FACT SHEET

(Pursuant to Nevada Administrative Code [NAC] 445A.401)

Permittee Name:	**STC (Schlumberger Technology Corporation)**
Project Name:	**Clayton Valley Rapid Infiltration Basins**
Permit Number:	**NEV2022101**
Review Type/Year/Revision:	**New Permit 2023, Fact Sheet Revision 00**

A. Location and General Description

Location: The Clayton Valley Rapid Infiltration Basins (RIBs) is a water management facility located in Esmeralda County, approximately 3 miles southeast of the town of Silver Peak, Nevada. The RIBs and associated monitoring wells are on public land administered by the U.S. Bureau of Land Management (BLM), Tonopah Field Office. The legal land description for the proposed activity is Section 29, Township 2 South (T2S), Range 40 East (R40E), Mount Diablo Baseline and Meridian.

Site Access: The Project Area can be accessed from Tonopah, Nevada, by traveling approximately 34 miles west on United States Highway-95 (US-95), turning south onto Nevada State Road SR-265, traveling approximately 20 miles to the town of Silver Peak and continuing south on Lida Wash Road (Esmeralda County Right-of-Way N-92359) for approximately another 5 miles to an unnamed road, turning east and traveling approximately 3 miles to the Project Area.

General Description: STC (Schlumberger Technology Corporation) intends to employ a Direct Lithium Extraction (DLE) process in their pilot facility (Water Pollution Control Permit [WPCP] NEV2020114) to recover lithium from brines and produce either a lithium carbonate and/or lithium hydroxide monohydrate concentrate without the need for conventional evaporation ponds. Although this technology has been successfully demonstrated on a bench-scale; it has yet to be proven on a pilot or commercial scale. A benefit of the DLE process is the anticipated significant reduction in water consumption when compared to conventional brine evapo-concentration methods.

The pilot facility is anticipated to operate intermittently over an 18-month period, during which time the DLE process may be modified by STC to optimize recoveries. The Nevada Division of Water Resources (NDWR) has limited STC to pump no more than 50 acre-feet of brine solution in total. Any increase above this volume will require STC to negotiate additional water rights from NDWR. In addition, unlike other types of WPCPs issued by the Division, RIB permits cannot be modified to accommodate any requested increases in volume of water discharged to the RIB. Therefore, if an increase in discharge is requested, STC is required to submit an updated groundwater flow model incorporating any new data along with a revised application and fee for a new WPCP.

Lithium-depleted brine (e.g., "spent" brine) from the DLE process will be returned to the Clayton Valley Aquifer via the rapid infiltration basins (RIBs). STC is authorized to discharge up to 116 gallons per minute, 168,000 gallons per day, and 50-acre feet in total, of spent brine solution into the RIBs. A limited exemption from the water quality standards allows the discharge of spent brine solution with a constituent concentration no more than 10% or 2-standard deviations; whichever is greater, above the maximum concentration of samples collected analyzed, and reported from Brine Source Well CV-9.

In the event the depleted brine fails to meet the above discharge criteria after additional treatment or the RIB does not infiltrate as predicted, STC can utilize the three double-lined tanks (two-2.52 million gallons and one 378,000 gallon) at the pilot plant site (WPCP NEV2020114) to store and evaporate the spent brine prior to final disposition. Should the pilot operation prove successful, STC's long-term plans include the construction and operation of a large-scale extraction program and production facility with underground injection of spent brine back to the Clayton Valley Aquifer. Underground injection will need to be permitted under the purview of the Bureau of Water Pollution Control-Underground Injection Control (UIC) Program.

Specific Facility Conditions and Limitations: In accordance with operating plans and facility design plans reviewed and approved by the Division, STC is permitted to construct, operate, and close the Rapid Infiltration Basins in accordance with those plans.

Schedule of Compliance (SOC) items have been incorporated into WPCP NEV 2022101 to address any uncertainty in the water quality of the pilot plant discharge solution stream prior to discharge into the RIBs. SOC I.B.1 states that prior to the initial operation of the RIBs, the Permittee (STC) shall perform testing and analysis to compare specific parameter concentrations to discharge standards in Section I.G of the WPCP. STC must demonstrate through testing, analysis and reporting the spent brine tank discharge solution generated from the operation of the pilot facility (WPCP NEV 2020114) meets parameters in Sections I.D and I.G of the WPCP prior to discharge to the RIBs.

STC will operate the pilot facility to gather multiple samples from CV-9. Spent brine will be discharged to the double-lined above ground storage tanks. After the process has stabilized, <u>at least</u> three-acre ft of spent brine shall be accumulated in the above ground storage tanks and an aggregate sample will be taken from within the tank (the "Tank Discharge Sample" or TD) to determine suitability for discharge. The 3-acre-ft was chosen to consider any variation from CV-9 brine concentrations and provide more representative samples. The most likely adjustments after stabilization/steady-state is reached would be small increases in temperature and internal pumping rates with the aim at increasing lithium extraction efficiency (the front end of the process). After the impurity removal is optimized, the character of the spent brine is not expected to change except with variation from the source brine itself.

Profile I, Sulfites, and TOCs will be measured in the TD sample. Bench scale testing has shown that the two organics proposed for use can potentially increase in TOC concentrations when added to brine. The operation of the GAC Circuit (granular-activated carbon) will remove any residual TOCs. There are no plans to use any VOCs or SVOCs on site except as diesel fuel. The diesel is segregated in a separate containment area and is only used to power the generators. There is nothing within the process that could cause an increase in VOCs or SVOCs. All samples will be analyzed by a Nevada-certified lab and will follow chain of custody and other applicable protocols.

- For the Profile I analysis, the maximum value of constituents within the TD shall be no more than 10% above the maximum value of the samples collected, analyzed, and reported from CV-9.
- For TOCs and Sulfites, the TD shall contain no more than the maximum value in samples collected from CV-9.
- Prior to discharge, STC will compare the tanked brine to the natural maximum values measured in the CV9 samples to ensure the discharge is within 10% of the maximum values collected from the sampling campaign.
- The maximum value of CV-9 will be determined by samples taken on a rolling basis for two weeks on a twice daily basis from the initiation of pilot plant operation. The maximum value of the constituents from those samples will be used as the "measuring stick" or "point of reference" against which the proposed discharge will be compared as outlined in the WPCP.
- These criteria consider natural variations in the native brine and the response of the process due to those natural variations.
- TD meeting these criteria shall be authorized for discharge to the RIBs and the Schedule of Compliance (SOC) Item shall be considered complete.
- TD not meeting the above criteria shall not be discharged to the RIBs and must be either retreated to meet the above-mentioned criteria or evaporated.

SOC I.B.6 states that should STC propose to increase surface discharge and/or groundwater pumping rates, they will be required to submit a new Permit application and a new, full-scale numerical groundwater flow model as a pre-application review document with a $1500 fee for Division review and approval. The numerical model will allow for 3D simulation of groundwater flow paths and a greater degree of complexity to be incorporated in the model framework, thus permitting a better understanding of impacts to surface and groundwater resources and nearby receptors.

The Division-approved code (https://ndep.nv.gov/uploads/land-mining-regs-guidance-docs/20210830_BMRR_CodesListing_Rev01_ADA.pdf) will be used to construct the flow model. Additionally, the numerical model must incorporate basin-scale climate (precipitation, evapotranspiration, etc.), nearby surface water features, geology, hydraulic stresses, steady-state and transient calibration, and any other aquifer testing as deemed necessary by the Division. This pre-application predictive model submittal requirement has been incorporated into WPCP NEV2022101, Part

I.B as an SOC item. If the model results are determined to be acceptable and approved by the Division, STC will then be required to submit a new WPCP application and fee for review and approval.

Except for the limited discharge and exemption granted pursuant to Nevada Administrative Code (NAC) 445A.424 and authorized by the WPCP NEV2022101 and any other approved uses, STC must contain within the fluid management system all lithium-depleted brine ("spent brine") and all meteoric waters that enter the system as a result of the 100-year, 24-hour storm event. In addition, STC must not release or discharge any contaminants from the fluid management system that would result in degradation of waters of the State or impact the current designated industrial beneficial use, subject to the limited exemption provided for in WPCP NEV2022101 and pursuant to NAC 445A.424 and the rationale for the exemption as explained further in this Fact Sheet.

Justification for issuance of WPCP NEV2022101 and the temporary exemption is fact specific. It is not intended to serve, and its issuance will not be used as precedent for future exemption requests for discharges in this basin or any other basin in the State of Nevada.

B. Synopsis

Geology: The basement rock of Clayton Valley consists of late Neoproterozoic to Ordovician carbonate and clastic rocks that were deposited along the ancient western passive margin of North America. During late Paleozoic and Mesozoic orogenies, the region was shortened and subjected to low-grade metamorphism, and granitoids were emplaced at about 155 and 85 million years ago (Ma). Extension commenced at approximately 16 Ma and has continued to the present, with changes in structural style as documented in the Silver Peak-Lone Mountain Extensional Complex. A metamorphic core complex just west of Clayton Valley was exhumed from mid-crustal depths during Neogene extension. There is a Quaternary cinder cone and associated basaltic lava flows in the northwest part of the basin.

The basin is bounded to the east by a steep normal fault system toward which basin strata thicken. These basin-filling strata compose the aquifer system which hosts and produces the lithium-rich brine. The north and east parts of Clayton Valley are flanked with Miocene to Pliocene sediments containing multiple primary and re-worked volcanic ash deposits within fine-grained clay and silt units. These deposits are a part of the Esmeralda Formation, a sedimentary sequence grading from coal-bearing siltstones, sandstones and conglomerates at the base to fine-grained, tuffaceous lacustrine sediments at the top of the section.

The presence of travertine (a variety of limestone or calcium carbonate) deposits which occur in the northeast part of the valley, as well as the west and central parts of the valley are evidence of past hot spring activity on the valley floor. At the base of Paymaster Canyon, gravity and seismic surveys have been conducted to map the

Weepah Hills detachment fault and reveal the presence of tuff at depth coincident with a geothermal anomaly.

Hydrology: The Project is located on the eastern side of Clayton Valley, Esmeralda County, Nevada. Clayton Valley is a closed hydrographic basin, approximately 29 miles in length and approximately 19 miles in width. The Clayton Valley hydrographic basin is internally drained, and the approximate area of the topographically closed basin is 555 square miles, or 355,200 acres. There is no permanent, naturally occurring surface water in the basin. Watercourses in the basin are generally ephemeral and flow only during periods of intense precipitation. The nearest mapped channel is an ephemeral drainage located over 1,000 feet south of the STC's pilot facility and RIBs. The channel is dry with limited signs of vegetation and evidence of dispersed, overland flow as opposed to channelized flow. This channel is classified as an intrastate, isolated aquatic resource with no apparent interstate or foreign commerce connection.

Recharge to the basin from surface water occurs by precipitation and runoff, controlled by the ephemeral streams in alluvial washes and at mountain fronts. Recharge via groundwater to the basin is from Big Smoky Valley inflow and to a lesser extent, inflows from Alkali Springs Valley, and potentially from Fish Lake Valley and Lida Valley basins. Since Clayton Valley is a closed basin, outflow is solely from evapotranspiration occurring in the lowland areas of the valley.

Groundwater flows from the higher elevations toward the center of the valley with steeper gradients in the mountains and extremely flat gradients across the playa. The lowest groundwater elevations based on available data are between 4080 and 4110 feet above mean sea level (ft amsl) and generally occur in the vicinity of the evaporation ponds associated with a neighboring lithium brine extraction facility. Groundwater extraction for this neighboring facility is believed to further contribute to the already internally draining nature of the basin by lowering the groundwater in the playa.

Basin Water Use: Nevada Groundwater Pumping Inventory from 2017 reports that 8,802 acre-ft per annum (AFA) were extracted from Clayton Valley in 2017, with 8.387 AFA (95.3 percent) used for mining and milling, 408 AFA (4.6 percent) used for municipal or quasi-municipal supply, and 6 AFA (less than 0.1 percent) used for livestock.

A hydrographic area summary report indicates there is 23,908 AFA allocated for the Clayton Valley Basin (Hydrographic Area-143). Of this volume, 23,281 AFA were allocated to mining and milling (97.4 percent), 589 AFA (2.5 percent) allocated to municipal or quasi-municipal use, and 38 AFA (less than 0.1 percent) allocated for livestock. Assuming similar usage and approved usage rates in 2021 as compared to 2017, only 36 percent of the groundwater was extracted.

There are no known domestic water users downgradient of the STC project area, drinking water for the town of Silver Peak is obtained from wells located upgradient of the playa floor within the Silver Peak Range to the west and Weepah Hills to the north of Clayton Valley.

Exploration Well Background Groundwater Quality: During an earlier exploration program, Pure Energy constructed eight exploration wells (CV-1 through CV-9 and CV-MW1) within the Project Area. Detailed well completion information was provided for each well and can be found in "*Clayton Valley Pilot Plant—Discharge Water Pollution Control Application, April 4, 2022, Attachment B, Section 5.0—Hydrogeology*". Two of the wells, CV-1 and CV-3, were within the footprint of the pilot facility. Depth to groundwater in the Project Area is estimated to be approximately 40 to 56 feet below ground surface (ft bgs). In May 2020, STC drilled a new exploration well CV-9 within the footprint of the pilot plant facility and monitoring well CV-MW1 in September 2021. Depth to groundwater measured in CV-9 was approximately 46 ft bgs, depth to groundwater at CV-MW1 was approximately 41 ft bgs. Wells CV-7 through CV-9 are active, with CV-9 designated as the brine source well.

Water quality samples were collected by Pure Energy at exploration wells CV-1 through CV-8 in 2016 and 2017 at depths ranging from 250 to 2,800 ft bgs. Water quality samples were collected by STC from CV-9 in 2020 and 2021 at depths ranging from 600 to 1,500 ft bgs. The samples for shallow monitoring well CV-MW1 were taken in 2021 at depths ranging from 41 to 50 ft bgs.

Each of the samples included analyses for major ions, which suggest the water predominantly contains sodium and chloride typical of brines. Profile I analytical results for these wells are presented in ***Table 1--Average Exploration and Monitoring Well Brine Compositions***. The TDS concentrations in the representative water samples ranged from 3,000 to 170,000 milligrams per liter (mg/L). Groundwater at CV-4, CV-5, and CV-6 located to the south of the Project Area contains less than 10,000 mg/L TDS. Groundwater at CV-MW1 also contains less than 10,000 mg/L TDS. Groundwater at CV-2 exhibits TDS greater than 10,000 mg/L, and groundwater at CV-1, CV-3, CV-7, CV-8, and CV-9 exhibits TDS greater than 35,000 mg/L in the representative samples. Closest to the Project Area, samples from CV-1, CV-3, and CV-9 have Profile I exceedances for chloride (65,000 to 66,700 mg/L), iron (0.964 mg/L), magnesium (460 to 510 mg/L), manganese (2.4 to 5.15 mg/L), sulfate (2,680 to 4,800 mg/L), and TDS (92,400 to 110,000 mg/L).

Once constructed, a groundwater sample will be collected from monitoring well CV-MW2 to establish background. An SOC item in the Permit requires the submittal of the Profile I analytical results from CV-MW2 to the Division for review prior to commencing Pilot Plant operations.

Brine Extraction and Recovery: Brine extraction and recovery are discussed in greater detail in STC's *"Clayton Valley Pilot Plant Project Mining Water Pollution*

Control Permit Application, WPCP NEV2020114". Brine source well, CV-9, will be the primary source of brine to the facility. Brine will be pumped at a maximum 116 gpm (186,000 gpd and 50-acre ft in total) filtered for solids and pumped into seven 21,000-gallon storage tanks within the Pilot Plant facility in preparation for extraction and recovery.

Table 1—Average Exploration Well Brine Compositions (mg/L unless otherwise indicated)

Analyte	NDEP Profile I	CV-MW1	CV-1	CV-2	CV-3	CV-4	CV-5	CV-6	CV-7	CV-8	CV-9
Alkalinity, HCO_3 (as $CaCO_3$)	-	94	--	--	--	--	--	--	--	--	149
Alkalinity, Total (as $CaCO_3$)	-	94	--	--	--	--	--	--	--	214	149
Aluminum	0.2	<0.05	<2.0*	<0.045	<0.9*	<0.045	<0.045	<0.045	1.46**	<0.8*	5.65
Antimony	0.006	<0.0025	--	--	--	--	--	--	--	--	<0.02
Arsenic	0.01	0.0058	<0.2*	<0.03*	<0.6*	0.04**	0.11**	<0.005	<0.8*	<0.8*	0.186
Barium	2.0	0.13	<0.25	0.14	<0.2	<0.01	<0.01	0.16	0.546	0.308	0.152
Beryllium	0.004	<0.001	<0.05*	<0.001	<0.02*	<0.001	<0.001	<0.001	<0.02*	<0.02*	<0.02*
Cadmium	0.005	<0.001	--	--	--	--	--	--	--	--	<0.001
Calcium	-	180	870	1100	1580	15	6.9	210	4770	910	1061
Chloride	400	1600**	65000**	11000**	66700**	180	71	1200**	32300**	42400**	72256**
Chromium	0.1	<0.005	<0.15*	<0.005	<0.1	<0.005	<0.005	<0.005	<0.1	<0.1	<0.10
Copper	1.0	<0.04	1.0	--	--	--	--	--	--	--	<0.80
Fluoride	4.0	3.6	<50*	<10*	<25*	1.3	3.9	<1.0	<20*	<40*	<50*
Iron	0.6	<0.1	<1.0*	0.32	0.96**	0.037	0.024	0.064	4.53**	0.7**	7.0**
Lead	0.015	<0.0025	--	--	--	--	--	--	--	--	0.00233
Magnesium	150	32	460**	130	510**	0.88	<0.5	11	747**	92	505**
Manganese	0.1	0.031	2.4**	1.9**	5.15**	0.037	0.0064	0.17**	4.53**	2.26**	4.57**
Mercury	0.002	<0.00045	--	--	--	--	--	--	--	--	<0.005*
Nitrate + Nitrite (as N)	10	--	--	n--	--	--	--	--	--	--	<0.1
Nitrogen, Total (as N)	10	--	--	--	--	--	--	--	--	--	0.49
pH (S.U.)	6.5-8.5	7.78	7.41	7.39	7.37	8.07	8.32	7.55	7.04	7.79	7.29
Potassium	-	91	4300	620	2320	7.8	8.5	53	660	490	3556
Selenium	0.05	--	--	--	--	--	--	--	--	--	<0.01
Silver	0.1	--	--	--	--	--	--	--	--	--	<0.001
Sodium	-	690	38000	7000	34300	180	130	720	11700	25000	42578
Sulfate	500	60	4800**	520**	2680**	25	18	62	1850**	863**	3943**
Thallium	0.002	<0.001	--	--	--	--	--	--	--	--	0.0037**
Total Dissolved Solids	1000	3000**	110000**	18000**	92400**	540	430	2600**	54800**	--	107800**
Uranium	0.01	--	--	--	--	--	--	--	--	--	<0.001
WAD Cyanide	0.2	<0.01	--	--	--	--	--	--	--	--	<0.01
Zinc	5.0	<0.02	0.67	0.3	1.23	<0.01	<0.01	0.011	<0.4	<0.4	0.72

**Method Detection Limit is Above NDEP Profile I Reference Values*
***Exceed NDEP Profile I Reference Values*

Reagents added during the Brine Extraction and Recovery process include hydrochloric acid, sodium hydroxide, iron (III) chloride, sodium hypochlorite, sodium bisulfite, an organic scale inhibitor, and an organic flocculant polymer. Both the scale inhibitor and flocculant are commonly used in water treatment. There are several process steps and several recycle loops within the Pilot Plant to optimize lithium recovery, conservation of water, and removal of any residual reagents prior to spent brine discharge to the tanks and RIBs:

1. *Brine Pre-treatment:* The brine produced from CV-9 well has a pH measured at the surface of~ 7.4. The optimum pH for the brine pre-treatment process is 5.5 - so the brine is pH corrected (with hydrochloric acid solution) before being subjected to the pre-treatment process. The pre-treatment process uses a lithium selective sorbent material to remove lithium from CV-9 brine and transfer it to a freshwater solution.

2. *Metal and Silicate Removal:* Metals and silicates must be removed from the lithium rich stream to protect the membranes in the Lithium Concentration step and ensure product quality in the Precipitation Step. Iron (III) chloride solution is added as a coagulating agent and sodium hypochlorite (i.e., bleach) is added to oxidize and precipitate transition metals. Sodium hydroxide (caustic) is added to increase the pH and drive solids precipitation. A solution containing 1% flocculant is then added to aggregate impurity clusters to form disposable solids. Solids are gravity separated from the lithium rich stream which is then sent to an ultrafiltration membrane to ensure no solids or polymers are passed to the next processing block. The pore size of an ultrafiltration membrane is too small to allow solids or polymer flocculants to pass through.

3. *Ion Exchange:* The lithium-rich solution is passed through ion exchange columns to remove residual divalent ions (i.e., calcium, magnesium, and strontium ions). The circuit must be periodically regenerated to restore the sodium ions on the resin. This is accomplished by flowing HCl through the columns to remove the collected divalent ions and then flowing sodium hydroxide (i.e., caustic soda) through the columns to regenerate the sodium ions. Sodium bisulfite, a reducing agent commonly used in water treatment is also added to oxidize any residual components of the bleach added in the precipitation step. This reaction results in the formation of chloride and sulfate ions. The sodium bisulfite dosing is monitored by in line analyzers to ensure all the bleach has been neutralized. Any residual sulfite ions remaining in solution are oxidized to sulfate by dissolved oxygen in the feed brine. Discharge from the ion exchange operation flows to the tanks and eventually the RIBs.

4. *Lithium Concentration:* The lithium-rich solution is primarily lithium chloride with few impurities present. The solution must be concentrated further to optimize conversion to lithium carbonate. This is accomplished with a commercial reverse osmosis (RO) membrane. An organic scale inhibitor commonly used in water treatment is added to the process stream to

protect the semipermeable membrane from fouling. The scale inhibitor remains in the concentrate stream which is passed on to the Lithium Conversion step. The freshwater permeate stream is returned to the Brine Pre-treatment step.

5. *Lithium Conversion:* The concentrated lithium chloride solution is passed to the Lithium Conversion step where sodium carbonate (soda ash) is added to precipitate lithium carbonate by a substitution reaction. The remaining mother liquor is recycled back to the beginning of the process to ensure that no unreacted lithium ions are lost.

6. *Precipitation and Freshwater Generation:* A significant quantity of freshwater is generated during the Lithium Concentration step; however additional make-up water is required for the Pre-Treatment process. To accomplish this, brine is siphoned from the reject stream of the Pre-Treatment step for treatment. The first part of the freshwater generation step is precipitation. Metals and silicates must be removed to protect the reverse osmosis membrane. The purified brine is passed to another RO membrane. No antiscalant is required for the freshwater generation membrane. The permeate of the RO membrane (freshwater) returns to the Pretreatment Step and the concentrate passes to the tanks and eventually the RIB.

7. *Granular Activated Carbon:* Two Granular Activated Carbon (GAC) systems are placed within the process to ensure no organics (antiscalant) returns to the RIB. The first bed is in the recycle stream between the Conversion Step and Pre-Treatment. A second, redundant bed, is placed just upstream of the RIB tanks as a precaution against breakthrough.

Lithium-Depleted Brine Chemistry: As stated previously, TDS concentration in the aquifer generally exceeds 10,000 mg/l and the ground water is not reasonably expected to become a supply of drinking water. Preliminary bench scale testing results presented in **Table 2**, indicate that the depleted brine solution intended for discharge to the RIBs is expected to exceed Profile I reference values for aluminum, arsenic, chloride, iron, magnesium, manganese, sodium, sulfate, and TDS. When the depleted brine constituent concentrations are compared to average Brine Source Well CV-9 concentrations, increases in chloride, sodium, sulfate, and TDS concentrations between 1.1% and 1.5% can be expected based on bench testing. Conversely, iron and manganese can be expected to decrease significantly (67%) compared to Brine Source Well CV-9.

STC anticipates that once the lithium extraction process achieves stability and operational experience gained, discharge constituent concentrations will equilibrate, any increases that do occur will be less than 1.5% of average Brine Source Well CV-9 concentrations. Because pilot plant operation is limited to the total extraction and return of 50-acre ft back to the aquifer, STC proposed a compliance limit of no more than 10% above the maximum Brine Source Well CV-9 concentrations to account for the following:

- Poor water quality in the aquifer,
- Variability of brine concentrations, and
- Need to fine tune the process during start-up and as it reaches stable conditions.

The increase in TDS is exclusively the result of the additional sodium, chlorides, and sulfates noted in the table. The changes are presented as percentages because of the natural variability in the brine. Expected changes in fluoride, mercury, thallium, and zinc concentrations in the lithium-depleted brine could not be positively determined since the Method Detection Limit was above their respective NDEP Profile I Reference Values.

To address any uncertainty in the water quality of the pilot plant discharge solution stream prior to discharge into the RIBs, STC is required to determine the suitability of the spent brine tank discharge solution generated from the operation of the pilot facility (WPCP NEV2020114).

Table 2—Comparison of Depleted Brine Chemistry to Average Brine Source Well Chemistry (in mg/L unless otherwise indicated)

Analyte	NDEP Profile I	CV-9 Brine Source Well			Depleted Brine Chemistry		CV-MW1 Monitoring Well
		Min.	Max.	Avg.	% Change from average	Concentration In brine	
Aluminum	0.2	0.06	28.2	5.65	-67%	1.86	<0.05
Arsenic	0.01	0.144	0.224	0.186	No change	0.186	0.0058
Chloride	400	63000*	82000*	72256*	+1.1%	73050*	1600*
Iron	0.6	0.6	29.6*	7.0*	-67%	2.31*	<0.1
Magnesium	150	470*	555*	505*	No change	505*	32
Manganese	0.1	4.04*	5.59*	4.57*	-67%	1.51*	0.031
Sodium	-	38400	48100	42578	+1.5%	43217	690
Sulfate	500	3160*	4700*	3943*	+1.1%	3986	60
Total Dissolved Solids	1000	16200*	170000*	107800*	+1.5%	109417*	3000*

**Exceed NDEP Profile I Reference Values*

Multiple samples from Brine Well CV-9 will be collected and compared to solution concentration data obtained from the above ground, double-lined, Spent Brine Discharge Tank (TD). After the process has stabilized, at least three-acre ft (approximately 978,000 gallons) of spent brine shall be accumulated in the TD and an aggregate solution sample will be collected to determine suitability for discharge. Profile I, Sulfites, and TOCs will be measured in the TD. All samples will be analyzed by a Nevada-certified lab and shall follow chain of custody and other applicable procedures.

- For the Profile I analysis, the maximum value of constituents within the TD shall be no more 10% above the maximum value of the samples collected, measured, and reported from CV-9.
- For TOCs and Sulfites, the TD shall contain no more than the maximum value in samples collected from CV-9.
- The maximum value of constituents from CV-9 will be determined by samples taken on a rolling basis for two weeks from the initiation of pilot plant operation. Brine samples from CV9 will be taken twice daily for two weeks. The maximum value of the constituents from those samples will be used as the "measuring stick" or "reference point" against which the proposed discharge will be compared as outlined in the draft WPCP.
- Prior to discharge, STC will compare the tanked brine to the natural maximum values measured in the CV9 samples to ensure the discharge is within 10% of the maximum values collected from the sampling campaign.
- These criteria consider natural variations in the native brine and the response of the process due to those natural variations.
- TD meeting these criteria shall be authorized for discharge to the RIBs and the Schedule of Compliance (SOC) Item shall be considered complete.
- TD not meeting the above criteria shall not be discharged to the RIBs and must be either retreated to meet the above-mentioned criteria or evaporated.

Water utilization by STC in the Clayton Valley plant has been engineered to minimize unnecessary loss during lithium carbonate generation. All freshwater required for the various plant operations is generated on site from spent brine that has been treated. Reducing concentrations of sodium, chloride and sulfate discharged to the solution tanks and RIBs to original feed brine levels although possible, is cost prohibitive at this time.

Rapid Infiltration Basins: As previously described, the two streams from the Clayton Valley Pilot Plant will be returned to the reservoir through rapid infiltration basins. The first is the depleted brine which is discharged from pre-treatment step, and the second is RO concentrate. Both streams will be combined then analyzed and compared to Profile I standards as well as total organic carbon to assess potential residual anti-scalant in the brine and ensure waters of the State will not be degraded. The Project is estimated to generate a total of 4,000 barrels per day (168,000 gallons per day) of spent brine at a maximum rate of 116 gpm and is assumed to operate intermittently for approximately 18 months. The schedule would likely be variable based on operational needs of the Pilot Plant, with some periods of 24-hour per day operations and other periods of reconfiguration or low-intensity operation during day shifts only.

Once the lithium is removed from the brine, the spent-brine solution will be held in tanks within the pilot plant and pumped to the RIBs via a 4-inch diameter, highdensity-polyethylene (HDPE) pipeline approximately 1,500 linear feet along the site access road to the RIBs for infiltration. The maximum flow rate from the tank through the pipeline is 116 gallons per minute (gpm).

The RIB facility will consist of two, 1.82-acre infiltration cells, each containing an enhancement trench along the cell axis perpendicular to groundwater flow. These trenches will be excavated to a depth of approximately 25-30 feet bgs then filled with imported gravel from a licensed pit, to provide direct access to material with more consistently favorable permeability. Although STC will construct and operate two RIBs, only one RIB will be receiving spent brine solution at any one time while the other is resting.

The proposed RIB area has a total disturbance area of approximately 12 acres. Cells are comprised of 3:1 H:V interior and exterior slopes to an embankment crest set at an elevation of approximately 4 ft above cell basin. Spillways between cells are set at an elevation of approximately 2 ft above cell basin elevation. The crest width of embankments between cells is 10 ft. The crest width of the perimeter embankment /road is 20 ft with a 2% slope away from the cells. Each cell has an access ramp that is sloped at 5:1 H:V for maintenance. The total estimated cut for the RIB is 20,167 cubic yards (cu yds) and total estimated fill for the RIB embankments is 10,612 cu yds. A perimeter stormwater swale directs stormwater from the southeast around RIB and discharge to the flat area to the northwest and northeast corners of the RIB facility.

The RIB will be excavated to a minimum depth of 3 feet in undisturbed ground and have an approximate 1-foot-high embankment surrounding each cell for a total depth of 4 feet which accounts for 1 foot for operation, 1 foot for emergency storage, and 2 feet of freeboard. Material from the excavation of the RIB cells will be utilized to create the surrounding berms and access points, the excess material will be stored in a stockpile adjacent to the RIB cells and maintained for use in reclamation at the completion of the Project. Best management practices to minimize dust and erosion will be exercised during construction.

Construction activity would avoid any action that would unnecessarily reduce the hydraulic conductivity of the basins. Once the floor of the RIB has been brought to grade, the surface would be ripped and cross ripped in a perpendicular direction. If clods are caused by ripping actions, disc-harrow or scarifying equipment would be brought in to break up clods.

The average vertical hydraulic conductivity (K_V) of 2.5x10-3 cm/sec from the field investigation at the selected RIB location was reduced to 1.0x10-3 cm/sec before being applied as the starting infiltration rate for the cell-sizing calculations for two reasons. First, this value provides a starting safety factor of 2.5, as the average estimated K_V of 2.5x10-3 cm/sec was the result of limited in situ permeability testing completed in the field investigation in the specific RIB location. Secondly, this permeability was confirmed in the sediments below the clay layer, which was found in varying thicknesses across the project site during the field investigation.

Assuming a worst-case scenario where both the RIBs and enhancement trenches failed to operate (i.e., zero hydraulic conductivity and no infiltration), the combined RIBs would have approximately 14 days of storage capacity with 2 feet of freeboard. This is based on a maximum permitted discharge rate of 168,000 gpd.

Groundwater Mounding and Analysis: Groundwater mounding refers to the localized rise in the groundwater table in response to focused recharge to an aquifer or a vadose zone at a rate that exceeds the capacity of the aquifer or the soil to convey these amounts of water away from the recharge zone. Mounds often occur near surface during the operation of RIBs. Unmanaged groundwater mounds can potentially degrade groundwater quality and reduce recharge rate to aquifers. Mounds can act as a hydraulic barrier against inflow from contaminated waters or saltwater intrusion.

A groundwater mounding analysis is performed to demonstrate that the groundwater below a RIB will not rise up and encroach upon the unsaturated zone and break the surface of the ground at the infiltration area or downslope, thereby creating an overland flow situation or drainage problem.

To address the potential of groundwater mounding due to the installation of a RIB facility as a part of the Project, a mounding analysis was performed following the RIB field investigation. The mounding analysis incorporated results from the in-situ permeability tests, the preliminary dimensions for the RIB construction at the time of the analysis. The final results of the analysis indicate a maximum mounding height of between 2.8 and 5.7 ft using the dimensions of the RIB cells only in the process and between 0.2 and 0.9 ft using the dimensions of the infiltration trenches only. In either scenario, the analysis indicates mounding is not expected to compromise operation of the RIBs as designed.

Following RIB construction and prior to the commencement of infiltration operations, three piezometers (CV-PZ3, CV-PZ4, and CV-PZ5) will be installed to evaluate mounding. Depth to the uppermost saturated interval is anticipated to range from approximately 46 to 56 feet bgs. The borehole drilled would be a minimum of 5 inches, nominal in diameter. The piezometers would be constructed with a 20-foot screen placed near the top of the water table at the time of drilling. The total depth of the piezometers is anticipated to be less than 100 feet. The piezometers would be constructed with 1-inch nominal Schedule 40 polyvinyl chloride (PVC) pipe.

C. Exemption Analysis

Background: The Clayton Valley aquifer is not the primary source of drinking water for the region, due to its high TDS and salinity. Drinking water for the unincorporated community of Silver Peak and the surrounding area is obtained from wells upgradient of the basin located within the Silver Peak Range and Weepah Hills. As stated previously, the Division has the regulatory authority to exempt water from the standards, pursuant to NAC 445A.424(2)(b), if 1) TDS concentration is greater than 10,000 mg/L and 2) it is not reasonably expected to be a source of drinking water. The Clayton Valley aquifer has TDS concentrations that typically range from a low of 450 mg/L around the periphery of the basin to greater than 170,000 mg/L in the vicinity of the STC project site and the municipality of Silver Peak. The water is considered economically or technologically impractical to render it fit for human consumption.

The aquifer produces the mineral lithium at concentrations that are capable of commercial production. Clayton Valley is known for its lithium-bearing brines and a neighboring lithium brine extraction facility has operated for decades. STC seeks to continue lithium extraction as a beneficial use of the aquifer system pursuant to the approved water right.

In accordance with NAC 445A.424(2) STC requested an exemption from the limitations on degradation for the Project Area for the 18-month period of Pilot Plant operation and discharge of spent brine through the RIB to the groundwater aquifer.

Lithium extraction and spent brine treatment will requires the addition of hydrochloric acid, sodium hydroxide, iron (III) chloride, sodium hypochlorite, sodium bisulfite an organic scale inhibitor, and a flocculant polymer during the various process steps. Constituents not native to the brine are removed using the processes outlined in the Brine Extraction and Recovery section. As shown in **Table 2**, the depleted brine is anticipated to exceed Profile I reference values for multiple constituents including aluminum, arsenic, chloride, iron, magnesium, manganese, sodium, sulfate, and TDS. Sodium concentration is expected to increase by less than 1.5% above the average concentration observed in Brine Source Well CV-9, while chlorides and sulfates are calculated to increase by less than 1.1% relative to their average concentrations in the feed brine. Lithium-depleted brine from the Pilot Plant would be discharged into the same single, multi-layer, unconfined aquifer system via the RIB. When the Pilot Plant is commissioned and operating, a sample of the spent brine Profile I analysis and results would be submitted to NDEP.

Predictive Groundwater Modeling and Determination of Impacts: An analytic element model was initially prepared by Stantec Consulting Services (Stantec) for STC using GFLOW model as requested by the Division in May of 2022. The purpose of this modeling exercise was to further evaluate the impacts of discharging up to 50 acre-feet of spent brine from a proposed lithium extraction pilot plant to a RIB in eastern Clayton Valley.

Division Confirmation of the Predictive Groundwater Model and Parameters: Because of the proximity of the Clayton Valley Pilot Plant to a major lithium brine extraction facility and minimal Division experience with water quality standards exemptions, the Division opted to run the GFLOW model with additional data to confirm Stantec's impact findings. The Division's GFLOW model expanded upon the Stantec assessment to include additional hydrogeologic data for the Clayton Valley aquifer as well as sensitivity analyses to test model input parameters.

A one-mile radius was chosen for this modeling exercise to incorporate relevant features of the basin including the groundwater gradient and pumping stresses from a nearby lithium brine extraction operation. Geologic features that were featured in the model include Angel Island and the Paymaster fault, both located on the eastern edge of the model domain. The Paymaster fault is thought to control lithium brine movement in the region and was represented as a semi-permeable feature.
Near the proposed STC RIBs and pilot plant, groundwater flows northwest towards the center of the basin. Based on a review of water levels in the area, the measured groundwater gradient is approximately 0.03 ft/ft from the proposed pilot plant to the nearest lithium extraction well not owned by STC. Water levels reside around 50 to 60 feet below the ground surface. Groundwater levels were incorporated from multiple sources including the Nevada Division of Water Resources, United States Geologic Survey, and data from nearby wells not owned by STC but in the public record. Recent water elevation measurements provided by a neighboring facility were reviewed by the Division to ensure reported water levels agreed with the modeling results. Due to the small model footprint and low annual precipitation rates (<6 inches per year), recharge was considered negligible for this exercise. Using the online tool *Climate Engine*^{TM}, an assessment of site precipitation was made to confirm this assumption.

Pumping rates of nearby extraction wells, which were retained from the Nevada Division of Water Resources, were cross-checked with those provided by a neighboring facility and in the public record. Pumping rates ranged from 50 to 300 gpm and were included as an extraction rate in GFLOW to assess whether this nearby stress on groundwater would impact particle tracking of spent brine solution. The 50 acre-feet of spent brine was modeled as a head dependent drain over a 24-month period with particle tracking of the solution for a total of 10 years.

The aquifer was modeled as a simplified saturated unit with uniform properties, although sensitivity analyses were run to test different possible values for the represented hydrologic properties. This approach allowed for a reasonable assessment of water movement through the system without the inclusion of multiple hydrogeologic units and their respective properties. The aquifer thickness was modeled as 350 feet and was based on the depth of sandy silt that was present in nearby exploration borehole CV-9.

Clayton Valley contains numerous aquifers and aquitards that are separated by layers of alluvial, volcanic, and lacustrine sediments. Upper layers tend to be composed of alluvial and sand layers with higher hydraulic conductivity (K) while deeper layers contain more silt, clay, and ash that tend to lower K. Hydraulic conductivity has been measured from pumping tests at both exploration wells near the proposed pilot plant and from wells at the neighboring lithium brine extraction operation. Measurements of K ranged from 0.02 to 0.19 ft/day based on pumping tests performed in eight exploration wells (installed by STC or their affiliates) and from 0.01 to 59 ft/day across wells at the neighboring lithium brine extraction operation from data in the public record. Values of K used in the Division's GFLOW exercise ranged from 1.4 to 5.6 ft/day and were based on in-situ permeability tests completed on boreholes in the proposed RIB area. These measured K values also fall within the range of hydrogeologic units that are generally found in northeastern Clayton Valley.

In addition to hydraulic conductivity, drainable porosity (or specific yield) was considered. Porosity allows GFLOW to trace path lines and calculate groundwater residence times, which was necessary in this exercise to understand the fate and transport of discharged brine solution. Literature values of specific yield typically range from 1 to 20% for sand, clay, gravel, tuff, and limestone units – all of which are found in Clayton Valley. Although estimates of specific yield or porosity are limited for the area, drainable porosity was measured in cores from exploration wells using laboratory methods. An average of 6% was used as the base case value in the model.

Based on a review of the supporting literature for the data included in this model, no discrepancies were found. Additionally, model input files were reviewed to ensure no inconsistencies existed between reported and utilized parameters in the GFLOW model. Since several of the parameters are known to be variable in nature (hydraulic conductivity, aquifer thickness, porosity), four sensitivity analyses were incorporated to assess model results under alternate conditions as outlined below. Values chosen for the sensitivity analyses were based on Division recommendations as well as literature and field observations

- Aquifer thickness: 350 to 510 feet
- Hydraulic conductivity: 1.4 to 5.6 ft/day
- Effective porosity: 6 to 20%

Predictive Groundwater Modeling Results and Comparative Analysis: All five model runs exhibited particle tracks that remained on the project site with migration distances ranging from approximately 250 to 1000 feet in a north-westerly direction. These results are similar to a previous RIB impact analysis conducted by Stantec for STC. The nearest extraction well not owned by STC is approximately three-quarters of a mile away, therefore impacts to downgradient receptors as a result of discharging 50 acre-feet of spent brine solution are not anticipated. Based on these predictive modeling results and the Division's comparative analysis, the Division concurs that STC's request for a water quality standards exemption is justified and authorizes the exemption while WPCP NEV2022101 remains active.

Division Recommendations: Based on the Permit compliance items, conditions, and limitations, the Division believes that the decision to issue the RIB Permit and limited groundwater standards exemption is justified for 50-acre feet of brine solution in total. Should STC propose to increase surface discharge and/or groundwater pumping rates, they will 1) be required to obtain additional water rights from NDWR, 2) submit a new, full-scale numerical groundwater flow model as a pre-application review document with a $1500 fee for Division review and approval, and 3)If the model is determined to be acceptable and approved by the Division, STC will be required to submit a new WPCP application and fee for review and approval.

The numerical model will allow for 3D simulation of groundwater flow paths and a greater degree of complexity to be incorporated in the model, thus permitting a better understanding of impacts to surface and groundwater resources and nearby receptors. The Division-approved code (https://ndep.nv.gov/uploads/land-mining-regs-guidance-docs/20210830_BMRR_CodesListing_Rev01_ADA.pdf) will be used to construct the flow model. Additionally, the numerical model must incorporate basin-scale climate (precipitation, evapotranspiration, etc.), nearby surface water features, geology, hydraulic stresses, steady-state and transient calibration, and any other aquifer testing as deemed necessary by the Division. This pre application modification requirement has been incorporated into WPCP NEV2022101, Part I.B as a Schedule of Compliance item.

D. Procedures for Public Comment

The Notice of the Division's intent to issue a Permit authorizing the facility to construct, operate and close, subject to the conditions within the Permit, is being published on the Division website: https://ndep.nv.gov/posts/category/land. The Notice is being mailed to interested persons on the Bureau of Mining Regulation and Reclamation mailing list. Anyone wishing to comment on the proposed Permit can do so in writing within a period of 30 days following the date the public notice is posted to the Division website. The comment period can be extended at the discretion of the Administrator. All written comments received during the comment period will be retained and considered in the final determination.

A public hearing on the proposed determination can be requested by the applicant, any affected State or intrastate agency, or any interested agency, person or group of persons. The request must be filed within the comment period and must indicate the interest of the person filing the request and the reasons why a hearing is warranted.

Any public hearing determined by the Administrator to be held must be conducted in the geographical area of the proposed discharge or any other area the Administrator determines to be appropriate. All public hearings must be conducted in accordance with NAC 445A.403 through NAC 445A.406.

E. Proposed Determination

Based on the Division review and concurrence with the results and findings of the **Permit Application** and **Exemption Analysis**, the Division has made the tentative determination to issue the new RIB Permit WPCP NEV2021101.

F. Proposed Limitations, Schedule of Compliance, Monitoring, Special Conditions

See Section I of the Permit.

F. Rationale for Permit Requirements

The facility is located in an area where annual evaporation is greater than annual precipitation. Therefore, it must operate under a standard of performance which authorizes no discharge(s) except for those accumulations resulting from a storm event beyond that required by design for containment.
The primary method for identification of escaping RIB discharge solution will be placed on required routine monitoring of the RIBs and piezometers as well as routinely sampling downgradient monitoring wells. Specific monitoring requirements can be found in the Water Pollution Control Permit.

G. Federal Migratory Bird Treaty Act

Under the Federal Migratory Bird Treaty Act, 16 U.S. Code 701-718, it is unlawful to kill migratory birds without license or permit, and no permits are issued to take migratory birds using toxic ponds. The Federal list of migratory birds (50 Code of Federal Regulations 10, 15 April 1985) includes nearly every bird species found in the State of Nevada. The U.S. Fish and Wildlife Service (the Service) is authorized to enforce the prevention of migratory bird mortalities at ponds and tailings impoundments. Compliance with State permits may not be adequate to ensure protection of migratory birds for compliance with provisions of Federal statutes to protect wildlife.

Open waters attract migratory waterfowl and other avian species. High mortality rates of birds have resulted from contact with toxic ponds at operations utilizing toxic substances. The Service is aware of two approaches that are available to prevent migratory bird mortality: 1) physical isolation of toxic water bodies through barriers (e.g., by covering with netting), and 2) chemical detoxification. These approaches may be facilitated by minimizing the extent of the toxic water. Methods which attempt to make uncovered ponds unattractive to wildlife are not always effective. Contact the U.S. Fish and Wildlife Service at 2800 Cottage Way, Room W-2606, Sacramento, California 95825, (916) 414-6464, for additional information.

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