Homestake Mining Company of California
Grants Reclamation Project
Pre-ACL Application
Scoping Conference Call
June 25, 2020

AGENDA

Purpose & Objectives

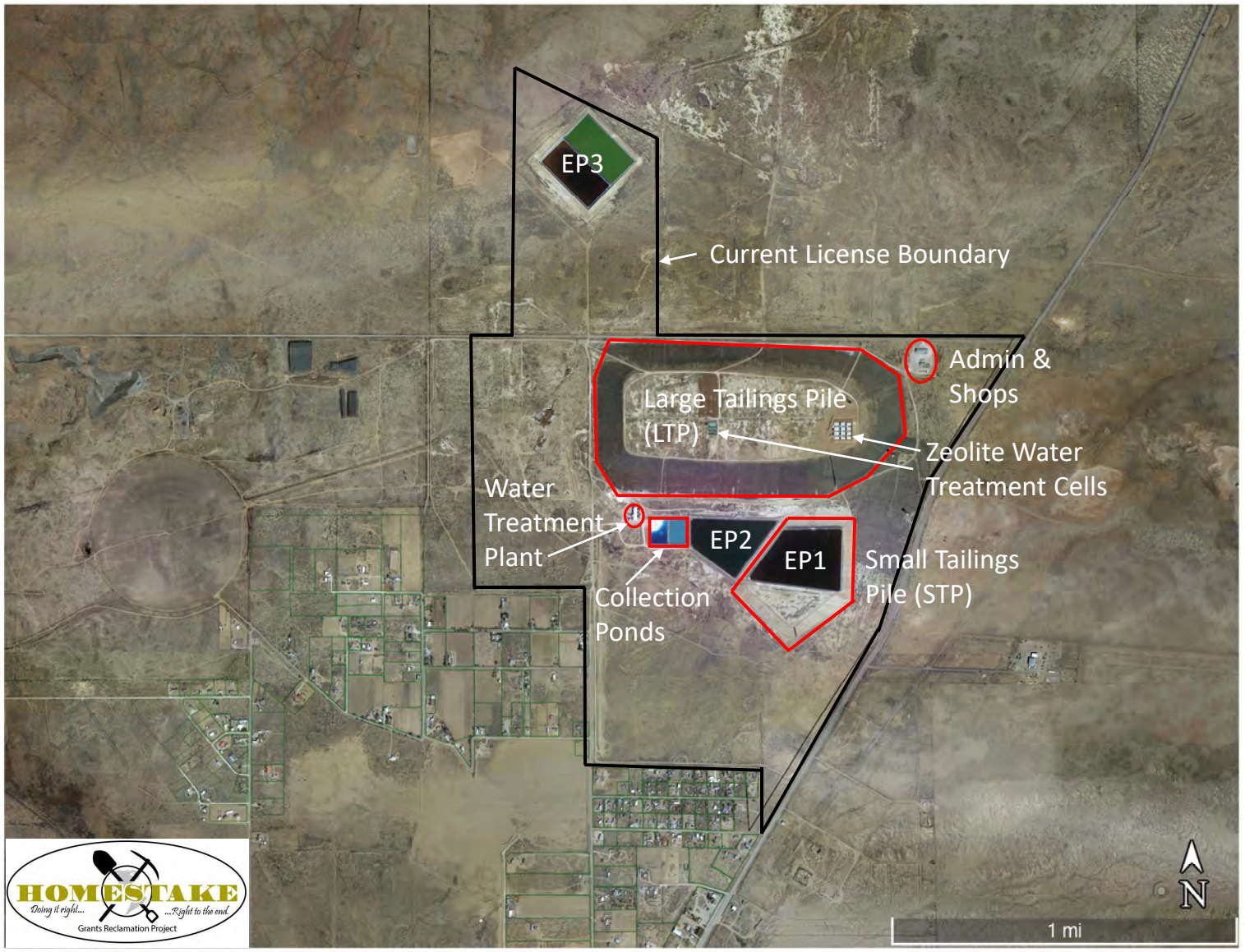
Brief Overview of Site Conditions and GW Corrective Actions

- Current Extent of Groundwater Contamination
- Corrective Action Summary
- How Did We Get Here

ACL Technical Approach

- Site Characterization
- Hazard Assessment
- Exposure Assessment
- Corrective Action Assessment
- ACL and LTCB Development

Discussion


EP3
Current License Boundary
Admin &
Shops
Large Tailings Pile
(LTP)
Zeolite Water
Treatment Cells
Water
Treatment
Plant
EP2
EP1
Small Tailings
Pile (STP)
Collection
Ponds
HOMESTAKE
Doing it right... ...Right to the end.
Grants Reclamation Project
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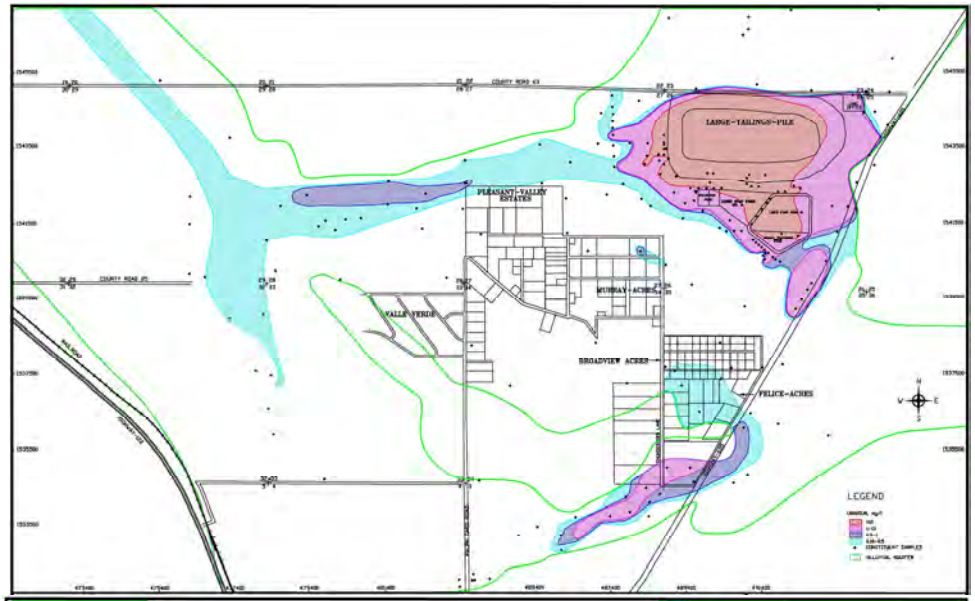
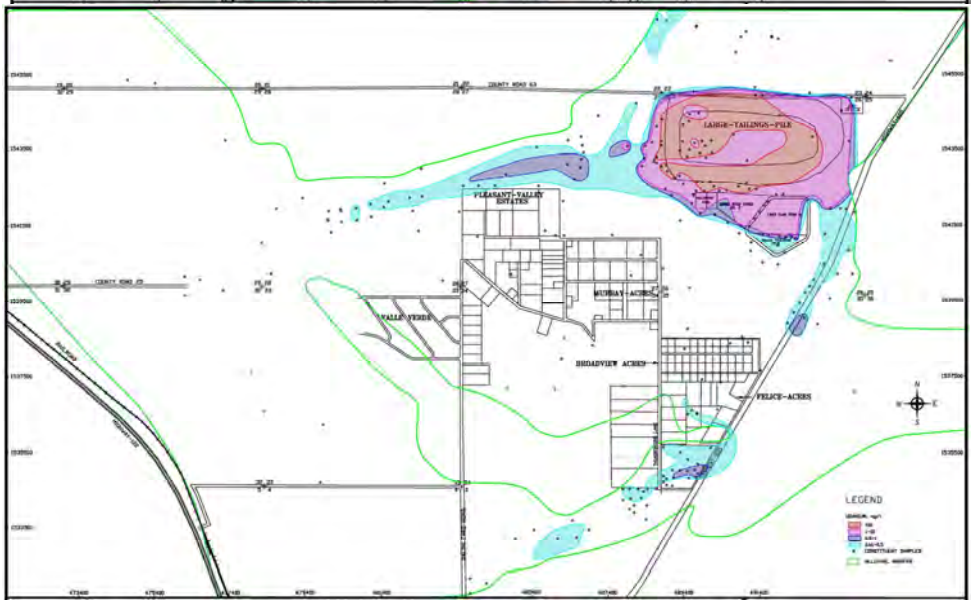
Brief Overview of Site Conditions and GW Corrective Actions

Current Extent of Groundwater Contamination

- Hazardous Constituents (LC 35B)
  - Selection of hazardous constituents narrowed by process knowledge and tailings solution sampling
  - Molybdenum, Selenium, Nitrate, Uranium, Vanadium
  - Ra-226+228, Th-230
  - Plus standards for Sulfate, Chloride, TDS
- Maximum uranium extent occurred around 1999 (Alluvium)
- Uranium extent in alluvium in 2019
- Uranium extent in upper Chinle in 2019
- Uranium extent in middle Chinle in 2019
- Uranium extent in lower Chinle in 2019

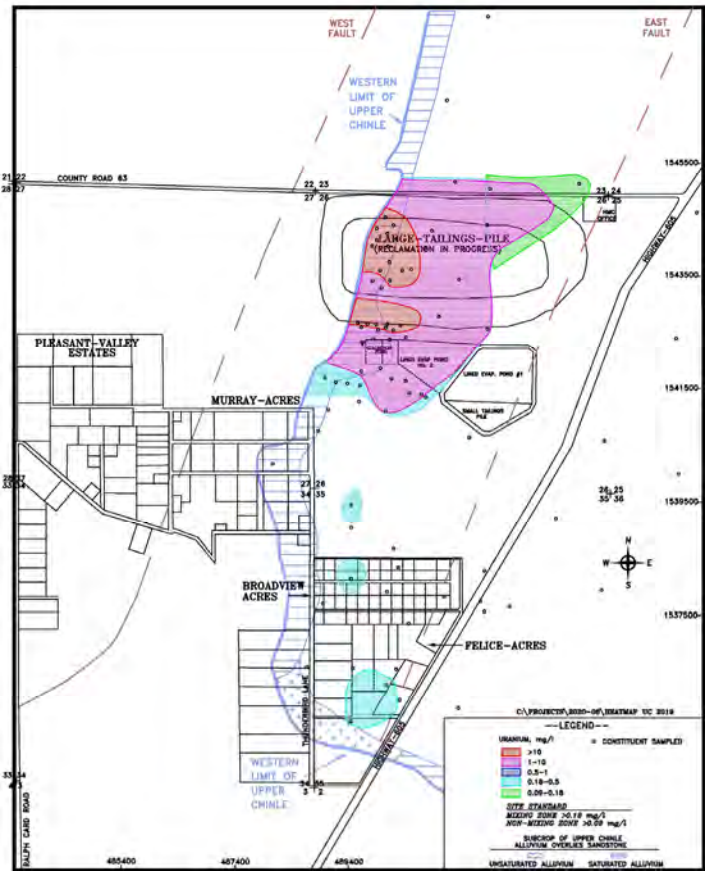


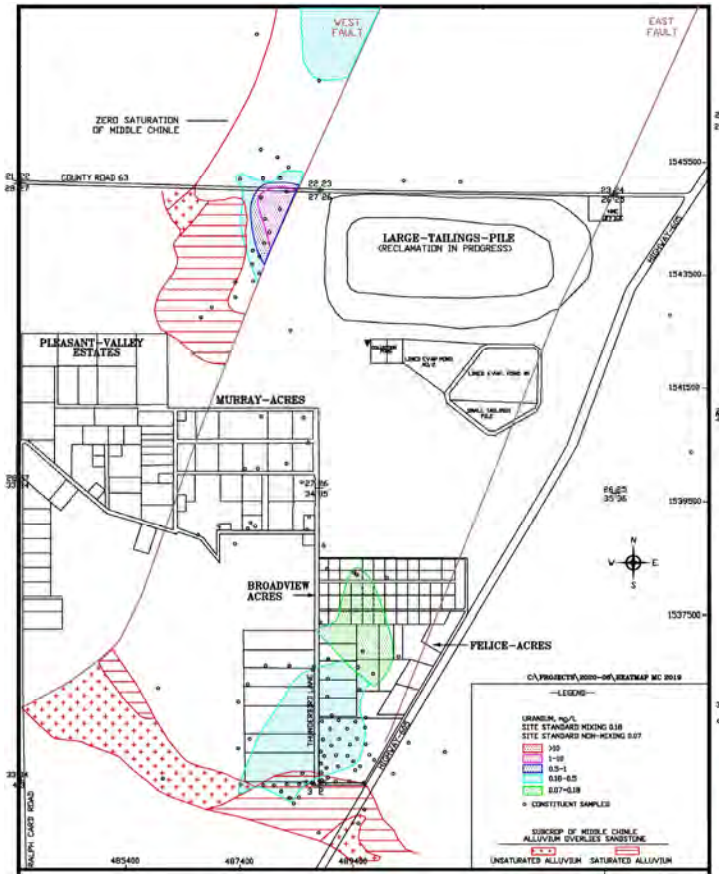
Maximum Extent of Uranium in Alluvial Aquifer, ≈1999



Extent of Uranium in Alluvial Aquifer, 2019

Extent of Uranium in Upper, Middle and Lower Chinle Aquifers, 2019

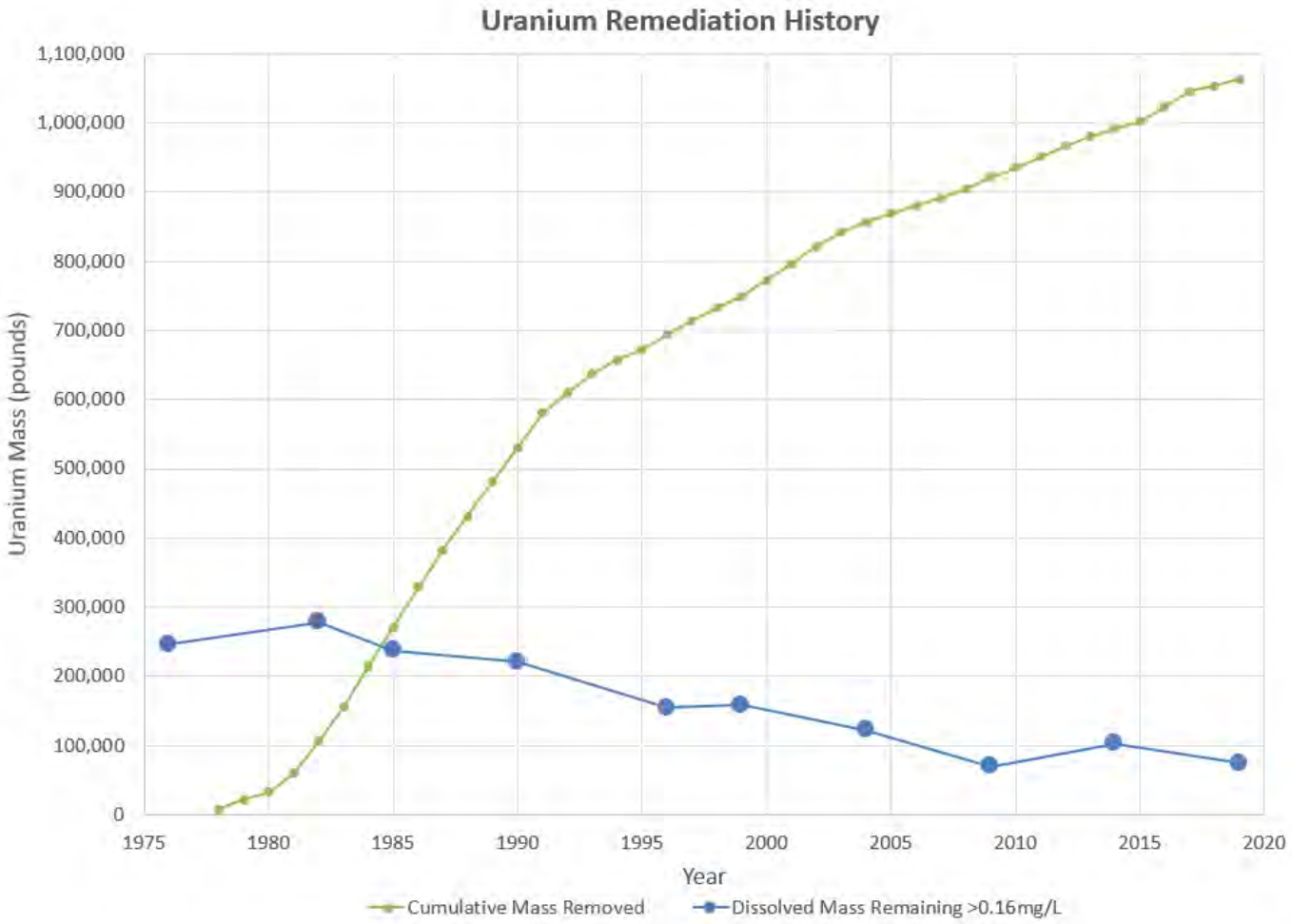




Corrective Action Summary

- More than 40 years of groundwater corrective action
- More than 2,000 wells
- More than 9,500,000,000 gallons of groundwater pumped
  - >1,000,000 pounds of uranium removed
  - > 1,500,000,000 gallons permanently removed via evaporation
- Over $240,000,000 spent on groundwater corrective action to date.
- Municipal water supply provided to affected properties to eliminate exposure pathway
- Updated modeling indicates that long-term mobilization of mass from the alluvial aquifer and long-term seepage from LTP makes groundwater restoration not reasonably achievable.

Corrective Action Summary



HOW DID WE GET HERE?

- Groundwater corrective action initiated in 1977.
- Last GW CAP approved by NRC in 1989, amended for RO water treatment in 1998, amended for zeolite water treatment in 2019.
- GW CAP infrastructure and scope evolved from 1989 through 2015 to address nature and extent of GW impacts.
  - NRC reviewed and inspected GW CAP regularly between 1989 and 2015
  - HMC submitted Revised GW CAPs in 2006 and 2012, reviews and approvals never completed

HOW DID WE GET HERE?

Confirmatory Order

- NRC issued NOV in 2015 regarding previously unidentified inconsistencies between GW CAP implementation and 1989/1998 approved GW CAPs
- HMC elected to resolve the enforcement cooperatively, arbitration resulted in NRC Confirmatory Order (CO).
- CO required submittal of updated GW CAP within a limited time frame.
- HMC submitted updated GW CAP in December 2019.
  - Developed GW model to assess scope of 2019 GW CAP actions
  - 2019 GW CAP identifies to NRC that further GW corrective action is not likely to restore GW to the higher of MCLs or background per 10 CFR 40 Appendix A, Criterion 5B(5), therefore an ACL application is anticipated as the sole remaining path to long-term GW protection and compliance.
- NRC requested supplemental information on 2019 GW CAP before acceptance for detailed review (June, 2020)

Previous and Current Corrective Actions

- **Source Control** – LTP flushing & dewatering
  - >900,000,000 gallons collected through dewatering wells and toe drains since 1992
  - Tailings flushing performed from 2000 through 2015
- **Plume Control -** Groundwater extraction from all affected aquifers
  - > 9,500,000,000 gallons pumped, >1,500,000,000 gallons permanently removed from aquifer via evaporative treatment
  - Groundwater treatment – RO, Zeolites, Evaporation
  - Injection of compliant treated water – hydraulic control, flushing of impacted aquifer strata
- >40 years of remedial action and most recent assessment of sources, geochemistry, and transport indicates aquifer restoration to higher of MCLs or background per Criterion 5B(5) is not reasonably achievable.

ACL Technical Approach

- Parallel regulatory efforts with EPA and NRC
  - Consistent information between processes and applications
  - Completeness while recognizing differences between regulatory processes
- ACL Application to be based on:
  - NUREG-1620 (Section 4.0 Protecting Water Resources and Appendix K, TOC)
  - NRC 1996 (Alternate Concentration Limits For Title II Uranium Mills)
  - Environmental Report (ER) to be based on NUREG-1748 (NMSS Environmental Review Guidance)
- HMC has developed a detailed crosswalk between NUREG-1620 acceptance criteria and ACL application sections to ensure completeness.

ACL Technical Approach

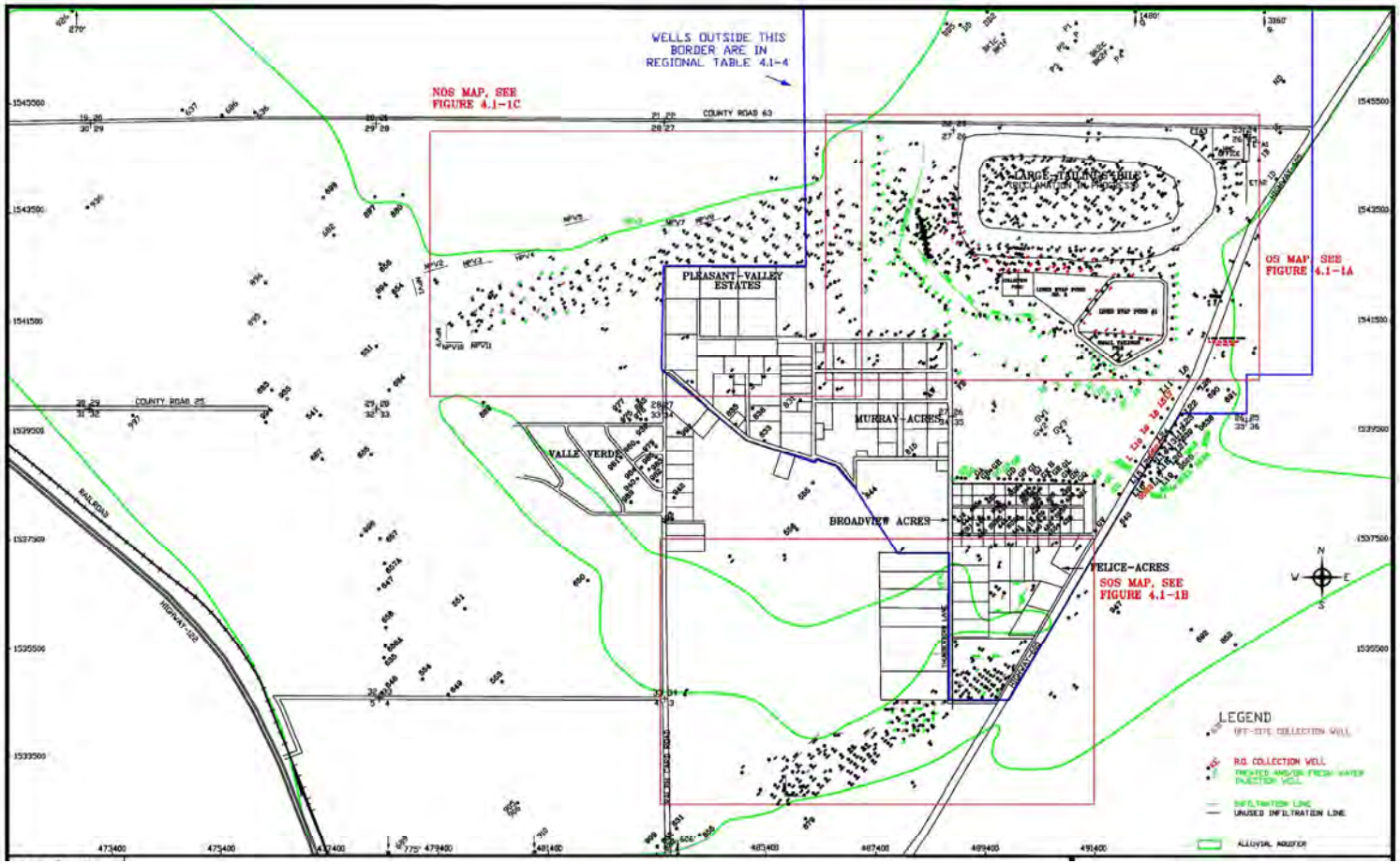
ACL will completely address all acceptance review criteria for:

- Hazard Assessment & Site Characterization
- Exposure Assessment
- Corrective Action Assessment
- Development of ACLs, implementation and proposed monitoring

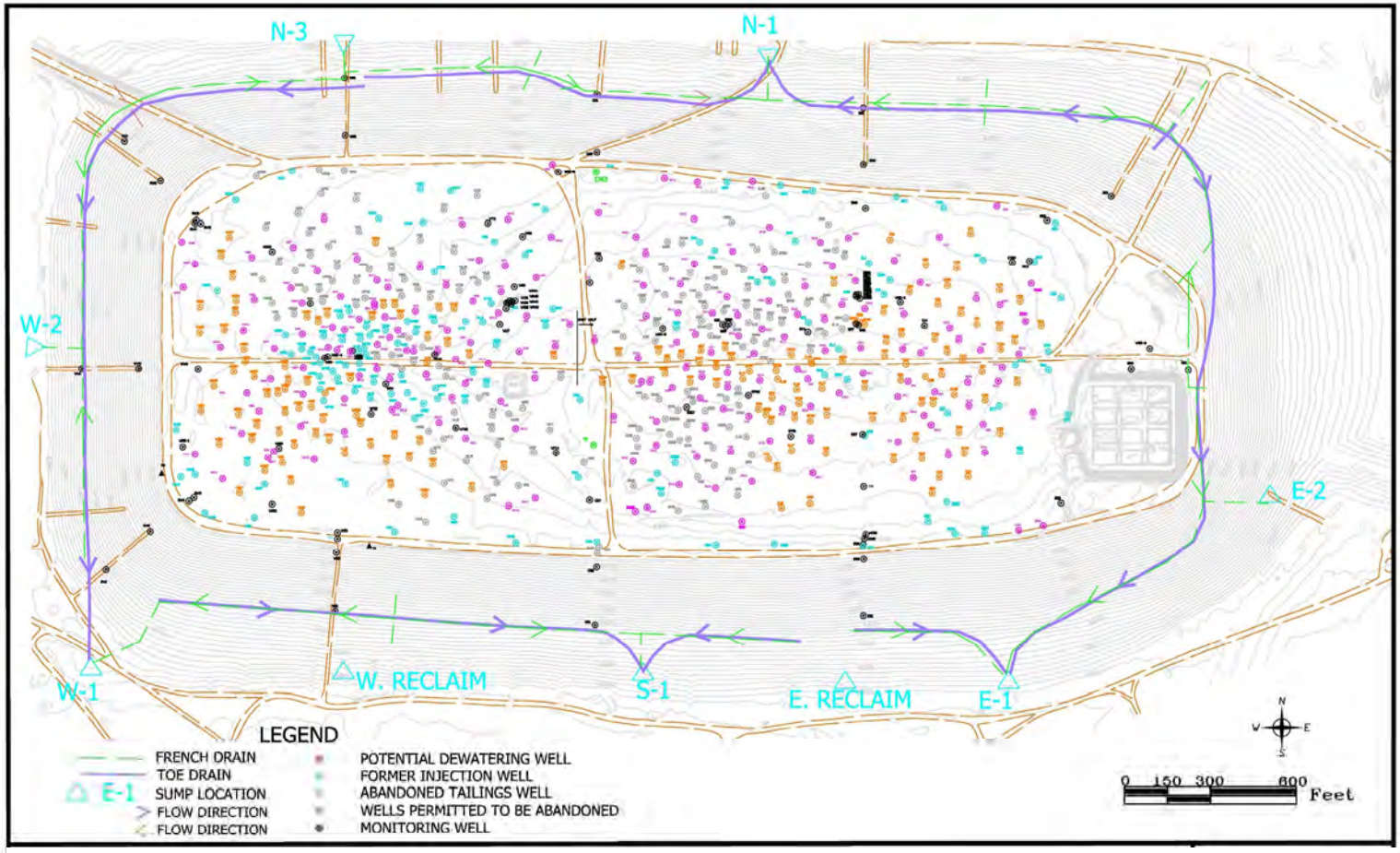
ACL Technical Approach

Hazard Assessment & Site Characterization

- Extensive characterization of hydrogeological & water quality conditions
  - > 2,000 wells, borings for geologic, geophysical, hydrologic, and water quality data
  - Potential future impacts to Site GW quality from upgradient mine waters
- Geochemical Characterization of Tailings and Alluvial Aquifer
  - Mineralogy, redox state, acid/base accounting, weathering and rebound potential
- Hazardous Constituents (LC 35B)
  - Per LC 35 and considering NRC tailings analyses in 1987
  - Molybdenum, Selenium, Nitrate, Uranium, Vanadium, Ra-226+228, Th-230
  - Sulfate, Chloride, TDS: Not considered hazardous constituents but will address nature and extent in the ACL application



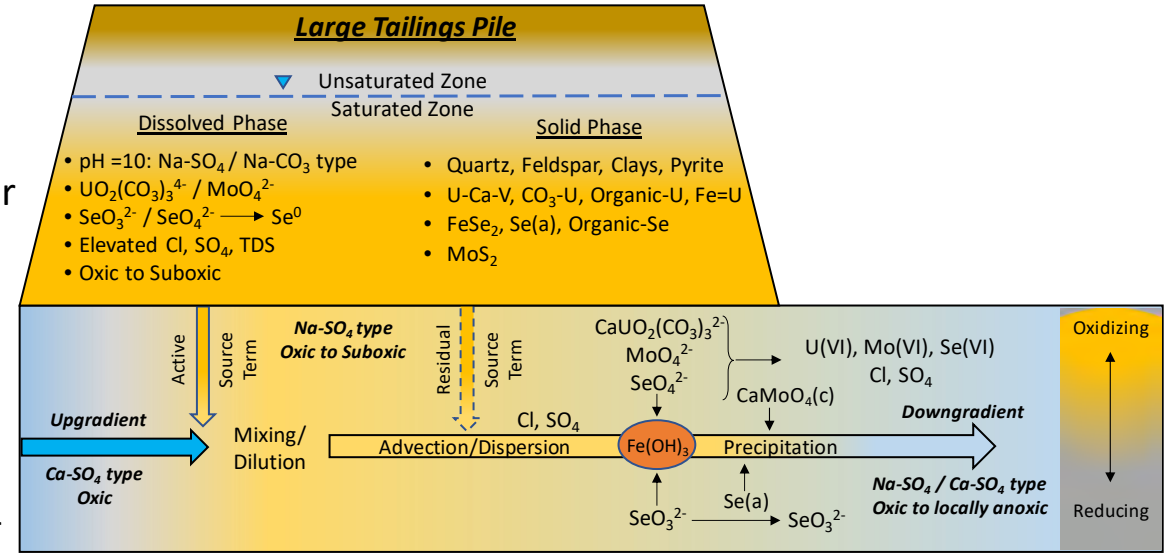
Alluvial Aquifer Corrective Action Program Wells, 2019



Tailings Wells, 2019

ACL Technical Approach

- Site Characterization (cont'd)
  - Robust geochemical characterization of the tailings sources
    - Current and long term geochemistry
  - Geochemical modeling of transport in aquifer
    - Surface complexation mixing model using liner Freundlich Equation
    - Added dual-domain based upon site-specific contaminant transport behavior
    - Fit to observed conditions for alluvial aquifer
  - Detailed and defensible geochemical conceptual model



ACL Technical Approach

Exposure Assessment

- Transport and Pathways
  - Developed calibrated 3-D GW flow and contaminant transport models
    - U.S. Geological Survey code MODFLOW-USG (Panday, et al., 2013; Panday, 2014)
    - ACL model refined from 2019 GW CAP model
      - Scaled for Site-specific flow and transport for 1,000 years
      - Added dual-domain solutions to account for heterogeneity in porosity and hydraulic conductivity in alluvial aquifer
      - Based upon site-specific contaminant transport behavior
    - Transient flow and transport calibration to >400 wells with >7,000 targets for 15 year period (2002-2017).
    - Deterministic modeling transport of natural uranium and molybdenum
      - Conservatively bound transport of all other hazardous constituents

ACL Technical Approach

Exposure Assessment

- Pathway and Receptor Characterization.
  - Though multiple land uses are possible, critical receptor is “Resident Farmer” using an existing GW well
    - Exposure duration is annualized, can calculate lifetime risks (30 year exposure)
  - Human exposure pathways addressed
    - Ingestion of GW
    - Dermal Contact
    - Consumption of produce and livestock exposed to impacted GW
  - Ecological exposure pathways
    - Potentially exposed ecological populations include small mammals, large mammals (livestock and wildlife), avian receptors (livestock and wildlife)
    - Ecological exposure pathways include ingestion of GW consumption of forage irrigated with impacted GW

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Corrective Action Assessment

- Alternatives Assessment (Expanded from 2019 GW CAP)
  - Screened Technologies (Effectiveness, Implementability, Relative Cost)
    - Ex Situ
      - Reverse Osmosis
      - Evaporation
      - Zeolite
      - Electrocoagulation (EC)
      - Ion Exchange (IX)
      - Activated Alumina (AA)
      - Deep Well Injection
    - In Situ
      - Extraction/Injection
      - Tripolyphosphate/Hydroxyapatite
      - Bioremediation

ACL Technical Approach

Corrective Action Assessment (cont'd)

- Alternatives Assessment (Expanded from 2019 GW CAP)
  - Develop and Screen Alternatives (Effectiveness, Implementability, Relative Cost)
  - Detailed screening process and criteria consistent with CERCLA 40 CFR 300.430
    - Overall Protection of Human Health and the Environment
    - Compliance with Groundwater Corrective Action Objectives
    - Long-Term Effectiveness and Permanence
    - Reduction of Toxicity, Mobility, or Volume through Treatment
    - Short-Term Effectiveness
    - Implementability
    - Cost

ACL Technical Approach

Corrective Action Assessment (cont'd)

- Evaluation of Alternatives
  - Costs (Capital Costs, O&M Costs, Decommissioning Costs)
  - Benefits
    - Direct benefits (value of water resource/alternate water supply, avoided adverse health effects)
    - Indirect Benefits (property depreciation, timeliness of remedy)
- ALARA Demonstration
  - Use modeling results to calculate the cost of reducing concentrations to acceptable concentrations for each applicable hazardous constituent
  - Radionuclides
    - Calculate the cost of treatment per person-rem averted
    - Compare that result to the NRC ALARA cost per person-rem guidance
  - Non-Radionuclides (Carcinogens)
    - Compare costs to EPA guidance for $1x10^{-4}$ Cancer Risk
  - Non-Radionuclides (Non-carcinogens)
    - Qualitative assessment of costs and avoided adverse health effects

ACL Technical Approach

Alternate Concentration Limits

- Extent of proposed LTCB based on modeling of hazardous constituent extent over 1,000 years
  - Predictive model runs
  - Sensitivity analyses run on proposed alternative (aerial recharge)
- Presumes removal of all potential POE within the proposed LTCB (e.g., existing 3rd party wells)

ACL Technical Approach

Alternate Concentration Limits

- Potential need for institutional controls (ICs) not known at this time.
  - Acquisition and transfer of simple fee title to all lands and interests therein (surface and subsurface estates) is primary mechanism for control over access to and use of groundwater.
  - If documented good-faith efforts cannot acquire title to all lands, will request approval for use of ICs restricting access to and use of groundwater as an exception to requirements of 10 CFR 40 Appendix A and document good-faith effort to acquire one or more of the following:
    - Fee title to subsurface estate only
    - Durable and enforceable restrictive covenants that run with the land
    - Permission to abandon existing private wells within the proposed LTCB
  - NRC has precedent for approving use of ICs as an acceptable alternative to fee title transfer (SECY 02-0138)
  - NRC has precedent for accepting ACL application for Technical Review prior to all IC's being in place (Split Rock).
  - NRC has precedent for documented good-faith effort to acquire lands and ICs as sufficient for ACL approval even if all controls are not in place (Split Rock).
- New Mexico Office of State Engineer Order
  - Prohibits new appropriations of groundwater including new or replacement wells or changes to groundwater points of diversions for alluvial and Chinle aquifers.
  - Restrictions shall remain in place in perpetuity or until such time as the groundwater concentrations have decreased to levels less than WQCC standards set forth in 20.6.2.3103 NMAC.

ACL Technical Approach

Alternate Concentration Limits

- ACLs for modeled hazardous constituents (U, Mo) will be proposed based on results of modeling sensitivity
- ACLs for all other hazardous constituents will be proposed based on model results of U and Mo and conservative assumptions regarding future transport
- Considering proposal for ACLs to automatically adjust upward based on upgradient baseline monitoring, due to known upgradient increases in COC concentrations.
- Propose pre-submittal application audit with NRC or submittal of draft application and fixed draft comment period
  - Similar to Ross and Sheep Mountain license application pre-submittal audits

ACL Technical Approach

Questions?