Work Plan for Leaching Analysis of Hydro Pit Fill, Revision 1
Three Kids Mine
Henderson, Nevada

Prepared for:

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Project No. 14-01-156

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December 23, 2021 Project No. 14-01-156

Alan Pineda, PE
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Nevada Division of Environmental Protection
375 E. Warm Springs Rd., Ste. 200
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Attn: Mr. Pineda

Re: Work Plan for Leaching Analysis of Hydro Pit Fill, Revision 1
Three Kids Mine, Henderson, Nevada

Dear Mr. Pineda,

Broadbent & Associates, Inc. (Broadbent) is pleased to submit this *Work Plan for Leaching Analysis of Hydro Pit Fill, Revision 1* for the Three Kids Mine located in Henderson, Nevada.

Please do not hesitate to contact us if you should have any questions or require additional information.

Sincerely,
BROADBENT & ASSOCIATES, INC.

Kirk Stowers, CEM
Principal Geologist

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Work Plan for Leaching Analysis of Hydro Pit Fill, Revision 1
Three Kids Mine
Henderson, Nevada

REVIEW AND APPROVAL:

JURAT: I, Kirk Stowers, hereby certify that I am responsible for the services in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state and local statutes, regulation and ordinances.

______________________________ **12/23/2021**

Kirk Stowers **Date**
CEM #1549, Exp 10/11/2022

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1.0 INTRODUCTION

This work plan was prepared by Broadbent & Associates, Inc. (Broadbent) and EA Engineering, Science, and Technology, Inc. PBC (EA) on behalf of Lakemoor Ventures, LLC (Lakemoor) for the Three Kids Mine (site) located in Clark County, Nevada, just east of the city of Henderson. The site is being remediated and reclaimed by Lakemoor in conjunction with residential development. The work plan is being submitted to the Nevada Division of Environmental Protection (NDEP), Bureau of Industrial Site Cleanup, the lead agency overseeing the reclamation of the site, for review and approval.

Prior investigations indicate that the site related chemicals (SRC) present in soils, rock, and mine waste present at the site include arsenic, lead, manganese, copper, zinc, diesel-range organic (DRO) constituents, and semi-volatile organic compounds that could potentially mobilize in meteoric water and impact surface and groundwater (Zenitech, 2007). Hydrologic and leachability assessments (Leaching Analysis) are being conducted to support further site characterization, remediation, and reclamation plans. The Leaching Analysis includes a comprehensive review of site conditions, geology, hydrology, configurations of closed mine facilities, climate, vegetation, mine waste, backfill, and cover material characteristics. The objective of this analysis is to evaluate and develop best management practices for waste rock and tailings planned to be used as backfill for the Hydro Pit, the deepest open pit on the site. The analysis will evaluate characteristics of backfill mixtures at various waste rock and tailings ratios with respect to leaching potential and potential impacts to waters of the State of Nevada.

A Phase I Environmental Site Assessment (ESA) was completed by Zenitech Environmental, LLC (Zenitech) in 2007 which summarized known conditions and extent of contamination at the site and recommended an evaluation of background concentrations of SRC in soils, rock, and mine wastes. In late 2020, Lakemoor hired Broadbent teamed with EA to reinitiate investigation work at the site. The Broadbent team is currently implementing the Phase II Sampling and Analysis Plan (SAP; Broadbent, 2021) that includes collection of samples for particle size, compaction and consolidation, shear strength, initial moisture content, unsaturated and saturated hydraulic properties, meteoric water mobility procedure (MWMP), and mineralogy analyses, including clay speciation. To complete the Leaching Analysis, data will be used from both Phase I and II ESAs.

1.1 SITE BACKGROUND

1.1.1 Location

The Three Kids Mine is located approximately five miles northeast of central Henderson, Nevada along East Lake Mead Parkway (State Road 564). The property occupies most of Section 35 and parts of Sections 26, 34, and 36 of Township 21S, Range 63E, Mount Diablo Meridian. The approximate center of the site is at 36°05'00"N latitude and 114°54'50"W longitude. Access to most of the site is gained via a locked gate and unpaved road in the northeast corner of the site. A small portion of the site is located north of Lake Mead Drive and can be accessed by foot. A general location map is provided in Figure 1.

1.1.2 Physiography

The site is located in the Mojave Desert Biome. Native flora of the Mojave includes sparsely populated creosote bush, tumbleweed, occasional grasses, perennial wildflowers, and cacti.

Mining activities, primarily in the 1940s and 50s, changed the topography through the excavation of large open pits, the construction of tailings ponds, and the emplacement of upgradient dams to prevent washes from emptying into pit operations. Site elevations within the subject property range from 1,550 feet in the bottom of the Hydro Pit to 2,515 feet at a nearby peak in the River Mountains with large portions of the site near 1,800 feet in elevation. Most of the surface area of the mill site, although modified by mill activities, is currently close to the pre-mining elevations of approximately 1,800 to 1,870 feet (Zenitech, 2007). A topographic map from 1983 is provided in Appendix A.1, Figure 7 of the Phase I ESA.

1.2 NATURAL SETTING

1.2.1 Climate

Regional climate of the Mojave is arid with coldest month temperatures averaging above 32°F, leading to a Köppen classification of BWh or hot desert climates typically found under the subtropical ridge in the lower middle latitudes, often between 20° and 33° north and south latitude (Zenitech, 2007). Average summer temperatures range from 70 to 104.5°F though highs of greater than 115°F are not uncommon. Average winter temperatures range from 34 to 57°F (Western Regional Climate Center, 2021).

Annual rainfall averages 4.15 inches per year with an annual evaporation rate of greater than 70 inches per year (Zenitech, 2007). High resolution measurements of evaporation on Lake Mead were 7.5 feet from January 1998 to December 1999 (USGS, 2006). The location is generally windy, with an annual average windspeed of nine miles per hour. Winds predominantly blow from the south and west.

A detailed compilation, review, and summary of local climate data (daily rainfall, temperature range, evaporation, transpiration, etc.) needed for infiltration modelling input will be completed for the Leaching Analysis. The process of plant interception of precipitation and root uptake and transpiration of soil moisture is commonly referred to as evapotranspiration (ET) and potential ET (PET) is a function of climate.

1.2.2 Geology and Geomorphology

The site is situated near the northern end of the River Mountains in southern Nevada and is part of the Basin and Range province. The site is surrounded on the south, east, and north by volcanic units of the River Mountains and is open west to a basin. Prior to mining activities, the site overlaid a gently northwest-sloping, thin alluvial plain deposit within the basin. Historical maps show the plain to have been dissected by rills and gullies (Zenitech, 2007). The alluvial plain where the mine and mill was constructed sat on units of the sedimentary Muddy Creek Formation. The regional geology around the site is provided in Figure 2, and the site-specific geology is shown in Figure 3.

Phase II sampling includes collection of representative samples of mined and milled materials that were derived from the native manganese ore and overburden. In addition, unmined and unprocessed samples of in-place volcanic rocks, manganese ore, and Muddy Creek Formation will be analyzed to determine the geochemical and physical properties of Hydro Pit wall rock. The chemical analyses and physical properties derived from the samples will be used to assess the geochemical reactivity of and infiltration rates through the Hydro Pit backfill through modeling described in this work plan.

1.2.3 Soils

Site soils tend to be gypsiferous with clasts of dacite, basalt, and tuff (Zenitech, 2007). Gypsum content is locally highly variable. Fill is observed in various portions of the site and is composed of tailings, overburden/low-grade ore, and manganese nodules from mining operations. The fill ranges from less than an inch to near 90 feet in thickness. Areas of thick fill from tailings disposal show little or no soil development and are classified as regoliths or regosols. Appearance, texture, and grain size of tailings sediments indicate silty to clayey silt soils and are typically gypsiferous or silicaceous in composition. Tailings are dry and dusty at or near the surface and may become damp several feet below ground surface (bgs).

Phase II sampling includes collection of representative samples of site soils and overburden. The chemical analyses and physical properties derived from analysis of the samples will be used to assess the geochemical reactivity of and infiltration rates through the Hydro Pit backfill and cover through modeling described in this work plan.

1.2.4 Groundwater

Groundwater is encountered at a significant depth at the site. There are four wells located near the site. These wells include:

- a test well drilled by Three Kids Partnership in the northeast corner of the site (log #35212 drilled in 1991)
- a municipal/industrial well at Laker Plaza located at 2310 Lake Mead Drive (log #82441 drilled in 2001)
- a monitoring well owned by Clark County 0.5-mile northwest of the Hydro Pit (log #111218 drilled in 2008)
- a monitoring well owned by the United States Government on Lake Mead Parkway 0.75-mile west of the Hydro Pit (log #111266 installed in 2008)

Well locations are depicted in Figure 4, and well logs are provided in Appendix B. The Driller's Reports shed light on local geology and hydrology; however, no hydrologic data is available for the monitoring wells: no water levels or well yields are provided. Groundwater information exists for the test well and Laker Plaza well. The lithologic logs provided by the well driller for these wells are instructive for understanding the relationship between the River Mountain volcanics and the Muddy Creek Formation.

The Government well (111266) is located 0.75 miles west of the Hydro Pit. To its total depth of 411 feet, unaltered Muddy Creek Formation was encountered consisting of reddish-brown claystone, siltstone, and sandstone that is weakly cemented. Thinly bedded gypsum was encountered below 402 ft bgs.

From surface to 219 feet, the Clark County well (111218) is completed in unaltered Muddy Creek Formation, logged as weakly cemented brownish siltstone with gypsum. At 219 ft bgs is the contact with dacite of the River Mountain volcanics, marking the thickness of sedimentary deposits at this location. Well 111218 terminated in dacite at 270 feet bgs. It is believed this well is dry.

The Three Kids Partnership test well (35212) was drilled on the east side of the proposed development, in River Mountain volcanics and undifferentiated Muddy Creek Formation. After penetrating what may be alluvium to 47 feet bgs, Muddy Creek Formation then River Mountain volcanics were encountered in the test well to a total depth of 1,100 feet bgs. Groundwater in well 35212 is first encountered at 720 feet bgs. Surface elevation at the well location is approximately 1,820 feet, placing the water-bearing zone at 1,100 feet above mean seal level (amsl). A static water level was measured at 562 ft bgs (or 1,258 ft amsl) in November 2021, indicating confined conditions.

The Laker Plaza property well (82441) was drilled at 2310 Lake Mead Drive through the Muddy Creek Formation including 350 feet of cemented gravel which may be River Mountain conglomerate of Muddy Creek Formation (Scott, 1997) to 410 ft bgs where limestone (possibly Horse Springs Formation) was encountered. The Laker Plaza well terminates in limestone at 600 feet bgs. Groundwater was first noted at 480 feet bgs. A static water level measured after well placement in February of 2001 at 160 ft bgs, indicating confined conditions similar to the test well discussed above, albeit at a much higher potentiometric surface elevation. Ground elevation at the well location is approximately 1,810 feet amsl.

When taken together, data from the four wells suggest that the depth to first water bearing zones at the Three Kids Mine is in the range of 500 to 700 ft bgs. Water does not seep into and accumulate in the pits, indicating groundwater elevations lower than the base of the Hydro Pit. Relationships between known information from well logs and subsequent data can be used to estimate the thickness of native materials between the base of the Hydro Pit and water bearing zones (WBZ) as presented in Table 1. Based on these relationships, the following conclusions are derived: 1) the Clark County well terminates in dacite and is thought to be dry; 2) the Three Kids Mine well is separated from the Laker Plaza well and the U.S. Government well by a fault and has a much lower water level; and 3) the Laker Plaza well and U.S. Government well are the west side of the fault and have comparable depths to first WBZ. Separation of the WBZ elevation and the base of the Hydro Pit elevation is about 200 feet, and this is the layer thickness of native materials below placed tailings and waste rock that will be used for infiltration modeling.

1.2.5 Surface water

Prior to the onset of mining activities, most of the present-day disturbed area sat upon an alluvial plain at the north end of the River Mountains. Most surface water, both local and that draining from the River Mountains, flowed in a combination of narrow channels and washes that exited the site at the northwest boundary. At that location it joined a larger drainage system known historically as the Three Kids Wash, which flowed north approximately one mile to the Las Vegas Wash (Zenitech, 2007). Currently, no perennial or intermittent streams are present on site, but there is visual evidence of contemporary surface water flow following heavy storm events. Currently, tailings dams and mine pits constrain most disturbed area surface water from exiting the site. Following reclamation, runoff and detention in constructed ponds during storm events may occur. Cover materials will be tested prior to placement to avoid surface water impact from reclaimed areas.

2.0 METHODOLOGY

The methodology for the Leaching Analysis includes the development of a geochemical reaction model and an infiltration model. The Leaching Analysis will evaluate leachability of the Hydro Pit backfill and rate of infiltration under different closure and cover scenarios to evaluate concentration and fate and transport of SRC in leachate (if any) per NDEP guidelines (BMRR, 2018a). The conceptual models, inputs, selection of code, implementation, and validation for each model are described below.

2.1 DEVELOP GEOCHEMICAL REACTION MODEL

2.1.1 Conceptual Geochemical Model

A conceptual geochemical model of the site will be developed based on previous studies, results from Phase II sampling and analysis, and guidelines from NDEP (BMRR, 2018b,c) and Nordstrom and Nicholson (2017). The current reclamation plan includes backfill of the Hydro Pit and placement of a final cover. Two alternative or complimentary covers are being considered:

1. Impermeable synthetic cover using geomembranes that detain precipitation and runoff

2. Earthen soil covers that reduce movement of moisture into backfill by storage and ET

In either cover situation, the backfill will essentially be a large diameter column filled with a mixture of tailings and waste rock that will be excavated from the site and placed in the pit. Meteoric water or other infiltrate, if any, that makes it through the cover will come in contact with backfill material and pit wall rock. The resulting reactions between infiltrate and solids could result in solubilization of SRC.

The geochemical conceptual model will be developed based on the column flow reactor concept and define the most likely reaction(s) that may occur. Examples could include mineral dissolution, ion exchange, sorption, and oxidation/reduction. The conceptual model will guide the development of the numerical geochemical model providing information to help establish boundary and initial conditions, potential range of SRC, and other conditions related to potential leaching reactions such as:

- Atmospheric boundary conditions, precipitation and temperature
- Initial moisture content of mine waste or geologic layer and pore water chemistry
- Layer thickness of cover, mine waste backfill, underlying natural soils or geologic formations, and depth to groundwater
- Vertical flow boundaries such as no flow, seepage, and faults
- Geothermal gradients
- Mineralogy

Climate data will be derived from published sources such as the Western Regional Climate center. Long term daily climate data from local stations such as the Boulder City, Nevada station will be used for model input (Table 2).

The moisture content of the backfill and other construction materials used for backfill may be adjusted for optimization of compaction and dust suppression and have been determined by Proctor testing on mine wastes and waste blends. Geotechnical testing of native and borrow materials is also being conducted and will be a source of data for the leaching model.

MWMP testing provides information on the initial pore water chemistry of mine wastes (Table 3) after backfilling and regrading. MWMP data will also provide estimates of in situ and contact water with native and borrow materials. MWMP is required in the state of Nevada for characterization of mine wastes (BMRR, 2019) and is a realistic and representative of leachate contact water quality in arid climates where little water infiltrates the ground surface, and any remaining infiltration moves slowly through soil and mine waste. MWMP concentrations usually represent the first flush concentrations after water contacts the waste and these concentrations are usually very high, owing to build up of soluble reaction products, as compared to continuous steady state flow as mimicked by column leach tests. Hence the MWMP test is a conservative measure of SRCs and other constituent concentrations in mine waste and native geologic materials. Humidity Cell Tests (HCT, BMRR, 2019) are not applicable because there are no reactive sulfide minerals in site mine wastes as indicated by reports on ore deposit manganese mineralogy (Van Glider, 1963), and the tailings and waste rock mineralogical analyses conducted for the RI described below.

Layer thicknesses of covers and mine waste backfill have been estimated from reclamation grading plans and estimates of the depth to groundwater at the site (provided in Section 1.2.4). Flow boundaries will be developed for model sections and contacts and faults are known from reclamation plans and geologic maps.

Geothermal gradients can be estimated from groundwater temperature measurements and published studies. Mineralogy is known from reports on the Three Kids ore deposit (Van Glider, 1963) and from X-ray diffraction analyses on mine wastes (Table 4). The tailings have no detectable sulfide minerals but do have a very high swelling clay content that binds organics and metals (Table 5). Given the high valence state manganese minerals in ore residual tailings the presence of native sulfide minerals is not thermodynamically possible at this site. Minerals provide the SRCs and other constituent source terms, solubility limits, pH, and Eh controls in the model and may also attenuate metals and organic compounds by oxidation, ion exchange, and sorption reactions that will be included in the model by thermodynamic equilibrium and kinetically-controlled reactions.

2.1.2 Geochemical Data Compilation for Model Input

2.1.2.1 Critical Data Review

A critical review of Phase I and Phase II data will be conducted as part of the Leaching Analysis. The review will result in selection of data relevant to the Leaching Analysis which will be compiled, formatted, and provided in the Leaching Analysis Report Appendices. The data review will include results of tailings and waste rock meteoric water mobility procedure testing (MWMP, ASTM, 2007), mineralogy and clay mineralogy by X-ray diffraction, particle size analysis (ASTM, 2016), and geomechanical and hydraulic testing such as soil water characteristic curve (SWCC) measurements (Stephens, 1996; EPA, 1996) that are being performed to characterize the physical properties of backfill mixtures. Mineralogical and MWMP data provide model input for initial chemical conditions including concentrations of SRCs, pH and redox (Eh).

2.1.2.2 Assessment of Parameter Variability and Statistics

A statistical summary will be prepared to inform model input parameter selection and evaluate parameter variability.

2.1.3 Selection of Geochemical Modeling Codes

The hydrogeochemical modeling code Hydrus-1D and HP1 subroutine (Simunek, et al., 2009) was selected following guidelines in Nordstrom and Nicholson (2017). The code is acceptable as approved code according to NDEP (BMRR, 2018b,c), able to simulate a wide range of solid leachate reactions for the site SRC, and will be used for geochemical modeling of leaching and other reactions that may occur owing to infiltration of meteoric water through the Hydro Pit backfill under variably saturated conditions. Infiltration rates will be determined by infiltration modeling as described in Section 2.2 below. The Hydrus-1D variably saturated flow code also contains reactive transport and, with HP1 reaction, capabilities to determine partitioning and retardation owing to sorption and precipitation reactions along flow paths. Site SRCs like arsenic can be simulated accurately using this approach as current data suggests that leachate pH is circumneutral, carbonate buffered, and oxidized owing to unsaturated air-filled pores in the waste rock. Hence partition coefficients, which are pH and Eh dependent, remain constant in the model system. If the findings of the Phase II study suggest that more sophisticated reactions such as pH reduction owing to acid generation reactions and other oxidation reduction reactions are deemed to be active in the backfill, then acceptable sub-models and code coupling, as described in Section 2.1.4.4 below, can be implemented in the Hydrus-1D model and software platform.

2.1.4 Geochemical Model Implementation

2.1.4.1 Development of Equilibrium and Kinetic Assumptions and Calculations

The geochemical conceptual model will identify the potential equilibrium and kinetic reactions that may occur between the backfill minerals, chemical compounds, and leachate under variable moisture, temperature, and chemical conditions, such as ionic strength, pH, and redox potential (Eh). The appropriate numerical model reaction expressions, partition coefficients, thermodynamic data, and kinetic rate functions will be developed using the geochemical modeling and reactive transport code for the system components. System pH will be calculated by the model by balancing acid-base reactions based on molar concentrations of mineral and dissolved aqueous species using a published and maintained thermodynamic database like MINTEQ (Allison, et al., 1991 and the more current Visual MINTEQ database is maintained by Jon Petter Gustafsson, at the Royal Institute of Technology, Stockholm, Sweden, https://vminteq.lwr.kth.se/). System electrical balance and Eh will be determined by thermodynamic reaction calculations in the model which balances paired, half reactions based on molar concentrations of mineral and dissolved aqueous species with variable redox states like Mn.

2.1.4.2 Empirical Fitting and Scaling Factors

Some model input parameters may require empirical fitting or scaling to laboratory derived values. These fitting and scaling factors may also be derived from published field studies of large-scale systems such as closed mine facilities (Nordstrom and Nicholson, 2017; BMRR, 2018b).

2.1.4.3 Model Period and Discretization

The model period or time boundaries and spatial discretization will be adjusted to achieve the best numerical simulation stability and resolution appropriate for the site and modeling objectives (Nordstrom and Nicholson, 2017). The model period will be extended to practicable timeframes for human risk analysis given the thickness of anticipated backfill, depth to groundwater, and time required for meteoric water to wet, percolate, and achieve steady state conditions. Model predictions for timeframes greater than 100 years are not considered practical given the uncertainties of human use of resources and technological advancements.

2.1.4.4 Sub-Models

Subroutines in the model or independent model calculations or simulations may be needed to adjust model input parameters or model output and to accurately simulate complicated geochemistry. For example, within the Hydrus-1D software platform, the code HP1 combines the geochemical model PHREEQC as a sub-model coupled with the infiltration and transport code Hydrus-1D (Jacques and Šimůnek, 2005). This sub-model may be required to simulate leaching, precipitation, and oxidation and reduction reactions that may result in pH and Eh changes.

2.1.4.5 Sulfide Oxidation and Reactive Rock Mass Estimation

The Three Kids manganese oxide ore body does not contain abundant sulfides that could result in acid leachate generation by sulfide oxidation, and preliminary data indicates that leachates will be circumneutral and carbonate buffered. Three tailings and three waste rock samples will be submitted for acid base accounting (modified Sobek method) for confirmation. However, even under circumneutral pH, the geochemical simulations of SRC leaching will require an estimate of the Hydro Pit backfill and reactive wall rock mass. The effective rock mass will be estimated using empirical and site-specific scaling factors as described in 2.1.4.2 and the Global Acid Rock Drainage (GARD) guide (INAP, 2021).

2.1.4.6 Sensitivity and Uncertainty Analysis

A range of sensitivity simulations will be conducted to evaluate the uncertainty in model predictions based on uncertainty in model input parameters and boundary conditions. For example, simulation scenarios will cover a range of tailings to waste rock mixtures as described in Section 3 below. Other sensitivity simulations will include the water to rock ratio, leachate compositions, mineralogical makeup of the tailings waste rock mixture, and temperature which will be developed using Phase II data.

2.1.4.7 Probabilistic Analysis

The Hydro Pit dimensions and other site conditions are known with a high degree of certainty, and the range of other model input parameters and boundaries will be quantified through statistical analysis. Hence there is little need for probabilistic analysis in the Leaching Analysis as the backfilled pit's hydrologic and geochemical system resistance to external loading is high (Ganoulis, 1994). The results of sensitivity and uncertainty analysis in Section 2.1.4.6 will confirm or question this assumption, and the conclusion will be summarized in the Leaching Analysis Report.

2.1.5 Geochemical Model Validation

The geochemical model will be validated or benchmarked by comparison with published and widely accepted case studies.. Several modeling case studies are presented in the Nordstrom and Nicholson (2017). Other references to geochemical and hydrologic modeling are provided in the INAP GARD guide (2021). These peer reviewed modeling studies will be reviewed, and relevant modeling results will be compared to calibration and base case predictive simulations for the Site. There are six to 10 published studies referenced in the reference bibliographies that have modeling components that are directly relevant for comparison depending upon professional opinion on which are relevant.

In addition, Broadbent is collecting samples from native soils and formations underneath the tailings for chemical analysis. If SRCs and breakdown products are detected beneath the mine waste facilities, the depth of migration and concentrations can be used to test and validate the predictive accuracy of the geochemical reactive transport model.

2.2 DEVELOP INFILTRATION MODEL

2.2.1 Conceptual Infiltration Model

As with the conceptual geochemical model, a conceptual infiltration model of the site will be developed (Figure 5) based on previous studies, results from Phase II sampling and analysis, and guidelines from NDEP (BMRR, 2018a,c) and Nordstrom and Nicholson (2017). Following the geochemical conceptual model briefly described in Section 2.1.1, the Hydro Pit backfill will be essentially a large diameter column filled with a mixture of tailings and waste rock that will be excavated from the site and placed in the pit. Meteoric water or other infiltrate, if any, that makes it through the cover will flow vertically through the backfill which is variably saturated. For all practical purposes, the pit walls are essentially no flow boundaries with respect to unsaturated water and mass transport. The conceptual infiltration model will guide the development of the numerical infiltration model, providing information to help establish realistic boundary and initial conditions, potential range of hydraulic properties, and geochemical conditions related to components of the system that govern unsaturated flow. Geochemical conditions include initial and transient moisture conditions, climate and atmospheric conditions, vegetation rooting density and depth, subsurface material layers, textures, and faults, and contact water reactions with site mine wastes native soil, rock, and borrow soils.

2.2.2 Infiltration Model Selection

The infiltration and variably saturated modeling code Hydrus-1D (Simunek, et al., 2009) was selected following guidelines in Nordstrom and Nicholson (2017). The code is accepted as approved code according to NDEP (BMRR, 2018a,c), able to simulate a wide range of hydraulic properties and moisture conditions at the site, and will be used to simulate soil water balance and vertical infiltration of meteoric water through the Hydro Pit backfill under realistic variations of site climate conditions.

2.2.3 Hydraulic Data Compilation

A critical review of the Phase I and Phase II data will be conducted as part of the Leaching Analysis. The review will result in selection of data relevant to the Leaching Analysis which will be compiled, formatted, and provided in the Leaching Analysis Report Appendices. Hydraulic data may be adjusted and scaled if necessary to compensate for oversized materials (Hlavacikova et al., 2016).

2.2.4 Model Period and Discretization

The model period or time boundaries and spatial discretization will be adjusted to achieve the best numerical simulation stability and resolution appropriate for the site and modeling objectives (Nordstrom and Nicholson, 2017). For example, most climate station data is summarized daily and the time-dependent soil-air surface boundary conditions will be discretized according to daily input variables such as precipitation. As described in Section 2.1.4.3 above, the model period will be extended to practicable timeframes for human risk analysis given the thickness of anticipated backfill, depth to groundwater, and time required for meteoric water to wet, percolate, and achieve steady state conditions. Model predictions for timeframes greater than 100 years are not considered practical given the uncertainties of human use of resources and technological advancements.

2.2.5 Water Balance and Model Calibration

In the design of a backfill cover, the infiltration of meteoric precipitation into the cover and downward flow through backfill is reduced by the amount of ET of soil moisture by plants established on the cover during reclamation. The following soil water balance equation:

$$S + D = I - ET \qquad [1]$$

shows that storage (S) of water infiltration (I) into the cover material pore spaces and drainage (D) through the cover into the underlying waste rock are reduced by increasing ET. Infiltration is equal to precipitation (P) unless runoff (R) occurs at the surface as shown in the following equation:

$$I = P - R \qquad [2]$$

The water balance components are also illustrated in Figure 5. The cover must store infiltration long enough for the plants to take up pore water into roots and transpire the water as vapor. The rate of plant transpiration is partially controlled by potential evapotranspiration (ET_o) which is the maximum potential rate of moisture the atmosphere can receive by plant leaf transpiration.

Calculated model ET, using the formula developed by Hargreaves et al. (2003) or other ET calculations will be used to estimate the expected vegetated soil ET assuming successful reclamation and mature revegetation (BMRR, 2016). In the case of an impermeable cover with ponded stormwater, the rate of leakage for given hydraulic head conditions is based on liner design and material properties.

Surface water flow will be managed by the construction of lined drainage infrastructure at the site to divert runoff (R) away from backfilled mine pits and other areas where infiltration may generate SRCs containing leachate. In addition, the potential impacts from landscape irrigation and water line and liner leaks for the water detention basin will be simulated in model sensitivity scenarios to evaluate the potential of migration of SRCs from localized sources of leachate. The city of Henderson is providing information on potential leakage from existing water distribution systems, irrigation rates, and other water losses in that municipality that can be applied at the site. Newer developments in the desert southwestern U.S. are even more keenly aware of the need for water conservation and data on current water losses will be conservative with respect to site infrastructure.

2.2.6 Solute Mass Balance and Transport

Solute mass balance and transport can be tracked in the infiltration and variably saturated flow model to simulate movement of SRC into the cover and backfill. Over time, moisture conditions in the cover and backfill transition to a steady state condition that balances the rate of infiltration and equilibration with wall rock moisture and other boundary and material properties such as:

- Initial concentrations of SRCs
- Porosity, dispersion, and flow path directions
- Solubility and attenuation capacity
- Matrix mineralogy

Hydrus-1D assumes that solutes can exist in all three phases (liquid, solid, and gaseous) and that the decay, retardation, and production processes can be different in each phase. Interactions between the solid and liquid phases may be described by nonlinear nonequilibrium equations, while interactions between the liquid and gaseous phases are assumed to be linear and instantaneous. Hydrus-1D simulates solute transport by convection and dispersion in the liquid phase as well as by diffusion in the gas phase. The adsorption isotherm relating soil and leachate concentrations is described by generalized nonlinear equations like the Freundlich, Langmuir, and linear adsorption equations, which are special cases of adsorption. The rate of equilibration to steady state will also be affected by moisture uptake by soil and backfill minerals and weathering products. Hence steady state conditions will likely be achieved very slowly, but the model period will be extended until steady state is achieved, and beyond if necessary, to predict climate driven variations in steady state flow and transport.

2.2.7 Sensitivity and Uncertainty Analysis

A range of sensitivity simulations will be conducted to determine the uncertainty in model predictions based on uncertainty in model input parameters and boundary conditions. For example, simulation scenarios will cover a range of tailings to waste rock mixtures as described in Section 3 below. Other sensitivity simulations may include the climate input and cover design parameters which will be developed using Phase II data.

The sensitivity and uncertainty analysis will address the seven problem statements identified in the Data Quality Objectives (DQO) table summary provided in Step 1 of Table 6. The range of model input parameter values (Step 3) will span the expected and statistically derived variability of measured soil and mine waste geochemical and hydrologic properties (determined by optimized sample design, Step 7) that are represented in the model. This will result in a range of model predictions that covers the possible concentration and extent of SRCs within the model boundaries (Step 4) and results in small errors in predictive capabilities such that the error tolerances set in Step 6 are not exceeded and the decisions in Step 2 are supported according to decision rules (Step 5).

3.0 DEVELOP MODELING SCENARIOS

Described below are modeling scenarios for the Hydro Pit and other reclamation areas on site. Additional scenarios may be developed for sensitivity analysis and alternative pit reclamation configurations, if necessary, as the project progresses and reclamation plans are further developed and refined.

3.1 HYDRO PIT SCENARIOS

The following modeling scenarios will be developed and simulated to predict the rate of infiltration and flow and SRC transport through alternative Hydro Pit covers and backfill mixtures. Model scenarios will be developed based on the expected range of mixtures of waste rock and tailings in the Hydro Pit backfill. In addition, alternative covers will be simulated including low permeability covers (such as synthetic, high density polyethylene covers if the Hydro Pit is used as a water detention feature) and earthen ET cover which allows infiltration and storage of moisture balanced with plant transpiration.

The 85/15 to 90/10 apportionment of tailings to waste rock volumes deposited in the Hydro Pit represents the currently favored range according to reclamation designers. Current projections indicate that the entire volume of tailings can be placed into the Hydro Pit at this range of ratio. However, other model scenarios using other relative percentages will be developed for sensitivity analysis. Scenarios with greater waste rock than tailings will not be tested as they are not relevant to the current reclamation plan. Hence, the following blends of waste rock and tailings will be simulated based on testing of hydrologic, geomechanical, and geochemical (e.g. leaching potential) properties:

- 50 percent tailings to 50 percent waste rock
- 67 percent tailings to 33 percent waste rock
- 85 percent tailings to 15 percent waste rock
- 90 percent tailings to 10 percent waste rock

In addition, another model scenario that simulates the potential generation of leachate from other deep fill areas will be developed based on the deepest thickness of the regraded waste rock across this area.

3.2 REMAINING RECLAMATION AREAS

Reclamation plans for the other facilities and areas of the site are in development but will likely involve less volumetric material movement and backfilling than the Hydro Pit. Therefore, these areas will require extended characterization of the variable hydraulic, geotechnical, and geochemical properties of native ground and Muddy Creek Formation. The Hulin Pit is a steep-walled cylindrical pit like the Hydro Pit but is only about 225 feet deep compared to the Hydro Pit which is approximately 411 feet deep. The Hulin Pit may be partially backfilled and regraded to stabilize and flatten the steep pit walls presently cut into the Muddy Creek Formation. The A-B Pit is not as deep as the Hulin Pit but is an elongate cut into the Muddy Creek Formation and volcanic rock footwall that will require regrading, partial backfilling, and mine wall stabilization by regrading. Furthermore, tailings removal from drainages in the southern areas of the site will uncover gently sloping native soils and Muddy Creek Formation north of the Hulin Pit. The hydraulic and geochemical properties of native soils and Muddy Creek Formation will vary across the site and vertically in the Hulin and A-B pits. The extended characterization of these materials will be conducted as Phase II sampling and analysis progresses into other mine areas, and the hydraulic, geotechnical, and geochemical characterization methods will be the same as for the Hydro Pit backfill and cover materials.

Reclamation of the Hulin and A-B pits and other deep fill areas will likely require different cover designs that will require site specific ground and cover material characterization as well as site specific modeling of infiltration, drainage, and leachability. Vertical and non-vertical infiltration and drainage flow paths may be involved such that a two dimensional, variably saturated flow model such as Hydrus 2D (Simunek, et al., 2016) will be needed to conduct flow and leaching simulations through covers and along slopes of varying hydraulic and geochemical properties. However, climate data input will be the same across the site.

4.0 LEACHING ANALYSIS REPORT

The predictive results and major findings of the Leaching Analysis geochemical and infiltration modeling will be summarized and presented in a report with appropriate tables and figures. Model input and output files will be included with attachments. A final summary of the results that integrates the geochemical and infiltration modeling will be developed in the report with summary bullet points that provide the highlighted findings and overall conclusion on the Hydro Pit reclamation approach and backfill design. The report will also consider scenarios for the Hulin Pit, the A-B Pit, and other deep fill areas. The predicted performance will be compared to accepted cover and leachate reduction performance by industry standards (Dwyer et al., 2000; MEND, 2004; Zhan, et al., 2014). If modeling predicts SRC to the depth of groundwater, concentrations will be compared with applicable standards or screening levels.

5.0 REFERENCES

Allison, J.D., Brown, D.S., and Novo-Gradac, K.J., 1991. MINTEQA22/PRODEEA@, A Geochemical assessment Model for Environmental Systems, Version 3.0 User's Manual, EPA/600/3-91/021. Athens GA: U.S. Environmental Protection Agency.

ASTM, 2007. E2242-07 Standard Test Method for Column Percolation Extraction of Mine Rock by the Meteoric Water Mobility Procedure, ASTM International, West Conshohocken, PA, www.astm.org.

ASTM, 2016. ASTM D422-63(2007)e2, Standard Test Method for Particle-Size Analysis of Soils (Withdrawn 2016) ASTM International, West Conshohocken, PA, www.astm.org.

Broadbent, 2021. Phase II Sampling and Analysis Plan. Former Three Kids Mine, Henderson, Nevada. October 5.

Bureau of Mining Regulation and Reclamation (BMRR), 2016. Nevada Guidelines for Successful Revegetation for the Nevada Division of Environmental Protection, The Bureau of Land Management and the United States Forest Service. Bond Release – Permit Attachment B. https://ndep.nv.gov/land/mining/reclamation/guidance-documents

BMRR, 2018a. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation, Guidance for Hydrogeologic Groundwater Flow Modeling at Mine Sites. Prepared by Connor P. Newman, March 22, 2018. https://ndep.nv.gov/land/mining/closure/guidance-policies-and-applications

BMRR, 2018b. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation, Guidance for Geochemical Modeling at Mine Sites. November 26, 2018. https://ndep.nv.gov/land/mining/closure/guidance-policies-and-applications

BMRR, 2018c. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation, Listing of Accepted Codes for Groundwater and Geochemical Modeling at Mine Sites. November 26, 2018. https://ndep.nv.gov/land/mining/closure/guidance-policies-and-applications

BMRR, 2019. Nevada Division of Environmental Protection, Bureau of Mining Regulation and Reclamation, Waste Rock, Overburden, and Ore Characterization and Evaluation. April 12, 2019. https://ndep.nv.gov/land/mining/regulation/guidance-policies-references-and-requirements

Dwyer, S.F., Reavis, B., and Newman, G., 2000. Alternative Landfill Cover Demonstration, FY2000 Annual Data Report. Sandia National Laboratories, Sandia Report SAND2000-2427, October 2000, 27p.

EPA, 1996. UNSODA The UNSODA Unsaturated Soil Hydraulic Database User's Manual Version 1.0. EPA/600/R-96/095.

Ganoulis, J.G., 1994. Engineering Risk Analysis of Water Pollution. Probabilities and Fuzzy Sets. VCH, New York, New York, USA. 306p.

INAP, 2021. Global Acid Rock Drainage (GARD) Guide. Chapter 5, Prediction. International Network for Acid Prevention (INAP). http://www.gardguide.com

Hargreaves, G.H., and Allen, R.G., 2003. History and evaluation of the Hargreaves evapotranspiration equation. J. Irr. Drain. Eng., 129(1), p. 53-63.

Hlavacikova, H., Novak, V., and Simunek, J., 2016. The effects of rock fragment shapes and positions on modeled hydraulic conductivities of stony soils. Geoderma, 281, p. 39-48.

Jacques, D and Šimůnek, J. 2005. User Manual of the Multicomponent Variably-Saturated Flow and Transport Model HP1, Description, Verification and Examples, Version 1.0, SCK•CEN-BLG-998, Waste and Disposal, SCK•CEN, Mol, Belgium, 79 pp.

Johnston, C.T., 1996. Sorption of organic compounds on clay minerals: A surface functional group approach. In Sawhney, B.L. (ed.), 1996. Organic Pollutants in the Environment. Clay Minerals Society CMS Workshop Lectures, v. 8. Boulder, Colorado US, p. 1-44.

Johnson, K.L., McCann, C.M. and Clarke, C.E., 2017. Breakdown of organic contaminants in soil by manganese oxides: a short review. Chapter 11 in Ahmed, I.A.M. and Hudson-Edwards, K.A. (eds.) 2017. Redox reactive Minerals: Properties, Reactions and Applications in Natural Systems and Clean Technologies. European Mineralogical Union, EMU Notes in Mineralogy 17. London, UK, p. 313-356.

Mine Environment Neutral Drainage Program (MEND), 2004. Design, construction and performance monitoring of cover systems for waste rock and tailings, MEND 2.21.4, July 2004, 82pp.

Nevada Bureau of Land Management, 2013. Nevada Bureau of Land Management Rock Characterization and Water Resources Analysis Guidance for Mining Activities. Instruction Memorandum No. NV-2013-046, September 19, 2013.

Nevada Division of Environmental Protection (NDEP), 2014. Waste rock, overburden, and ore evaluation. Nevada Division of Environmental Protection, Bureau of Mining Regulation & Reclamation, Carson City, NV. February 28, 2014.

NDEP, 2016. List of Approved Labs. Nevada Division of Environmental Protection, Bureau of Mining Regulation & Reclamation, Carson City, NV. August 8, 2016. http://ndep.nv.gov/bsdw/lab_mining_industry.htm.

Nordstrom, D.K. and Nicholson, A., 2017. Geochemical Modeling for Mine Site Characterization and Remediation. SME, Englewood, Colorado, USA. 159p.Scott AJ. 1997. The Muddy Creek Formation: Depositional environment, provenance, and tectonic significance in the western Lake Mead area, Nevada and Arizona. UNLV Retrospective Theses & Dissertations.

Šimůnek, J., Šejna, H., Saito, H., Sakai, M., van Genuchten, M. Th., 2009. The Hydrus-1D Software Package for Simulating the One-Dimensional Movement of Water, Heat, and Multiple Sollutes in Variabley-Saturated Media. Version 4.08, January 2009. https://www.pc-progress.com/en/Default.aspx?H1D-description#k1

Simunek, J., vanGenuchten, M. Th., and Senja, M., 2016. The HYDRUS Software Package for Simulating the Two- and Three-Dimensional Movement of Water, Heat, and Multiple Solutes in Variably-Saturated Porous Media Technical Manual, Version 2.0. July 2016, 230 p.

Stephens, D.B., 1996. Vadose Zone Hydrology. Lewis Publishers and CRC Press, 347 p.

USGS, 2006. Evaporation from Lake Mead, Arizona and Nevada, 1997–99. United States Geological Survey (USGS) Scientific Investigations Report 2006-5252, 24p.

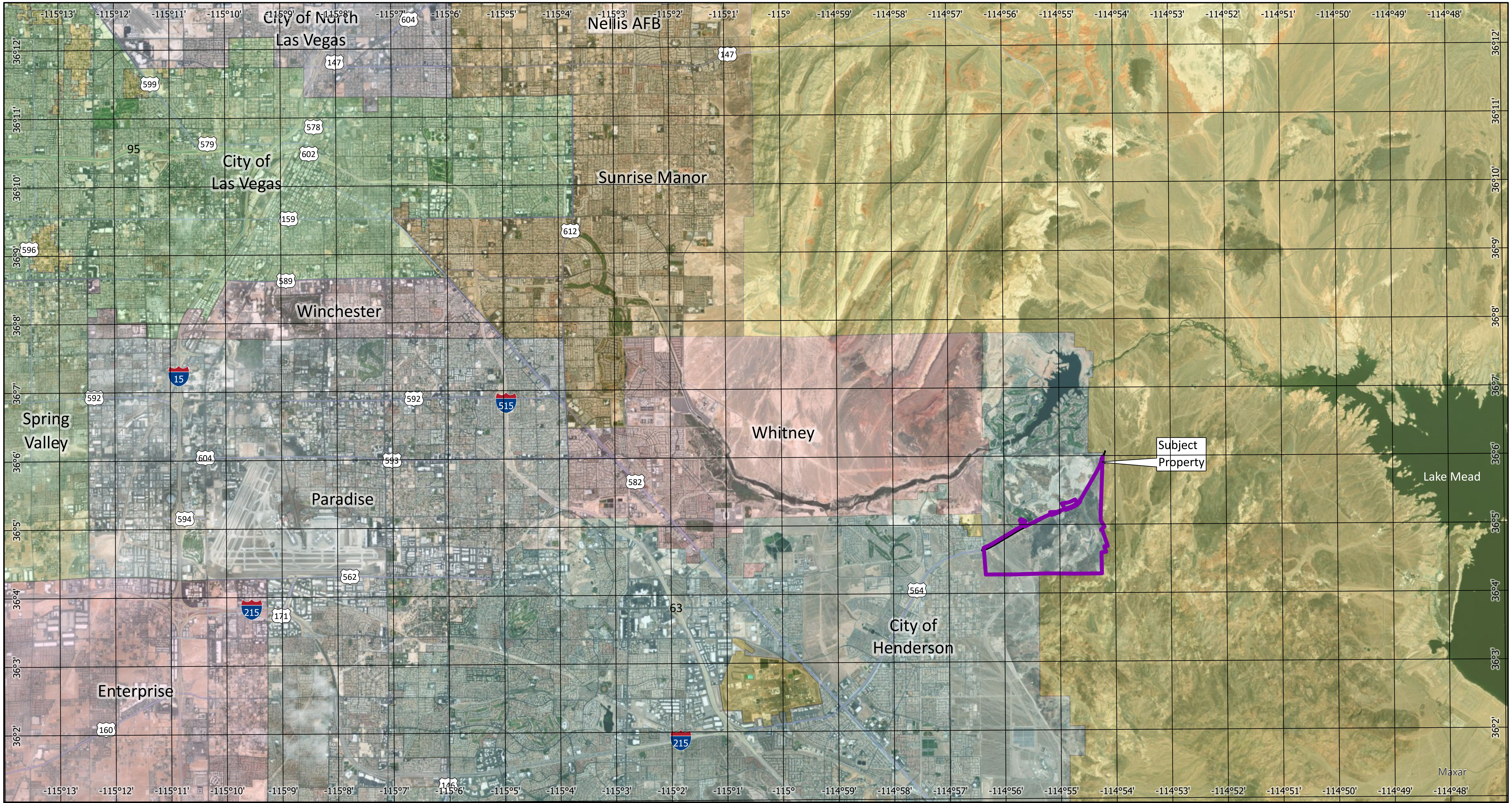
Van Glider, K.L., 1963. The Manganese Ore Body at the Three Kids Mine, Clark County Nevada. Master's Thesis, University of Nevada, Reno Nevada. May 1963. 94p.

Western Regional Climate Center, 2021. "Monthly Climate Summary, Las Vegas WSO Airport, Nevada." 2021. Desert Research Institute.

Zenitech, 2007. Phase I Environmental Site Assessment (ESA). Three Kids Mine and Mill Site, Clarke County Nevada. September 14, 2007.

Zhan, G., Keller, J., Milczarek, M, and Giraudo, J., 2014. 11 years of evapotranspiration cover performance at the AA leach pad at Barrick Goldstrike Mines. Mine Water Environ, 33, p. 195-205.

FIGURES



BROADBENT

8 West Pacific Avenue
Henderson, NV, 89015
(702) 563-0600 (P) * (702) 563-0610 (F)

Job # 14-01-156 Date: 10/7/2021

Legend:

Subject Property	Nellis AFB
City of Henderson	Paradise
City of Las Vegas	Spring Valley
City of North Las Vegas	Sunrise Manor
Unincorporated Clark County	Whitney
Enterprise	Winchester

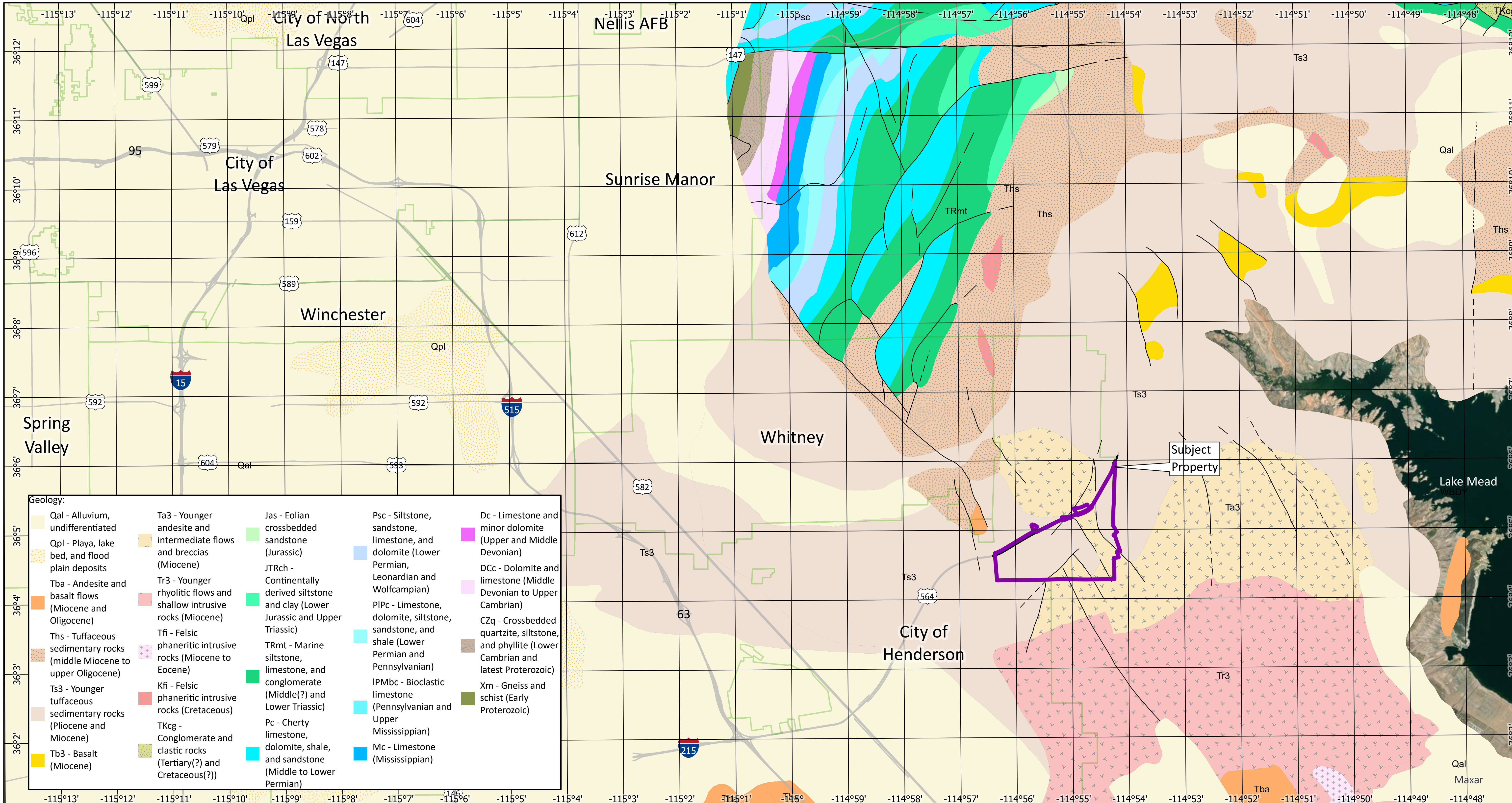
Notes:
1. Imagery Source: Esri World Imagery
2. Datum: NAD 1983 StatePlane Nevada East FIPS 2701 Feet
3. Political Boundary Source: Clark County GIS Management Office.
4. Parcel Boundary Source: Clark County Assessor.
5. Roads Source: Nevada DOT GeoHub.
6. Geographic grid divided at every minute of latitude and longitude.

Nevada

N

1 0.5 0 1 Miles

Figure 1	
Site Location	
Former Three Kids Mine	
Designed	
Drawn	JCM
Approved	



BROADBENT

8 West Pacific Avenue
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Job # 14-01-156 Date: 9/9/2021

Legend:
- Subject Property
- Political_Boundaries

Faults
- Known fault
- Inferred fault
- Concealed fault

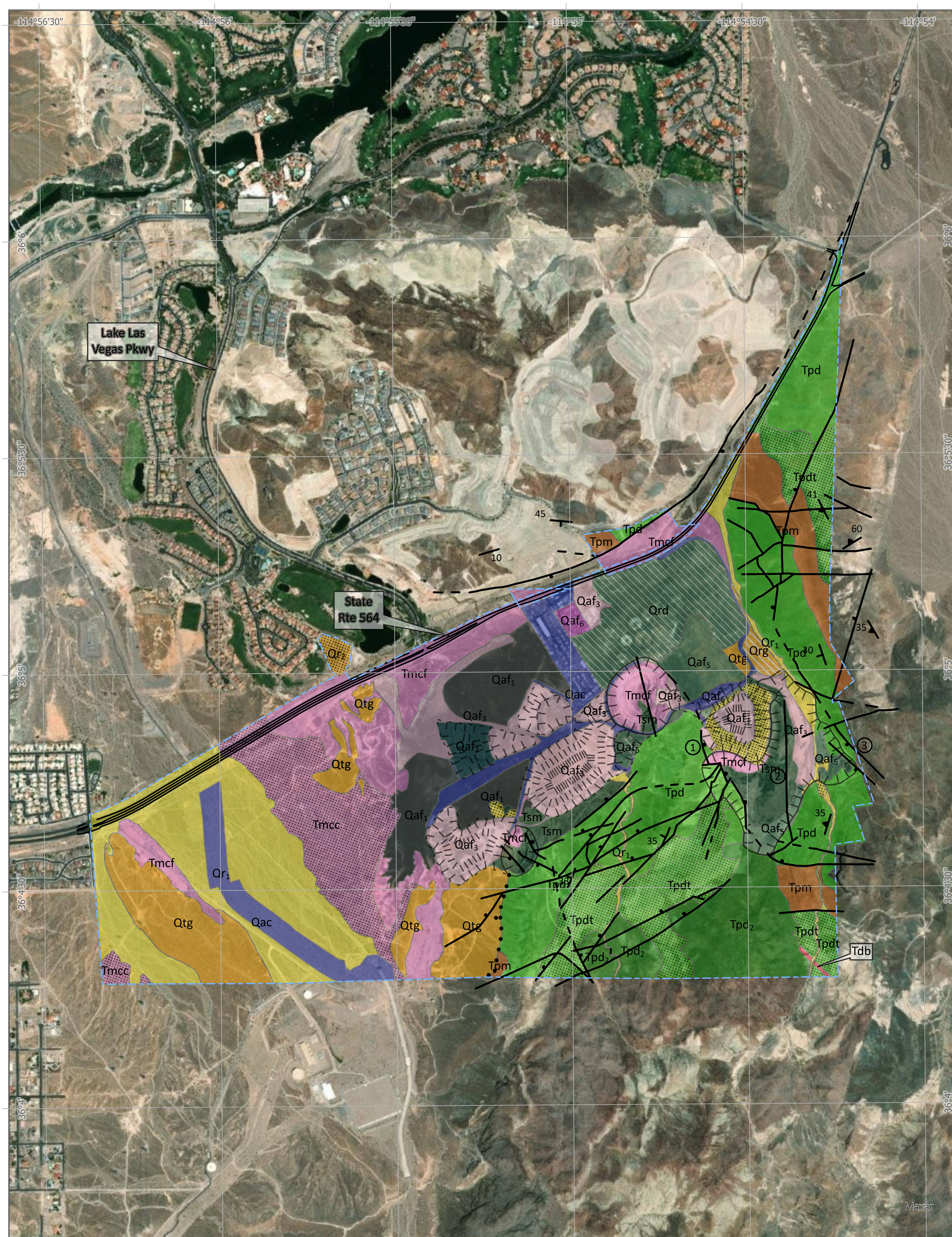
Notes:
1. Imagery Source: Esri World Imagery
2. Datum: NAD 1983 StatePlane Nevada East FIPS 2701 Feet
3. Political Boundary Source: Clark County GIS Management Office.
4. Parcel Boundary Source: Clark County Assessor.
5. Roads Source: Nevada DOT GeoHub.
6. Geology Source: Crafford, A.E.J., 2007, Geologic Map of Nevada: U.S. Geological Survey Data Series 249, 1 CD-ROM, 46 p., 1 plate.
7. Geographic grid on map divided at every minute of latitude and longitude.

Nevada

N

1 0.5 0 1 Miles

Figure 2	
Regional Geology	
Former Three Kids Mine	
Designed	
Drawn	JCM
Approved	



Legend:

Project Area

Lithology

Qac	Qaf_3	Qrd	Tpd
Qaf_1	Qaf_4	Qrg	Tpd_2
Qaf_2	Qaf_5	Qtg	Tpdt
	Qaf_6	Tdb	Tpm
	Qr_1	Tmcc	Tsm
	Qr_2	Tmcf	

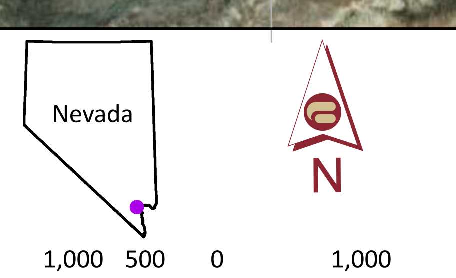


Figure 3A

Site Geology

Former Three Kids Mine

Designed	
Drawn	JCM
Approved	

BROADBENT
8 West Pacific Avenue
Henderson, NV, 89015
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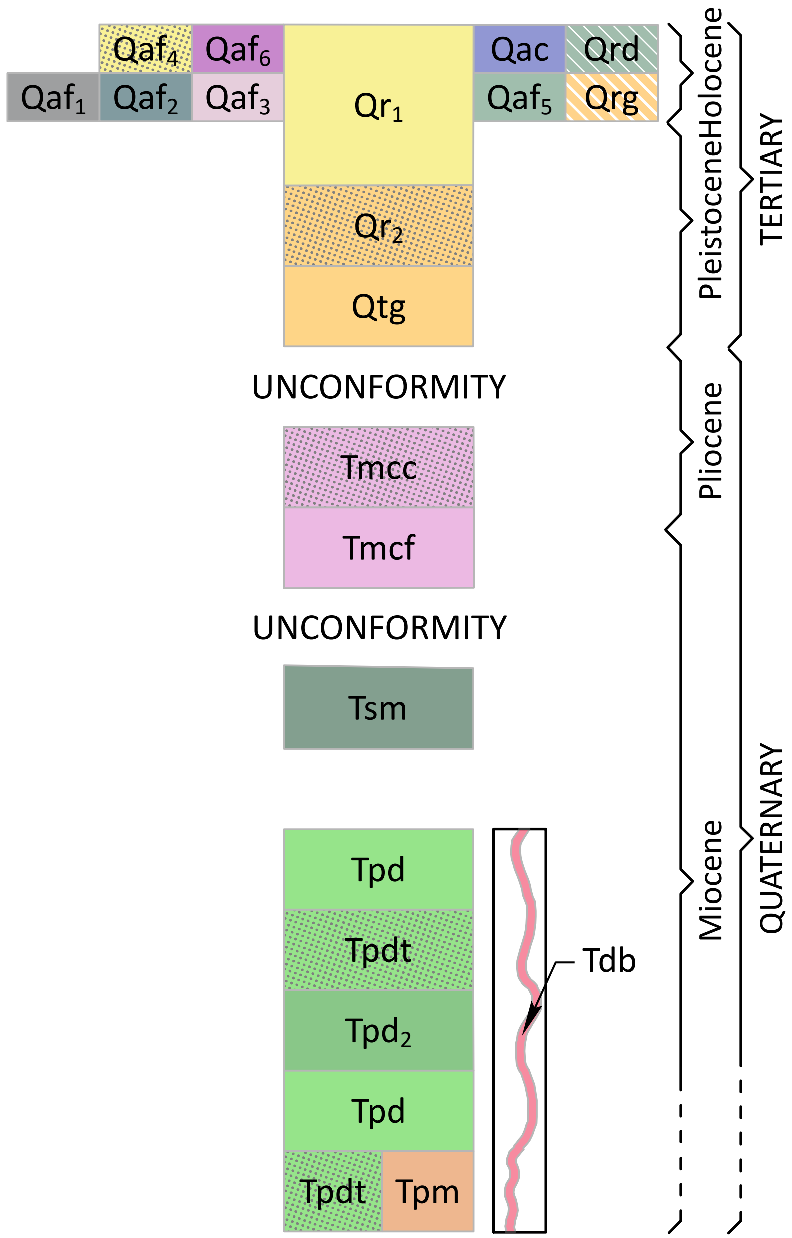
Job # 14-01-156 Date: 9/9/2021

Notes:
1. Imagery Source: Esri World Imagery
2. Datum: NAD 1983 StatePlane Nevada East FIPS 2701 Feet
3. Not a survey. Grid origin at southwest corner of Section 34, Township 21 S., Range 63 E. Mount Diablo Meridian, Index grids on 500 foot intervals. Sample grid size is 100 feet.
4. Geographic grid on map divided at 30 seconds of latitude and longitude.

LITHOLOGIC KEY



DETAILED LITHOLOGY

LATE HOLOCENE AND MINE RELATED DEPOSITS (LATE QUATERNARY)

Qac – Compacted alluvium. Roads and reworked alluvium or overburden. Compacted roadways (paved and unpaved) or graded and currently developed/occupied properties. In the west of the Three Kids Mine area, a large swath is a former ultra light landing strip. Comparative topography from 1917 data suggests many of these roads are "built up" or elevated above natural topography.

Qrg – Graded pediment / alluvial plain deposit. Alluvial deposits typically composed of decomposing Powerline Road volcanic materials from the River Mountains. Locally graded or compacted based on the presence of building foundations, but not commingled with other material from the area.

Qrd – Disturbed, graded, commingled, alluvial deposits. Former alluvial deposits of Powerline Road volcanics and Muddy Creek materials which have been graded, transported, and commingled or covered with product, and/or Tsm material. This is typical of the former mill site in the Three Kids Mine area, where dark sediments produced by mill activities cover the area from a few inches to feet thick and large area grading is evident. Mining debris and modern refuse are common.

Qaf_1 – Tailings. Tailings of the former Three Kids Mine and Mill Site. Unit composed of dark colored clay, silt, and sand sized particles. Materials were flow deposited into artificial ponds created by damming drainages. Tails are lead and arsenic laden residues containing diesel-range petroleum constituents, polar organic compounds (Oronite-S, linoleic acid, oleic acid, and wood tannin), water, iron, other metals, silica, and alumina. The upper portion of the tailings material is dry and silty and prone to eolian deflation and transport. Within ponds, approximately five feet below ground surface, the material is a highly viscous semi-solid prone to liquefaction when agitated.

Qaf_2 – Wind blown tailings. Suspect eolian deposits of tailings creating a dune field within an area mottled with overburden from various sources. Tailings particles are well sorted and sand sized. Overburden material up to boulder size are somewhat evenly scattered in the area and eolian deposits sit between the boulders. Unit occurs in only one, well demarcated area, leading to some question as to actual deposition origin of the sandy material. Windblown deposits typically do not follow demarked boundaries; however, the overburden may be acting as dune anchors and windbreaks.

Qaf_3 – Muddy Creek overburden. Gypsum, sandstone, and other sedimentary units derived from the Muddy Creek formation. Material was overburden to the mining operation and is typically found in the form of terraced overburden piles or as a construction material in tailings pond damns and dikes. Contains plentiful massive gypsum boulders with clasts of red siltstone and sandstones. May contain minor amounts of manganiferous sedimentary rock (source: Tsm) and River Mountains (source: Tpd) materials.

Qaf_4 – River Mountains alluvium / overburden. Alluvium and rock from Powerline Road volcanic units similar in origin to Qrg. May be remnants of the original alluvial plain in place or relocated alluvial plain overburden from mining operations. Largest deposit forms the base terrace of a multi-terraced overburden pile north of the A/B Pit. Surface in this location is covered with Tsm fines or tailings 1-6 inches thick. Particle sizes typically no larger than cobble and dominantly sand and silt sized.

Qaf_5 – Manganiferous sedimentary fill. Pyroclastics, sandstones and other material derived from Tertiary manganiferous sedimentary units (Tsm). Material may have been low-grade ore, overburden, or stockpile. Found in the form of dams, ramps, and unterraced overburden piles. Most significant deposit is thought to have been used to create the ore stockpile yards just south of, and overlooking, the former mill area.

Qaf_6 – Artificial fill. Transported, compacted, and graded fill of fine sand to gravel sized particles. Material is composed of commingled Qaf_3, Qaf_4, and Qaf_5 that have been used to "build up" an area along Lake Mead Parkway within a developed property. Distinguished from Qac by its high manganiferous fill content (Qaf_5).

EARLIER QUATERNARY DEPOSITS

Qr_1 – Wash Deposits. Alluvial deposits derived mainly from the River Mountains (Powerline road volcanics). Dominantly sand and silt sized particles with minor contributions of up to boulder sized volcanics. Deposits become more gypsiferous and contain Muddy Creek formation material within the drainage on the east side of the Three Kids Mine and Mill Site where the drainage intersects with Highway 564.

Qr_2 – Pediment and fan deposits of River Mountains material. Undisturbed pediment or fan deposits derived from Powerline Road host material. Dominantly sand and silt sized particles. May be gypsiferous from contributions of Muddy Creek material, especially further from the drainage mouth.

Qtg – Older alluvial fan deposits and pediments. Sandy pebble to boulder gravels with desert pavement surfaces. Generally gypsiferous with dacite and other volcanic clasts originating from the River Mountains. Pediment former. Surface typically unconformably overlying Tmcc of Tmcf. Units range from 1-30 feet thick (Bell and Smith, 1980).

LATE TERTIARY DEPOSITS

Tmcc – Muddy Creek fanglomerate. Coarse gypsiferous reddish to yellow fanglomerate. Well cemented coarse sandy, pebble to cobble gravels. Upper portion is well bedded with volcanic pebble clasts (River Mountains in origin). Locally may contain gypsiferous siltstone interbedding. Lower portion is poorly to moderately bedded with igneous and reworked sedimentary clasts.

Tmcf – Muddy Creek Formation. Sedimentary beds of red siltstone, sandy siltstone, and claystone, with dominate white to light pink, massive gypsum occurring in the upper portion. Claystone interbedding locally occurring. Locally manganiferous within gypsum according to Bell and Smith, 1980. Badland and bluff former in the region although, at Three Kids Mine, the unit is mainly buried or has been distributed through mining activity. These units unconformably overlie Tsm and Tpd in the Three Kids area. They are thought to have been "lapped" into a graben structure of the River Mountains that is the location of the Three Kids Mine and Mill Site.

Tsm – Manganiferous sedimentary rocks of the Three Kids Mine. Top of unit is well defined beds of light gray, red, and black manganese rich tuff, tuffaceous sandstone, and siltstones. Forms a "bacon rind" appearance many tens of feet thick feet where exposed. A basal sub-unit of Tsm as exposed at the Hulin pit is comprised of a thick (up to 100 feet), poorly bedded, unsorted breccia with clasts from <1 inch to >3 feet in diameter and of volcanic origin. Sub-unit probably deposited as mud or debris flow(s) and appears to represent a single large, or limited series of large deposition events.

Tsm was originally mapped as part of the Muddy Creek formation (McKelvey et al., 1949; Longwell et al., 1965). Bell and Smith, 1980, present that the Tsm may be closer associated to the Powerline Road units that comprise the River Mountains in the area. It may also be a remnant of an interstitial unit that has been mostly eroded away. Hydrothermal transport and deposition from, and within, this unit into faults and fractures may have been the petrogenetic mechanism of high-grade manganese ore (wad) formation. Chemical data from fault gauge within the Tsm at the Hulin pit indicates high arsenic and lead. Tsm, where present, underlies and unconformably contacts the Muddy Creek formation, observable in the Hulin pit. This contact appears to be gradiated at the Hulin pit and some fluvial reworking may have occurred during Muddy Creek deposition.

MID TERTIARY ROCKS

Tpd – Resistant volcanic units of Powerline Road. Numerous dacite flows. Units are texturally variable, plagioclase, biotite, and hornblende bearing. Flows are commonly banded. Bell and Smith noted large amplitude flow folds. Unit as mapped is a ridge former in the River Mountains. Dacite varies in color from gray on fresh surfaces to reddish black on well weathered surfaces. Upper and lower parts of many flows, and at the contact between Tpd and Tpdt, are brecciated.

Tpdt – Saddle forming volcanic units of Powerline Road. Tuffaceous interbedded units in the River Mountains. Units consist of interbedded pyroclastic, breccia, dacite, zeolitized, and perlitic flows. Breccias often contain purple/red andesite xenoliths. Rock units are dark grey, buff or tan. Previously mapped by Bell and Smith (1980) as part of the Tpd, the units are separately mapped here due to their fissile/less resistant qualities. These units are easily decomposed and are saddle formers in the River Mountains.

Tpd_2 – Resistant volcanic units of Powerline Road. Grayish red to red dacite flows. Contain numerous clasts/xenoliths of grey andesite. Bell and Smith (1980) noted vertical thickness of 150-200 feet. The unit is a resistant ridge former in the River Mountains and considered a marker horizon for the northern part of the mountain range. At the Three Kids Mine the unit outcrops exclusively in the southeastern area of the site within the "House" region.

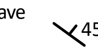
Tpm – Resistant volcanic units of Powerline Road. Interbedded basalt and andesite flows of the River Mountains. Basalts are typically vesicular and mafic containing phenocrysts of augite and olivine. Andesites are reddish purple with plagioclase, hornblende, and augite phenocrysts. These are ridge formers in the River Mountains and occur mainly on the eastern boundary of the Three Kids Mine and Mill Site.

Tdb – Dikes. Basalt/Andesite composition dikes of Miocene age. Associated with Tpd and Tpdt in the Three Kids Mine area. Thickness variable. Only dikes >10 feet thick are mapped.

KEY TO MAP SYMBOLS

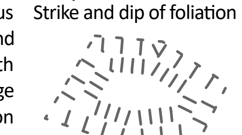
Contact. Dashed where approximate or concealed.

Fault. Dashed where approximate or inferred, dotted where concealed, ball on downthrown side.



Strike and dip of beds

Strike and dip of foliation



Mine Waste

Pit

BROADBENT
8 West Pacific Avenue
Henderson, NV, 89015
(702) 563-0600 (P) * (702) 563-0610 (F)

Job # 14-01-156 Date: 9/9/2021

Legend:
As shown above.

Notes:
1. Source: 2005-2008 Field and Aerial data combined with data from Bell and Smith, 1980, *Geologic map of the Henderson Quadrangle, Nevada*, Nevada Bureau of Mines and Geology, Map 67, and Hunt, et. al., 1942, *Three Kids Manganese District Clark County, Nevada*, United States Department of the Interior, Bulletin 936-L.

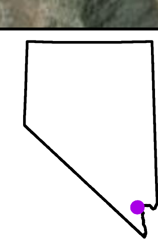
Figure 3B	
Detailed Geologic Map Key	
Former Three Kids Mine	
Designed	
Drawn	JCM
Approved	

Legend:

- Site Feature
- Project Area

Wells in Project Area

- Active Well
- Plugged Well



N

Scale: 1:14,000

1,000 500 0 1,000 Feet

Figure 4

Well Locations

Former Three Kids Mine

Designed	
Drawn	JCM
Approved	

BROADBENT
8 West Pacific Avenue
Henderson, NV, 89015
(702) 563-0600 (P) * (702) 563-0610 (F)

Job # 14-01-156 Date: 12/22/2021

Notes:
1. Imagery Source: Esri World Imagery
2. Datum: NAD 1983 StatePlane Nevada East FIPS 2701 Feet
3. Source: Nevada Well Log Data Base.

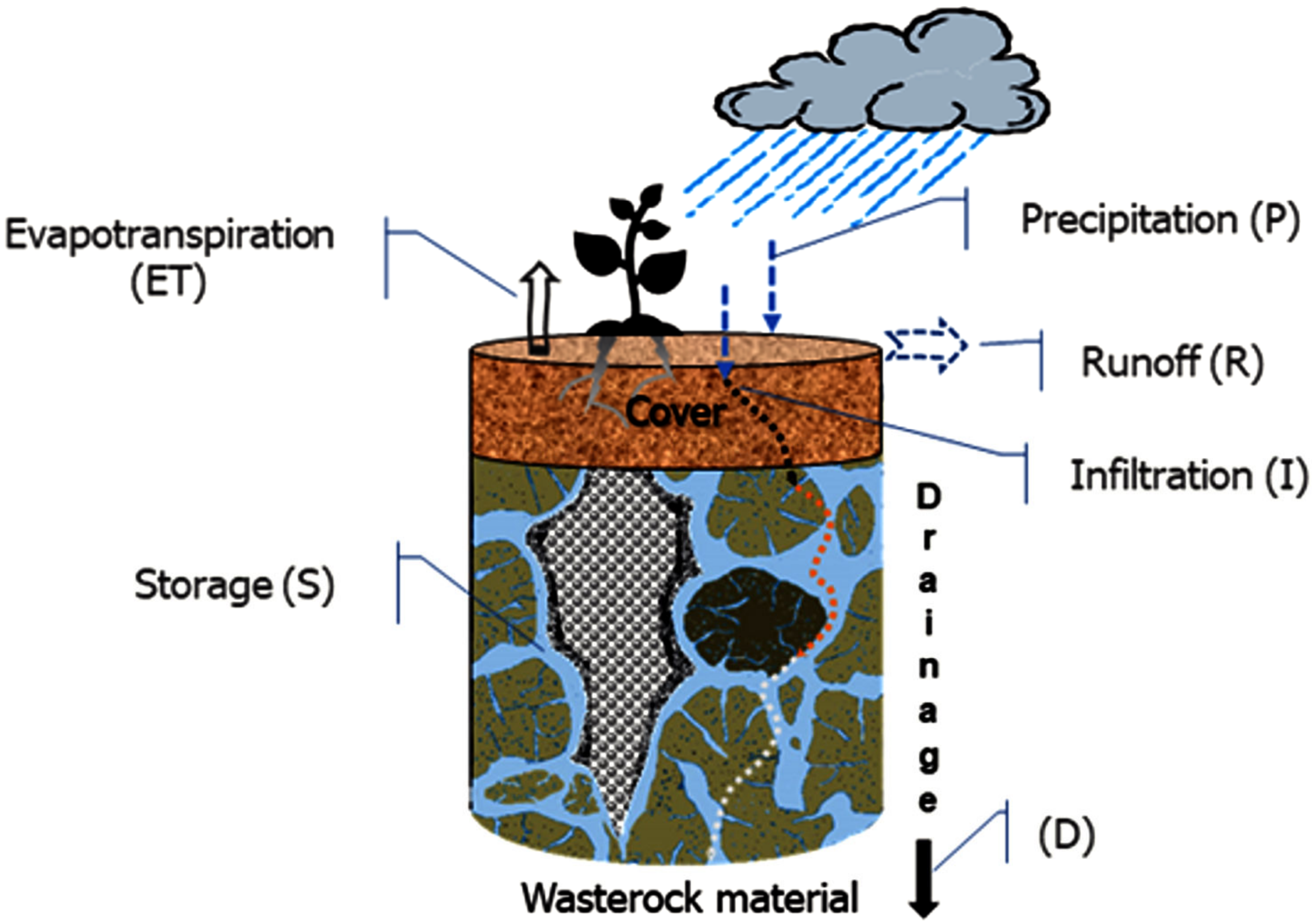


		Figure 5
		Conceptual Infiltration Model Illustration
BROADBENT 8 West Pacific Avenue Henderson, NV, 89015 (702) 563-0600 (P) * (702) 563-0610 (F) Job # 14-01-156 Date: 10/1/2021		Former Three Kids Mine

Designed	
Drawn	DE
Approved	

TABLES

TABLE 1
Relationship of Well Information to Aquifer Elevations and Infiltration Layer Thickness
Three Kids Mine
Henderson, Nevada

Well ID	Description	Surface Elevation[1]	Depth to WBZ[2]	WBZ Elevation[3]	DTW[4]	Water Level[5]	Infiltration Layer Thickness[6]
35212	Three Kids Test Well	1,820	720	1,100	562	1,258	455
82441	Laker Plaza Well	1,810	480	1,330	160	1,650	225
111266	US Gov't	1,740	390	1,350	81.1	1,659	205
111218	Clark County	1,746	253	1,493	NM	NM	62
	Base of Hydro Pit	1,555					

Notes
Elevations estimated feet above mean sea level
WBZ = Water Bearing Zone
DTW = Depth to Water
1 Estimated from Google Earth
2 Noted on drillers logs and depth to top of screen for Clark County and US Gov't wells
3 Surface elevation minus depth to WBZ
4 Previous gauging
5 Surface elevation minus DTW
6 Base of Hydro Pit minus WBZ Elevation (feet)

TABLE 2

Boulder City, Nevada Monthly Climate Summary: 09/01/1931 - 10/28/2005

Three Kids Mine

Henderson, Nevada

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	54.5	59.9	67.6	76.4	85.9	95.9	101.6	99.5	92.6	79.8	64.5	55.6	77.8
Average Min. Temperature (F)	38.6	42.3	47.0	53.8	61.9	70.4	76.7	75.4	69.0	58.5	46.6	39.7	56.7
Average Total Precipitation (in.)	0.66	0.64	0.66	0.34	0.18	0.09	0.49	0.71	0.51	0.32	0.43	0.51	5.55
Average Total SnowFall (in.)	0.6	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0
Average Snow Depth (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

References:

Western Regional Cliamte Center https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?nv1071

TABLE 3
Representative Meteoric Water Mobility Procedure Results
Three Kids Mine
Henderson, Nevada

		NDEP Profile 1[a]	Tailings TP01	Tailings TP02	Tailings TP03	Waste Rock WR09	Waste Rock WR07	Waste Rock WR02	Waste Rock WR05	Waste Rock WR06	Waste Rock WR12	Waste Rock WR04	Waste Rock WR03	Waste Rock WR15
	Units		TP1WN-TSP03	TP02-TSP04-COMP	TP03-TSP08	WR09-TSP14-48	WR07W-TSP16-96	WR02-TSP09-132	WR05-TSP11-12	WR06-TSP12-12	WR12-TSP21-36	WR04-TSP15-36	WR13-TSP20-96	WR15-TSP23-72
PH	s.u.	6.5 - 8.5	8	7.9	7.9	7.7	7.7	8.3	8.1	7.9	7.6	7.9	7.6	7.5
Total Dissolved Solids	mg/L	1000	3150	2420	4240	4100	4140	5760	5080	3720	2880	4480	3630	3160
Alkalinity, Total (as $CaCO_3$)	mg/L		163	128	150	44	37	55	43	33	30	30	27	26
Total Nitrogen	mg/L	10	4	<1	2	15	9	2	14	4	2	4	32	4
Nitrogen, total Kjeldahl	mg/L		1.4	0.5	1.3	<0.1	<0.1	<0.1	0.6	0.1	0.2	0.2	0.3	<0.1
Cyanide, WAD	mg/L	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Moisture Content	%		22	21.6	18.7	8.7	9.9	18.3	12.5	15.8	3.6	8.2	13.8	5
Anions														
Alkalinity, as HCO3	mg/L		199	156	183	54	45	63	52	40	36	37	33	32
Chloride	mg/L		55	24	83	97	87	132	57	4	1	87	27	10
Fluoride	mg/L		2.7	2	1.4	0.9	2.1	2	4.2	2.3	2.2	1.7	0.8	0.5
Nitrate-Nitrite (as N)	mg/L		2.3	<0.1	0.6	14.8	8.9	2.4	13.4	3.7	2	4	32.1	3.8
Sulfate	mg/L		1660	1240	1980	2340	2410	3430	2730	2320	1880	2610	2030	1950
Cations														
Calcium	mg/L		238	230	431	470	475	459	422	445	529	458	501	499
Magnesium	mg/L		73	60	117	114	199	74	115	68	92	140	130	105
Potassium	mg/L		61	39	53	61	48	45	84	68	69	36	26	27
Sodium	mg/L		477	262	438	437	335	1020	710	440	46	542	243	160
Dissolved Metals														
Aluminum	mg/L	0.2	0.03	0.02	0.05	0.05	0.05	0.12	0.11	0.06	0.05	0.08	0.09	0.04
Antimony	mg/L	0.006	<0.003	<0.003	<0.003	0.01	<0.003	<0.003	0.004	0.006	<0.003	<0.003	<0.003	<0.003
Arsenic	mg/L	0.01	0.797	0.733	0.765	2.08	0.596	0.443	0.607	0.511	0.157	0.944	0.339	0.184
Barium	mg/L	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Beryllium	mg/L	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron	mg/L		2.23	2.03	2.26	1.71	2.51	39.6	17.7	15.7	3.64	11.8	8.68	0.53
Cadmium	mg/L	0.005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002
Chromium	mg/L	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	mg/L	1	0.03	0.01	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron	mg/L	0.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Lead	mg/L	0.015	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese	mg/L	0.1	<0.01	0.03	0.41	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	mg/L	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium	mg/L	0.05	<0.005	<0.005	<0.005	0.33	0.32	0.14	0.26	0.049	0.035	0.11	0.039	0.007
Silver	mg/L	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium	mg/L	0.002	<0.001	<0.001	<0.001	<0.001	0.003	0.01	0.006	0.013	0.008	0.003	0.001	<0.001
Zinc	mg/L	5	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Notes:

Results in red exceed Profile I reference values.

References:

[a]ndep.nv.gov/uploads/documents/20141027_Profile_I_List.pdf

TABLE 4
X-Ray Diffraction Mineralogical Analysis: Tailings
Three Kids Mine
Henderson, Nevada

Mineral Phase	Nominal Atomic Formula	TP1E-TSP01-12	TP1E-TSP01-60	TP1C-TSP02-12	TP1C-TSP02-48	TP1WN-TSP03-96	TP1WN-TSP03-12	TP02-TSP04-48	TP02-TSP04-96	TP3W-TSP07-48	TP3W-TSP07-96	TP03-TSP08-48	TP03-TSP08-96
		Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings	Tailings
quartz	SiO_2	11.5	11.2	16.1	14.3	17.6	17.3	13.4	13.2	12.1	14.3	14.9	23.2
K-feldspar	$KAlSi_3O_8$	6.7	5	5.7	5.5	7.2	4.7	9.8	6.7	5.7	5.3	5	7.4
plagioclase	$(Na,Ca)(Si,Al)_4O_8$	13.7	17.3	26.3	21	23.5	20.3	30.3	17.5	11.1	10.7	10.7	18.3
mica	$KAl_2(Si_3Al)O_{10}(OH)_2$	19.6	19.8	16.6	14.5	14	12.5	7.6	10.7	21.2	23.9	18.2	14.7
hornblende	$NaCa_2(Mg,Fe)_4Al_3Si$	<1.0	<1.0	<1.0	<1.0	<1.0	2.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
clinoptilolite	$(Na,K,Ca)_{2.5}Al_3(Al,Si$	6.5	5.9	10.8	10.5	9.3	11.2	7.1	5.7	6.2	6.4	5.1	5.2
kaolinite	$Al_2Si_2O_5(OH)_4$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.3	1.7	2.7	3.5	1.2	<1.0
magnesite	$MgCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	1.9	<1.0	<1.0	1.2	1.2	1.3	<1.0
calcite	$CaCO_3$	1.1	1.2	<1.0	2	<1.0	<1.0	1.9	1.3	<1.0	<1.0	<1.0	<1.0
aragonite	$CaCO_3$	1.2	1.7	2.1	1	1.9	1.2	1.8	1.7	<1.0	<1.0	1.1	1.3
dolomite	$CaMg(CO_3)_2$	<1.0	<1.0	<1.0	1.3	1.2	<1.0	<1.0	1.1	<1.0	1.3	<1.0	<1.0
kutnahorite	$CaMn(CO_3)_2$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
rhodochrosite	$MnCO_3$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1	<1.0	<1.0
manganosite	MnO_2	<1.0	<1.0	<1.0	<1.0	<1.0	5.6	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ramsdellite	MnO_2	<1.0	<1.0	<1.0	1.6	1.4	1.3	1.2	0.9	<1.0	<1.0	<1.0	<1.0
todorokite	Mn_6O_{12}	<1.0	<1.0	1.4	<1.0	1.7	1	<1.0	<1.0	<1.0	1	<1.0	<1.0
celestine	$SrSO_4$	4.1	2.7	1.2	1.6	1	1.9	11	6.7	2.4	<1.0	5	1.8
gypsum	$CaSO_4(H_2O)_2$	<1.0	<1.0	1.6	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
goethite	FeO(OH)	1.3	<1.0	<1.0	<1.0	<1.0	1.1	1	<1.0	<1.0	1.3	<1.0	<1.0
amorphous	micro/non-crystalline	32.6	32.1	15.3	24.4	19.1	16.5	11	31.2	28.1	25.2	32.5	24.2

Notes:
The high concentration of amorphous material is composed of swelling clays (montmorillonite) and other clay and amorphous components. The high concentrations of amorphous material made quantification of trace minerals difficult but detection of "trace minerals" (<1.0 wt pct) was verified by XRD analysis of coarse to mid grain size fractions. Trace minerals detected but not quantified were reported as less than 1.0 percent by weight.

TABLE 5
X-Ray Diffraction Analysis Identification of Clay Content in Tailings
Three Kids Mine
Henderson, Nevada

Clay Mineral	TP1E-TSP01-12	TP1E-TSP01-60	TP1C-TSP02-12	TP1C-TSP02-48
montmorillonite	major	major	major	major
mica (illite)	major	major	major	major
kaolinite	trace	trace	trace	trace
kaolinite-smectite	n/d	n/d	n/d	Trace
amorphous %	32.6	32.1	15.3	24.4
Clay Mineral	**TP1WN-TSP03-96**	**TP1WN-TSP03-12**	**TP02-TSP04-48**	**TP02-TSO04-96**
montmorillonite	major	major	major	major
mica (illite)	major	major	major	major
kaolinite	trace	trace	minor	minor
kaolinite-smectite	n/d	trace	n/d	minor
amorphous %	19.1	16.5	11	31.2
Clay Mineral	**TP3W-TSP07-48**	**TP3W-TSP07-96**	**TP03-TSP08-48**	**TP03-TSP08-96**
montmorillonite	major	major	major	major
mica (illite)	major	major	major	major
kaolinite	trace	trace	trace	trace
kaolinite-smectite	trace	trace	n/d	n/d
amorphous %	28.1	25.2	32.5	24.2
amorphous	micro/non- crystalline	32.6	32.1	15.3

TABLE 6
Data Quality Objectives Worksheet for Leaching Analysis for Three Kids Mine
Henderson, Nevada

	Step 1 State the Problem	Step 2 Identify Decisions	Step 3 Identify Inputs	Step 4 Specify Boundaries	Step 5 Define Decision Rules	Step 6 Specify Error Tolerances	Step 7 Optimize Sample Design
1	What is the mine waste reactivity, initial concentrations of SRCs in pore water, and source strength of SRCs in mine wastes after remediation and reclamation of the Three Kids Mine?	If the concentrations of SRCs in leachates are higher than standards, then corrective actions must be implemented unless fate and transport modeling shows downgradient attenuation to standards.	Meteoric Water Mobility Procedure (MWMP) for SRC concentrations in leachates, total metal concentrations, and X-ray diffraction data for mineralogy. Also general geologic logging and mineral processing descriptions provide information on chemistry and mineralogy of the mine waste and natural geologic materials.	The most reactive waste rock, highest concentration of SRCs in leachate, and total concentrations will bound the upper and most conservative boundary with respect to SRC concentrations in the reclaimed mine waste repository.	Review geochemistry data and pick representative results for model inputs that bracket high and average expected SRC release concentrations. Determine if raw data accurately represents expected leachate chemistry or if scaling functions or geochemical equilibrium conditions need to be applied.	Scope out geochemical conditions and sources that might increase leachate SRC concentrations above MWMP levels. If higher solubility is possible, raise the maximum limit of SRC concentrations in the model. Define minimum SRC concentrations below which there is no risk. Use model sensitivity analysis to determine response of model output to ranges of model input.	Mine waste reactivity and source strength of SRCs has been determined during RI by materials characterization including MWMP tests on representative samples of mine wastes, natural geologic materials and borrow materials.
2	What will be the thicknesses and hydraulic properties of mine waste and substrates beneath the site, and what will be the rate and volume of infiltration into the reclaimed areas of the Three Kids Mine?	Thicknesses will be determined by-final backfill depths based on estimated material volumes. Cover thicknesses are specified based on soil exposure pathway elimination. Seepage through mine wastes will be determined by unsaturated flow modeling of reclaimed subsurface pathways for moisture and seepage.	Model inputs will include the thickness of the entire seepage and water flow path through thicknesses of 1) final covers, 2) unsaturated waste rock and tailings, and 3) underlying materials. Depth to groundwater from developed grade defines the total thickness of all layers.	Upper boundary is the top surface and cover or regraded 10 ft reclamation surface. Mine waste layer boundaries are top and bottom fill elevations. Base of fill to groundwater is thickness of natural underlying materials. Temporal boundary is placement of fill (t_0) to 100 years simulation.	Review mine grading plans and current pit configurations. Decide what will be the ultimate top surface of the mine waste repository and reclaimed surface. Determine bottom of mine pits and volumes of mine waste and backfill that will be located in reclaimed pits. Determine how much cover thickness to apply and where liner systems will be used for water detention in backfilled pit facilities.	Relative mine waste and backfill/reclamation material thicknesses should be known with a reasonable amount of certainty. Depth to groundwater may be uncertain. Depth and thickness tolerances for mine waste should be less than approximately 5 ft, however model sensitivity analysis will be used to determine significant changes in predictive result with respect to SRC concentrations and velocity as a function of mine waste and cover thickness. Tolerances for cover thickness accuracy will be less than 1 ft. Residence times will be high owing to low rates of infiltration hence errors in layer thicknesses will have to be 10s of feet to result in any significant changes in SRC velocity in downward migrating infiltration and seepage.	Hydraulic properties including unsaturated relative hydraulic conductivity with variable moisture have been determined by laboratory testing on representative samples of mine waste and natural geologic materials and borrow materials during RI.

TABLE 6
Data Quality Objectives Worksheet for Leaching Analysis for Three Kids Mine
Henderson, Nevada

	Step 1 State the Problem	Step 2 Identify Decisions	Step 3 Identify Inputs	Step 4 Specify Boundaries	Step 5 Define Decision Rules	Step 6 Specify Error Tolerances	Step 7 Optimize Sample Design
3	What will be the initial state of mine wastes (moisture, moisture chemistry, compaction, temperature etc.) after reclamation and how long until new steady state conditions (moisture, moisture chemistry, compaction/density, temperature etc.) are achieved after reclamation of the Three Kids Mine?	Initial moisture contents and densities will be derived from regrading specifications. Final densities can be estimated from consolidation tests conducted. Determine natural geothermal gradient.	Layer by layer initial moisture and density specifications or estimation from backfill compaction (modified proctor and consolidation tests) studies. Initial temperatures will be atmospheric.	The upper and lower expected moisture contents of mine waste and reclamation materials that are within construction specifications.	Select moisture concentrations and densities that are representative and maximum to simulate most conservative cases where SRCs travel fastest. Temperatures will also be set to conservative values with respect to geochemical reactivity. Actual compacted densities and moisture content will be field measured during construction.	Error tolerances for moisture and density should be no more than 2%. Temperature tolerances should be within 5 degrees Celsius.	Moisture and density of construction materials will be determined by field measurements and sampling. Mine pit backfill material densities will be estimated from laboratory determined Proctor and consolidation testing on test pit samples. Nuclear density and water content will measured during construction. Temperature variation with depth can be estimated by from published geothermal gradient studies.
4	What are present and future climate inputs at the Three Kids Mine?	Determine if site climate will be significantly different in future from published predictions.	Climate predictive models such as Rubel and Kottek, 2010 (http://koeppen-geiger.vu-wien.ac.at/pdf/Paper_2010.pdf)	Upper and lower temperature and precipitation changes predicted as a result of climate change.	Modify climate input into model to adjust for any expected changes in the future over the model prediction boundary of 100 years.	Model sensitivity analysis will be used to determine if climate change results in significant changes in SRC concentrations and travel times through mine wastes and reclamation materials.	Climate change is predicted on the basis of global climate databases. Alternative predictions will be consulted to bracket the range of expected climate change.
5	What will be the geochemical reactions and conditions (i.e. pH, Eh, equilibrium, kinetics, etc.) in the mine wastes and substrate beneath the Three Kids Mine?	Determine representative mineralogy and geochemical state of mine wastes and reclamation materials and potential reactions between solid, liquids, and gases (i.e. air).	MWMP, XRD mineralogical data and expected air contents in unsaturated mine wastes and reclamation materials. Define system reactions and potentials in terms of both thermodynamic equilibria and kineticly-limited reactions. These include dissolution, ion exchange sorption, and redox couple reactions.	Boundaries on geochemical reactions and conditions will be limited by the composition, moisture, and air availability in the mine wastes and reclamation materials.	Decisions to include geochemical components like mineralogy will be based on existing XRD data and geological descriptions of mine materials and geological formations. Moisture and air contents will be determined from geotechnical and hydraulic testing data.	Error tolerances will be limited by available mineralogy data on modal abundance of mine waste minerals, porosity density, and other bulk properties. It is expected that pH and Eh errors will be less than 1 unit or 0.1 V, respectively.	Representative samples of mine waste and other geologic materials have been sampled and analyzed for mineralogy and leachate quality during the RI. On-site and nearby wells and water levels were researched in preparation of SAP and presented in this work plan.

TABLE 6
Data Quality Objectives Worksheet for Leaching Analysis for Three Kids Mine
Henderson, Nevada

	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
	State the Problem	Identify Decisions	Identify Inputs	Specify Boundaries	Define Decision Rules	Specify Error Tolerances	Optimize Sample Design
6	What is the fate and transport of SRCs through mine wastes and substrate after remediation and reclamation of the Three Kids Mine?	The fate and transport of SRCs is dependent on geochemical materials, geochemical conditions, hydraulic properties, climate, and attenuation capacity, which will be inputs to the reactive transport model. The decision on parameterization will dictate the predictive capability of the model.	MWMP, XRD mineralogical data, and expected air contents in unsaturated mine wastes and reclamation materials and attenuation coefficients (partition coefficients or K_d).	Boundaries on fate and transport are dictated by the physical and chemical boundaries of the model including depth to groundwater.	Decisions to include geochemical and hydrologic components like mineralogy will be based on existing XRD data and geological descriptions of mine materials and geological formations. Moisture, relative hydraulic conductivity, and air contents will be determined from geotechnical and hydraulic testing data.	Error tolerances will be dictated by receptor risk.	The field sampling and analysis conducted during the RI selected samples, analyses, and testing required to evaluate the fate and transport of SRCs beneath the site as a result of leaching and downward migration of infiltrating meteoric water.
7	What will be the anthropogenic input of water from water line leakage and lawn irrigation?	Determine the maximum likely rates of leakage of site water infrastructure.	Studies on water infrastructure leakage from new construction with modern materials. Design utility alignments. Water loss statistics from City of Henderson.	Water conveyance corridors across and upgradient of the site.	Based on maximum estimated and conservative leakage rates, run model to evaluate if SRC migration will occur. Compare to no leakage base case.	Leakage rates will be a percentage of the water conveyance capacity of the infrastructure. Rates can be scaled according to capacity and projected population and use at the site.	Acquire and review published studies on water infrastructure leakage for different types of facilities from sites similar to the Three Kids Mine site (i.e. residential development and associated services).

APPENDICES

Appendix A

Response to NDEP Comments

Appendix A

Responses to NDEP Comments made on November 18, 2021

1. **General Comment #1** – Jurat page should include CEM number and expiration date for primary CEM.

> The jurat page has been edited accordingly.

2. **General Comment #2** – There are several sections throughout the work plan (identified below) that generally refer to "other conditions" but do not specify what those other conditions are. It would be helpful to be more specific where possible. Sections that refer to "other conditions" include:

a. **Section 2.1.1 Conceptual Geochemical Model** – "other conditions related to potential leaching reactions"

b. **Section 2.1.4.1 Development of Equilibrium and Kinetic Assumptions and Calculations** – "other physical and chemical conditions"

c. **Section 2.2.1 Conceptual Infiltration Model** – "other conditions related to components of the system that govern unsaturated flow"

d. **Section 2.2.6 Solute Mass Balance and Transport** – "wall rock moisture and other boundary conditions"

> a. **Section 2.1.1 Conceptual Geochemical Model** – The work plan states that "The conceptual model will guide the development of the numerical geochemical model providing information to help establish boundary and initial conditions, potential range of SRC, and other conditions related to potential leaching reactions. The "other conditions related to potential leaching reactions" include:
>
> i. Atmospheric boundary conditions precipitation and temperature
> ii. Initial moisture content of mine waste or geologic layer and pore water chemistry
> iii. Layer thickness of cover, mine waste backfill, underlying natural soils or geologic formations, and depth to groundwater
> iv. Vertical flow boundaries such as no flow, seepage, and faults
> v. Geothermal gradients
> vi. Mineralogy

b. **Section 2.1.4.1 Development of Equilibrium and Kinetic Assumptions and Calculations** – The work plan states that "The geochemical conceptual model will identify the potential equilibrium and kinetic reactions that may occur between the backfill and leachate under variable moisture, temperature, and other physical and chemical conditions. The "other physical and chemical conditions" include:
   i. pH
   ii. Eh or Oxidation Reduction Potential (ORP)
   iii. Ionic strength, which is related to total dissolved solids
   iv. Porosity and hydraulic conductivity, or relative hydraulic conductivity
   v. Mineralogy

c. **Section 2.2.1 Conceptual Infiltration Model** – The work plan states that "The conceptual infiltration model will guide the development of the numerical infiltration model providing information to help establish boundary and initial conditions, potential range of hydraulic properties, and other conditions related to components of the system that govern unsaturated flow." The "other conditions related to components of the system that govern unsaturated flow" include:
   i. Initial and transient moisture conditions
   ii. Climate and atmospheric conditions (precipitation and temperature)
   iii. Vegetation and rooting density and depth
   iv. Subsurface material layers, textures, and faults

d. **Section 2.2.6 Solute Mass Balance and Transport** –The work plan states that "Over time, moisture conditions in the cover and backfill transition to a steady state condition that balances the rate of infiltration and equilibration with wall rock moisture and other boundary conditions." The "other boundary conditions" and material properties related to components of the system that govern unsaturated flow and reaction include:
   i. Initial concentrations of SRCs
   ii. Porosity, dispersion, and flow path directions
   iii. Solubility and attenuation capacity
   iv. Matrix mineralogy

3. **General Comment #3** (related to comment #19) – Since leaching conditions have been in place since the closure of the mine, would it be worthwhile to investigate areas below tailings/waste rock and/or groundwater to determine if leachate has already had an adverse impact? Use existing conditions as a large-scale pilot test to back up modeling results?

Following September sampling when samples were collected from eight borings at 2 feet and 10 feet below tailings, Broadbent is conducting a drilling investigation of subsurface soil for additional delineation of nature and extent of mining-related impacts. These data will also be used for model validation (see details in Section 2.1.5).

4. **General Comment #4** – It is important to understand groundwater elevation relative to the lowest point in the Hydro Pit, as well as the potential for lateral infiltration of water into the Hydro Pit.

Broadbent is currently analyzing water level data from the onsite test well and nearby wells that are accessible and are developing projections of expected water table elevations beneath the Hydro, Hulin, and A-B Pits. Some limited water level measurements are being conducted during the remedial investigation (RI).

5. **General Comment #5** – The work plan should consider integrating use and application concepts from an overarching modeling quality guideline framework such as described in *Evaluating the Reliability of Predictions Made Using Environmental Transfer Models* (International Atomic Energy Agency, Vienna, 1989).

The Leaching Analysis relies on modeling guidance published by NDEP (see work plan reference to BMRR, 2018a,b,c) and other scientific organizations (e.g. Nordstrom and Nicholson, 2017 and INAP, 2021). Broadbent will also consult with the IAEA 1989 guidelines and other NDEP-recommended guidance to improve model design and development.

6. **General Comment #6** – The models discussed, (e.g., Hydrus-1, PHREEQE) all have input parameter requirements. It is recommended that an assessment be made to identify whether sufficient data is available to fulfill the input requirement needs, particularly the critical "master-variable" parameters. A conventional Data Quality Objectives (DQO) type approach - starting with the decisions to be made from the model- applied to developing inputs for critical parameters could be useful in insuring model usefulness and reliability.

A DQO table containing critical model input parameters has been prepared (included as Table 6).

7. **General Comment #7** – The transport models should be examined to ensure that, to the extent practicable, they mathematically incorporate the key physical/chemical processes noted in the conceptual infiltration model (Figure 4), as well source release mechanisms.

> Agreed. The conceptual model in Figure 4 illustrates the principal mechanisms of precipitation and infiltration and this input has been derived from climate datasets. The hydraulic properties of the solid matrix have also been characterized. The conceptual model for geochemistry involves many different reactions that will occur between solid, liquid, and gases that will exist in the backfilled pits and reclaimed areas subsurface. The primary components are known from the site geological descriptions plus accounts of mining and milling practices. In addition to SRCs, the whole rock chemistry and mineralogy of the mine wastes and native ground has been studied and characterized during the RI.

8. **General Comment #8** – The work plan mentions that the range of other model input parameters and boundaries will be quantified through statistical analysis. Is there any more information available as to the nature, type, and target levels of statistical significance, etc., (e.g., are these descriptive, correlational, inferential)?

> The range of model inputs for predictive simulations will be selected to generate conservative value outputs in terms of leachate flux and SRC concentrations. Hence the statistical analysis will be relatively simple and focus on mean and upper percentile values that will generate upper-level results in terms of volumetric flux through reactive mine wastes and SRC concentrations in leachates. Assuredness that upper percentile model predictions of flux and SRC concentrations from upper percentile model inputs will be tested through model sensitivity analysis. Complete statistical analysis of datasets is part of the Leaching Analysis and will be presented in tables and summaries. Broadbent does not advocate comprehensive stochastic analysis of all potential model input values which will require extensive resources to explore both lower and upper predicted limits of leachate flux and concentrations of SRCs. Decisions will be risk based and focused on reasonable upper limits of model predictions with respect to leachate flux and concentrations.

9. **General Comment #9** – Based on previous assessments, the tailings are known to contain a substantial amount of diesel range organics and associated constituents, however, this is not discussed in the work plan. How will the potential impacts from the leaching of DRO-containing soils be evaluated? Also, will the presence of DRO affect the leaching conditions being evaluated for the metals?

DRO is not discussed explicitly but will be considered in the modeling. It is known that the tailings contain an abundance of expandable clays like montmorillonite from X-ray diffraction analysis (see Table 5). These clays are strong sorbents of DRO and other organics, and the X-ray results indicate that DRO is strongly bound in the interlayers of clays and will not react significantly with leachates. However, the model input will include the expected levels of DRO and included in the reactive transport modeling to predict that rate and extent of oxidative breakdown and associated reduction of electron acceptors like manganese oxides.

10. **Section 1.0 Introduction** – The third paragraph in this section states that Zenitech's Phase I ESA "focused on characterizing the nature and extent of contamination at the site and background concentrations of COPC in soils, rock, and mine wastes." This does not appear to have been the focus of the Phase I ESA, which did not include any environmental sampling. The Phase I ESA recommended that a background study be performed during future Phase II ESA sampling.

Text edited to state more correctly that a Phase I Environmental Site Assessment (ESA) was completed by Zenitech Environmental, LLC (Zenitech) in 2007, which focused on known conditions and extent of contamination at the site and recommended an evaluation of background concentrations of SRCs in soils, rock, and mine wastes.

11. **Section 1.1.2 Physiography** – The first paragraph in this section states that "site elevation ranges from 1,550 to 2,250 feet above mean sea level." The second paragraph in this section states that "site elevations within the subject property range from 1,545 feet…to 2,515 feet." The site elevation ranges provided in these statements are inconsistent with each other. Please clarify.

Section 1.1.2 edited to remove inconsistency.

12. **Section 1.2.4 Groundwater** – Although this section includes references to the Phase II SAP, it would be helpful for the work plan to include a map of the groundwater well locations, approximate elevation contours, and well logs since potential groundwater concerns are a factor in this leaching analysis. Inclusion of these items would help add context to the groundwater elevations/depths, potentiometric surfaces, and hydraulic gradients described in this section.

A map depicting well locations and well logs have been added as Figure 4 and Appendix B, respectively.

13. **Section 1.2.4 Groundwater** – The first paragraph in this section states the following:

    "Water level data from the wells suggests that depths to first water bearing zones at the site are in the range of 500-700 feet bgs. It should be noted that previous investigators observed that water does not accumulate in the pits, suggesting that the true static groundwater elevation is lower than 1,530 feet amsl, or at least 280 feet bgs at the Laker Plaza well."

    A brief background discussion of first water-bearing zone vs. static water level, or an introduction of the Laker Plaza well in relation to the site before the quoted text could help provide clarity. Depth to groundwater will be a key input for modeling and should have a clear path on how it is going to be determined and which depth will be used. It would also be helpful to consistently use either feet bgs or feet amsl when describing depth to groundwater, rather than using both.

A description of groundwater level data has been clarified in Section 1.2.4 and Table 1 using consistent units, including a comparison to the elevation at the base of the Hydro Pit. Predicted depths to groundwater beneath backfilled pits and reclaimed areas will be developed in the Leaching Analysis Report and used as a basis for designing the model domain and layer thicknesses.

14. **Section 1.2.4 Groundwater** – The last sentence in this section ("The Leaching Analysis will evaluate leachability of the Hydro Pit backfill and rate of infiltration…per NDEP guidelines") seems out of place. It is suggested that it be relocated to a more appropriate section of the work plan.

This sentence has been moved to Section 2.0 to state the overall objective of the Leaching Analysis.

15. **Section 1.2.5 Surface Water** – It may no longer be accurate to state that "no surface flow has been captured or observed since September of 2006" considering that the statement was originally made in 2007. Furthermore, it may be a good idea to state that the described drainages are ephemeral drainages that convey stormwater runoff following heavy precipitation events - no perennial or intermittent streams are present.

Text in Section 1.2.5 has been revised accordingly to state the status of surface water observations more accurately. In the future, surface water flow will be managed by the construction of lined drainage infrastructure at the site to divert water away from backfilled mine pits and other areas where infiltration may generate SRC-containing leachate.

16. **Section 2.1.1 Conceptual Geochemical Model** – Previous discussions have indicated that the final cover overlying the backfilled Hydro Pit will serve as a lined detention basin. This section indicates that the final cover could consist of an impermeable synthetic cover, an earthen soil cover, or a combination of the two. Because the detention basin is specifically meant to hold excess storm water for up to 12 hours, additional water infiltration will need to be considered in the model for scenarios in which an earthen-only cover is used.

    Cover scenarios that include lined detention and earthen cover alternatives will be included in the Leaching Analysis modeling.

17. **Section 2.1.1 Conceptual Geochemical Model** – The second paragraph indicates that the backfill material in the Hydro Pit will be unconsolidated. Why will the backfill material remain unconsolidated? Could this increase the potential for future subsidence to occur?

    The word "unconsolidated" has been removed from Section 2.1.1 to avoid confusion. The material will be initially unconsolidated then compacted and will consolidate over time. However, it will never reach a state of consolidation and density comparable to native materials. Thus, in geological terms, sediments will not be subject to enough pressure, temperature, and cementation to result in "intact rock" that cannot be broken or eroded without considerable force. In engineering terms, however, the backfill will compact under the weight of overlying materials and may become weakly cemented or indurated over time by precipitation of soluble minerals such as gypsum.

18. **Section 2.1.1 Conceptual Geochemical Model, and Section 2.2.5 Water Balance and Model Calibration** – Is there potential for landscape irrigation to occur in the vicinity of the reclaimed pit? Sporadic meteoric water infiltration alone may not generate a significant flux of solutes to groundwater, but infiltration of water from irrigation, water line leaks, or other water usage at the housing development could significantly increase water and solute fluxes.

    There may be enhanced infiltration at the Site as a result of irrigation and water infrastructure leakage. Model scenarios that incorporate this potential source of infiltration and seepage will be constructed based on expected irrigation rates and anticipated leakage rates from pipelines based on data from the city of Henderson and case studies of actual developments that are similar to the Three Kids Mine site redevelopment plan. For example, extensive mine land reclamation and redevelopment at the Daybreak Community near Salt Lake City in Utah may be one case study that can be used to estimate post development irrigation and pipe leakage rates in situations where extensive mine disturbance has been reclaimed and redeveloped for residential use.

19. **Section 2.1.2 Geochemical Data Compilation for Model Input** – Will MWMP analyses be adequate to represent leaching through the vertical profile of backfill over time to assess if a redox horizon will develop (oxidized above, anoxic below), which could drive up manganese concentrations (soluble in anoxic conditions)? Larger or longer-term column tests may be warranted to approximate conditions within the pit backfill. Will there be biological or chemical oxygen demand that will generate anoxic conditions within the backfill? The infiltrate could develop high dissolved Iron and Manganese concentrations, and potentially elevated metals from dissolution of Fe and Mn sediments in anoxic conditions. If the analysis intends to include redox conditions and associated mineral reactions, it is unclear how that can be modeled (conceptually or otherwise) without column or field testing that more closely replicates field conditions. Borings in deep waste rock and tailings dumps may shed light on anticipated in-situ conditions and mineral reactions.

    Following September sampling, Broadbent is conducting a subsurface drilling investigation that can be used for model validation. The extensive period since mine closure (60 years and more) and realistic in situ conditions beneath tailings and waste rock provide a much better dataset for evaluation of leachate migration potential than a shorter term artificially constructed pilot test for model calibration and predictive model validation. Pilot test construction and operation over periods of time is not feasible in terms of resources and time constraints.

20. **Section 2.1.5 Geochemical Model Validation** – What is the minimum number of "published and widely accepted case studies" to which the geochemical model will be compared in order to validate it? Is this number based on any sort of standard? If so, what standard?

    Several modeling case studies are presented in the Nordstrom and Nicholson (2017) reference provided in the reference section of the Work Plan for Leaching Analysis. Other references to geochemical and hydrologic modeling are provided in the INAP GARD guide (http://gardguide.com/index.php?title=Main_Page). These peer-reviewed modeling studies will be consulted, and relevant modeling results will be compared to calibration and base case predictive simulations for the Site. There are six to 10 published studies referenced in the aforementioned summary references that have modeling components that are directly relevant for comparison depending upon professional judgment.

21. **Section 3.1 Hydro Pit Scenarios** – During project meetings, it has been suggested that all tailings (about 1.6 million cubic yards) will be placed in the Hydro Pit (approximately 2 million cubic yards of total containment volume). This equates to a blend of 80 percent tailings to 20 percent waste rock. Section 3.1 does not list 80/20 as one of the modeling scenarios, but it does list 85/15. Should 85/15 be changed to 80/20, or is 85/15 considered sufficiently representative (for modeling purposes) of the all-tailings-in-Hydro Pit containment scenario? Furthermore, the consideration of modeling scenarios

with a lower percentage of tailings suggests that it is possible that one of those alternatives could be selected based on modeling results, in which case not all tailings would be placed into the Hydro Pit. Will the modeling scenarios for the Hulin and A-B Pits include a percentage of tailings to account for scenarios in which not all tailings are contained in the Hydro Pit? If not, how would tailings that are not placed into the Hydro Pit be managed?

The 85/15 to 90/10 apportionment of tailings to waste rock volumes deposited in the Hydro Pit represents the currently favored range according to reclamation designers. Current projections indicate that the entire volume of tailings can be placed into the Hydro Pit at this ratio range. However, other model scenarios using other relative percentages will be developed for sensitivity analysis. Scenarios with greater waste rock than tailings will not be tested as they are not relevant to the current reclamation plan.

22. **Section 4.0 Leaching Analysis Report** – This section indicates that the Leaching Analysis Report will include a final summary of the results, findings, and conclusion on the Hydro Pit reclamation approach and backfill design. What about for the Hulin and A-B Pits?

The report will also include the same summary of results, findings, and conclusions on the Hulin and A-B Pits as well as deep fill areas and will follow the NDEP modeling guidance (BMRR 2018a,b,c references in the 2021 Leaching Analysis Draft Workplan). Section 4.0 has been edited to reflect this.

Appendix B

Well Logs

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

Please complete this form in its entirety

PRINT OR TYPE ONLY

OFFICE USE ONLY
Log No. 35212
Permit No. 55268
Basin 212

NOTICE OF INTENT NO. 5222

1. OWNER Three Kids Partnership
MAILING ADDRESS 3624 Goldfield St.
N. Las Vegas, Nev. 89030

ADDRESS AT WELL LOCATION

2. LOCATION lot 3 ¼ ¼ Sec. 26 T. 21 N/S R. 63 E Clark County

PERMIT NO. 55268 (Issued by Water Resources) Parcel No. Subdivision Name

3. TYPE OF WORK
New Well ☒ Recondition ☐
Deepen ☐ Other ☐

4. PROPOSED USE
Domestic ☐ Irrigation ☐ Test ☒
Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL
Cable ☐ Rotary ☒
Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
Sandy black volcanic rock		0	47	47
brown hard silty clay		47	85	38
gray sandstone & black silty mixture		85	152	67
sand, gravel, clay conglomerate		152	230	78
yellow clay sand gravel		230	260	30
cemented gravel		260	293	45
red clay sand & gravel		293	315	22
yellow " " "		315	325	10
balck cemented rock		325	435	110
gravel conglomerate		435	690	255
cemented conglomerate	720	690	720	30
yellow sandstone		720	735	15
cemented green brittle stone	770	735	827	92
green stone & quartz-type	825	827	835	8
stone	866	835	860	25
red sandstone	970	860	1005	145
green brittle stone	1010	1005	1100	95

Date started Jan. 2, 19 91
Date completed Jan. 30, 19 91

7. WELL TEST DATA

Pump RPM	G.P.M.	Draw Down	After Hours Pump

RECEIVED
FEB 12 1991
Div. of Water Resources
Branch Office - Las Vegas, NV

BAILER TEST
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours
G.P.M. .... Draw down .... feet .... hours

8. WELL CONSTRUCTION
Diameter 10 inches Total depth 1100 feet
.... inches
.... inches
Casing record
Weight per foot .... Thickness

Diameter	From	To
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☐ No ☐ Type
Depth of seal .... feet
Gravel packed: Yes ☐ No ☐
Gravel packed from .... feet to .... feet

Perforations:
Type perforation
Size perforation
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet
From .... feet to .... feet

9. WATER LEVEL
Static water level .... feet below land surface
Flow .... G.P.M. .... P.S.I.
Water temperature .... °F Quality

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name Allen Drilling, Inc. (Contractor)
Address 4847 So. Valley View Blvd. (Contractor)
Nevada contractor's license number issued by the State Contractor's Board 0018917
Nevada contractor's driller's number issued by the Division of Water Resources 1301
Nevada driller's license number issued by the Division of Water Resources, the on-site driller 1661
Signed [signature] By driller performing actual drilling on site or contractor
Date 2-8-91

WHITE—DIVISION OF WATER RESOURCES
CANARY—CLIENT'S COPY
PINK—WELL DRILLER'S COPY

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STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

OFFICE USE ONLY
Log No. 82441
Permit No. 66108
Basin 212

NOTICE OF INTENT NO. 21635

1. OWNER PAUL ADDI/DAVID GROSSHEIM
MAILING ADDRESS 2319 E. LAKE MEAD DR.
HENDERSON, NV 89014

ADDRESS AT WELL LOCATION 2310 Lake Mead Dr. Henderson

2. LOCATION NE ¼ NW ¼ Sec. 35 T 21 N/S R 63 E CLARK County
PERMIT NO. 66108 (Issued by Water Resources) 160-35-101-004 (Parcel No.) Subdivision Name

3. WORK PERFORMED
☒ New Well ☐ Replace ☐ Recondition ☐ Deepen ☐ Abandon ☐ Other

4. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test ☒ Municipal/Industrial ☐ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☒ Rotary ☐ RVC ☒ Air ☐ Other

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
LOOSE GRAVEL		0	15	15
RED CLAY		15	40	25
CEMENTED GRAVEL		40	390	350
RED CLAY		390	410	20
LIMESTONE		410	470	60
RED CLAY		470	480	10
CEMENTED GRAVEL	X	480	520	40
LIMESTONE	X	520	600	80

MAR 14 2001

Date started 2/8/01, XX
Date completed 2/13/01, XX

7. WELL TEST DATA

TEST METHOD: ☐ Bailer ☐ Pump ☐ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)

8. WELL CONSTRUCTION

Depth Drilled 600 Feet Depth Cased 600 Feet

HOLE DIAMETER (BIT SIZE)

Inches	From (Feet)	To (Feet)
11	0	600

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
6 5/8	12.9	.188	+1	600

Perforations:
Type perforation SAW
Size perforation 1/8 X 3 6 ROWS
From 520 feet to 580 feet

Surface Seal: ☒ Yes ☐ No
Depth of Seal 50
Placement Method: ☐ Pumped ☒ Poured
Seal Type: ☐ Neat Cement ☐ Cement Grout ☒ Concrete Grout

Gravel Packed: ☒ Yes ☐ No
From 50 feet to 600 feet

9. WATER LEVEL

Static water level 160 feet below land surface
Artesian flow G.P.M. P.S.I.
Water temperature °F Quality

10. DRILLER'S CERTIFICATION

This well was drilled under my supervision and the report is true to the best of my knowledge.

Name WATER WELL SERVICES (Contractor)
Address 6475 GARY AVE. (Contractor)
LAS VEGAS, NV 89139

Nevada contractor's license number issued by the State Contractor's Board 22311B

Nevada driller's license number issued by the Division of Water Resources, the on-site driller 1594

Signed [signature] By driller performing actual drilling on site or contractor

Date 2/20/01

(Rev. 3-91) USE ADDITIONAL SHEETS IF NECESSARY (O)-627

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Log No. 111218
Permit No.
Basin

STATE OF NEVADA
DIVISION OF WATER RESOURCES
WELL DRILLER'S REPORT

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Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

NOTICE OF INTENT NO. 33613

1. OWNER Clark County
MAILING ADDRESS 500 S, Grand Central Pkwy
Las Vegas, NV 89115

ADDRESS AT WELL LOCATION
Subdivision Name: County: Clark

2. LOCATION NW ¼ NW ¼ Sec 35 T 21S N/S R 63 E
PERMIT/WAIVER No. (Issued by Water Resources) 160-35-199-002 Parcel No.

Latitude 36.08542 UTM E 851966.03 ☐ NAD 27
Longitude -114.9211 N 26737087.85 ☒ NAD 83/WGS 84

3. WORKED PERFORMED
☒ New Well ☐ Replace ☐ Recondition
☐ Deepen ☐ Other

4. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☒ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☐ Rotary ☐ RVC
☐ Air ☒ Other core

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
Sand		0	8	8
Silty Gypsum-white to pale				
yellow brown,very fine to fine				
grained, extremely weak		8	16	8
Sandstone/siltstone-very fine to				
fine grained,weak mod weathered		16	25	9
Silty Gypsum-lt brown to gray				
some fine grained sand, weak		25	41	16
Sandstone/siltstone-pale brn.				
weak,fine grained		41	53	12
Gypsum-silty, lt brown to gray				
mod weak to strong, sand		53	111	58
Siltstone-lt brownish gray,weak		111	116	5
gypsum-lt yellowish gray to pale				
olive, mod strong,		116	121	5
Siltstone/gypsum-olive gray,				
weak,some silt/sand		121	141	20
Siltstone-weak,very fine to fine,		141	208	67
Sandstone/siltstone- lt brown				
to med brown, fine to med.grain				
weak, some clay		208	219	11
Dacite-pale greenish yellow to				
pale orange,weak,porous		219	270	51

Date started: 25-Mar , 20 2008
Date completed: 4-Apr , 20 2008

9. WELL CONSTRUCTION
Depth Drilled 270 Feet Depth Cased Feet

HOLE DIAMETER (BIT SIZE)

	From	To
6 inches	0 Feet	270 Feet
inches	Feet	Feet
inches	Feet	Feet

CASING SCHEDULE

Size O.D. (inches)	Weight/Ft. (Pounds)	Wall Thickness (inches)	From (Feet)	To (Feet)
1.5"		Sch. 40	0	253

Perforations:
Type of perforation Slotted PVC
Size of perforation 10-slot
From 253 feet to 270 feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

Annular Seal: ☒ Yes ☐ No
☐ Neat Cement to ☐ Pumped ☐ Poured
☒ Cement Grout 0 to 250 ☐ Pumped ☒ Poured
☐ Concrete Grout to ☐ Pumped ☐ Poured
☐ ≥30% Bentonite Grout to ☐ Pumped ☐ Poured
Gravel Pack: ☒ Yes ☐ No 253 to 270 ☐ Pumped ☒ Poured
Type: 10 -- 20
Bentonite Chips: ☒ Yes ☐ No 250 to 253 ☐ Pumped ☒ Poured
Type:

7. *Water Level*
Static water level: n/a feet below land surface
Artesian Flow: G.P.M. P.S.I.
Water Temperature: °F
Quality:

8. WELL TEST DATA
TEST METHOD: ☐ Bailer ☐ Pump ☐ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name Crux Subsurface, Inc.
Contractor
Address 16707 E. Euclid Ave., Spokane Valley, WA 99216
Contractor

Nevada contractor's license number issued by the State Contractor's Board 0060707
Nevada driller's license number issued by the Division of Water Resources, the on-site driller m-2314

Signed [signature]
By driller performing actual drilling on site or contractor
Date 2/24/2010

USE ADDITIONAL SHEETS IF NECESSARY

(Rev 08-09)

STATE OF NEVADA
DIVISION OF WATER RESOURCES
WELL DRILLER'S REPORT

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Permit No.
Basin

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Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

NOTICE OF INTENT NO. 33614

1. OWNER USA - US Government
MAILING ADDRESS Washington, DC

ADDRESS AT WELL LOCATION
Subdivision Name: County: Clark

2. LOCATION SW ¼ NE ¼ Sec 34 T 21S N/S R 63 E
PERMIT/WAIVER No. _____ (Issued by Water Resources) 160-35-101-008 Parcel No.

Latitude 36.08169 Longitude -114.92749
UTM E 8500073.62 ☐ NAD 27
N 26735717.82 ☒ NAD 83/WGS 84

3. WORKED PERFORMED
☒ New Well ☐ Replace ☐ Recondition ☐ Deepen ☐ Other

4. PROPOSED USE
☐ Domestic ☐ Irrigation ☐ Test ☐ Municipal/Industrial ☒ Monitor ☐ Stock

5. WELL TYPE
☐ Cable ☐ Rotary ☐ RVC ☐ Air ☒ Other core

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
sand		0	4	4'
Claystone-reddish orange to reddish brown,very fine to med very weak, slightly weathered		4	12	8
Sandstone- reddish orange, fresh very weak to fiable, silt to sand		12	13	1
Congomerate-med brown, fine to coarse grained, very weak		13	90	77
Claystone/sandstone-reddish orange to reddish brown, fresh very weak, low hardiness		90	159	69
Siltstone/sandstone-brown/gray		159	167	8
Siltstone-pale brown		167	181	14
Sandstone-pale reddish brown		181	186	5
Silstone-reddish brown/gray		186	191	5
Siltsone-gray,light and porous		191	200	9
Sandstone-pale reddish brown		200	206	6
Siltstone/Claystone- reddish		206	223	17
Sandstone-pale brown		223	229	6
Claystone/Siltstone-reddish brn		229	236	7
Siltstone/sandstone-lt brown		236	281	45
Siltstone-lt gray,porous		281	291	10
Claystone/sandstone- reddish orange to reddish brown,		291	402	111
Siltstone-reddish brown, thinly embedded gypsum		402	411	9

Date started: 6-Apr , 20 2008
Date completed: 9-Apr , 20 2008

9. WELL CONSTRUCTION
Depth Drilled 408 Feet Depth Cased Feet

HOLE DIAMETER (BIT SIZE)

Inches	From (Feet)	To (Feet)
6	0	411

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
1.5"		Sch. 40	0	390

Perforations:
Type of perforation Slotted PVC
Size of perforation 10-slot
From 390 feet to 411 feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

Annular Seal: ☒ Yes ☐ No
☐ Neat Cement ___ to ___ ☐ Pumped ☐ Poured
☒ Cement Grout 0 to 383 ☒ Pumped ☐ Poured
☐ Concrete Grout ___ to ___ ☐ Pumped ☐ Poured
☐ ≥30% Bentonite Grout ___ to ___ ☐ Pumped ☐ Poured
Gravel Pack: ☒ Yes ☐ No 390 to 411 ☐ Pumped ☒ Poured
Type: 10 – 20
Bentonite Chips: ☒ Yes ☐ No 383 to 390 ☐ Pumped ☒ Poured
Type:

7. *Water Level*
Static water level: n/a feet below land surface
Artesian Flow: G.P.M. P.S.I.
Water Temperature: °F
Quality:

8. WELL TEST DATA
TEST METHOD: ☐ Bailer ☐ Pump ☐ Air Lift

G.P.M.	Draw Down (Feet Below Static)	Time (Hours)

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name Crux Subsurface, Inc (Contractor)
Address 16707 E. Euclid Ave.,Spokane Valley, WA 99216 (Contractor)

Nevada contractor's license number issued by the *State Contractor's Board* 0060707
Nevada driller's license number issued by the Division of Water Resources, the on-site driller m-2314

Signed [signature] (by driller performing actual drilling on site or contractor)
Date 2/24/2010

(Rev. 05-08)

USE ADDITIONAL SHEETS IF NECESSARY

STATE OF NEVADA
DIVISION OF WATER RESOURCES
WELL DRILLER'S PLUGGING REPORT

OFFICE USE ONLY
Log No. 111253
Permit No.
Basin

PRINT OR TYPE ONLY
DO NOT WRITE ON BACK

Please complete this form in its entirety in accordance with NRS 534.170 and NAC 534.340

NOTICE OF INTENT NO. 35298

1 OWNER U.S.A.
MAILING ADDRESS Washington DC

ADDRESS AT WELL LOCATION Henderson
RMT3-125
Subdivision Name: *County:* Clark

2 LOCATION NW ¼ NW ¼ Sec 35 T 21S *N/S* R 63 *E*
PERMIT/WAIVER No. 160-35-101-008
Issued by Water Resources *Parcel No.*

Latitude 36.05568
Longitude 114.56575
UTM E
N
☐ NAD 27
☒ NAD 83/WGS 84

3 TYPE OF WELL
☐ Domestic ☐ Irrigation ☐ Test
☐ Municipal/Industrial ☒ Monitor ☐ Stock

Is this well being plugged because a replacement well was drilled? No
If yes, what is replacement well NOI?

Is there an existing well log? No
If yes, what is NDWR well log #?

4 *EXISTING WELL CONSTRUCTION*
Depth Drilled N/A Feet Depth Cased 408 Feet

EXISTING CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
1.900		Sch 40	0	408

Existing Perforations:
Type of perforation N/A
Size of perforation
From feet to feet
From feet to feet
From feet to feet
From feet to feet
From feet to feet

5 *WATER LEVEL*
Static water level 81.1 feet below land surface
Artesian flow G.P.M. P.S.I
Water temperature °F Quality

6 Additional Notes or Comments

Pressure grout well, drilled out upper 5' concrete cap.

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LAS VEGAS OFFICE

7 WELL PLUGGING PROCEDURE
Was well cleaned out to total depth? ☒ yes ☐ no
If well was not cleaned out to total depth, please explain why:

Was the well contaminated? ☐ yes ☒ no
Was the casing pulled? ☐ yes ☒ no
Was the casing over drilled? ☒ yes ☐ no
If casing was left in place, please show where additional perforations were made:
Additional Perforations:
Type of perforater used: n/a
From feet to feet Number of perfs per linear foot
From feet to feet Number of perfs per linear foot
From feet to feet Number of perfs per linear foot
From feet to feet Number of perfs per linear foot
From feet to feet Number of perfs per linear foot
From feet to feet Number of perfs per linear foot

8 WELL PLUGGING MATERIALS

From	feet to	Material Used	Pumped	Poured
1	408	Bentonite Grout	☒	☐
0	1	Concrete	☐	☒
			☐	☐
			☐	☐
			☐	☐
			☐	☐

Neat Cement Fluid Weight lbs/gal
Bentonite Grout 20 % bentonite
Date Started 5/5/2010
Date Completed 5/5/2010

9 DRILLER'S CERTIFICATION
This well was plugged and abandoned under my supervision and the report is true to the best of my knowledge.
Name WDC Exploration & Wells
Contractor
Address 570 Corinthian Way
Contractor
N. Las Vegas, NV, 89030
Nevada contractor's license number issued by the *State Contractor's Board* 0012852
Nevada driller's license number issued by the Division of Water Resources, the on-site driller M-2381
Signed [signature]
By driller performing actual drilling on site or contractor
Date 5-10-10

(Rev. 05-06)

USE ADDITIONAL SHEETS IF NECESSARY