Feasibility Study to be conducted including consideration of all viable technological alternatives to those presently proposed in the CAP. This should include a full range of alternatives including relocation alternatives (distant isolated repository versus local repository). Failure by the PRP to conduct such an analysis in an unbiased manner, and by NRC to require the PRP to do so, suggests that EPA should assume primary responsibility for oversight and potentially conduct of the RI/FS process.

CAP Remedial Measures

Tailings Flushing

According to the CAP (p. xv) flushing of the tailings is being performed to expedite the draindown of seepage from the LTP to the groundwater. The CAP does not provide information how continuing to maintain the tailings in a saturated condition expedites draindown, when draindown is a direct function of discontinuing actions which maintain the tailings in a saturated condition thereby allowing them to drain of residual fluids. The flushing appears to prolong, rather than expedite, the draindown for as long as it is being performed.

The Nevada Department of Environmental Protection together with the Bureau of Land Management (BLM) have developed a protocol for tailings fluid management during the draindown period based on their extensive experience with tailings sites in Nevada and elsewhere. Figure 5.3[2] shows the various phases of draindown that are recognized. Phase 1, consisting of recirculation, is similar to the present "flushing" activity taking place at the site. As the figure demonstrates, once phase I is completed, draindown proceeds (and a final cover is placed on the tailings) which is typically followed by 30 years or more of decreasing seepage flow until steady state conditions, reflective of seepage conditions at final closure, will be realized. By continuing flushing as part of the CAP draindown and eventual final closure of the tailings is being delayed at the Grants site rather than expedited.

Source controls for hardrock mining applications are described in numerous publications and guidance documents including EPA's 2005 Draft Hardrock Mine Cleanup Guide and the Global

2 *See* Heap Leach Draindown Estimator (HLDE) at http://www.blm.gov/nv/st/en/prog/minerals/mining.htm

Acid Rock Drainage Guide (GARD 2012)[3]. Those highly regarded sources of information identify source controls to include materials handling and management methods such as selective disposal of acid generating or reactive materials into repositories or specially designed facilities. Source controls also include engineered methods intended to prevent or reduce the occurrence of contaminant leaching by preventing or minimizing infiltration of oxygen and meteoric water as well as flow of groundwater into source materials. Commonly used methods employ a variety of covers or caps to limit infiltration. The use of liners below potential sources to protect groundwater and recover seepage is also gaining in acceptance as a source control method. In some cases neutralization may also be used as a source control method.

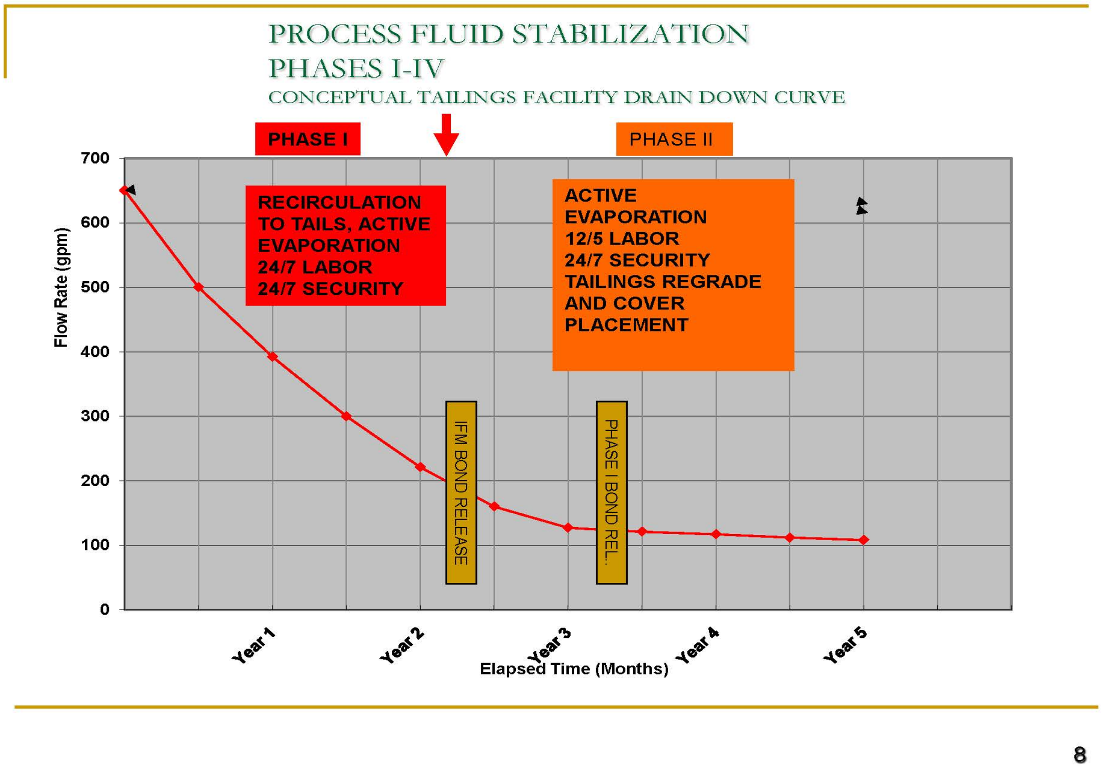
None of the measures which have been identified by industry references or regulatory agencies, with the exception of a few sites under NRC jurisdiction including the Grants site, have recognized much less utilized tailings flushing as a source control measure. Heap leach flushing is sometimes performed in the gold mining industry, however that practice has largely been discontinued because of failure to effectively remove residual process solution, and eventual rebound of contamination in seepage after rinsing is discontinued. In many cases rinsing has also been demonstrated to cause unpredicted undesirable effects such as leading to conditions where the solubility of a particular constituent, such as more alkaline conditions increasing arsenic or selenium mobility, have unintentionally occurred.

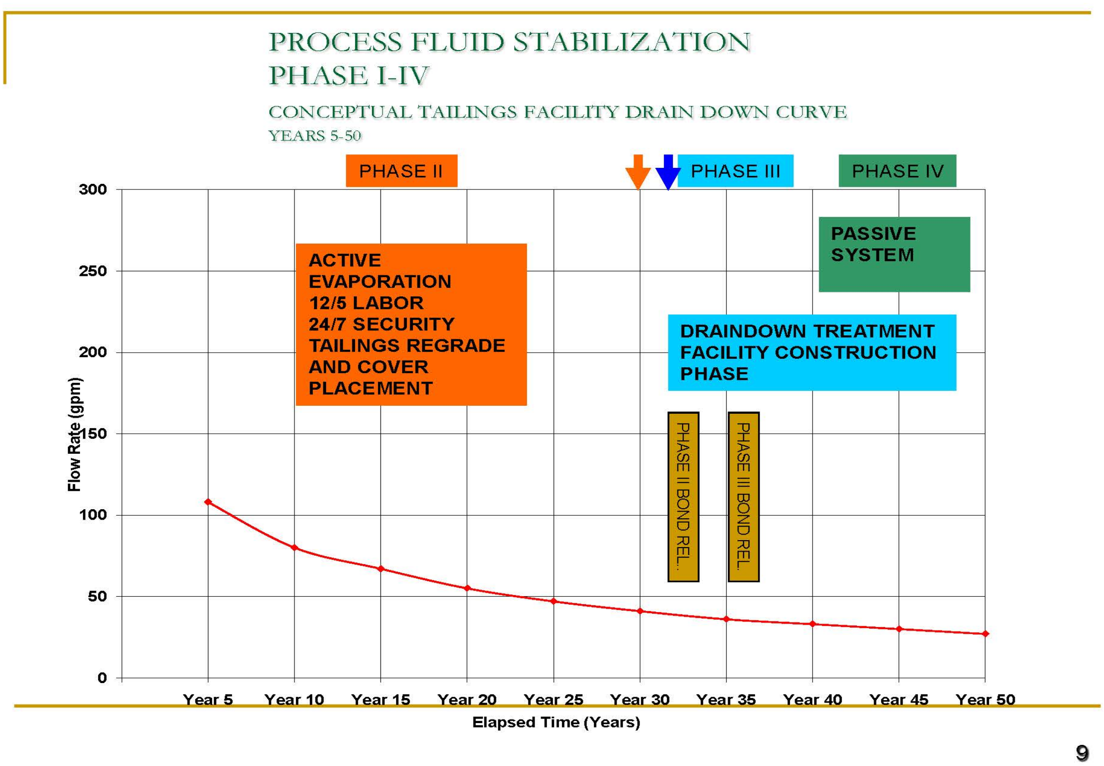
While the author knows of no examples of tailings flushing being practiced elsewhere in the hardrock mining industry in the US outside of those with NRC jurisdiction, from an engineering practices standpoint the same outcomes, namely that of incomplete flushing and high likelihood of rebound, would be likely to occur.

We recommend that immediate implementation of conventional source controls be evaluated for this site to expedite cleanup activities. This lack of typical process further demonstrates the need for an RI/FS to be conducted by EPA. This should include not only evaluation of measures to cover/cap the tailings in place, but also measures involving moving the tailings to a suitable nearby, or regional repository. Such a repository could be built using a lined system thereby preventing release of contaminants to the maximum extent.

3 http://www.inap.com.au/GARDGuide.htm -*this publication also addresses neutral and alkaline mine drainage*.

Figure 5.3 Tailings Process Fluid Stabilization Phases





Plume Control

According to the CAP ((p. xv) the plume control program involves the creation and maintenance of a hydraulic barrier downgradient of the LTP to inhibit the flow of contaminated groundwater and "Maintenance of the hydraulic barrier requires pumping of large volumes of groundwater." The water balance around the system is apparently maintained by the use of a land application disposal (LAD) method for discharging excess contaminated water. Beginning in 2010, however, NMED began to limit HMC's use of land treatment as part of its remediation strategy. According to the CAP, "if these land treatment limitations continue, additional delays should be expected, as this strategy is a critical component of the CAP."

NMED is concerned that HMC's practice of blending contaminated water with groundwater from the San Andres aquifer that presently achieves site alluvial aquifer groundwater standards. This practice essentially constitutes dilution followed by discharge of contaminants directly into groundwater, which is specifically disallowed by the New Mexico Water Quality Act.[4] NMED has required HMC to provide a demonstration, underpinned by observational data, that the continued land application of blended contaminated water as proposed in the CAP will not cause exceedance of site ground water standards at any time in the future. If HMC is unable to make this demonstration, NMED will not allow such land application to continue. NMED has also required HMC to submit preliminary plans for evaporation pond construction, which is a proven water treatment methodology that can replace land application, in the event that HMC cannot make the required demonstration, and to submit a comprehensive feasibility study of its work to date in evaluating alternative ground water treatment methods.[5]
The NMED is entirely correct in their concerns about the viability of LAD systems to not result in exceedances. LAD systems have been notoriously unpredictable and in many circumstances have resulted in either undesirable ecosystems (e.g. forage containing high quantities of contaminants) or impacts to water quality. Given New Mexico's highly protective groundwater regulations it is doubtful that any LAD system could be successfully operated to result in no discharge to groundwater of contaminants above standards if the discharge contains significant concentrations or quantities of contaminants. If an LAD system is to be used the following information needs to be collected and evaluated:

- Survey of surface waters (locations of streams, springs, lakes, wetlands).
- Depth of the shallowest water table or ground water aquifer.
- Hydrogeological characteristics of the disposal area.
- Ground water quality (State regulation).
- Soils and subsurface lithology, including attenuation analysis as needed.

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4 See recent NM AG opinion on proposed copper rules.

5 NMED Comments on Grants Reclamation Project - Homestake Mining Company Superfund Site, Updated Corrective Action Program (CAP), Draft-Final CAP, dated March 2012, Reviewed: May 29, 2012

- Vegetative survey including representative nearby riparian and wetland areas within a defined area of influence even if not included in area of disturbance.

- Ecological survey.

- Screening Level Ecological Risk Assessment/Ecological Risk Assessment.

These analyses would include, but not be limited to, state-required analyses for potential degradation of waters of the State. This should also include methods for validating operators' predictions, such as monitoring wells, lysimeters, and water-quality sampling.

As noted by NMED, there are alternatives to LAD which are much more environmentally acceptable than infiltration and dilution. In addition to passive evaporation, which is presently used at the site, active evaporation, using mechanized spray machines which enhance evaporation are routinely used throughout the mining industry for this purpose. In addition, evapotranspiration cells, wetlands and other means are available for discharge and are generally more acceptable and reliable than LAD systems.

Also according to the CAP (p. xvi) in 2001, the total mass of dissolved uranium in the alluvial plume was estimated to be 80,000 kilograms (kg) and in 2009, the total mass was estimated to be 30,000 kg. The CAP goes on to state that "furthermore, the results of this analysis directly address EPA and NMED concerns by conclusively demonstrating that the decrease in dissolved uranium concentrations observed in the plume is due to mass removal, not dilution from injected water. HMC conducted a mass removal analysis of dissolved uranium to demonstrate the effectiveness of the plume control program.

The results HMC presents are anything but conclusive. The "mass removal analysis" conducted by HMC is an unorthodox approach that is limited to consideration of the plume as defined by the model. It does not account for loss to groundwater outside of the plume and most importantly, does not account for the fate and transport of the total mass of 50,000kg dissolved uranium that mysteriously disappears from the plume in the mass removal analysis. A more orthodox approach would have been to conduct a standard site wide mass balance for all sources of contamination, existing contamination in groundwater, pumping and water treatment operations, LAD and evaporation operations, and any operations which might actually remove uranium from the site other than by discharges to the LAD system or losses to groundwater.

<u>Need for a Contemporaneous Project Evaluation</u>

According to the CAP (p. xvi) HMC has completed and is currently conducting numerous evaluations to determine if the performance and/or operation of the five existing components of the CAP has been effective or can be further optimized. While continued evaluation and operation of the existing CAP is one option, the project should be evaluated in terms of application of reclamation and closure practices contemporaneous with current development of the science and engineering underlying those practices. Over the past 30 years, essentially after the current remedial approach was developed and implemented in large part (the plume control program at the site began in 1977 (CAD p. 2-8)) much has been learned about the practice of mined land reclamation and methods to address potential sources of seepage related to geochemical leaching of residual toxic materials contained in mining and mineral processing sources. The recognized approach today is to utilize source controls which minimize or prevent infiltration or collect all discharges at the source and to only utilize methods which rely upon continuous water management and treatment as a last resort. But perhaps the most important development has been the recognition that a full tool-box of reclamation and closure measures needs to be considered, in the context of site specifics including current rather than historic adjacent land use.

A contemporaneous project evaluation would include the following:

- An updated source characterization providing detailed information on the tailings piles and their present geochemical composition including whole rock, static and kinetic testing as warranted.

- An updated hydrological characterization providing detailed information on the existing water (and elemental) balance for the site as well as evaluating likely post-present scenario hydrologic conditions under a variety of final remediation scenarios.

- A detailed fate and transport analysis showing the predicted discharge and groundwater quality as a result of various final remediation scenarios.

- Scenarios should be developed based on a consideration of all viable technological alternatives and a clearly understood set of remedial action objectives based on current ARARs.

- At a minimum the project alternatives considered should include: 1) an option for immediate cessation of tailings flushing and installation of a final reclamation source control cap on the tailings, 2) removal of the tailings to a repository (local or regional).

In 1983, the site was placed on the NPL. At that time, the EPA did not require additional response actions to remediate the groundwater because HMC was already implementing a state-approved plan. A Record of Decision (ROD) for OU3 was signed by the EPA on September 27, 1989, with the final selected remedial action being that no further action was required. However, the decision presented in the ROD did not constitute a finding by the EPA that adequate protection had been achieved within the neighboring subdivisions. Based on sampling of the soils and air in the neighboring subdivisions, the EPA continues to review outdoor monitoring and particulate data collected at the site boundary. Under CERCLA, EPA may reopen the administrative record to include new information. The EPA has been collecting air and soil sampling data in support of the development of a Human Health Risk Assessment, which includes both indoor and outdoor radon samples. A final Human Health Risk Assessment is expected to be issued by the EPA in the spring of 2012 (EPA 2011a). Therefore, determination of the protectiveness of the OU3 remedy will be deferred until the risk assessment report is completed.

The reviewer finds it remarkable that at this site, after almost 30 years of being listed on the NPL, there has yet to be a determination of whether the remedial actions are protective, and in fact has not yet conducted adequate site characterization/remedial investigation work to allow community members to have any confidence in their own health and welfare with respect to potential risks from this site. This is not to discount the work that has been done, but to point out that the health risks present at a site such as this are very real and significant and warrant a much higher level of concern that has been shown to date by both HMC and the government agencies involved. Inaction has potentially allowed the community to unnecessarily be exposed for more almost 30 years beyond when it was first determined to be a potential threat.

Institutional Controls

Based on my experience at the Anaconda Smelter Superfund site and other sites, these early NPL mining sites have demonstrated a propensity to have allowed inadequate and in some cases erroneous remedial approaches due to the lack of overall as well as agency specific experience in both the art and science of mined land reclamation and remediation of associated impacts such as to groundwater. In addition, most of those sites have not established the necessary institutional controls to ensure present or future protectiveness of either the remedial action in the future, or individual protectiveness of those community members living in close proximity to the site. This requires a substantive institutional capacity at the county or state level to provide both development controls (e.g. well drilling restrictions) and community health programs (e.g. medical monitoring) as well as an ability to enforce and fund such programs. Without a competent remedial plan in place it is not possible to develop an institutional controls program.

One of the main requirements under Superfund is to establish an effective ICs program at Superfund sites, and in the reviewer's opinion this is even more important at hardrock mining sites such as Grants where the risk of contaminant migration and exposure is relatively high and likely to be long-term.

Deed restrictions, without compensation, are likely unenforceable and provoke the likelihood of tort (takings) actions from property owners who are involuntarily subjected to them.

Comments on the *Grants Reclamation Project, Updated Corrective Action Program (CAP)* Homestake Mining Company of California, March 2012 and Notes on RAIs

George Rice
October 30, 2012

These comments are based on a review of *Grants Reclamation Project, Updated Corrective Action Program (CAP)*[1], and related documents. Notes on the requests for additional information (RAIs)[2] follow these comments.

Comment 1: San Andres/Glorietta Aquifer

The San Andres/Glorietta Aquifer directly underlies (subcrops) the alluvial aquifer approximately 2.5 miles southwest of the Homestake Mining Company's (Homestake) tailings pile[3]. In the subcrop area, groundwater from the alluvial aquifer flows into the San Andres/Glorietta Aquifer[4]. Thus, contaminants in the alluvial aquifer may enter the San Andres/Glorietta Aquifer.

Samples collected in 1998 and 2010 show that contaminants emanating from the tailings pile have migrated through the alluvial aquifer to less than a half mile from the San Andres/Glorietta Aquifer subcrop[5]. Contaminants may have reached the subcrop, but this cannot be determined because no alluvial wells have been installed above the subcrop[6]. Only one San Andres/Glorietta well (0911) appears to have been installed in the in the subcrop area[7].

Conclusion: Homestake does not appear to have investigated the possibility that contaminants from the alluvial aquifer may have entered the San Andres/Glorietta Aquifer via the subcrop. Homestake should monitor the subcrop area of the San Andres/Glorietta Aquifer to determine whether it has been affected by contaminants emanating from the tailings pile.

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[1] HMC, 2012a.
[2] HMC, 2012a, appendix A table A-2.
[3] HMC, 2012a, figure 3.2.4-3.
[4] HMC, 2012a, pages 3-13 and 3-14, and appendix J, attachment J-1, page 4-7.
[5] HMC, 2012a, figures 3.2.4-3, 4.2.3-1, and 4.2.3-4.
[6] HMC, 2012a, compare figures 3.2.4-3 and 5.2.3-1.
[7] HMC, 2012a, figure 3.2.4-3. No analyses of samples from well 0911 were found in the documents reviewed for these comments, i.e., HMC, 2012a; HMC and Hydro-Engineering, 2011; HMC and Hydro-Engineering, 2012; and USCOE, 2010a.

Comment 2: Flushing the large tailings pile

In 1995 Homestake began injecting water into the large tailings pile[8]. The purpose is to flush uranium and other contaminants from the pile[9]. In 2010 approximately 190 injection wells pumped a combined 193 gpm (approximately 300 ac-ft/yr) into the pile[10]. Most of the injected water is captured in either; 1) extraction wells installed in the pile, 2) extraction wells in the alluvium beneath the pile, or 3) toe drains installed along the perimeter of the pile. A portion of injected water remains, at least temporarily, in the pile[11].

Homestake plans to stop injecting water into the pile after 2014 because it predicts that by then, the vast majority of uranium will have been flushed from the pile[12]. However, this prediction is questionable for several reasons.

First, the permeability the slime[13] fraction of the tailings is probably much lower than that of the sand fraction. As a result, the injected water will tend to flow around rather than through the slimes. Thus, the slimes will, at best, be incompletely flushed and uranium in the pore water within the slimes will continue to be released after flushing ceases.

Second, the solid uranium in the tailings is likely to be mobilized as oxygen-rich precipitation percolates through the pile.

Third, Homestake used the model VADOSE/W to predict seepage rates through the large tailings pile. However, we cannot have confidence in the predictions produced by this model (see comment 4 below).

Finally, Homestake's predictions of uranium concentrations in the pile have not matched-up well with measured concentrations. This mismatch is illustrated in figure 1.

Conclusion: Although the injection of water has increased the rate at which uranium has been flushed from the pile, a significant reservoir of uranium will probably remain in the pile after injection is ceased. This uranium may continue to leach from the pile for many years or decades. Homestake should not rely on flushing to reduce this leaching to acceptable levels.

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[8] HMC, 2012a, page 5-5.
[9] HMC, 2012a, pages 5-5 and 5-6.
[10] HMC, 2012a, page 5-6.
[11] HMC, 2012a, page 5-6.
[12] HMC, 2012a, page 6-2; and HMC, 2012a, appendix G, attachment A, table A-3. According to the reformulated mixing model (RMM), the amount of uranium in the pile will have decreased from 105,600 pounds in 2003 to 1010 pounds in 2014.
[13] Slimes are the finer grained, clay to silt sized portion of the tailings. Water moves much slower through the slimes than it does through the sandy portion of the tailings. Thus, it takes longer for constituents to be flushed from the slimes.

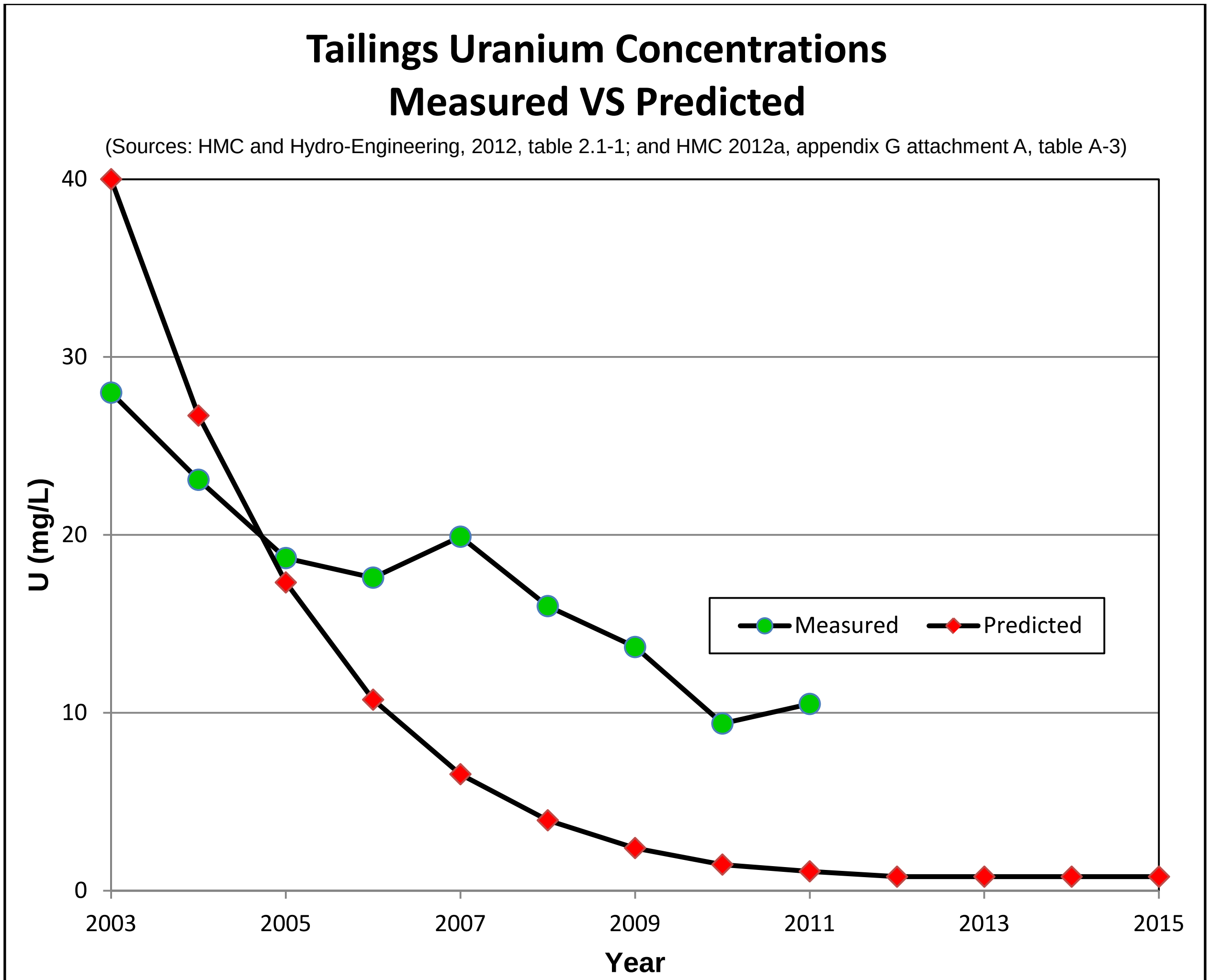

Figure 1

Comment 3: Model verification - groundwater flow and contaminant transport

Homestake used the coupled models MODFLOW and MT3DMS to simulate groundwater flow and contaminant transport[14]. The models were calibrated for the years 2000 through 2004[15]. In order to have confidence in model results, calibration is a necessary, but not a sufficient step. The models must also be verified[16]. Homestake does not appear to have verified the models.

Verification would involve performing model simulations for years not in the calibration period (e.g., 2005 - 2010) and comparing the model results with historical data (e.g., water levels, uranium concentrations). If the model is able to reproduce the historical

[14] HMC, 2012a, appendix G, page G-2.
[15] HMC, 2012a, appendix G, page G-9.
[16] Aka, history matching (Mandle, R.J., 2002, pages 18 and 19).

data, it is verified and we can have confidence in its ability to predict future conditions. Conversely, if the model is unable to reproduce the historical data, it is unverified and we cannot have confidence in its ability to predict future conditions.

Conclusion: Homestake should attempt to verify the groundwater flow and contaminant transport models. Until the models are verified, we cannot have confidence in their predictions of future conditions.

Comment 4: Model verification - tailings seepage rate

Homestake used the partially saturated flow model VADOSE/W to predict the rate of seepage from the large tailings pile. Seepage rates were predicted through the year 2050[17]. VADOSE/W was calibrated for the years 2000 through 2004[18]. However, Homestake does not appear to have verified VADOSE/W.

Conclusion: Homestake should attempt to verify the seepage rate model. Until the model is verified, we cannot have confidence in its predictions of seepage rates.

Comment 5: Land treatment

Homestake is treating contaminated water from the alluvial aquifer by using it to irrigate fields near the former uranium mill[19]. Contaminants (primarily selenium and uranium)[20] in the water are partially immobilized in the soil. The contaminated water is blended with uncontaminated water to keep contaminant concentrations below the land treatment standards established by the Nuclear Regulatory Commission (NRC) and the New Mexico Environmental Department (NMED)[21].

Four fields, ranging from 24 acres to 150 acres are irrigated[22]. Alfalfa, triticale, sorghum/sudan grass, canola, camelina, and winter wheat have been grown on the irrigated fields[23]. The amount of water applied to the fields from 2000 through 2010 ranged from 201 acre-feet to 1054 acre-feet. The average amount applied each year was 820 acre-feet (approximately 270 million gallons per year, or 500 gpm)[24].

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[17] HMC, 2012a, appendix G, attachment A, pages G.A-1 and table A-1.
[18] HMC, 2012a, appendix G, attachment A, page G.A-1.
[19] HMC, 2012a, pages 5-8 and 5-9.
[20] HMC, 2012a, appendix J, page J-1.
[21] HMC, 2012a, page 5-9.
[22] HMC, 2012a, page 5-9.
[23] HMC, 2012a, appendix J, pages J-4 and J-5.
[24] HMC, 2012a, appendix F, table F-5.

Modeling performed by Homestake predicts that the uranium in the irrigation water will never reach the groundwater beneath the irrigated fields[25]. The model used to make this prediction appears to be LEACHP[26]. However, the CAP[27] contains no description of LEACHP[28] or any indication that the model was calibrated or verified. Given this lack of information, it is not possible to have any confidence in the predictions produced by this model.

There is, however, evidence that contaminated water has moved a significant distance through the material beneath the irrigated fields. Samples collected from suction lysimeters show that contaminants have reached a depth of at least 15 feet in section 28[29], and a depth of at least 16 feet in section 33[30].

Homestake is monitoring wells near the irrigated fields to determine whether any contaminants have reached the underlying groundwater. However, many of the wells are not well-suited to this task. First, according to Homestake, contaminant concentrations in at least some of these wells may be affected by the groundwater restoration program[31]. Second, some of the monitor wells are also used as irrigation wells[32]. Thus, the water extracted from them is a mixture of water drawn from all directions around the well. Finally, the contaminant plume emanating from the large tailings pile passes directly beneath the irrigated area in section 28[33]. Contaminants in the plume could mask contaminants originating in the irrigation water.

Still, two monitor wells display increases in contaminants that could be caused by the irrigation. These wells are 844 (increases in uranium and selenium)[34] and 846 (increases in sulfate, chloride, total dissolved solids, and selenium)[35].

Conclusion: Homestake's contention that contaminants from the irrigated fields will not reach the underlying groundwater is not supported by the evidence. Lysimeter samples show that selenium and uranium from the irrigation water have already reached a depth of at least 15 feet. Two monitor wells contain elevated concentrations of contaminants that may have originated in the irrigation water. In addition, Homestake has not provided the information necessary to show that its LEACHP modeling is reliable.

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[25] HMC, 2012a, appendix J, attachment J-1, page ES-2.
[26] HMC, 2012a, page 3-4 and. appendix J, attachment J-1, page 3-62.
[27] HMC, 2012a.
[28] It is described only as a "partially saturated numerical model" (HMC, 2012a, appendix J, attachment J-1, page 3-62).
[29] Lysimeter LY28-1 (chloride, total dissolved solids, and uranium), (HMC, 2012a, appendix J, attachment J-1, figures 3-28 and 3-29).
[30] Lysimeter LY1 (chloride, sulfate, total dissolved solids, and selenium), (HMC, 2012a, appendix J, attachment J-1, figures 3-34 and 3-35).
[31] HMC, 2012a, appendix J, attachment J-1, pages 4-2, 4-3, and 4-5.
[32] Wells 649 and 881, see HMC, 2012a, appendix J, attachment J-1, figures 4-23, 4-24, 4-33, and 4-34. Note, figure 4-23 is mislabeled as 5-23.
[33] HMC, 2012a, appendix J, attachment J-1, page 4-5 and figure 4-21.
[34] HMC, 2012a, appendix J, attachment J-1, figures 4-8 and 4-10.
[35] HMC, 2012a, appendix J, attachment J-1, figures 4-2, 4-4, 4-6, and 4-10.

Comment 6: Site cleanup standards

The Nuclear Regulatory Commission (NRC), U.S. Environmental Protection Agency, and the New Mexico Environment Department have agreed on site standards (groundwater contaminant concentrations) that must be achieved by Homestake[36]. These standards must be met at five point-of-compliance (POC) wells[37]. Three of the POC wells are completed in the alluvial aquifer and two are completed in the Upper Chinle Aquifer[38]. All of the POC wells are within the NRC license boundary[39].

However, the groundwater contaminants emanating from the Homestake facility extend thousands of feet beyond the NRC license boundary[40]. It is not clear what groundwater cleanup standards apply beyond the license boundary.

Conclusion: Cleanup standards should be established for all groundwater that has been contaminated by the Homestake facility.

Comment 7: Windblown tailings and water quality

Homestake does not appear to have investigated surface water quality in the vicinity of its facility. Windblown contaminants from the tailings piles could be deposited in stream channels and subsequently entrained up by streamflows. This could affect both surface water quality and the quality of groundwater that receives recharge from an affected stream.

Conclusion: Homestake should determine whether windblown tailings have been deposited in stream channels near its facility. If they have, Homestake should determine whether they have affected water quality.

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[36] HMC, 2012a, pages 1-11 and 1-12.
[37] HMC, 2012a, pages 7-10 and 7-11.
[38] HMC, 2012a, page 1-11.
[39] HMC, 2012a, figures 1.1-1 and 2.1-1.
[40] HMC, 2012a, figure 4.2.3-4.

References

HMC, 2012a, *Grants Reclamation Project, Updated Corrective Action Program (CAP)*, pursuant to NRC Radioactive Material License SUA-1471, March 2012.

HMC and Hydro-Engineering, 2011, *Grants Reclamation Project, 2010 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200*, March 2011.

HMC and Hydro-Engineering, 2012, Grants Reclamation Project, *2011 Annual Monitoring Report/Performance Review for Homestake's Grants Project Pursuant to NRC License SUA-1471 and Discharge Plan DP-200*, March 2012.

Mandle, R.J., 2002, Groundwater Modeling Guidance, Michigan Department of Environmental Quality.

US Army Corps of Engineers (USCOE), 2010a*, Focused Review of Specific Remediation Issues, An Addendum to the Remediation System Evaluation for the Homestake Mining Company (Grants) Superfund Site, New Mexico*, Final Report, December 23, 2010.

Notes on RAIs

A listing of Homestake's responses to each RAI is given in table A-2 of Appendix A of the CAP[41]. The list identifies the sections of the CAP that address each RAI.

RAI 2:

> *The collection for re-injection program should have its own section to describe well locations and water quality for each extraction well. The water quality of the reinjection area should be discussed including the effectiveness the program will have on the injection area.*

Homestake states that this RAI is addressed in section 5.3.2 of the CAP.

This section of the CAP contains no information regarding the … *water quality for each extraction well*. Nor does it discuss *The water quality of the reinjection area …* .

RAI 4:

> *Section 2.3, paragraph 1, page 9: The statement that "natural water quality was generally poor" is not supported with actual data.*
>
> *Provide water quality data from the Atomic Energy Commission's required monitoring program for groundwater protection that started in the 1950s (mentioned in paragraph 2 of this section). Also, include available water quality results from domestic wells that were installed in the 1960s and 1970s to justify your statement.*

Homestake states that this RAI is addressed in section 4.1 of the CAP.

This section of the CAP contains no information regarding … *the Atomic Energy Commission's required monitoring program for groundwater protection that started in the 1950s.* Nor does it … *include available water quality results from domestic wells that were installed in the 1960s and 1970s … .*

RAI 13:

> *Section 2.4.3, paragraph 1, page 17: The future impacts to the Middle Chinle aquifer need to be addressed in this section.*

Homestake states that this RAI is addressed in section 4.2 and appendix E of the CAP.

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[41] *Grants Reclamation Project, Updated Corrective Action Program (CAP)*, pursuant to NRC Radioactive Material License SUA-1471, Homestake Mining Company of California, March 2012.

These parts of the CAP contains no information regarding … *future impacts to the Middle Chinle aquifer … .*

RAI 15:

> *Section 2.4.4, paragraph 1, page 18: HMC needs to support the statement "natural water quality of the major constituents in the shaley Lower Chinle aquifer is poor".*

Homestake states that this RAI is addressed in section 3.2.3.3 of the CAP.

This section of the CAP contains only qualitative information[42] to … *support the statement "natural water quality of the major constituents in the shaley Lower Chinle aquifer is poor".* The statement is not supported by chemical analyses of water from the Lower Chinle Aquifer.

RAI 20:

> *Section 2.5, paragraph 2, pages 20 and 21: HMC should provide data to support its conclusion "… that baseline water quality in the Alluvial aquifer may change in the future. Discharge of groundwater from past mine dewatering in Ambrosia lake area (north and upgradient of the site) to San Mateo Alluvial aquifer had elevated levels of the same constituents as are elevated in the Grants tailings impoundments. Travel time calculations and preliminary information from far upgradient wells indicates selenium, uranium and other constituents from mine discharges to the Alluvial aquifer could reach the Grants site in the next 20 years." HMC should include a comparison of current discharges from the tailing piles into the Alluvial aquifer and the up-gradient groundwater quality of the Alluvial aquifer.*
>
> *Further, HMC should discuss how former up-gradient mine discharges to the Alluvial aquifer will impact efforts to remediate the effects of the tailing piles on the down-gradient groundwater in the Alluvial aquifer.*

Homestake states that this RAI is addressed in section 4.1 and appendix E of the CAP.

Neither part of the CAP contains data or analyses to support the statements that 1) *… baseline water quality in the Alluvial aquifer may change in the future*. 2) *Discharge of groundwater from past mine dewatering in Ambrosia lake area (north and upgradient of the site) to San Mateo Alluvial aquifer had elevated levels of the same constituents as are elevated in the Grants tailings impoundments.* Nor did they contain *Travel time calculations and preliminary information from far upgradient wells indicates selenium, uranium and other constituents from mine discharges to the Alluvial aquifer could reach the Grants site in the next 20 years.*

[42] Homestake states: *The natural water quality of the aquifer is poor due to the low permeability of the shale and the associated long residence time for groundwater.* (HMC, 2012a, page 3-13).

These sections do not … *discuss how former up-gradient mine discharges to the Alluvial aquifer will impact efforts to remediate the effects of the tailing piles on the down-gradient groundwater in the Alluvial aquifer.*

RAI 23:

> *Sections 3.1 and 3.2, page 22, should be revised to include a discussion of the objectives of the tailings injection/extraction program. The discussion should include an explanation of how the final injection/extraction dates were determined. Provide a table with past injection/extraction rates compared to model predicted rates. Describe why past rates have been sufficient or insufficient to meet remediation goals and timelines. Explain how the seepage into the Alluvial aquifer is being contained and remediated since more water is being injected than extracted.*

Homestake states that this RAI is addressed in section 5.3.1 of the CAP.

This section of the CAP does not … *include an explanation of how the final injection/extraction dates were determined.* Nor does it *Describe why past rates have been sufficient or insufficient to meet remediation goals and timelines.*

RAI 24:

> *HMC needs a more thorough discussion of the tailing toe drain and the French drain. How do they differ? Are they interconnected?*

Homestake gives no information on where this RAI is addressed.

RAI 26:

> *Additional clarification is required on the effectiveness of extraction well P2 that pumps approximately 40 gpm of "clean groundwater" up-gradient from the Large Tailings Pile.*

Homestake states that this RAI is addressed in section 5.3.2 of the CAP.

This section of the CAP does not discuss … *the effectiveness of extraction well P2 that pumps approximately 40 gpm of "clean groundwater" up-gradient from the Large Tailings Pile.*

RAI 29:

> *Section 3.6, page 24 discusses the Upper Chinle extraction wells. However, the description does not provide enough detail for the staff to determine exactly where the 5 gpm is being injected and what is the concentration level of this water.*

> *Section 3.6, paragraph 1, page 24 should describe exactly where the 5 gpm is being injected and what the contaminate concentration level of this water is.*

Homestake states that this RAI is addressed in figure 5.2-1 of the CAP. This appears to be a typo. Pumping from the Upper Chinle is illustrated in figure 5.2.2.

However, neither figure contains … *enough detail for the staff to determine exactly where the 5 gpm is being injected and what is the concentration level of this water.*

RAI 30:

> *Sections 3.5, 3.7 and 3.9, pages 23-24, should provide the minimum injection rate needed in each well to create an effective hydraulic barrier and how these rates are achieved, as well as how these rates were determined to be effective.*

Homestake states that this RAI is addressed in section 5.3.2 of the CAP.

This section of the CAP refers to appendix M which lists pumping rates for wells at the Homestake facility. However, it does not 1) … *provide the minimum injection rate needed in each well to create an effective hydraulic barrier …* , or 2) explain *… how these rates are achieved,* or 3) explain *… how these rates were determined to be effective.*

RAI 31:

> *Please describe which San Andres wells are being pumped to supply the injection water for the Upper Chinle aquifer.*

Homestake states that this RAI is addressed in section 5.3.2 and appendix F of the CAP.

Neither section 5.3.2 or appendix F identify any … *San Andres wells* … *being pumped to supply the injection water for the Upper Chinle aquifer.*

RAI 32:

> *Please describe which San Andres wells are being pumped to supply the injection water for the Middle Chinle aquifer.*

Homestake states that this RAI is addressed in section 5.3.2 and appendix F of the CAP.

Neither section 5.3.2 or appendix F identify any … *San Andres wells* … *being pumped to supply the injection water for the Middle Chinle aquifer.*

RAI 33:

> *Section 3.12, paragraph 1, page 25: A discussion on past and future treatment rates for the RO plant and constituent levels for pre- and post-treated water needs to be included in this section. Provide a discussion on the RO systems optimum treatment rate for successful remediation. A comparison of actual rates to projected rates should be provided and discussed to determine if HMC is staying on track with the remediation timeline. Please explain why the RO treatment plant is running at 43% efficiency and include options to increase the capacity*.

Homestake states that this RAI is addressed in sections 5.3.3 and 5.5.3, and in appendices F and I of the CAP.

Section 5.5.3 indicates that some of the issues raised in this RAI will be addressed in the future. However, neither of the sections or appendices … *explain why the RO treatment plant is running at 43% efficiency …* .

RAI 36:

> *Section 3.14, page 25, states that clean groundwater is pumped from extraction wells screened in the San Andres formation (Figure 34) and in the un-impacted areas of the Alluvial aquifer and injected into the Alluvial, upper, and middle aquifers. However, the discussion does not identify here the extraction wells are located in the Alluvial aquifer, and what the contaminant concentrations are to justify the un-impacted area designation.*
>
> *Please identify where the extraction wells are located in the Alluvial aquifer, and what the contaminant concentrations are to justify the un-impacted area designation.*

Homestake states that this RAI is addressed in section 5.3.2 and appendix F of the CAP.

Neither section 5.3.2 or appendix F identify … *what the contaminant concentrations are to justify the un-impacted area designation.*

RAI 45:

> *HMC should provide the following items for the groundwater calibration: (1) a comparison of measured versus simulated groundwater levels or U concentrations and other chemicals of concern concentrations at wells or model nodes; (2) statistical analysis like the root-mean square approach; (3) information on the acceptable calibration criteria; and (4) more details on the calibration approach (trial and error changes, apparently a manual approach was used instead of a numerical approach).*

> *With regard to transport modeling, only U concentrations are compared in the discussion. HMC should provide comparisons of observed versus simulated concentrations of the other chemicals of concern at the site.*

Homestake states that this RAI is addressed in section 5.1 and appendix G of the CAP.

Neither section 5.1 or appendix G contains 1) … *statistical analysis like the root-mean square approach* …, 2) … *information on the acceptable calibration criteria …* or, 3) *comparisons of observed versus simulated concentrations of the other chemicals of concern at the site.*

JAMES R. KUIPERS, P.E.
P.O. Box 641, Butte, MT 59703
Phone (406) 782-3441
E-mail jkuipers@kuipersassoc.com

SUMMARY OF EXPERIENCE

Over 30 years experience in mining and environmental process engineering design, operations management, regulatory compliance, waste remediation, reclamation and closure, and financial assurance. Over 15 years experience providing technical assistance to public interest groups and tribal, local, state and federal governments on technical aspects of mining and environmental issues.

EDUCATION

Montana College of Mineral Science and Technology, B.S. Mineral Process Engineering, 1983.

PROFESSIONAL REGISTRATION

Professional Engineer (PE Mining/Minerals): Colorado (No. 30262), Montana (No. 7809 & Corp. No. 197)

PROFESSIONAL EXPERIENCE

1996 to Present Kuipers & Associates/J. Kuipers Engineering, Butte, MT.

- *ABN AMRO Bank, Netherlands*: Consulting Engineer, confidential mine evaluation.

- *Amigos Bravos, Taos, NM*: Consulting Engineer, Molycorp Questa Mine, technical review committee and working group member in reclamation and closure/closeout permitting and bonding process.

- *Anaconda Deer Lodge County, MT*: Consulting Engineer/Project Manager, Anaconda Superfund Site, provide technical services related to institutional controls, property conveyance and redevelopment, property and facility operation and maintenance, review of regulatory documents, renewable energy development , air and water monitoring and other tasks related to county involvement in Superfund activities.

- *Bannock Technologies, Pocatello, ID*: Consulting Engineer, Shoshone Bannock Tribe mining oversight project studies.

- *Blackfoot Legacy, Lincoln, MT:* Consulting Engineer, McDonald Project, review of project feasibility and environmental issues.

- *Border Ecology Project, Santa Fe, NM:* Consulting Engineer, Cananea Project (Mexico), consulting engineer mine reclamation and closure planning.

- *Cabinet Resource Group, Noxon, MT*: Consulting Engineer, Rock Creek Project, review of proposed tailing impoundment.

- *Clark Fork River Technical Advisory Committee, Missoula, MT*: Technical Advisor, Clark Fork River and Milltown Reservoir Operable Units, Upper Clark Fork Basin Superfund Sites.

- *Center for Science in Public Participation, Bozeman, MT:* See separate description below.

- *Citizens' Technical Environmental Committee, Butte, MT:* Technical Advisor, Butte-Silver Bow Site Operable Units, Upper Clark Fork Basin Superfund Sites.

- *Cottonwood Resource Council, Big Timber, MT:* Consulting Engineer, Lodestar Mine and Mill, review of operating and MPDES permits, financial assurance and operations data.

- *Earthjustice, Bozeman, MT:* Consulting Engineer, Montanore and Rock Creek Projects permitting process.

- *Earthworks, Washington, D.C.:* Project Manager and co-author, Water Quality Predictions and NEPA/EIS Studies.

- *Environmental Defender Law Center, Bozeman, MT*: Expert Witness and Consulting Engineer, Boliden Promel, Chile arsenic waste disposal.

- *Gila Resources Information Project, Silver City, NM:* Consulting Engineer, Phelps Dodge Chino, Cobre and Tyrone Mines, reclamation and closure/closeout permitting and bonding process.

- *Great Basin Mine Watch, Reno, NV:* Expert Witness and Consulting Engineer, various NV projects, permitting and reclamation and closure/closeout permitting and bonding process.

- *ICF International, Stafford, VA*: Consulting Engineer, 108(b) rulemaking technical support contract including financial assurance cost estimation model evaluations.

- *Johnson County, KS:* Consulting Engineer, Sunflower Limestone Mine reclamation plan and financial assurance.

- *Little Salmon Carmacks First Nation, Yukon Territory, Canada*: Expert Witness and Consulting Engineer, Carmacks Copper Project.

- *Montana Attorney Generals Office, Helena, MT:* Consulting Engineer, assist in defense of I-137 Open Pit Cyanide Mine Ban appeals.

- *Montana Department of Environmental Quality, Helena, MT*: General Contractor, Pony Mill Site Reclamation.

- *Montana Environmental Information Center, Helena, MT and National Wildlife Federation, Missoula, MT*: Expert Witness and Consulting Engineer, Golden Sunlight Mine, EIS Review and assist appeal of State operating permit.

- *Montana Environmental Information Center, Helena, MT*: Expert Witness, Bull Mountain Coal Mine appeal.

- *Montana Trout Unlimited, Missoula, MT*: Consulting Engineer, Trout Unlimited's Four Mines Campaign, review and provide technical assistance on McDonald, Crandon, New World and Rock Creek Mines.

- *Natural Resources Defense Council*; New York State: Consulting Engineer, review of Oil & Gas Draft EIS.

- *New Mexico Environmental Law Center, Santa Fe, NM*: Consulting Engineer, Oglebay Norton Mica Mine reclamation and financial assurance; New Mexico Environment Department Copper Rules Stakeholder Process.

- *Northern Plains Resource Council, Cottonwood Resource Council, Stillwater Protective Association, Billings. MT:* Consulting Engineer, Stillwater Mining Company Nye and East Boulder Mines, facilitate and perform technical aspects of Good Neighbor Agreement.

- *Northern Plains Resouce Council, Billings, MT; Wyoming Outdoor Council, Sheridan, WY:* Consulting Engineer, Montana Statewide and Wyoming Powder River Basin Coal Bed Methane EIS.

- *Northern Plains Resouce Council, Billings, MT:* Project Manager and co-author, Coal Bed Methane Produced Water Studies.

- *Northern Alaska Environmental Council, Fairbanks, AK:* Consulting Engineer, Pogo Mine NPDES permit negotiations.

- *Picuris Pueblo, Penasco, NM:* US Hill Mica Mine Reclamation Plan and financial assurance cost estimate and site reclamation project management.

- *Powder River Basin Resource Council, Sheridan, WY/Steven Adami, Buffalo, WY:* Expert Witness, Kennedy Oil IMADA POD appeals.

- *Rock Creek Alliance, Missoula, MT:* Expert Witness and Consulting Engineer, Rock Creek and Montanore Mines permitting.

- *Selkirk First Nation, Yukon Territory, Canada:* Expert Witness and Consulting Engineer, Minto Mine Project reclamation and closure and financial assurance.

- *Sheep Mountain Alliance, Telluride, CO*: Expert Witness and Consulting Engineer, Silver Bell Tailings remediation.

- *Shoshone-Paiute Tribes of the Duck Valley Reservation, NV:* Consulting Engineer, Rio Tinto Mine Reclamation and Closure.

- *Sierra Club and Mineral Policy Center:* Expert Witness, Cripple Creek and Victor Mining Company Clean Water Act case.

- *SKEO, Charlottesville, VA*: Consulting Engineer, 108(b) rulemaking technical support contract and EPA Region NEPA review and financial assurance support.

- *Southern Environmental Law Center, Charleston, SC*: Consulting Engineer, Haile Gold Mine permitting.

- *Systems Research and Applications Corporation, Fairfax, VA:* Consulting Engineer, mine cleanup and financial assurance guidelines subcontract to EPA.

- *Montana Trout Unlimited, Missoula, MT:* Consulting Engineer, I-147 initiative campaign.

- *Tohono O'odham Nation, San Xavier District, AZ:* Consulting Engineer, Mission Mine reclamation plan and financial assurance.

- *Trust for Public Lands, San Francisco, CA:* Consulting Engineer, Viceroy Castle Mountain Mine, evaluated pit backfill and reclamation alternatives for settlement agreement trust fund determination.

- *Walz and Associates, Albuquerque, NM:* Expert Witness and Consulting Engineer, assist in defense of New Mexico Environment Department and Mining and Minerals Division permitting and takings case (Manning v. NM).

- *Western Organization of Resource Councils, Billings, MT:* Oil and gas reclamation and financial assurance guide.

- *Western Resource Advocates, Salt Lake City, UT*: Expert Witness and Consulting Engineer, Red Leaf Resources oil shale project permitting.

1997 to 2005 Center for Science in Public Participation, Bozeman, MT.

- *Canadian Earthcare Society, Vancouver, BC*: Consulting Engineer, Brenda Mine, assist appeal of reclamation and closure permit.

- *CEE Bankwatch, Budapest, Hungary*: Consulting Engineer, Rosario Montana Mine (Romania), economic feasibility study of mine proposal.

- *Friends of the Similkameen, Hedley, BC*: Consulting Engineer, Candorado Mine, assist appeal of reclamation and closure permit.

- *Fort Belknap Tribal Council and Environment Department, Fort Belknap,MT*: Consulting Engineer, Zortman and Landusky Mines, Alternative Reclamation and Closure Plan, multiple accounts analysis working group member and technical advisor during supplemental environmental impact statement.

- *Guardians of the Rural Environment, Yarnell, AZ*: Consulting Engineer, Yarnell Project, EIS review and assist appeal of State operating permit.

- *Mineral Policy Center, Washington, D.C.*: Technical Advisor on general mining issues and Author of MPC Issue Paper.

- *National Wildlife Federation, Boulder, CO*: Consulting Engineer authoring report on Hardrock Mining Reclamation and Closure Bonding Practices in the Western United States.

- *Sakoagan Chippewa Tribes, Mole Lake Reservation, Wisconsin*. Consulting Engineer, Crandon Project, permitting process review.

1993 - 1995 Denver Mineral Engineers, Inc., Littleton, CO.

- Manager, Process Engineering Department.

- Manager, Mining and Environmental Wastewater Treatment Program

- *Arrowhead Industrial Water Co., San Jose, CA*: Project Manager, evaluation of reverse osmosis for mine wastewater treatment.

- *Barrick Goldstrike, USA, Elko, NV*: Project Engineer, engineering design, construction and installation of 1.5 M oz/year stainless steel electrowinning system.

- *Battle Mountain Gold, Co., Battle Mountain, NV*: Project Manager, evaluation, pilot testing, and preliminary feasibility study of wastewater treatment options for groundwater remediation of Fortitude Mine tailings area.

- *Commerce Group Corporation, Milwaukee, WI*: Project Manager, San Sebastian Gold Project, El Salvador.

- *Independence Mining Corp, Jerritt Canyon, NV*: Project Manager, technical evaluation and feasibility study of column flotation for beneficiation of refractory ores.

- *Kennecott Utah Copper, Bingham Canyon, UT*: Project Manager, design and construct stainless steel solvent extraction mixer settlers for prototype SX/EW plant.

- *Israeli Chemical Corp., Beersheeba, Israel*: Project Manager, evaluation of bromine as an alternative to cyanide gold leaching and prototype design.

- *Marston and Marston, St Louis, MO*: Project Manager, Kommunar Gold Mill Modernization Project, Kommunar, Siberia, Russia (CIS) and Suzak Polymetal Leach Circuit Evaluation and Feasibility Study, Kazakhstan (CIS).

- *Nevada Goldfields Mining Co., Denver, CO*: Project Manager, Nixon Fork Mine Preliminary Engineering Design and Feasibility Study, Concentrate Marketing Study, and environmental permitting studies.

- *Southern Pacific Railroad, Denver, CO*: Project Manager, design, construction and installation of dissolved air flotation wastewater treatment system.

1991 - 1992 Western States Minerals Corp.

- Project Manager, Northumberland Gold Mine, Round Mountain, NV.

- Corporate Senior Metallurgist, Wheat Ridge, CO. Engineering design and feasibility evaluations.

1986 - 1991 Western Gold Exploration and Mining Co. (WESTGOLD)/Minorco

- Corporate Senior Metallurgist / Project Manager, WESTGOLD, Golden, CO. Acquisitions and engineering design and feasibility evaluations, corporate acquisitions and business development group.

- Project Manager, Shamrock Resources (WESTGOLD Subs.), Reno, NV. Evaluation, engineering design and feasibility study, and prototype plant operation of refractory gold ore bioleaching technology program.

- Project Manager, Balmerton Mine, Ontario: Refractory gold ore bioleaching project and feasibility evaluation.

- Project Engineer, Johannesburg South Africa: Evaluation of Anglo American Corp. Pumpcell Technology.

- Mill Superintendent, Austin Gold Venture (WESTGOLD), Austin, NV.

- Shift Foreman, Inspiration Consolidated Copper Co, Globe, AZ.

1984 - 1985 Canyonlands 21st Century Corporation

- Director of Metallurgy, Blanding, UT. Project Manager, Jarbidge, NV.

1983 - 1984 Cumberland Mining Corporation

- Mill Superintendent / Head Metallurgist, Basin and Virginia City, MT.

1974 – 1980 Huckaba Construction

- Summer employment as Underground and Surface Miner, Millwright, Mill Operator, Fire Assayer, Whitehall and Cooke City, MT. Family owned small mining operation.

PRESENTATIONS and PUBLICATIONS

- *Financial Assurance Regulations and Cost Estimation at US Hardrock Mines,* U.S. Chile Mining Financial Assurance Seminar, US Office of Surface Mining and Environmental Protection agency and Chilean Ministry of Mining, Santiago, Chile, May 2012.

- *Mining Reclamation and Closure Regulations and Best Practices*, 2012 International Conference on Mining in Mindanao, Ateneo de Davao University, Davao City, Philippines, January 26-27, 2012.

- *Beyond the Global Acid Rock Drainage Guide,* Lake Superior Binational Program, Mining in the Lake Superior Basin Webinar Series, Environmental Impacts of Mining in the Lake Superior Basin, October 27, 2009

- *Characterizing, Predicting, and Modeling Water at Mine Sites,* California Environmental Protection Agency, California Water Board Training Academy, May 18 - 21, 2009

- *Mitigating Mining Impacts: Principles and Practices,* Lake Superior Binational Program, Mining in the Lake Superior Basin Webinar Series, Environmental Impacts of Mining in the Lake Superior Basin, March 24, 2009

- *Long-term Requirements & Financial Assurance at Superfund & Other Mine Sites*, Mine Design, Operations and Closure Conference, Fairmont Hot Springs, MT, April 2008.

- *The Effects of Coalbed Methane Production on Surface and Ground Water Resources*, Committee on Earth Resources, Board on Earth Sciences and Resources, National Research Council, Meeting on the Status of Data and Management Regarding the Effects of Coalbed Methane Production on Surface and Ground Water Resources, Denver, Colorado, April 2008.

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- *Reclamation Bonding Regulations of Precious Metal Heap Leach Facilities in the Western United States:* Presented at the workshop on Closure, Remediation and Management of Precious Metals Heap Leach Facilities, University of Nevada, Reno, Jan 15, 1999.

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- *Bacterial Leaching Pilot Study – Oxidation of a Refractory Gold Bearing High Arsenic Sulphide Concentrate:* Randol Gold Forum, Squaw Valley, 1990. Co-authored with J. Chapman, B. Marchant, R. Lawrence, R. Knopp.

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George Rice
Groundwater Hydrologist

414 East French Place
San Antonio, TX 78212
(210) 737-6180
jorje44@yahoo.com

General

More than 20 years experience in groundwater contamination investigations.

Education

M.S. Hydrology, University of Arizona, 1991
B.S. Hydrology, University of Arizona, 1979

Employment History

1993: Consultant
1988 - 1993: The MITRE Corporation, Brooks Air Force Base, Texas
1983 - 1988: SHB Geotechnical Engineers, Inc., Albuquerque, New Mexico
1980 - 1983: University of Arizona, Tucson, Arizona
1979 - 1980: U.S. Forest Service, Gifford Pinchot National Forest, Vancouver, Washington

Experience

- Design and install monitor well networks.
- Design, perform, and analyze aquifer tests.
- Design and install vadose zone monitor networks.
- Design and conduct groundwater sampling programs.
- Apply groundwater flow and contaminant transport models to predict the fate of groundwater contaminants.
- Participate in multidisciplinary teams to select and design hazardous waste disposal sites.
- Conduct third party reviews of environmental documents and field programs.
- Expert Witness.

Representative Projects

UMTRA Project, Arizona, Colorado, New Mexico, Utah, Wyoming. Groundwater contamination caused by uranium mill tailings. Typical contaminants: metals (arsenic, uranium). Worked for SHB Geotechnical Engineers, Inc. Determined extent and character of contamination, developed plans to cleanup tailings and groundwater.

Yucca Mountain Nuclear Waste Repository, Yucca Mountain, Nevada. Worked for Southwest Research Institute and HOME (Healing Ourselves and Mother Earth). Evaluated the potential for groundwater to contact waste canisters, and established background concentrations for radionuclides in aquifer down gradient of the proposed waste repository.

Kelly Air Force Base, San Antonio, Texas. Groundwater contamination caused by discharge of contaminated water, leakage from tanks and lines, and disposal of wastes. Typical contaminants: solvents (TCE, PCE), fuel components (benzene), metals (chromium, thallium). Member of Kelly Air Force Base RAB. Commented on Air Force's plans to cleanup contaminated soils and groundwater.

Pantex Plant, Amarillo, Texas. Groundwater contamination caused by discharge of manufacturing process water and disposal of wastes. Typical contaminants: (TCE, PCE), explosives (RDX), metals (chromium), radionuclides (tritium). Worked for STAND (Serious Texans Against Nuclear Dumping). Evaluated DOE's plans to delineate, cleanup, and monitor contaminated groundwater.

Los Alamos National Laboratory, Los Alamos, New Mexico. Groundwater contamination caused by discharges and disposal of industrial wastes. Typical contaminants: explosives (RDX, perchlorate), metals (chromium), radionuclides (plutonium, tritium). Worked for CCNS (Concerned Citizens for Nuclear Safety) and Los Alamos National Laboratory. Evaluated the potential for laboratory contaminants to reach the Rio Grande, and evaluated disposal options for radioactive wastes.

Kingsville Dome Mine, Kleberg County, Texas. Groundwater contamination caused by in-situ uranium mining. Typical contaminants: metals (molybdenum, uranium). Worked for the Kleberg County URI Citizen Review Board. Evaluated URI's progress in cleaning up contaminated groundwater, and plans for post-cleanup monitoring.

Flint Hills Refinery, Corpus Christi, Texas. Groundwater contamination caused by leakage from refinery. Typical contaminants: fuel components (benzene). Worked with concerned citizens to evaluate the Texas

Commission on Environmental Quality's plans to determine the extent of contamination.

Longhorn Army Ammunition Plant, Karnack, Texas. Groundwater contamination caused by discharge of contaminated water, leakage from tanks, and disposal of wastes. Typical contaminants: solvents (TCE, DCE), explosives (RDX, perchlorate), metals (antimony, thallium). Worked for Caddo Lake Institute. Evaluated Army's plans to clean-up contaminated groundwater.

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