HYDROLOGIC EVALUATION
GERLACH GEOTHERMAL EXPLORATION PROJECT
WASHOE COUNTY, NEVADA

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TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

°C	Degrees Celsius
°F	Degrees Fahrenheit
AFA	Acre-Feet Per Annum
AMSL	Above Mean Sea Level
AOI	Area of Interest
B	Boron
BCM	Basin Characterization Model
bgs	Below Ground Surface
BLM	Bureau of Land Management
Ca	Calcium
Cl	Chloride

CO_3	Carbon Trioxide
DEM	Digital Elevation Model
GGID	Gerlach General Improvement District
gpm	Gallons Per Minute
HCO_3	Bicarbonate
HUC	Hydrologic Unit Code
K	Potassium
Mg	Magnesium
mg/L	Milligram Per Liter
Na	Sodium
NDWR	Nevada Division of Water Resources
NHD	National Hydrography Dataset
NWIS	National Weather Information System
Ormat	Ormat Nevada, Inc.
POD	Points of Diversion
POU	Places of Use
Project	Gerlach Geothermal Exploration Project
RFP	Ready for Action (Protested)
SiO_2	Silica
SO_4	Sulfate
Study Area	Hydrologic Evaluation Study Area
TDS	Total Dissolved Solids
UG	Underground
USGS	United States Geological Survey

1.0 INTRODUCTION

Ormat Nevada, Inc. (Ormat) is proposing to conduct geothermal exploration activities at the Gerlach Geothermal Exploration Project (Project) near the town of Gerlach in northeastern Nevada. The Project area of interest (AOI) is located on federal lands managed by the United States Department of the Interior, Bureau of Land Management (BLM), and private lands. The Project AOI is anticipated to consist of exploration wells and well pads for geothermal exploration and associated access road construction and improvements.

This report summarizes existing hydrologic conditions at the Project AOI. This report describes the climate, recharge/discharge estimates, surface water, and spring features generally within the vicinity of the Project AOI, as well as geology, geophysics, and properties of shallow groundwater and the targeted geothermal reservoir.

1.1 LEASE AREA DESCRIPTION

The Project (AOI) is located in central Washoe County, Nevada (**Figure 1**) on both public and privately leased lands, and unleased public lands. The Project AOI is located on federal geothermal leases NVN-55718, NVN-75228, NVN-98640, NVN-98641, and NVN-100029 (ORNI, 2020).

The Project AOI covers approximately 2,724 acres of land and is solely located within all or portions of Township 33 North (T33N), Range 23 East (R23E), Sections 34 and 35, and T32N R23E, Sections 3, 9, 10, 15, 16, 17, 20, and 21, Mount Diablo Basin and Meridian.

1.2 PROJECT WATER REQUIREMENTS

Ormat is proposing to drill and test geothermal wells within the federal geothermal leases, unleased public land, and privately leased land. Exploration wells will target the main thermal anomaly and potential injection zones (ORNI, 2020).

The Project will require water for well drilling at a rate up to 35,000 gallons per day (0.11 acre-feet per day) (ORNI, 2020). Additional water will be required for grading, construction, and dust control, with an average estimate of 6,000 gallons per day. One or more portable water tank(s), holding a combined total of at least 10,000 gallons, would be maintained on the well sites during drilling operations.

This water may be sourced from temporary shallow water wells co-located with geothermal wells or sourced from a private ranch source within the vicinity and trucked to the drill site (ORNI, 2020). The drilling and utilization of temporary shallow wells would be approved by the BLM and under a waiver for the temporary use of groundwater from the Nevada Division of Water Resources (NDWR). Ormat's construction and dust control water supply will also be available for fire suppression in the event of wildfire occurrence within their property leases. Drinking water will be imported daily.

Short-term testing will produce geothermal water in quantities of approximately 1.5 million gallons per test. Long-term testing will produce approximately 15 million gallons of geothermal water per test. Produced geothermal water will be captured in reserve pits, tanks, and/or reinjected to test injectivity.

2.0 HYDROLOGIC SETTING

2.1 HYDROLOGIC UNITS AND HYDROGRAPHIC BASINS

The Project AOI location is within the Great Basin Region, which covers much of Nevada and parts of Oregon, Idaho, Utah, and California. The Great Basin region is divided into progressively smaller hydrologic units, which have unique Hydrologic Unit Codes (HUCs), defined by the United States Geological Survey (USGS). These subdivision levels and the HUCs that overlap the Project AOI are summarized in **Table 1** and shown on **Figure 2** .

The basins of the Great Basin have also been divided into numbered and named groundwater basins, which are used for administrative and scientific purposes by the USGS (Cardinalli et al., 1968). Basin designations are also used by the NDWR and are referred to as hydrographic basins. The Project AOI falls within the San Emidio Desert (hydrographic basin 022) and the Black Rock Desert (hydrographic basin 028) (**Figure 2**). Within five miles of the Project AOI there is the Smoke Creek Desert (hydrographic basin 021), Granite Basin (hydrographic basin 023), and Hualapai Flat (hydrographic basin 024) (**Figure 3**). The hydrographic basin boundaries are similar to the HUC-08 or HCU-10 boundaries near the Project AOI, though differences exist.

Table 1 Hydrologic Units of the Project AOI

Region HUC-2	Subregion HUC-4	Accounting Unit HUC-6	Cataloguing Unit HUC-8	Watershed HUC-10	Sub-watershed HUC-12
Great Basin Region: 16	Black Rock Desert-Humboldt: 1604	Black Rock Desert: 160402	Lower Quinn: 16040202	Donnelly Creek-Frontal Black Rock Desert: 1604020214	Bowen Canyon-Frontal Black Rock Desert: 160402021405
				Trego Hot Springs-Frontal Black Rock Desert: 1604020215	Great Boiling Spring-Frontal Black Rock Desert: 160402021502
			Smoke Creek Desert: 16040203	Town of Empire: 1604020305	Town of Empire: 160402030500
				Dry Creek-Frontal Smoke Creek Desert: 1604020306	Dry Creek-Frontal Smoke Creek Desert: 160402030603

Source: USGS, 2021a

2.2 DEFINITION OF STUDY AREA

Exploration activities within the Project AOI are anticipated to target depths of 1,500 and 7,500 feet below ground surface (bgs) near the boundaries of the Granite Range, Black Rock Desert, San Emidio Desert, and Smoke Creek Desert hydrographic basins. For the purpose of inventorying hydrologic features in the vicinity of the AOI, a hydrologic evaluation study area (Study Area) was designated. With the exception of initial reservoir and pump testing during exploration activities, extracted geothermal fluids will be reinjected to maintain reservoir pressure utilizing a closed drilling system; therefore, significant drawdown in the vicinity of the Project AOI is not anticipated. For that reason, the Study Area referenced herein encompasses a five-mile buffer around the Project AOI, which is reasonably beyond any potential zone of influence.

The Study Area includes portions of the playa and alluvial deposits of the Black Rock Desert, San Emidio Desert, Smoke Creek Desert, and Granite Basin hydrographic basins and encompasses approximately 78,973 acres (123.4 square miles). The Study Area was chosen due to the surficial continuity between the alluvial deposits of the three basins which suggests that there may be connected aquifer system(s) in these three basins. Hydraulic connections are not anticipated across the Granite Basin due to its inferred low permeability; however, the Study Area included the Granite Basin to identify and inventory water resources that may be near the Project AOI.

The Study Area was modified to exclude features that likely have little to no hydraulic connection to the Project AOI, including the Hualapai Flat basin and bedrock exposures in the Selenite Range and Fox Range (**Figure 2**). Within the Study Area, the Hualapai Flat basin drains to the north and there is no identified hydraulic connection to the groundwater or surface water systems near the AOI. Furthermore, a groundwater divide is expected in the Granite Range at the basin boundary. The bedrock of Selenite Range and Fox Range were excluded because the hydraulic connection between these ranges and the adjacent alluvium is expected to be minimal. Furthermore, groundwater divides in the alluvium, roughly corresponding with the basin axes are expected.

2.3 CLIMATE

The Gerlach weather station (USC00263090) is located approximately 0.5 miles southeast of the Project AOI (**Figure 2**) at an elevation of 3,954 feet above mean sea level (AMSL), which is similar in elevation to the Project AOI. Weather has been monitored and recorded at the Gerlach station as far back as 1948 (NCEI, 2021) . It should be noted the Gerlach station was not operating from February 1951 to May 1962 and September 1973 to August 1985; and has not been operational since May 2019. Weather data from the Gerlach station includes daily records of minimum temperature, maximum temperature, precipitation, and snowfall. **Table 2** shows average minimum monthly temperatures between approximately 22 and 60 degrees Fahrenheit (°F) while average maximum temperatures range between approximately 41°F and 93°F. Annual total precipitation (i.e., rainfall, snowmelt, etc.) averages 7.70 inches and generally occurs throughout the year but with lower monthly totals (less than 0.5 inches) in July through October. Average annual snowfall totals of 9.9 inches with snowfall occurring November through April.

Table 2 Long-Term Climate Conditions Near the Project AOI

Month	Average Min. Temperature (°F) 1948–2019	Average Max. Temperature (°F) 1948–2019	Average Total Precipitation[1] (inches) 1948–2019	Average Total Snowfall (inches) 1948–2017
Jan	22.2	41.9	0.95	2.5
Feb	26.4	48.5	0.75	1.8
Mar	31.3	56.9	0.70	0.9
Apr	36.4	64.5	0.71	0.4
May	44.9	73.5	0.94	0.0
Jun	52.7	83.2	0.67	0.0
Jul	59.7	93.1	0.26	0.0
Aug	56.9	91.3	0.22	0.0
Sep	47.8	82.2	0.26	0.0
Oct	37.2	69.1	0.48	0.0
Nov	28.1	52.3	0.84	1.0
Dec	21.5	41.0	0.91	3.3
Annual	38.7	66.4	7.70	9.90

Source: NCEI, 2021
[1]Includes rainfall, snowmelt, etc.

The nearby mountain ranges, including the Granite Range (immediately north), Selenite Range (approximately three miles southeast), and Fox Range (approximately four miles southwest), receive higher precipitation, as based on precipitation modeling (PRISM, 2021). The highest parts of the Granite Range (8,974 feet AMSL at Granite Peak; nine miles northwest from the Project AOI) have documented over 20 inches of annual precipitation (Olmsted et al., 1975).

2.4 SURFACE WATER INVENTORY

2.4.1 Wetlands

The Project AOI includes 436 acres of wetlands (16 percent of the Project AOI), as mapped by the United States Fish and Wildlife Service National Wetlands Inventory Wetlands Mapper (USFWS, 2021), including 197 acres of lakes, 127 acres of fresh emergent wetlands, 40 acres of freshwater ponds, 39 acres of freshwater forested/shrub wetland, and 33 acres of riverine features (**Table 3** and **Figure 4**).

Wetland features within the Study Area cover 24,152 acres (31 percent of Study Area) and include lakes, rivers, freshwater ponds, freshwater emergent wetlands, and freshwater forested/shrub wetland (**Table 3** and **Figure 4**) (USFWS, 2021). These features are predominantly natural features while a small fraction (0.1 percent of total acreage) of these features occur in excavated areas or areas where water is retained by dikes or impoundments.

Mapped lakes within the Study Area, such as the playas of the Black Rock, San Emidio and Smoke Creek Desert basins, occupy 22,572 acres and are classified as mostly intermittently flooded (78 percent), followed by temporarily flooded (13 percent), and seasonally flooded (nine percent).

Freshwater ponds within the Study Area occupy 331 acres and are characterized as intermittently flooded (78 percent), temporarily flooded (12 percent), seasonally flooded (eight percent), permanently flooded (two percent), and semi-permanently flooded (less than one percent).

Riverine features within the Study Area occupy 824 acres and are characterized as intermittently flooded (71 percent), seasonally flooded (14 percent), temporarily flooded (13 percent), semi-permanently flooded (two percent) and permanently flooded (one percent).

Freshwater emergent wetland within the Study Area occupy 276 acres and are generally located on the margins of the Granite Range and some are collocated with known springs. Areas of freshwater emergent wetlands were characterized as seasonally flooded (48 percent), temporarily flooded (46 percent), seasonally saturated (six percent), and intermittently flooded (less than one percent). Freshwater forested/shrub wetland accounted for 150 acres and were characterized as intermittently flooded (69 percent), temporarily flooded (25 percent), and seasonally saturated (six percent).

Table 3 Types and Areas of Wetlands Within the AOI and Study Area

Wetland Type	Classification	System	Subsystem	Class	Subclass	Modifier	Area (acres)	
							AOI	Study Area
Freshwater Emergent Wetland	PEM1A	Palustrine	-	Emergent	Bedrock	Temporarily Flooded	64.4	125.5
	PEM1Ax	Palustrine	-	Emergent	Bedrock	Temporarily Flooded - Excavated	0.0	0.7
	PEM1B	Palustrine	-	Emergent	Bedrock	Seasonal Saturated	7.8	16.6
	PEM1C	Palustrine	-	Emergent	Bedrock	Seasonal Flooded	54.5	132.0
	PEM1Cx	Palustrine	-	Emergent	Bedrock	Seasonal Flooded - excavated	0.0	0.7
	PEM1J	Palustrine	-	Emergent	Bedrock	Intermittently Flooded	0.0	0.6
						Sum of Freshwater Emergent Wetland	**126.8**	**276.2**
Freshwater Forested/Shrub Wetland	PFO1A	Palustrine	-	Forested	Bedrock	Temporarily Flooded	0.0	0.3
	PFO1B	Palustrine	-	Forested	Bedrock	Seasonal Saturated	0.0	1.2
	PSS1A	Palustrine	-	Scrub-Shrub	Bedrock	Temporarily Flooded	14.6	36.9
	PSS1B	Palustrine	-	Scrub-Shrub	Bedrock	Seasonal Saturated	0.3	8.0
	PSS1J	Palustrine	-	Scrub-Shrub	Bedrock	Intermittently Flooded	24.5	103.2
						Sum of Freshwater Forested/Shrub Wetland	**39.4**	**149.7**
Freshwater Pond	PUBFx	Palustrine	-	Unconsolidated Bottom	-	Semi-Permanently Flooded - Excavated	0.5	0.5
	PUBHh	Palustrine	-	Unconsolidated Bottom	-	Permanently Flooded - Diked/Impounded	0.0	0.9
	PUBHx	Palustrine	-	Unconsolidated Bottom	-	Permanently Flooded - Excavated	1.5	5.3
	PUSA	Palustrine	-	Unconsolidated Bottom	-	Temporarily Flooded	28.4	38.5
	PUSAx	Palustrine	-	Unconsolidated Shore	-	Temporarily Flooded - Excavated	1.0	1.3
	PUSC	Palustrine	-	Unconsolidated Shore	-	Seasonal Flooded	0.0	15.2
	PUSCx	Palustrine	-	Unconsolidated Shore	-	Seasonal Flooded - Excavated	0.0	8.8
	PUSJ	Palustrine	-	Unconsolidated Shore	-	Intermittently Flooded	8.7	259.5
	PUSJh	Palustrine	-	Unconsolidated Shore	-	Intermittently Flooded - Diked/Impounded	0.0	0.7
						Sum of Freshwater Ponds	**40.0**	**330.6**

Wetland Type	Classification	System	Subsystem	Class	Subclass	Modifier	Area (acres)	
							AOI	Study Area
Lake	L2USA	Lacustrine	Littoral	Unconsolidated Shore	-	Temporarily Flooded	161.1	2,951.7
	L2USC	Lacustrine	Littoral	Unconsolidated Shore	-	Seasonal Flooded	0.0	2,096.3
	L2USJ	Lacustrine	Littoral	Unconsolidated Shore	-	Intermittently Flooded	36.1	17,521.6
	L2USJh	Lacustrine	Littoral	Unconsolidated Shore	-	Intermittently Flooded - Diked/Impounded	0.0	2.1
						Sum of Lakes	**197.2**	**22,571.7**
Riverine	R3UBF	Riverine	Upper Perennial	Unconsolidated Bottom	-	Semi-Permanently Flooded	5.1	13.2
	R3UBFx	Riverine	Upper Perennial	Unconsolidated Bottom	-	Semi-Permanently Flooded - Excavated	0.0	1.1
	R4SBA	Riverine	Intermittent	Streambed	-	Temporarily Flooded	1.6	107.4
	R4SBAx	Riverine	Intermittent	Streambed	-	Temporarily Flooded - Excavated	0.5	0.5
	R4SBC	Riverine	Intermittent	Streambed	-	Seasonal Flooded	3.0	113.0
	R4SBJ	Riverine	Intermittent	Streambed	-	Intermittently Flooded	22.5	577.3
	R4SBJx	Riverine	Intermittent	Streambed	-	Intermittently Flooded - Excavated	0.0	5.2
	R5UBH	Riverine	Unknown Perennial	Unconsolidated Bottom	-	Permanently Flooded	0.0	5.8
						Sum of Riverine	**32.7**	**823.5**
						Sum of All Wetlands	**436.2**	**24,151.8**

Source: USFWS, 2021

2.4.2 Springs

The location and details of springs/seeps was derived from the National Water Information System (NWIS) (USGS, 2021b), the National Hydrography Dataset (NHD) (USGS, 2021a), the Great Basin Groundwater Geochemical Database (NBMG, 2021), field sampling conducted by Ormat in August 2019, and by Stantec Consulting Services Inc. (Stantec) starting in March 2020 and continuing quarterly to present date (Stantec, 2021).

Springs within the Project AOI include Great Boiling Springs, Ditch Spring, Horse (Corral) Spring, Mud Spring, and three unnamed seeps/springs (**Figure 5**). There are approximately 50 mapped springs within the Study Area. Several springs are present in clusters and have multiple outlets. Therefore, the reported number of springs is an estimate.

The location and available flow or temperature data for springs located within the Study Area is summarized in **Table 4**. Spring monitoring completed by Stantec in 2020 included 12 of the 15 locations from the NHD (USGS, 2021a) that are within one mile of the Project AOI (Stantec, 2021). These springs are named 'Spring 1' through 'Spring 12' in **Table 4** and on **Figure 5**. The remaining three NHD springs include Ditch Spring and two unnamed springs and were not visited due to access restrictions. Great Boiling Springs and Mud Spring both have multiple orifices or points of discharge. The remaining springs are located in the Granite Range or near the boundary between Smoke Creek Desert and San Emidio Desert.

Table 4 Springs and Seeps with the Study Area

Spring Site Name[1]	Temperature (°F)	Flow Rate (gpm)	UTM NAD83[2]		Source
			Easting (meters)	Northing (meters)	
Great Boiling Springs (Spring 1)	98-114	-	299,986	4,503,902	USGS, 2021a; Stantec, 2021
Great Boiling Springs (Spring 2)	180-191	-	299,944	4,503,861	USGS, 2021a; Stantec, 2021
Great Boiling Springs (Spring 3)	80-107	-	299,967	4,503,869	USGS, 2021a; Stantec, 2021
Great Boiling Springs (various orifices)	77-212	20-950	various	various	GeothermEx, 1992; Ormat, 2020; NBMG, 2021
Great Boiling Springs (Borax Spring)	191-204	103	299,988	4,503,787	NBMG, 2021
Horse (Corral) Spring	99-145	50	300,945	4,503,516	USGS, 2021b; Ormat, 2020; NBMG, 2021
Ditch Spring	193-199	0.5-54	300,169	4,505,260	USGS, 2021b; USGS, 2021a; Ormat, 2020; NBMG, 2021
Mud Spring-1	98	-	299,086	4,502,832	Ormat, 2020
Mud Spring-2	188	2-6	299,209	4,502,954	Ormat, 2020
Mud Spring-3	152	-	299,088	4,503,025	Ormat, 2020
Mud Spring-4	157	-	299,248	4,502,933	Ormat, 2020
Mud Spring (various)	81-197	0.8-49	various	various	NBMG, 2021
Water Tank Spring	66	>20	297,966	4,503,739	Ormat, 2020
Matts Spring	63-68	<1-20	295,729	4,503,007	Ormat, 2020
Spring 4	41-69	-	300,593	4,506,172	USGS, 2021a; Stantec, 2021
Spring 5	47-65	0-0.13	300,466	4,507,855	USGS, 2021a; Stantec, 2021
Spring 6	47-73	0.31-4.4	300,874	4,509,179	USGS, 2021a; Stantec, 2021
Spring 7	42-76	0-0.75	300,301	4,509,390	USGS, 2021a; Stantec, 2021
Spring 8	50-77	0.43-0.97	301,031	4,509,403	USGS, 2021a; Stantec, 2021
Spring 9	46-78	0-6.6	300,540	4,509,421	USGS, 2021a; Stantec, 2021
Spring 10	64	0-0.47	300,318	4,509,518	USGS, 2021a; Stantec, 2021
Spring 11	47-62	0-3.51	300,363	4,509,712	USGS, 2021a; Stantec, 2021
Spring 12	50-69	0-0.12	300,262	4,509,792	USGS, 2021a; Stantec, 2021
-	-	-	300,450	4,505,421	USGS, 2021a
-	-	-	300,223	4,504,978	USGS, 2021a
-	-	-	300,257	4,512,232	USGS, 2021a

Spring Site Name[1]	Temperature (°F)	Flow Rate (gpm)	UTM NAD83[2]		Source
			Easting (meters)	Northing (meters)	
-	-	-	300,326	4,511,620	USGS, 2021a
-	-	-	298,930	4,514,852	USGS, 2021a
-	-	-	297,381	4,514,083	USGS, 2021a
-	-	-	300,960	4,512,364	USGS, 2021a
-	-	-	300,144	4,512,629	USGS, 2021a
-	-	-	300,143	4,512,492	USGS, 2021a
-	-	-	300,655	4,511,240	USGS, 2021a
-	-	-	297,695	4,515,576	USGS, 2021a
-	-	-	300,600	4,511,279	USGS, 2021a
-	-	-	297,357	4,513,653	USGS, 2021a
-	-	-	300,467	4,511,296	USGS, 2021a
-	-	-	300,752	4,511,171	USGS, 2021a
-	-	-	300,876	4,511,892	USGS, 2021a
-	-	-	298,584	4,514,867	USGS, 2021a
-	-	-	300,535	4,511,408	USGS, 2021a
-	-	-	294,109	4,511,740	USGS, 2021a
-	-	-	297,200	4,509,996	USGS, 2021a
-	-	-	297,002	4,510,055	USGS, 2021a
-	-	-	294,068	4,511,873	USGS, 2021a
-	-	-	306,555	4,503,659	USGS, 2021a
-	-	-	302,606	4,511,972	USGS, 2021a
-	-	-	305,014	4,501,129	USGS, 2021a
-	-	-	299,794	4,513,746	USGS, 2021a
-	-	-	300,259	4,512,173	USGS, 2021a
-	-	-	297,252	4,514,286	USGS, 2021a
-	-	-	301,537	4,511,016	USGS, 2021a
-	-	-	298,932	4,513,635	USGS, 2021a
-	-	-	298,906	4,512,884	USGS, 2021a
-	-	-	298,979	4,508,678	USGS, 2021a

Spring Site Name[1]	Temperature (°F)	Flow Rate (gpm)	UTM NAD83[2]		Source
			Easting (meters)	Northing (meters)	
-	-	-	300,940	4,512,009	USGS, 2021a
-	-	-	298,637	4,508,594	USGS, 2021a

[1] Spring 1 through Spring 12 were informally named by Stantec for the purpose of field monitoring.
[2] Universal Transverse Mercator North American Datum 1983
gpm = gallons per minute

3.0 GEOLOGIC SETTING

3.1 REGIONAL GEOLOGICAL SETTING

The Study Area is located in the Basin and Range physiographic province. This province is characterized by north or northwest trending mountain ranges, which are fault-bounded against adjacent basins. This basin and range physiography is caused by east-west extension. Valley-bounding faults that generally trend north to south have been mapped in the region (**Figure 6**). Holocene deposits show offsetting from faulting (Olmsted et al., 1975) and there may be as much as 10,000 feet of offset along the faults bounding the eastern margin of the Granite Range (GeothermEx, 1992).

3.2 LOCAL SURFICIAL GEOLOGY

Surface geology in the Project AOI is dominated by granitic, volcanogenic-sedimentary, and sedimentary rocks in the Granite Range and Quaternary alluvial, eolian and lacustrine deposits in topographically low areas (**Figure 6**). Granitic formations include the Kg and Kgb units, both of which are Cretaceous in age and composed of biotite-hornblende granite. The Kgb unit is brecciated and the Kg unit includes highly weathered granite along the front of the Granite Range. The Tts volcanogenic-sedimentary unit is Tertiary (late to middle Miocene) in age and includes tuffaceous sediments, volcanoclastic sandstone, tephras, and granitic conglomerates and sandstones.

Quaternary sediments include Lake Lahontan lacustrine deposits (Qls), Holocene alluvial fans deposits (Q1), playa deposits (Qpl) and playa margin deposits (Qpm). North-northeast trending Basin and Range faults bound the Granite Range on the eastern margin. A series of northwest trending faults have also been identified or inferred near the southern terminus of the Granite Range (**Figure 6**).

Hydrothermal deposits have been mapped in the AOI (Matlick and Ehni, 1995). Siliceous sinter is present near Great Boiling Springs and Mud Springs. Altered granodiorite, containing silica-fill along fault zones, is present between Great Boiling Springs and the Granite Range.

3.3 LOCAL SUBSURFACE GEOLOGY

Subsurface geology is available from several exploratory boreholes drilled near and within the Project AOI; including several well logs across the Study Area (NDWR, 2021a) and data from Ormat's exploration drilling database (Ormat, 2020). In general, encountered lithologies include playa deposits, alluvium, granodiorite, and minor breccia. Exploration boreholes drilled into valley fill encountered up to 3,270 feet of alluvium before encountering the granodiorite basement. Detailed logs from borehole 18-10 show the alluvium is primarily arkose or arkosic sand with minor

amounts of clay, siltstone, and limestone (Tecton Geologic, 1994). The basement rock was primarily granodiorite with minor fractions of diorite and possibly quartz diorite.

Available NDWR well logs (NDWR, 2021a) near the Project AOI are generally clustered in four areas relative to the Project AOI: northwest, northeast, central, and south. All of these wells were collared in Quaternary sedimentary deposits. Well logs are compiled in **Appendix A** and shown on **Figure 7** and include information on well location, material specifics, and lithology through the borehole.

Wells located in the northwest region of the Project AOI consisted mainly of yellow, green, and black clays or clay with sand, both of which may have low permeabilities (lithological logs 93950 and 9151). Potentially high permeability units included a 25-foot-thick layer of coarse sand at lithologic log 93950 starting at 110 feet bgs and two feet of gravel at lithologic log 9151 starting at 36 feet bgs.

The northeast wells with lithological logs include 105925 and 8535 (**Figure 7**). Well 105925 logged 35 feet of sand and gravel overlying 165 feet of boulders and cobbles, followed by 50 feet of granite bedrock.

Wells in the central region were characterized by layers of clay, sandy clay, clayey sand, sand, and gravel.

The southern location (well log 4279) encountered, in decreasing order, sand and clay, sand, and boulders.

3.4 SURFACE GEOPHYSICAL SURVEYS

Surface geophysical surveys within and near the Project AOI include self-potential (Matlick and Ehni, 1995), gravity, and magnetics (GeothermEx, 1992; Ormat, 2020). Self-potential indicated two north trending structures that may be a conduit with active flow. Gravity surveys were recently updated by Ormat and generally show a gravity high over the Granite Range and gravity lows in the adjacent valleys due to low density valley fill material (**Figure 8**). Previous interpretation of gravity surveys included modeling the depth to the granitic basement in the vicinity of the Project AOI (GeothermEx, 1992).

Magnetic surveys generally indicate magnetic highs in the Granite Range and lows in the adjacent valleys (**Figure 9**). Magnetic highs also coincide with the fault that bounds the eastern side of Granite Range, possibly due to mineralization (Matlick and Ehni, 1995).

4.0 WATER USERS

4.1 EXISTING WATER RIGHTS

A total of 30 water rights associated with points of diversion (POD) and/or places of use (POU) were identified within the Study Area (NDWR, 2021b) (**Table 5**). The PODs and POUs associated with these water rights are shown on **Figure 10**. The PODs within the Study Area are categorized as irrigation (seven), municipal (six), livestock (five), wildlife (three), and commercial (one). Sources for these water rights include well/underground (13), spring (six), and stream (three). The statuses of all municipal water rights are listed as Ready for Action (Protested), while the irrigation, livestock, and wildlife water rights are listed as certificate, vested right, permit, or reserved.

While the town of Gerlach is located immediately southeast of the Project AOI, water for the town is sourced from beyond the Study Area. Water for the town of Gerlach is supplied by the Gerlach General Improvement District (GGID). Water rights owned by the GGID are associated with PODs Granite Spring and Garden Springs, which are located on the western margin of the Granite Mountains. Granite Spring is located just beyond the Study Area (5.04 miles northwest from the Project AOI) and Garden Springs is located 7.8 miles northwest from the Project AOI. The associated POU for these water rights corresponds with Gerlach in portions of T23E R32N, Sections 14, 15, and 22, some of which overlap the Project AOI (**Figure 10**).

Table 5 Water Rights from the Nevada Division of Water Resources Within the Study Area

Application/ Permit	Owner	Basin	Use	Source[1]	Source Description	Priority Date	Status	Duty Balance (AFA)
2660	Mott, Jola Guisasola	028	Irrigation	Stream	Granite Cove Creek	03/11/1913	Certificate	480
16189	United States Gypsum Company	022	Other	UG	-	07/15/1996	Certificate	256.0874294
17998	United States Gypsum Company	022	Mining and Milling	UG	-	05/14/1959	Certificate	542.9805
19985	United States Gypsum Company	022	Mining and Milling	UG	-	07/13/1961	Certificate	412.3681
21115	Mott, Jola Guisasola	028	Irrigation	UG (8535)	-	03/11/1963	Certificate	139.43
21116	Sherrill Don Guisasola	021	Irrigation	UG	-	03/11/1963	Certificate	61.56
25768	Empire Mining Co., LLC	022	Industry	UG (11313)	-	08/19/1970	Certificate	143.176
65622	Peregrine Properties, LLC	022	Wildlife	Spring	Sand J. Hot Springs	10/24/2003	Certificate	144.79
65623	Peregrine Properties, LLC	028	Wildlife	Spring	Great Boiling Spring #2	10/24/2003	Certificate	201
65624	Peregrine Properties, LLC	028	Wildlife	Spring	Great Boiling Spring #1	10/24/2003	Certificate	201
711213	Bogard Family Revocable Trust	021	Commercial	UG	-	12/21/1987	Certificate	8.28
74210	Gerlach GID	021	Quasi-Municipal	Spring	Granite Springs	04/17/2006	Permit	188
75230	Bright-Holland Corporation	028	Irrigation	UG	-	11/01/2004	Permit	320
76211	United States Gypsum Company	022	Mining and Milling	UG	-	07/13/1961	Permit	152.55
77782	Bogard Family Revocable Trust	021	Irrigation	UG (93950)	-	12/21/1987	Certificate	69.16
78054	Bogard Family Revocable Trust	021	Irrigation	UG	-	12/21/1987	Certificate	6.74
79438	Washoe County	021	Municipal	UG	-	02/01/2010	RFP	0
79445	Washoe County	021	Municipal	UG	-	02/01/2010	RFP	0
81592	Gerlach GID	021	Quasi-Municipal	Spring	Granite Springs	10/04/1909	Permit	166.51
81593	Gerlach GID	021	Quasi-Municipal	Spring	Garden Spring	11/15/1929	Permit	144.79
89358	St. Clair, Carol and Grant	028	Municipal	UG	Well BR-03	12/09/2019	RFP	5000
89359	St. Clair, Carol and Grant	028	Municipal	UG	Well BR-04	12/09/2019	RFP	5000
89360	St. Clair, Carol and Grant	028	Municipal	UG	Well BR-05	12/09/2019	RFP	5000

Application/ Permit	Owner	Basin	Use	Source[1]	Source Description	Priority Date	Status	Duty Balance (AFA)
89361	St. Clair, Carol and Grant	028	Municipal	UG	Well BR-06	12/09/2019	RFP	5000
R10169	U.S.-Bureau of Land Management	021	Stock	Spring	Unnamed Spring	04/17/1926	Reserved	0
V04627	Bogard Family Revocable Trust	021	Stock	UG	Well #4 Artesian	01/01/1913	Vested Right	0
V09124	Bright-Holland Corporation	028	Irrigation	Stream	Granite Cove Creek	04/01/1894	Vested Right	69.8
V09125	Bright-Holland Corporation	028	Stock	Spring	Unnamed Spring	01/01/1894	Vested Right	49.286534
V09126	U.S.-Bureau of Land Management	023	Stock	Spring	Unnamed Spring	01/01/1894	Vested Right	0
V09129	Northern Washoe Ranching Management, LLC	023	Stock	Stream	Granite Cove Creek	05/31/1890	Vested Right	0

Source: NDWR, 2021b
[1]UG = Underground (Well Log)
RFP = Ready for Action (Protested)
AFA = Acre-Feet per Annum

4.2 JURISDICTIONAL WATER

Ormat's contractor is currently completing an aquatic resources delineation for the Project AOI. A draft report is anticipated to be complete in September 2021 with an anticipated submittal requesting an Approved Jurisdictional Determination to the United States Army Corps of Engineers in mid-October 2021.

4.3 EXISTING AUTHORIZED LAND USES

All proposed geothermal exploration wells would be drilled and tested within federal geothermal leases within the Project AOI. Existing land uses within the Project AOI include livestock grazing as authorized by the BLM. Existing land uses within the Study Area include high and medium density residential developments and industrial developments in the towns of Gerlach and Empire (Washoe County Department of Community Development, 2010). Otherwise, the Study Area is rural in nature with land use generally including agriculture and recreation.

4.4 OTHER WATER USERS

All known water users, including those using water for irrigation, municipal, and wildlife are summarized in Section 2.4. No other water users are known.

5.0 HYDROGEOLOGY

5.1 WELL INVENTORY

All identified water wells within the Study Area are shown on **Figure 7** and all identified water wells within hydrographic basins that intersect the Project AOI are shown on **Figure 11**. Data from these water wells come from the NDWR (2021a), the NWIS (USGS, 2021b), and the NHD (USGS, 2021a). **Table 6** lists all identified wells within the Study Area, including any available construction details, water levels, yield, and water temperature. The NDWR well logs are provided in **Appendix A**. Where information was available, the designated purpose of these water wells include irrigation, domestic, monitoring, testing, industrial, unused, and other purposes.

Table 6 Well Construction and Groundwater Data in the Study Area

Well Name	Well Log	Stantec Well ID	UTM NAD83[1]		Elevation[2] (feet AMSL)	Depth Drilled (feet bgs)	Screened Depths (feet bgs)	Latest Water Level Date	Recent Water Level (feet AMSL)	No. Water Level Records	Temperature (°F)	Yield (gpm)	Data Source
			Easting (meters)	Northing (meters)									
021 N33 E22 26CC 1	--	1	291681.16	4509263.2	3,906	90	--	--	--	--	64.04	--	USGS, 2021b
021 N33 E22 26D 1	--	2	292365.21	4509367.4	3,913	--	--	--	--	--	61.7	--	USGS, 2021b
021 N33 E22 36AC 1	--	3	293546.93	4507945.6	3,888	120	--	8/4/1966	15	1	--	--	USGS, 2021b
021 N32 E23 18D 1	--	4	295922.13	4502911.2	3,912	--	--	--	--	--	66.2	--	USGS, 2021b
022 N32 E23 19DAC 1 USGS	--	5	297204.64	4501672.6	3,924	148	--	10/4/1973	21.68	1	--	--	USGS, 2021b
028 N32 E23 16CAC 1 USGS	--	6	299528.23	4503276	3,974	147	--	10/4/1973	27.29	1	--	--	USGS, 2021b
022 N32 E23 27B 1	--	7	299,959	4,500,055	3,908	8	--	11/9/1966	5.3	1	--	--	USGS, 2021b
028 N32 E23 16AAB 1 USGS	--	8	300,189	4,504,246	3,952	43	--	--	--	--	--	--	USGS, 2021b
022 N31 E23 11D 1	--	9	299,985	4,494,901	3,938	854	--	10/1/1956	159	1	--	--	USGS, 2021b
028 N32 E23 21AAD 1 USGS	--	10	300,259	4,502,485	3,937	148	--	10/4/1973	6.43	1	--	--	USGS, 2021b
028 N32 E23 10CBA 1 USGS	--	11	300,841	4,504,907	3,923	101	--	10/27/1973	9.35	1	--	--	USGS, 2021b
028 N32 E23 03DCB 1 USGS	--	12	301,557	4,506,184	3,911	5.9	--	--	--	--	--	--	USGS, 2021b
028 N32 E23 03DCB 2 USGS	--	13	301,625	4,506,121	3,911	145	--	10/4/1973	6.14	1	--	--	USGS, 2021b
028 N32 E23 03AAB 1 USGS	--	14	301,981	4,507,129	3,909	148	--	10/4/1973	11.65	1	--	--	USGS, 2021b
028 N33 E23 26D 1 L IRRIGATION	--	15	302,263	4,509,518	3,930	208	--	11/26/2013	11.63	6	--	--	USGS, 2021b
028 N33 E23 26D 2	--	16	302,530	4,509,213	3,912	--	--	--	--	--	60.8	--	USGS, 2021b
028 N32 E23 14CCD 1 USGS	--	17	302,431	4,502,828	3,913	21.7	--	10/4/1973	3.19	1	--	--	USGS, 2021b
028 N33 E23 35CDB 1 USGS	--	18	302,758	4,508,065	3,907	150	--	10/4/1973	11.65	1	--	--	USGS, 2021b
028 N33 E23 24D 1	--	19	304,310	4,509,907	3,907	72	--	6/15/1960	1.9	1	--	--	USGS, 2021b
028 N33 E24 30 1 Playa Well	--	20	305,609	4,507,527	3,907	--	--	--	--	--	62.6	--	USGS, 2021b
028 N33 E24 21CA 1	--	21	308,632	4,510,874	3,907	24	--	--	--	--	53.78	--	USGS, 2021b
--	4279	22	298,089	4,494,685	3,925	120	80-120	20-Oct-58	85	1	--	50	NDWR, 2021a
--	8535	23	302,504	4,509,410	3,918	208	148-208	16-Jun-65	7	1	--	2000	NDWR, 2021a
--	9151	24	294,161	4,508,341	3,898	120	100-120	8-Sep-66	15	1	--	--	NDWR, 2021a
--	9152	25	302,710	4,509,189	3,912	208	30-207	8-Sep-66	30	1	--	--	NDWR, 2021a
Cordero Gerlach No. 1	12574	26	300,573	4,503,074	3,954	660	--	--	--	--	--	--	NDWR, 2021a
Cordero Gerlach No. 2	12575	27	300,573	4,503,074	3,954	660	--	--	--	--	80	6	NDWR, 2021a
G-3 Well	--	28	300461	4504884	--	--	--	1981	--	--	213.8	--	GeothermEx, 1992
GCID Hot Pool Well	--	29	300479	4503105	--	--	--	7/16/1984	--	--	185	--	GeothermEx, 1992
GCID Community Center Well	--	30	300828	4502905	--	--	--	2/3/1992	--	--	154.5	--	GeothermEx, 1992
Pipe at 32n23e34ddd	--	31	301012	4497632	--	--	--	--	--	--	--	--	GeothermEx, 1992
--	12576	32	298,991	4,504,541	4,034	365	--	--	--	--	--	--	NDWR, 2021a
--	22035	33	299,922	4,502,474	3,930	5871	--	--	--	--	--	--	NDWR, 2021a
--	22036	34	299,922	4,502,474	3,930	0	--	--	--	--	--	--	NDWR, 2021a
--	25437	35	300,732	4,502,884	3,953	155	115-155	--	--	--	--	50	NDWR, 2021a
--	78408	36	300,362	4,503,084	--	300	200-300	--	--	--	--	--	NDWR, 2021a
--	93950	37	291,720	4,509,242	3,906	160	120-160	--	--	--	--	267	NDWR, 2021a
--	95147	38	291,720	4,509,242	3,906	42	--	--	--	--	60	--	NDWR, 2021a
--	105925	39	302,039	4,510,608	4,058	250	--	--	--	--	--	--	NDWR, 2021a
--	106240	40	302,039	4,510,608	4,058	250	1-58	--	--	--	--	--	NDWR, 2021a

Well Name	Well Log	Stantec Well ID	UTM NAD83[1]		Elevation[2] (feet AMSL)	Depth Drilled (feet bgs)	Screened Depths (feet bgs)	Latest Water Level Date	Recent Water Level (feet AMSL)	No. Water Level Records	Temperature (°F)	Yield (gpm)	Data Source
			Easting (meters)	Northing (meters)									
--	116391	41	301,332	4,501,700	3,917	14	2-14	10/12/11	4	1	--	--	NDWR, 2021a
--	123998	42	301,508	4,502,549	--	25	10-25	--	--	--	--	--	NDWR, 2021a
--	123999	43	301,470	4,502,599	--	25	10-25	--	--	--	--	--	NDWR, 2021a
--	124000	44	301,446	4,502,532	--	25	10-25	--	--	--	--	--	NDWR, 2021a
-	--	45	295,829	4,502,967	3,901	--	--	--	--	--	--	--	USGS, 2021a
--	--	46	308,215	4,506,978	3,927	--	--	--	--	--	--	--	USGS, 2021a
--	--	47	302,267	4,509,511	3,930	--	--	--	--	--	--	--	USGS, 2021a
Joe Selmi's Well	--	48	--	--	--	--	--	--	--	--	61	--	GeothermEx, 1992
Planet X Well	--	49	--	--	--	--	--	--	--	--	62.1	--	GeothermEx, 1992

[1] Universal Transverse Mercator North American Datum 1983
[2] Surface elevations were estimated from 10-meter digital elevation models (DEMs) (USGS, 2008)

5.2 GROUNDWATER FLOW AND AQUIFER PROPERTIES

5.2.1 Hydrostratigraphy

Hydrogeological units in the Study Area are characterized as basin-fill or noncarbonate consolidated rocks. Basin-fill units are generally productive aquifers in deposits of sand and/or gravel. However, at well log 8535, a thick clay zone with apparent voids or transmissive zones yielded 2,000 gpm (**Appendix A**). Noncarbonate consolidated rocks include low permeability rocks that generally act as barriers to flow unless highly fractured. At a regional scale, no highly-fractured noncarbonate consolidated rocks are identified in the Study Area (Harrill and Prudic, 1998). However, as described in Section 5.5, the intersection of fractures is the likely mechanism for fluid convection at the Project AOI. These fracture networks are likely present at a sub-regional or local scale.

5.2.2 Recharge, Discharge, and Interbasin Flow

Basin-scale hydrogeology of Basin and Range hydrographic basins, including estimates of recharge rates, discharge rates, and interbasin flow have been summarized in several groundwater resource studies (Sinclair, 1963; Glancy and Rush, 1968; Flint et al., 2004; Lopes and Evetts, 2004).

5.2.2.1 Recharge

Recharge rates for the hydrologic basins intersecting the Study Area are summarized in **Table 7**. Recharge was estimated using the Maxey-Eakin method (Glancy and Rush, 1968; Sinclair, 1963) and using the Basin Characterization Model (BCM) (Flint et al., 2004).

Recharge is likely higher in the mountainous areas and mountain fronts due to higher rainfall and less evapotranspiration. Bedrock in mountains is typically less permeable than alluvium in the valleys and may lead to runoff and mountain front recharge.

Table 7 Recharge Estimates by Hydrologic Basin

Hydrologic Basin	Area (acres)	Maxey-Eakin Recharge[1]		BCM Total Recharge[2]	
		acre-feet/ year	inches/ year	acre-feet/ year	inches/ year
021 Smoke Creek Desert	707,137	13,000	0.22	16,428	0.28
022 San Emidio Desert	194,846	2,100	0.13	4,858	0.30
023 Granite Basin	6,982	2,000	3.44	154	0.26
028 Black Rock Desert	1,404,835	13,900	0.12	5,847	0.05

[1] Glancy and Rush, 1968; Sinclair, 1963
[2] Flint et al., 2004

5.2.2.2 Discharge

Groundwater discharge occurs at springs and seeps located in and at the margins on mountain ranges and in the valleys of the San Emidio, Black Rock and Smoke Creek Deserts hydrographic basins. Groundwater discharge may also occur where the water table is near or above the ground surface. Discharge occurs through evaporation from the bare ground and evapotranspiration from phreatophytes, springs (geothermal and cold), and wetland areas. Evapotranspiration from Smoke Creek Desert and San Emidio Desert was estimated at 19,000 and 3,000 acre-feet per year, respectively (Glancy and Rush, 1968).

Groundwater discharge through well withdrawals in the Smoke Creek Desert, San Emidio Desert, Granite Basin, and Black Rock Desert hydrographic basins were last compiled for the year 2017 (NDWR, 2021c). Withdrawal rates were estimated from well and POU inventories and previous inventories (NDWR, 2013 and 2017). The location of all NDWR wells in these basins are shown on **Figure 11**.

Smoke Creek Desert well withdrawals in 2017 totaled 1,049 acre-feet with 47.3 percent of withdrawals for irrigation, 42.8 percent for wildlife, 8.0 percent for stock, 1.0 percent for domestic and 0.8 percent for commercial.

San Emidio Desert well withdrawals in 2017 totaled 4,841 acre-feet with 79.9 percent for irrigation and the remaining 20.1 percent used for industry (18.2 percent), quasi-municipal (1.8 percent), and domestic (0.1 percent).

Black Rock Desert well withdrawals in 2017 totaled 7,835 acre-feet with 97.9 percent of withdrawals for irrigation and the remaining 2.1 percent used for mining and milling (1.6 percent), stock (0.2percent), domestic (0.2 percent), and quasi-municipal (0.1 percent) use. It is noted that only one acre-foot of well withdrawals in the Black Rock Desert was estimated for Washoe County, 17 acre-feet in Pershing County, and the remaining in Humboldt County.

The Granite Basin had zero well withdrawals estimated for 2017.

5.2.2.3 Interbasin Flow

While groundwater flow paths are largely contained within individual hydrographic basins, topographic gradients and transmissive pathways between basins may result in interbasin flow. Interbasin flow has been estimated between the hydrographic basins in the Study Area and was summarized by Lopes and Evetts (2004). Net interbasin flows include:

- 5,680 acre-feet/year net inflow to Smoke Creek Desert from San Emidio Desert, Dry Valley, and Honey Lake Valley;
- 300 acre-feet/year net outflow from San Emidio Desert to Smoke Creek Desert and Black Rock Desert;
- Zero acre-feet/year net flow from Granite Basin; however, interbasin flow has not been estimated; and

- 3,860 acre-feet/year net inflow to Black Rock Desert from Pine Forest Valley, San Emidio Desert, Hualapai Flat, and Desert Valley.

5.2.3 Perennial Yield

The perennial yield of the hydrographic basins of the Study Area have been estimated based on recharge, discharge, and interbasin flow accounting (Sinclair, 1963; Glancy and Rush, 1968). Estimates of perennial yield have been adopted by NDWR to manage groundwater resources and limit the lowering of groundwater elevation beyond "reasonable" levels (Hutchins, 1955). The adopted perennial yields are:

- 021 Smoke Creek Desert: 16,000 acre-feet/year;
- 022 San Emidio Desert: 4,600 acre-feet/year;
- 023 Granite Basin: 200 acre-feet/year; and
- 028 Black Rock Desert: 30,000 acre-feet/year.

5.2.4 Water Level Timeseries

Temporal groundwater level data was reviewed to assess any apparent long-term trends in groundwater levels within the Study Area. Reviewed data sources included NWIS (USGS, 2021a) and NDWR's water level database (NDWR, 2021d). From this review, water level time series have been monitored in a single well within the Study Area (**Figure 12**). Well 028 N33 E23 26D 1 L IRRIGATION (Stantec Well ID 15) (approximately 0.5 mile north of the Project AOI was monitored semi-quarterly from 2011–2013. This well shows declining water level, dropping from 8.4 feet bgs in July 2011 to 11.6 feet bgs in November 2013 (**Figure 13**). The decline in water level may be attributed to nearby withdrawals related to irrigation.

Long term water levels have been and continue to be monitored at a few wells in the region but beyond the Study Area (**Figure 12**) (NDWR, 2021d; USGS, 2021a). Three USGS sites with monitoring since the 1960s and continuing into at least 2020 were evaluated and are presented on **Figure 13**.

Well 021 N31 E19 27ADAD1 USBLM - Salt Works is located approximately 24 miles southwest of the Project AOI, near the base of Burro Mountain in the Smoke Valley Desert basin. Following nearly a 17-foot decline from 1966 to 1968, depth to water at this site has been relatively constant since 1968. No identifiable developments, aside from a water tank in the vicinity of this well.

Well 022 N30 E23 29BACA1 is located approximately 14 miles south of the Project AOI in the San Emidio Desert basin. Water levels in the well were slightly artesian in 1967 (approximately two feet above ground surface), decreasing to 22 feet bgs in 2010 before increasing to approximately 18 feet bgs in 2017. Water levels have since remained relatively constant. Well 022 N30 E23 29BACA1 is in the vicinity of irrigated acreage and the Wind Mountain Mine.

Well 024 N35 E24 32DDCC2 USGS is located approximately 11 miles north of the Project AOI in Hualapai Flat basin. Depth to water in this well has decreased from approximately 45 feet bgs in 1969 to approximately 64 feet bgs in 2021. The rate of decline since 2008 may be lower than the

long-term rate, indicating that groundwater levels may be stabilizing. Well 024 N35 E24 32DDCC2 USGS is in the vicinity of irrigated acreage.

5.2.5 Potentiometric Surface

The potentiometric surface of the Study Area was approximated using static water elevations in wells and the presence of springs and other surface water features (**Figure 14**). Static water levels were compiled from state and national databases (NDWR, 2021a; USGS, 2021b). Water levels from NDWR were likely measured by the driller soon after the well was completed. These water levels may not have fully equilibrated, but the potential error is likely small for the scale of this map. Groundwater levels collected by the USGS were likely measured long after the well was completed and therefore may be better equilibrated to pre-drilling levels.

Water level elevations were determined by subtracting the static water level (depth to water) from the site elevation, as calculated from the digital elevation models (DEM) (USGS, 2018).

Discrepancies were present between reported elevation and DEM elevations at the reported locations. Assuming reported locations were correct, wellhead elevations were adjusted to match the DEM.

Springs emanating from bedrock are potentially associated with perched groundwater and therefore may not represent the regional potentiometric surface. Therefore, only springs emanating from basin sediments were included in the potentiometric surface and the potentiometric surface was not contoured within the Granite Range.

Water levels were generally shallow in the basins and follow the topographic profile (**Figure 14**).

The water table elevation at the Project AOI is approximated at 3,900 to 4,100 feet AMSL, depending on the relative distance from the Granite Range. West of the Granite Range, the potentiometric surface may reach approximately 4,560 feet AMSL, as noted by springs near the break in slope at the base of the range. The potentiometric surface decreases below 3,800 feet amsl near the southern margin on the Study Area, near the town of Empire, Nevada. Lower groundwater levels in this area may be associated with groundwater extraction related to mining, milling, or industrial purposes.

In the Granite Range, which exceeds 8,200 feet AMSL within the Study Area, springs are present at elevations above 7,000 feet AMSL. However, it is likely that many springs in the Granite Range are associated with perched groundwater.

The differentiation of confined, unconfined, and perched aquifers is generally unknown beyond the Project AOI where several boreholes are present and conditions have been classified as confined or unconfined (Olmsted et al., 1975). Geothermal waters do not reach the surface under artesian pressure. Instead, conductive fractures deliver geothermal water to a shallow aquifer. As groundwater flows downgradient towards the valley center, the water table intersects the ground surface, creating geothermal discharge areas (GeothermEx, 1992). Cold springs in the Granite Range may come from unconfined, perched aquifers.

5.2.6 Aquifer Properties

Well yield was measured at eight wells within the Study Area (NDWR, 2021a). The discharge rates ranged from 0.10 gpm from an unknown screened interval (NWIS well log 021 N33 E22 26CC 1) to 2,000 gpm from a 60-foot screened interval (NDWR well log 8535) (**Table 6**). The median yield was 32.5 gpm.

Transmissivity and hydraulic conductivity are expected to be locally high in the alluvial aquifers where sand and gravel lenses are present or at the mountain fronts where sediments are coarse and fine particulate is not present (Sinclair, 1963). Alluvium further into the basin is expected to have lower permeability due to generally finer particles.

Transmissivity of the shallow geothermal aquifer in the Project AOI was estimated at 30 square meters per day (Olmsted et al., 1975).

The granite bedrock of the Granite Range and underlying the valleys is expected to have very little permeability unless highly fractured and juxtaposed against hard rock (i.e., granite or Tertiary lava) as opposed to basin fill sediments (GeothermEx, 1992). This permeability is also expected to decrease with depth and fracture permeability may diminish as alternation deposits fill the joints. Therefore, repeated fracturing caused by ongoing seismic activity may be required to maintain permeability in these fractures.

No specific hydraulic properties of the targeted geothermal reservoir within the Project AOI have been measured.

5.2.7 Geothermal Water Budget

Olmsted et al. (1975) estimated the water balance for the Gerlach geothermal system, within the vicinity of the Project AOI, using water budget and heat budget approaches. Using the water budget method, recharge from precipitation and runoff was estimated at 0.2×10^6 m^3/year (101 gpm), upflow from the geothermal system was estimated at 1.5×10^6 m^3/year (754 gpm) and imported water from Granite and Garden Springs was estimated at 0.1×10^6 m^3/year (50 gpm). This total of inflows was balanced by evapotranspiration (1.7×10^6 m^3/year [854 gpm]) and groundwater outflow (0.1×10^6 m^3/year [50 gpm]). Using a heat budget approach, the upflow from the geothermal system was lower at 1.1×10^6 m^3/year (553 gpm). The discrepancy between the two methods was not determined.

5.3 SUBSURFACE TEMPERATURES

Geothermal gradient test holes and deeper exploration holes were drilled in the 1970s and 1980s. These holes, including total depth, maximum recorded temperature, and approximate location are summarized in **Table 8** and shown on **Figure 15**. Borehole depths ranged in depth from approximately 43 to 5,800 feet. Temperature gradients in boreholes were highest near Great Boiling Spring where they exceeded 20°F per 100 feet. However, temperature gradients vary with depths, as shown on **Figures 16A**, **16B**, and **16C**.

Exploration borehole 18A-10 was drilled approximately 1,300 feet northwest of Great Boiling Spring. Temperatures at 18A-10 increased rapidly with depth, exceeding 273°F at approximately 187 feet deep. The temperature then decreases with depth before becoming variable, but near 240°F to a depth of 2,878 feet. High temperatures at shallow depth suggest a shallow aquifer that is fed by deeper fluids traveling up a northeast-southwest trending fault zone and flowing to the southeast, progressively cooling (GeothermEx, 1992).

The shallow, geothermally heated aquifer has limited extent, which is likely fault controlled. For example, the 5,800-feet deep exploration borehole 1-15-G did not encounter this shallow aquifer. A maximum temperature of 197°F was encountered near the top of the 3,300-feet deep granitic basement.

Table 8 Exploration Boreholes

Borehole ID	Depth (feet bgs)	Collar Elevation (feet amsl)	UTM NAD83[1]		Max Temp (°F)	Min Depth of Max Temp (feet bgs)	Lithology (top elevation [feet bgs])
			Easting (meters)	Northing (meters)			
1-15-G	5,800	3,939.0	299,644	4,502,621	197.0	2500	Alluvium (0), Granodiorite (3270)
18-10	2,868	3,975.1	299,701	4,504,113	-	-	Alluvium (50), Breccia (370), Alluvium (425), Granodiorite (640)
18A-10	2,889	3,975.1	299,685	4,504,119	273.9	181	Alluvium (0), Granodiorite (670)
38-10RD2	3,187	3,949.1	300,213	4,504,169	-	-	Alluvium (0), Granodiorite (700)
68-3	-	3,913.4	300,785	4,505,640	-	-	-
76-9	2,296	4,075.8	299,418	4,504,427	-	-	Granodiorite (0)
76-15	200	3,946.2	300,832	4,502,882	141.0	160	-
AH-1A	145	3,919.9	300,593	4,505,933	85.8	135	Alluvium (0)
AH-2A	148	3,930.1	298,148	4,502,297	103.2	140	Alluvium (0)
AH-3B	148	3,915.0	301,479	4,502,375	57.8	144	Alluvium (0)
AH-4A	148	3,925.9	299,486	4,502,229	77.7	141	Alluvium (0)
AH-5	43.0	3,984.9	298,418	4,503,311	65.7	43	Alluvium (0)
AH-6A	147	3,955.1	298,399	4,502,936	88.8	120	Alluvium (0)
AH-7	153	3,924.9	296,067	4,501,373	59.3	153	Alluvium (0)
AH-8A	148	3,912.1	301,111	4,507,142	60.8	148	Alluvium (0)
AH-13A	150	3,904.9	301,662	4,507,651	55.3	130	Alluvium (0)
B-4	500	3,900.0	302,820	4,507,279	65.5	500	-
Cordero-1	679	3,950.0	299,956	4,503,219	-	-	-
DH-14	150	3,941.9	299,917	4,502,648	92.0	140	-
DM-15	101	3,972.1	299,964	4,504,669	235.4	98	-
Egbert1	3,664	3,945.5	300,433	4,504,236	101.2	281	-

Borehole ID	Depth (feet bgs)	Collar Elevation (feet amsl)	UTM NAD83[1]		Max Temp (°F)	Min Depth of Max Temp (feet bgs)	Lithology (top elevation [feet bgs])
			Easting (meters)	Northing (meters)			
F-1	500	3,920.0	299,630	4,502,580	162.6	500	-
F-2	500	3,927.0	301,133	4,503,794	86.3	498	-
F-3	500	3,932.2	300,535	4,505,353	173.6	495	-
G-1	1,021	3,952.8	301,596	4,508,424	73.0	-	-
G-3	691	3,931.4	300,458	4,504,884	213.0	420	-
G-4	356	4,083.3	297,939	4,504,818	71.0	300	-
GRZ	247	3,929.5	301,222	4,503,106	100.4	246	-
GTG-2	1,081	3,940.9	300,427	4,505,568	183.1	400	-
Peregrine1	1,070	3,958.7	299,927	4,504,238	261.0	180	Alluvium (300), Granodiorite (580)
TG-1	126	4,043.0	299,539	4,504,363	256.0	125	-
GE-1	657	3,964.9	299,864	4,503,152	273.2	205	Alluvium (0)
GE-2	616	3,945.2	300,865	4,503,359	119.3	615	Alluvium (0)
GE-3	361	4,047.6	299,462	4,504,081	266.0	154	Granodiorite (0)
U-3	400	3,915.0	298,848	4,501,478	-	-	-

Source: Ormat, 2020
Note: excludes shallow (2 meter) test holes from Hazelwood et al. (2013).
[1]Universal Transverse Mercator North American Datum 1983

5.4 WATER QUALITY

Water quality samples have been collected from several springs and wells in the region (**Figure 5**, **Figure 7**, and **Table 9**). Near the Project AOI, sites with water quality samples include geothermal springs Great Boiling Springs, Ditch Spring, Mud Spring, Horse (or Corral) Spring, several cold and geothermal wells, and a geothermal exploration borehole. The majority of sampling occurred in the 1970s and 1980s (USGS, 2021a; GeothermEx, 1992). Water quality samples were also collected in 1992 from Great Boiling Springs, Mud Spring, Ditch Spring, the GGID hot pool well, GGID community center well, and a cold water well (pipe at 32n23e34ddd) (GeothermEx, 1992). The locations of the Planet X well and Joe Selmi's well could not be determined from available literature. The pipe at 32n23e34ddd may be erroneous as no infrastructure is visible from aerial imagery at this location; furthermore, the GeothermEx (1992) descriptions of this well are inconsistent. Water samples from Great Boiling Springs and several unnamed springs within one mile of the AOI (Stantec, 2021). Water type, as defined by the major cations and anions, is shown in the Piper diagram on **Figure 17**.

Water from all geothermal sources near the Project AOI have sodium-chloride type water (**Figure 17**). Excluding the 1975 sample from Great Boiling Springs orifice 23, which had anomalously high chloride and total dissolved solids (TDS), concentrations from hot wells and springs were between 3,910 and 5,010 milligrams per liter (mg/L) and chloride concentrations were between 1,800 and 2,400 mg/L.

Relative to geothermal wells and springs, water samples from cold wells had higher ratios of bicarbonate relative to chloride. Well 028 N33 E24 21CA 1, which is located in the Black Rock Playa deposits (**Figure 17**), has major ion ratios similar to geothermal waters but with very high TDS (84,200 mg/L) and is likely unrelated to geothermal fluids.

Furthermore, water from hot springs and hot wells show little to no mixing with non-geothermal groundwater. This is evident from magnesium concentrations, which were very low at 0.0–2.2 mg/L. Cool groundwater contains magnesium from water-rock interactions. Due to the lower solubility of carbonate and sulfate minerals at high temperatures, magnesium, as well as calcium, concentrations are lower in geothermal fluids. The presence of magnesium in geothermal-related fluids can indicate mixing with cold groundwater. GeothermEx (1992) concluded that mixing between geothermal and cool groundwater "probably is not significant."

Table 9 Water Chemistry of Springs and Wells

Sample Name	Date	Temperature (°F)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SiO_2 (mg/L)	B (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)
Great Boiling Springs	1973	187	1,400	130	68	1.2	165	9.9	2,200	400	83	0
Great Boiling Springs: Orifice 3	1974	186.8	1,400	130	68	1.2	170	9.9	2,200	400	83	0
Great Boiling Springs	02/19/1974	183	1,548	113	89	0.98	170	-	2,238	385	91	0
Gerlach Hot Springs	02/19/1974	183.2	1,500	113	89	1	170	-	2,200	390	91	0
Great Boiling Springs: Borax Spring	1975	-	1,600	134	78	1.3	170	-	2,100	370	75	0
Great Boiling Springs: Orifice 9	1975	167	1,600	110	73	2	180	1.1	2,100	360	90	0
Great Boiling Springs: Orifice 18	1975	136.4	1,600	135	73	2.5	190	1.3	2,200	380	84	0
Great Boiling Springs: Orifice 19	1975	208.4	1,400	140	70	1	170	1.8	2,100	370	90	0
Great Boiling Springs: Orifice 22	1975	131.5	1,800	128	75	2.5	180	1.5	2,400	380	88	0
Great Boiling Springs: Orifice 23	1975	95.2	1,900	270	150	12	170	0.9	5,000	1,400	88	0
Great Boiling Springs: Orifice 24	1975	200.3	1,600	135	73	2	170	-	2,100	360	66	0
Great Boiling Springs: Orifice 27	1975	145.4	1,600	148	75	2.2	180	-	2,200	380	82	0
Great Boiling Springs: Orifice 28	1975	203.9	1,600	134	68	2.8	170	1.6	2,200	410	160	0
Great Boiling Springs: Orifice 37	1975	149	1,400	133	70	2.2	190	1.7	2,300	350	90	0
Great Boiling Springs: Orifice 43	1975	114.4	1,800	130	69	2.3	170	1.5	2,200	360	88	0
Great Boiling Springs: Orifice 55	1975	172.4	1,600	140	73	2.3	180	-	2,100	360	85	0
Great Boiling Springs	05/08/1977	197.6	1,500	110	72	1.2	160	-	2,200	370	85	0
Great Boiling Springs: Orifice 3	1978	-	1,300	67	67	1.4	280	7.65	1,800	340	100	0
Great Boiling Springs: Orifice 48	01/16/1980	201.2	1,500	100	67	1.5	160	-	2,300	370	84	0
Great Boiling Springs: Orifice 23	01/17/1980	212.9	1,500	120	74	1.2	170	-	2,200	380	100	0
Great Boiling Springs: #50	07/16/1984	172.9	1,411	102	63	1	160	5.3	2,250	374	74	0
Great Boiling Springs: Borax Pool	07/16/1984	120.9	1,554	111	72	2	187	5.8	2,340	398	111	0
Great Boiling Springs: Orifice 46	1975	182.8	1,400	136	96	2.3	170	1.5	2,400	400	83	0
Great Boiling Springs: Orifice 46	01/28/1980	191.3	1,400	120	70	1.1	210	8.2	2,100	380	96	0
Great Boiling Springs: Orifice 46	03/03/1992	192.2	1,482	110	71	1.23	170.1	8.43	2,160	404	91	0
Mud Springs Orifice 1	1975	140.9	1,500	135	75	2.8	170	2.1	2,100	380	75	0
Mud Springs Orifice 2	1975	165.2	1,500	134	74	2.5	170	-	2,100	370	70	0
Mud Springs Orifice 9	1975	183.7	1,500	143	73	2.4	170	1.1	2,100	380	70	0
Mud Springs Orifice 13	1975	107.6	1,600	131	50	2.3	170	1.2	2,400	370	71	0
Mud Springs Orifice 2	01/18/1980	196.7	1,500	100	79	2.8	140	0	2,200	380	120	0
Mud Springs Orifice 1	02/05/1980	174.2	1,400	120	77	2.6	190	0	2,200	390	120	0
Mud Spring #1	07/16/1984	158.9	1,378	102	68	3	135	5.4	2,120	264	120	0
Mud Spring	03/03/1992	167	1,369	101	70	2.4	136.5	7.72	2,010	364	118	0
Ditch Spring	1975	206.6	1,400	121	73	2.2	180	-	2,200	390	84	0
Ditch Spring	11/28/1979	194	1,400	110	56	0.9	160	7.9	2,000	370	68	0
Ditch Hot Spring	07/16/1984	195.1	1,383	95	55	1	142	5.1	2,160	336	71	0
Ditch Hot Spring	03/03/1992	196.4	1,373	96	58	1.1	140.5	7.73	2,010	364	80	0
Horse Spring	1975	145.4	1,400	130	74	1	180	1.8	1,900	360	74	0
G-3 Well	1981	213.8	1,590	66	50	3.3	104	7.11	2,000	375	434	0

Sample Name	Date	Temperature (°F)	Na (mg/L)	K (mg/L)	Ca (mg/L)	Mg (mg/L)	SiO_2 (mg/L)	B (mg/L)	Cl (mg/L)	SO_4 (mg/L)	HCO_3 (mg/L)	CO_3 (mg/L)
GGID Hot Pool Well	07/16/1984	185.4	1,325	99	74	4	247	5.1	2,020	317	179	0
GGID Hot Pool Well	02/02/1992	185	1,364	100	83	3.2	263.6	7.93	2,000	339	176	0
GGID Community Center Well (76-15)	03/03/1992	154.5	1,400	108	69	3.3	241	8.24	2,000	326	218	0
Pipe at 32n23e34ddd[1]	03/03/1992	-	1,585	34	12	18	52	10.11	2,190	-	774	0
Joe Selmi's Well[1]	07/16/1984	61	442	9	24	19	44	1.4	436	42	503	0
Planet X Well[1]	07/16/1984	62.1	124	10	8	3	54	0.3	79	23	220	0
021 N33 E22 26CC 1	9/23/2003	17.8	-	-	-	-	-	-	-	-	-	-
021 N33 E22 26D 1	10/15/1966	16.5	150 as Na		8.80	2.40	-	-	67.0	44	275	0
021 N32 E23 18D 1	9/16/1966	19.0	970 as Na		2.00	1.20	-	-	681	416	500	187
022 N32 E23 27B 1	11/9/1966	-	-	-	-	-	-	-	833	4500	358	0
028 N33 E23 26D 2	4/9/1945	16.0	305	10	18.0	5.00	44.0	-	160	79	361	48
028 N33 E24 21CA 1	11/12/1980	12.1	31,000	170	1.70	1.80	16.0	-	44,000	3,400	9,560	902
028 N33 E24 30 1 Playa Well	1/1/1975	17.0	2050	75	6	16	61	4.8	1680	10	1450	0

°C = degrees Celsius
mg/L = milligrams per liter
Na = sodium
K = potassium
Ca = calcium
Mg = mercury
SiO_2 = silica
B = boron
Cl = chloride
SO_4 = sulfate
HCO_3 = bicarbonate
CO_3 = carbon trioxide
GGID = Gerlach General Improvement District
[1]Location unknown or likely erroneous

5.4.1 Geochemical Geothermometry

No water quality samples have been collected directly from the targeted geothermal reservoir within the Project AOI. However, water quality samples have been collected from Great Boiling Springs, Mud Springs, Horse Spring, Ditch Spring, and several hot wells within the Project AOI (**Figures 5** and **7**) . The water chemistry from all wells and springs are presented in Section 5.4. The consistency of groundwater chemistry across geothermal sites and little evidence of mixing suggests the water chemistry from the targeted geothermal reservoir within the Project AOI may be similar.

The water discharging from Great Boiling Springs has been measured at 114°F to 213°F (excluding the 1975 sample from orifice 23). Using the silica geothermometer, source temperatures were estimated at a minimum of 293°F (assuming SiO_2 concentrations are controlled by chalcedony solubility). Using various cation geothermometers (Na-K-Ca-Mg, Na-K-Ca, Na/K), source temperatures were estimated at 358°F to 399°F (GeothermEx, 1992).

5.5 CONCEPTUAL HYDROLOGIC MODEL

The Project AOI is located at the base of the Granite Range at the boundary between the San Emidio, Smoke Creek, and Black Rock Desert hydrographic basins. Recharge to the groundwater system is likely primarily within the Granite Range and at the mountain block front. Groundwater flows from the fractured rock aquifers of the Granite Range and into alluvial aquifers located in the valleys. Coarser alluvium deposits at the base of the Granite Range likely also serves as transmissive aquifers, which are locally pumped for irrigation and livestock watering. Non-consumed groundwater flows west and southeast, discharging at geothermal and cold springs, or continuing to the playa zones of the basins where it may be lost to evapotranspiration where water levels are near the surface or periodically at the surface. Regional groundwater elevations have decreased within the last decades, which may be localized and attributed to withdrawals for irrigation.

The geothermal system at the Project AOI likely begins with a portion of recharge to the Granite Range circulating to depth within the fractured granite bedrock, where it is heated to temperatures that may be as high as 356°F to 392°F. Subvertical permeable faults in granite at depth allow the rapid ascent of geothermal fluids into a shallow aquifer.

The bedrock near the Project AOI generally has low permeability unless heavily fractured through seismic activity over geological time. Permeability in the Project AOI is likely enhanced by three structural features: (1) the intersection of two sets of normal faults that bound the Granite Range on the western and eastern flanks; (2) the southward termination of these fault zones, which likely result in main faults horse-tailing into smaller, permeable fractures zones; and (3) local complex structures that result from the former two regional features. Groundwater in the shallow aquifer discharges to Great Boiling Spring, Mud Spring, Ditch Spring, Horse Spring or outflows to the southeast where it progressively cools.

6.0 REFERENCES

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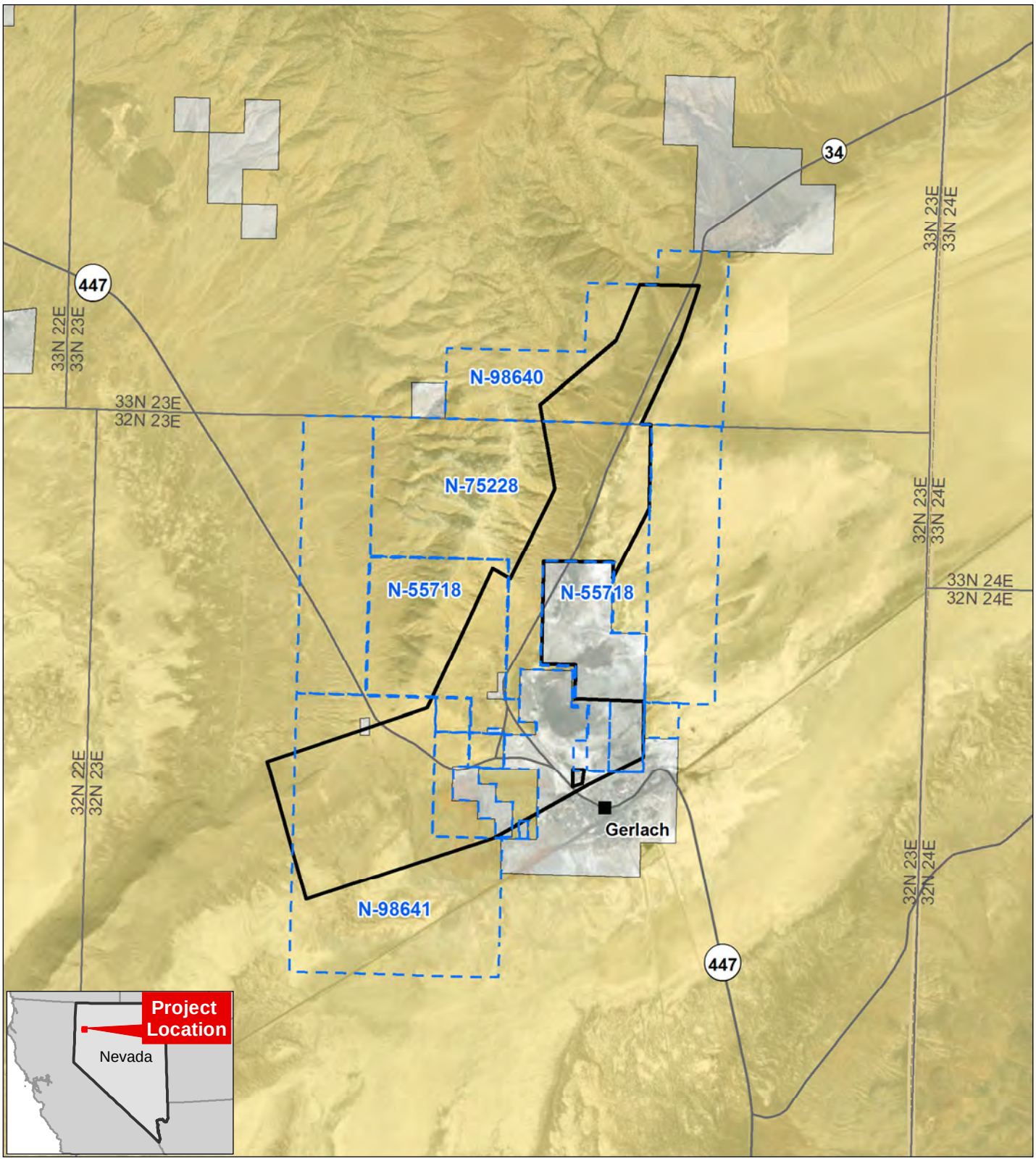
FIGURES



Project AOI
Nevada Cities/Towns
Major Roads
Federal Geothermal Lease
Bureau of Land Management
Private

N

Miles
0 0.5 1
1 in = 1 miles

Stantec

Washoe County, NV
NAD 1983 UTM Zone 11N

DRAWN BY: CJ	1ST REVIEW: JT	2ND REVIEW: SS
DATE: 8/26/2021	PROJECT NO: 203721766	

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 1
Project Location and Overview

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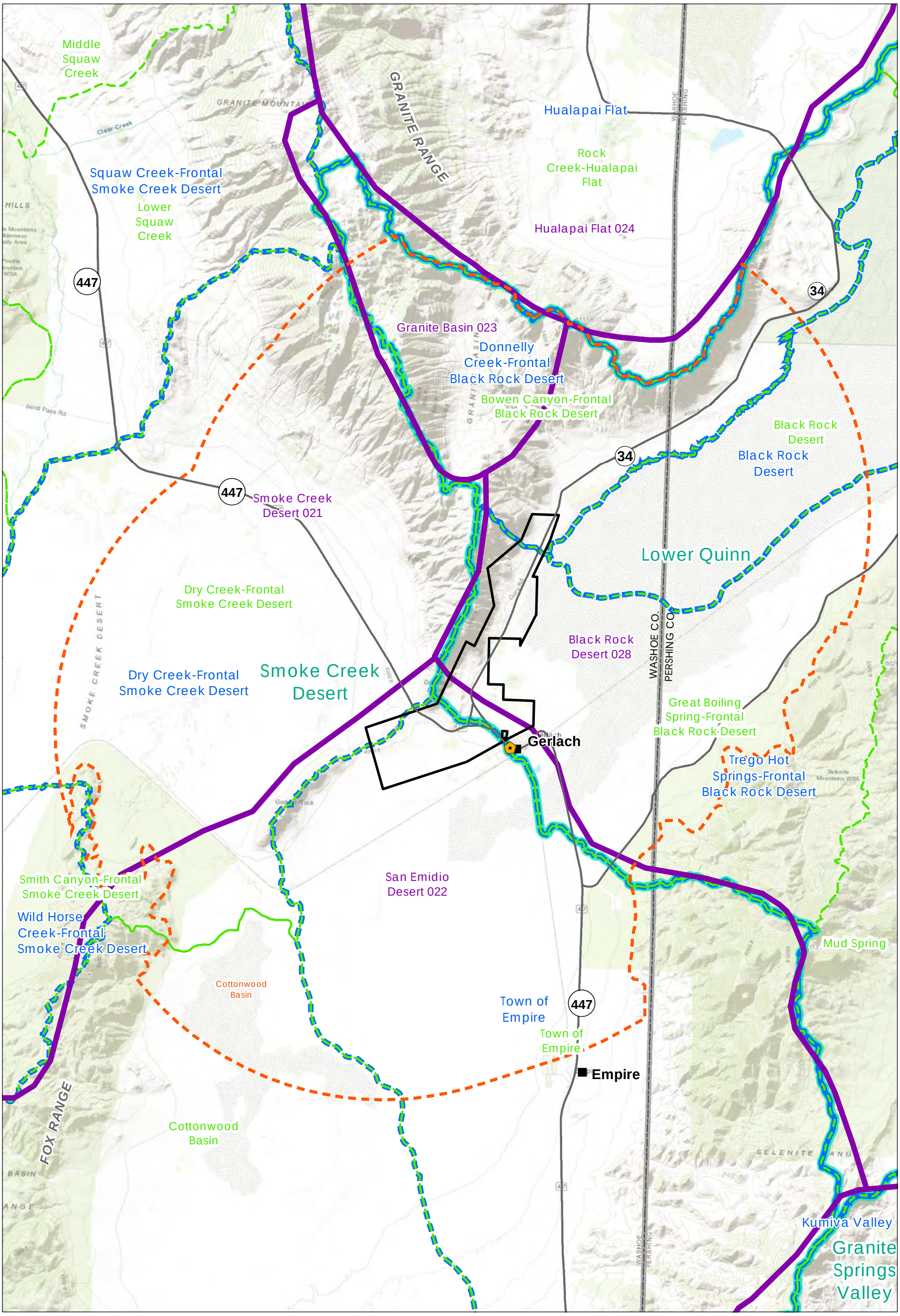

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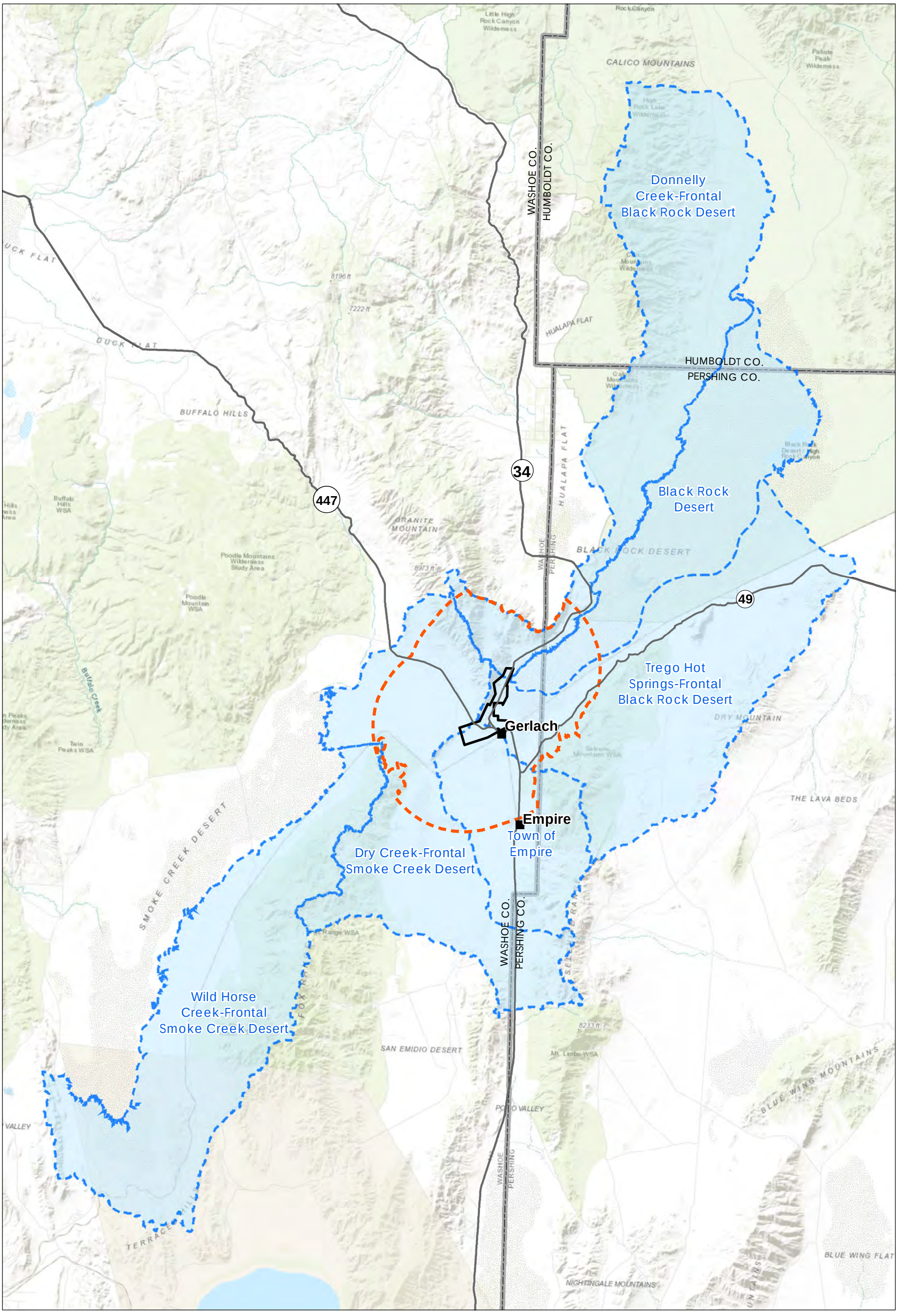

Project AOI

Hydrologic Evaluation Study Area

Nevada Cities/Towns

Major Roads

HUC 10 Hydrologic Basin

N

Feet

0 4,0C8,000

1 in = 29,000 feet

Stantec

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV
NAD 1983 UTM Zone 11N

DRAWN BY: JT	1ST REVIEW: BT	2ND REVIEW: SS
DATE: 8/27/2021	PROJECT NO: 203721766	

Figure 3
Hydrographic Basins
and Hydrological Units
In The Region

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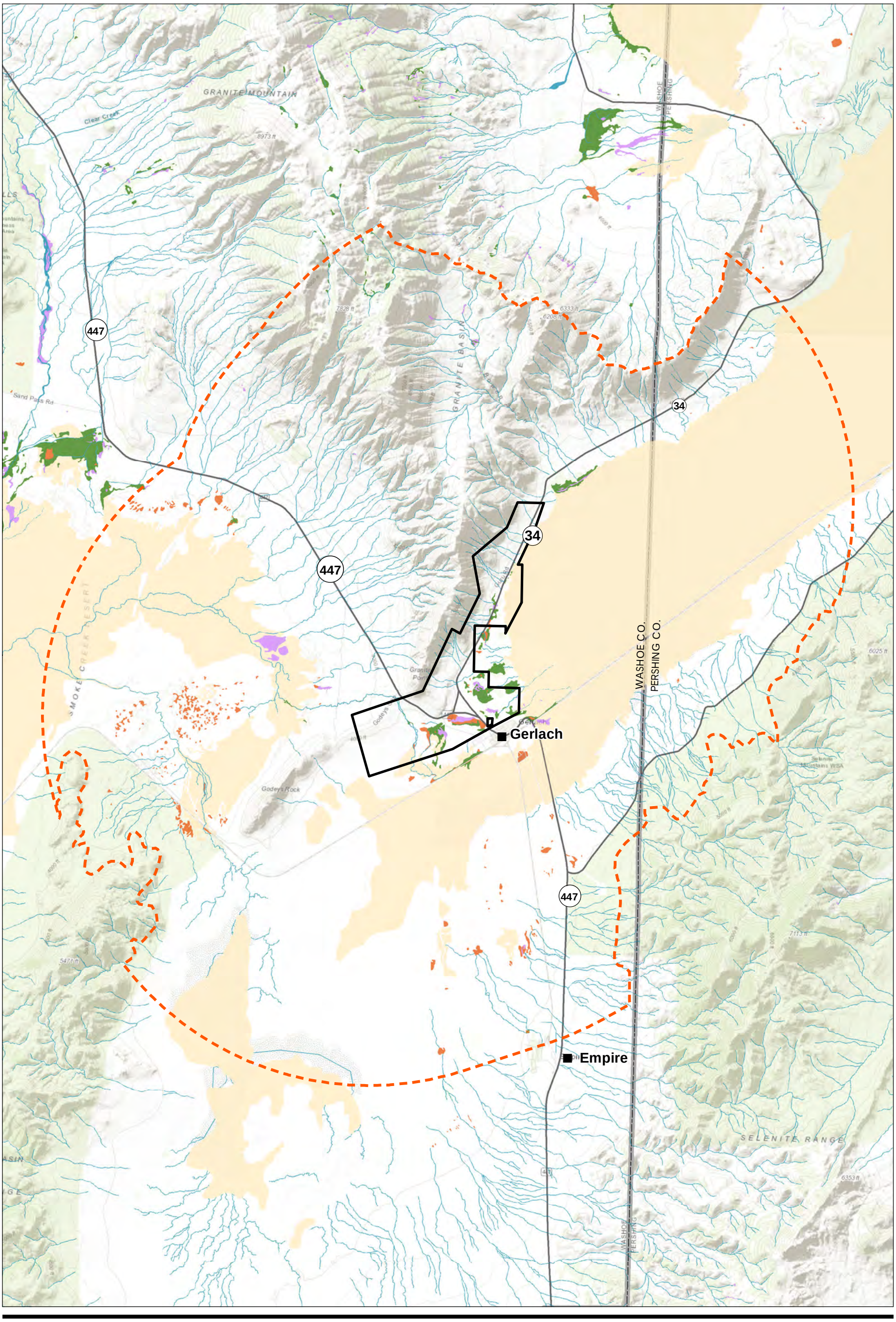
Service Layer Credits: Sources: Esri, HERE, Garmin, intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
Sources: Esri, USGS, NOAA



Project AOI

Hydrologic Evaluation Study Area

Nevada Cities/Towns

Major Roads

Wetlands

Freshwater Emergent Wetland

Freshwater Forested/Shrub Wetland

Freshwater Pond

Lake

Riverine

N

Feet

0 4,000 8,000 1 in = 8,000 feet

Stantec

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

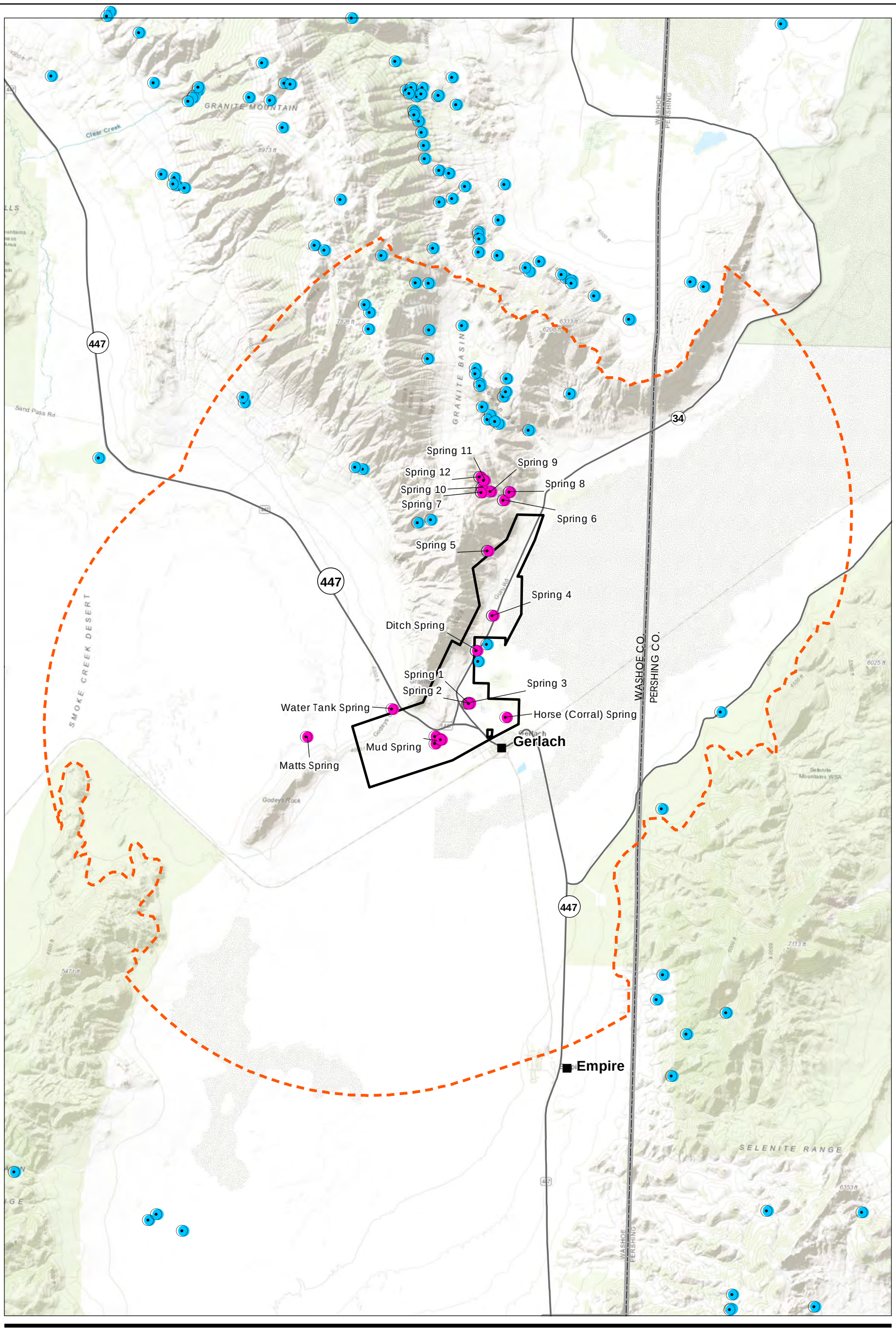
Washoe County, NV
NAD 1983 UTM Zone 11N

DRAWN BY: CJ	1ST REVIEW: BT	2ND REVIEW: SS
DATE: 1/20/2022	PROJECT NO: 203721766	

Figure 4
Surface Water
and Wetland Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_4_SurfaceWater_WetlandInventory_11x17P.mxd Revised: 2022-01-20 By: chrjohnson

Service Layer Credits: Sources: Esri, HERE, Garmin, intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Project AOI

Hydrologic Evaluation Study Area

Previously Sampled Springs

NHD Springs

Nevada Cities/Towns

Major Roads

N

Stantec

Feet

0 4,000 8,000 1 in = 8,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

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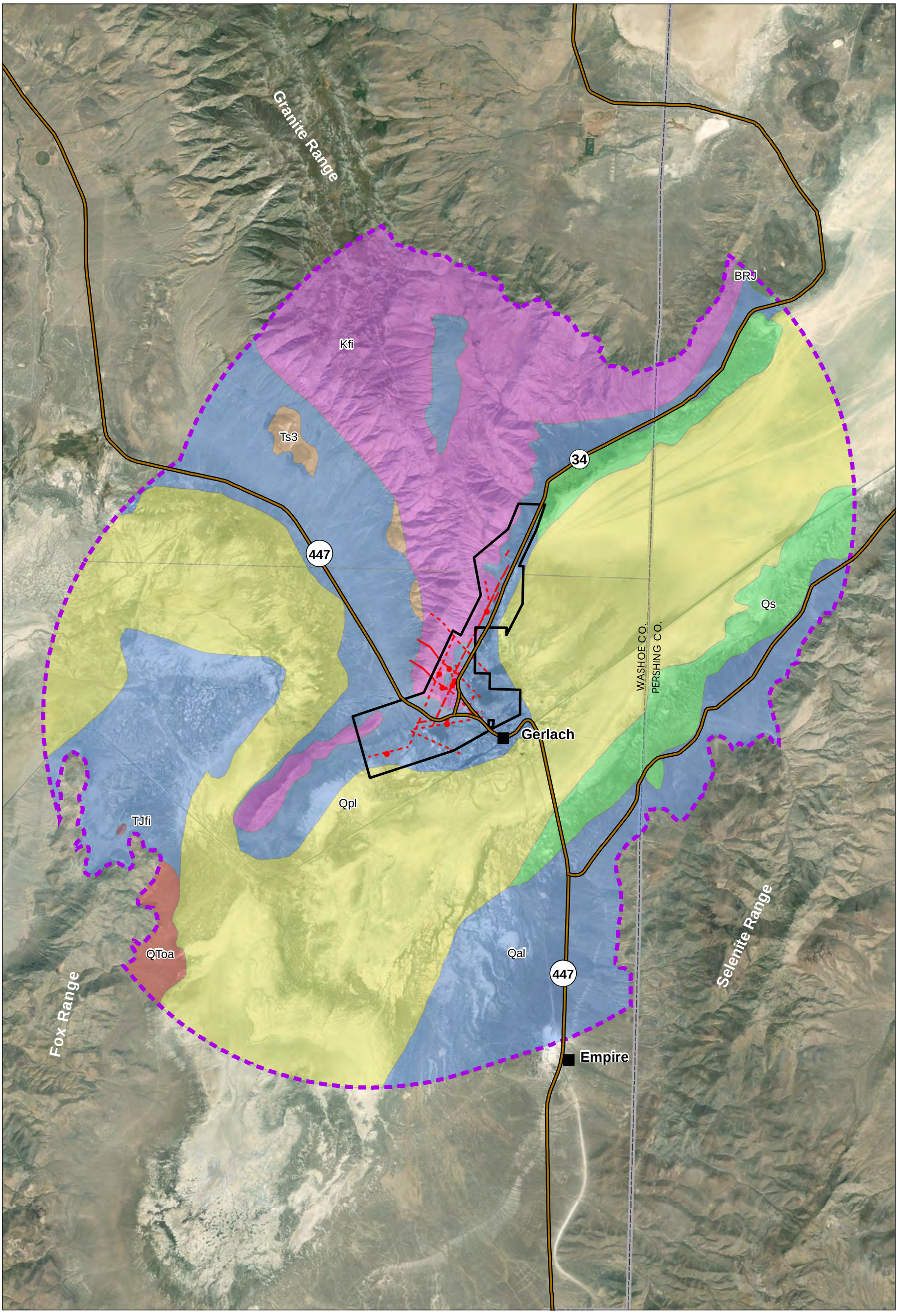
ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 5
Spring Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_5_Spring_Inventory_11x17P.mxd Revised: 2022-01-19 By: chrjohnson

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Project AOI

Hydrologic Evaluation Study Area

Nevada Cities/Towns

Major Roads

Faults

Certain

Concealed

Inferred

Normal Fault

Lithology

Qal

Qpl

QToa

Qs

TJfi

Ts3

Kfi

BRJ

N

Stantec

Feet

0 4,000 8,000 1 in = 8,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

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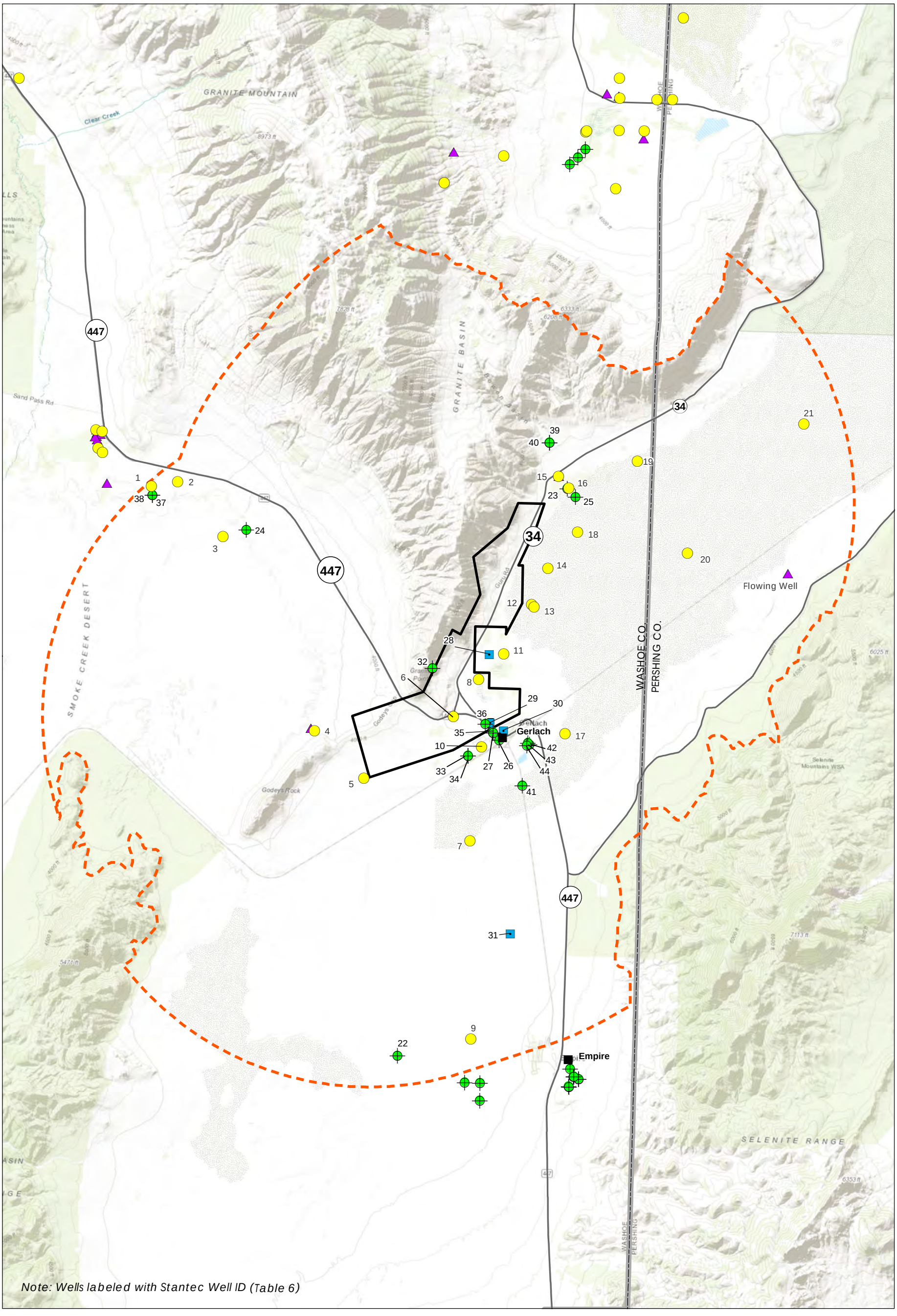
DATE: 1/20/2022 | PROJECT NO: 203721766

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 6
Surface Geology

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_6_Surface_Geology_11x17P.mxd Revised: 2022-01-20 By: chrjohnson

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Project AOI
Hydrologic Evaluation Study Area
Nevada Cities/Towns
Major Roads

NWIS Wells
NDWR Wells
NHD Wells
Other Wells (GerthermEx, 1992)

N

Stantec

Feet
0 4,000 8,000 1 in = 8,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

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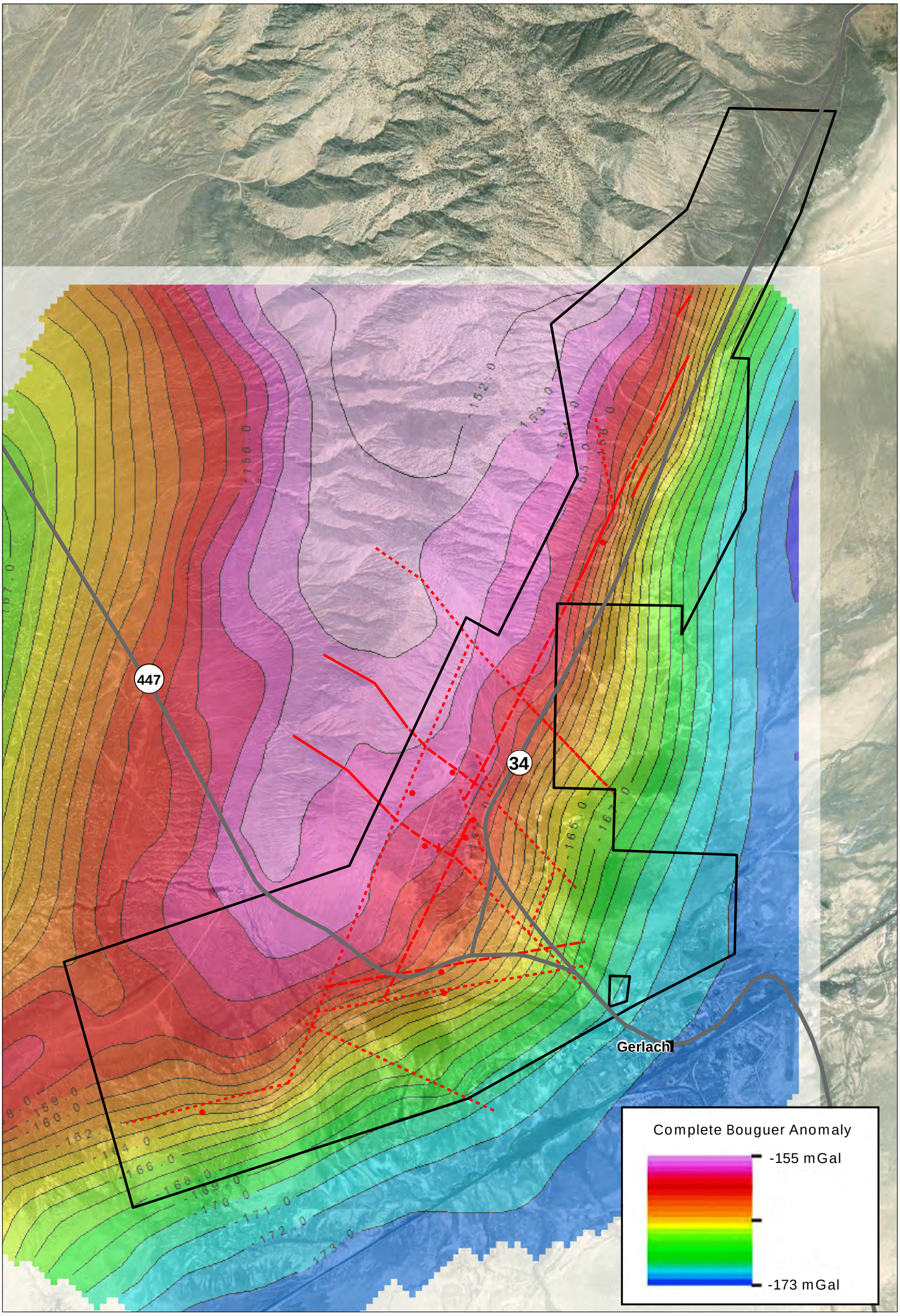
ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 7
Study Area Well Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_7_Study_Area_Well_Inventory_11x17P.mxd Revised: 2022-01-21 By: chrjohnson



Project AOI

Nevada Cities/Towns

Major Roads

Faults

Certain

Concealed

Inferred

Normal Fault

N

Feet

0 1,000 2,000 1 in = 2,000 feet

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GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV
NAD 1983 UTM Zone 11N

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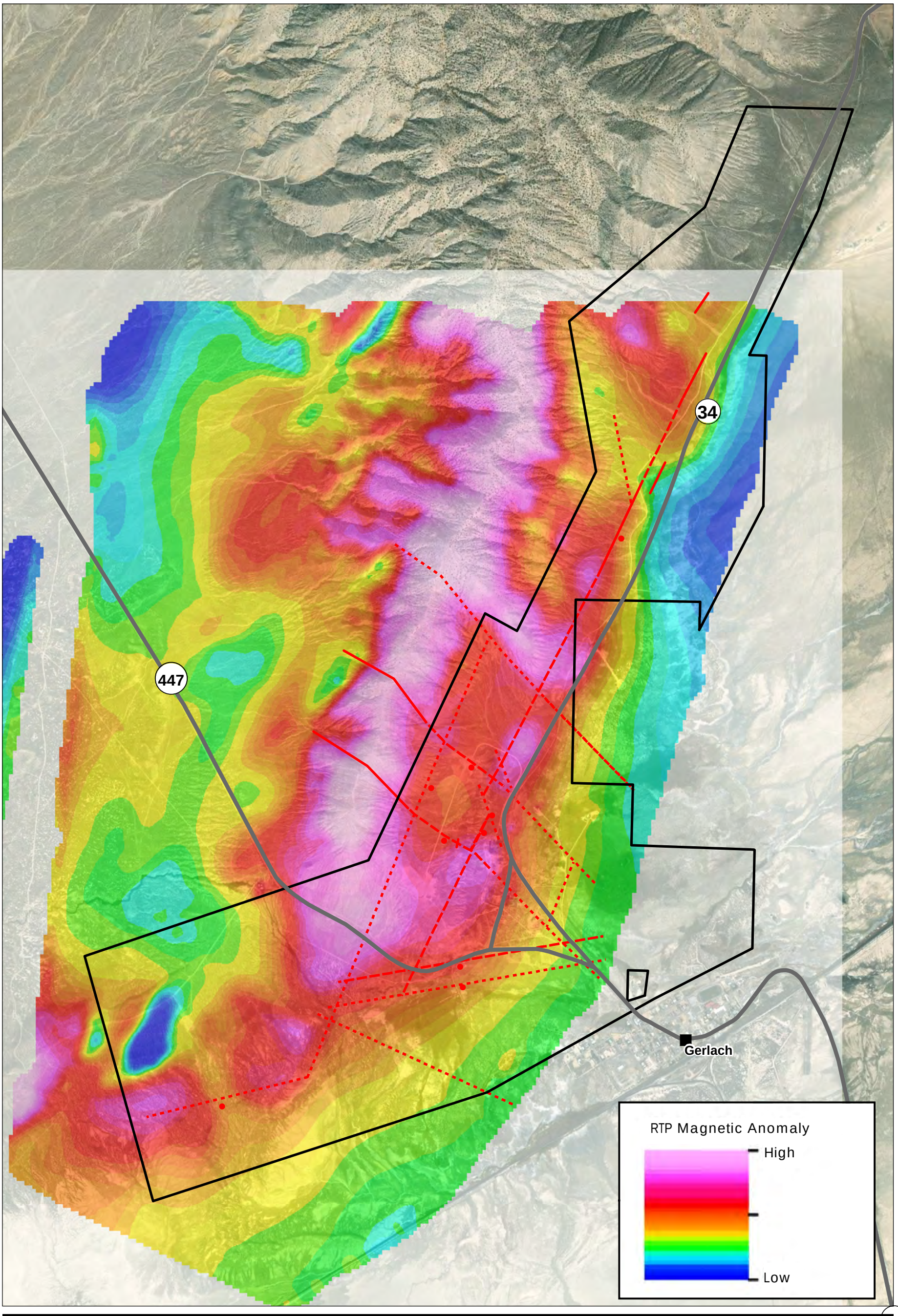
DATE: 1/21/2022	PROJECT NO: 203721766	

Figure 8
Complete Bouguer Gravity

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_8_Complete_Bouger_Gravity_11x17P.mxd Revised: 2022-01-21 By: chrjohnson

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Project AOI

Nevada Cities/Towns

Major Roads

Faults

Certain

Concealed

Inferred

Normal Fault

N

Stantec

Feet

0 1,000 2,000 1 in = 2,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

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DATE: 1/21/2022 | PROJECT NO: 203721766

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 9
Magnetic Survey

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_9_Magnetic_Survey_11x17P.mxd Revised: 2022-01-21 By: chrjohnson

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

5473

V09129
81592
2660
V09126
89360
89358
79438
V09125
V09124
89361
75230
89359
79445
R10169
21115
21116
34
447
V04627
78054
77782
65624
65623
65622
Gerlach
WASHOE CO.
PERSHING CO.
Empire
1

GRANITE MOUNTAIN
Clear Creek
GRANITE BASIN
SMOKE CREEK DESERT
Godeys Rock
SELENITE RANGE
Selenite Mountains WSA

Project AOI
Hydrologic Evaluation Study Area
POD Commercial
POD Industrial
POD Irrigation
POD Mining
POD Municipal
POD Other
POD Stockwater
POD Storage
POD Wildlife
POU Commercial
POU Industrial
POU Irrigation
POU Mining, Milling
POU Municipal
POU Other
POU Wildlife
Nevada Cities/Towns
Major Roads

N
Feet
0 4,000 8,000
1 in = 8,000 feet

Stantec

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV
NAD 1983 UTM Zone 11N

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DATE: 8/27/2021 | PROJECT NO: 203721766

Figure 10
Water Rights Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_10_Water_Rights_Inventory_11x17P.mxd Revised: 2021-08-27 By: chrjohnson

Valley

Sheldon National Wildlife Refuge

New Year Lake

CALIFORNIA

NEVADA

SURPRISE VALLEY

LONG VALLEY

7557 ft

WASHOE CO.

HUMBOLDT CO.

Summit Lake Reservation

7941 ft

BILK CREEK MOUNT

BLACK ROCK DESERT

HAYS CANYON RANGE

CALICO MOUNTAINS

Black Rock Desert / High Rock Canyon

9060 ft

8580 ft

JACKSON MOUNTAINS

8618 ft

Mud Meadow Creek

Jackson Creek Slough

34

8196 ft

7222 ft

GRANITE RANGE

447

Black Rock Desert

HUMBOLDT CO.

PERSHING CO.

Black Rock Desert / High Rock Canyon

BUFFALO HILLS

8773 ft

49

Smoke Creek Desert

Granite Basin

Gerlach

Empire

San Emidio Desert

SMOKE CREEK DESERT

7774 ft

7466 ft

KUVIMA VALLEY

8233 ft

WASHOE CO.

PERSHING CO.

SAGE VALLEY

TRINITY RANGE

Lovelock

GRANITE SPRINGS VALLEY

SAHWAVE MOUNTAINS

LOWER VALLEY

Pyramid Lake Paiute Reservation

Pyramid Lake

VIRGINIA MOUNTAINS

8628 ft

8716 ft

Churchill

Pershing

WEST HUMBOLDT RANGE

Project AOI

Hydrologic Evaluation Study Area

Hydrographic Basin

Nevada Cities/Towns

Major Roads

NWIS Wells

NDWR Wells

NHD Wells

Other Wells (GerthermEx, 1992)

N

Miles

0 4.5 9

1 in = 10 miles

Stantec

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV
NAD 1983 UTM Zone 11N

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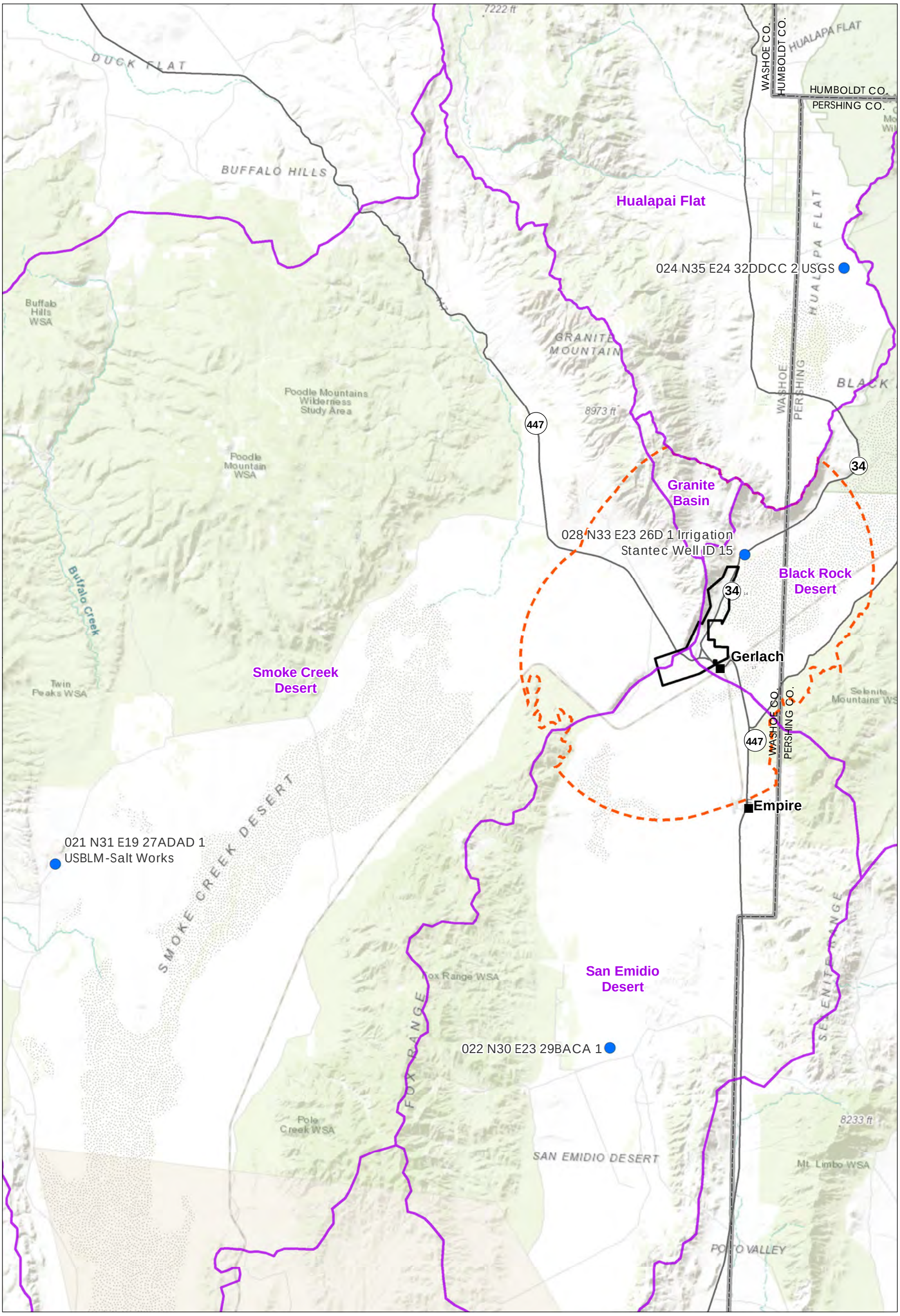
DATE: 1/21/2022 | PROJECT NO: 203721766

Figure 11
Hydrographic Basin
Well Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_11_Hydrographic_Basin_Well_Inventory_11x17P.mxd Revised: 2022-01-21 By: chrjohnson

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Project AOI
Hydrologic Evaluation Study Area
Hydrographic Basin
Wells Utilized for Water Level Timeseries
Nevada Cities/Towns
Major Roads

N

Miles
0 1.5 3 1 in = 4 miles

Stantec

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV
NAD 1983 UTM Zone 11N

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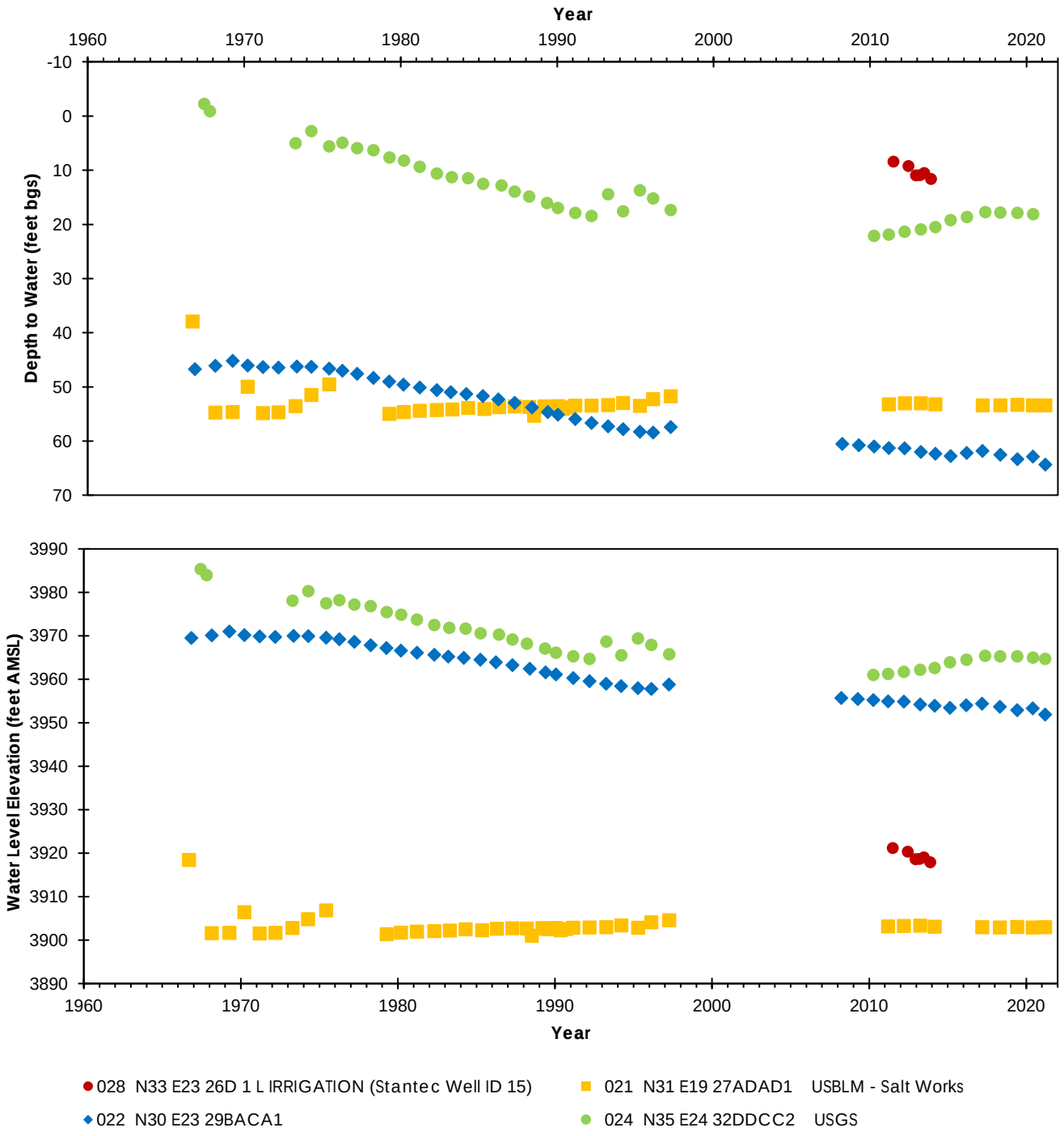
DATE: 1/21/2022	PROJECT NO: 203721766	

Figure 12
Wells Utilized for
Water Level Timeseries

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_12_Wells_Utilized_for_Timeseries_11x17P.mxd Revised: 2022-01-21 By: chrjohnson



Source: USGS, 2021b

Stantec

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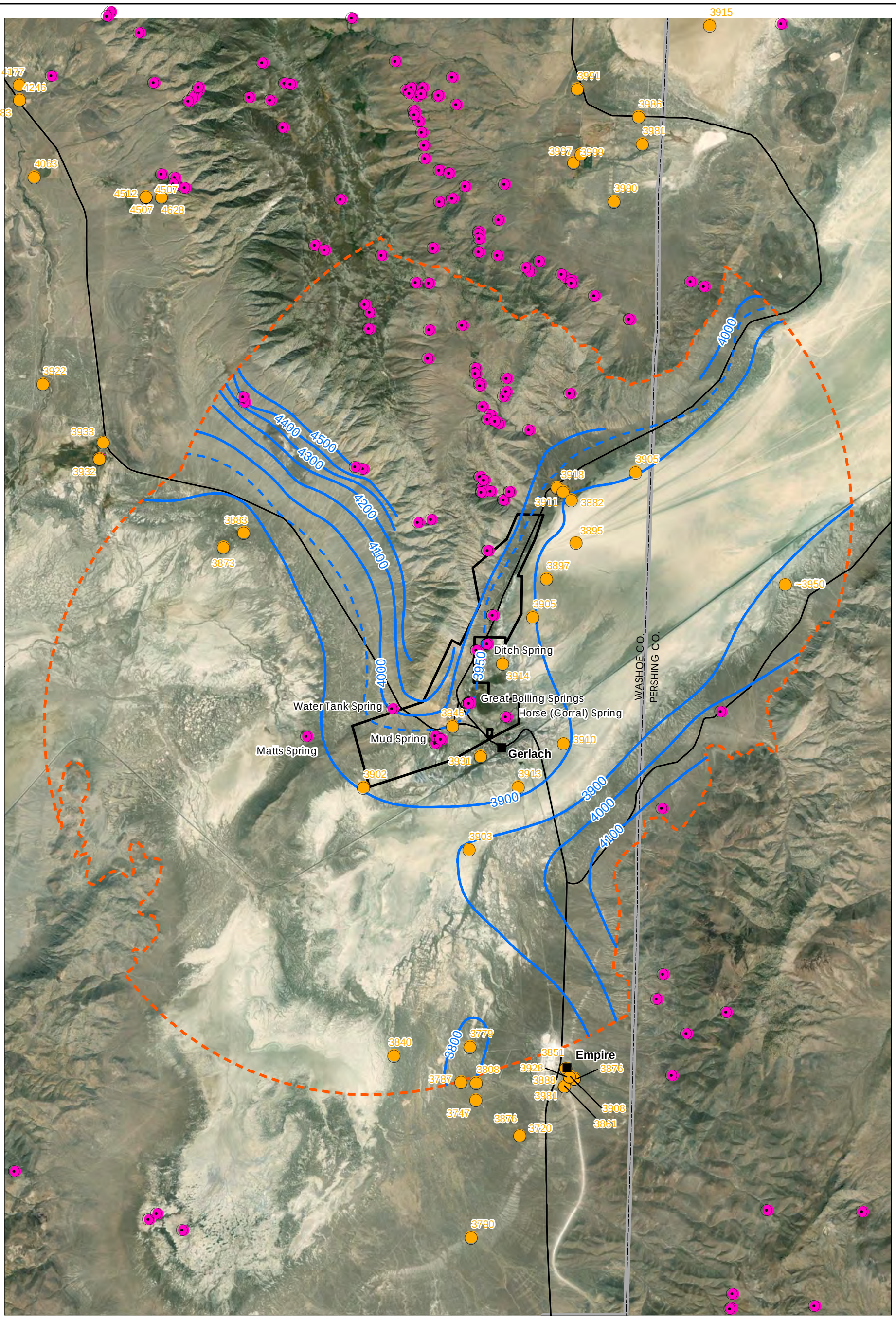
GERLACH GEOTHERMAL
EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV

DRAWN BY: BV	1ST REVIEW: SS	2ND REVIEW: CS
DATE: 1/20/2022	PROJECT NO: 203721766	

Figure 13
Groundwater Level Timeseries



Project AOI
Hydrologic Evaluation Study Area
Nevada Cities/Towns
Major Roads
Springs
Wells (Groundwater Elevation in feet AMSL)
Groundwater Elevation Contour (100-ft Contour Interval)
Groundwater Elevation Contour (50-ft Contour Interval)

N

Stantec

Feet
0 4,000 8,000 1 in = 8,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

DRAWN BY: CJ | 1ST REVIEW: BT | 2ND REVIEW: SS

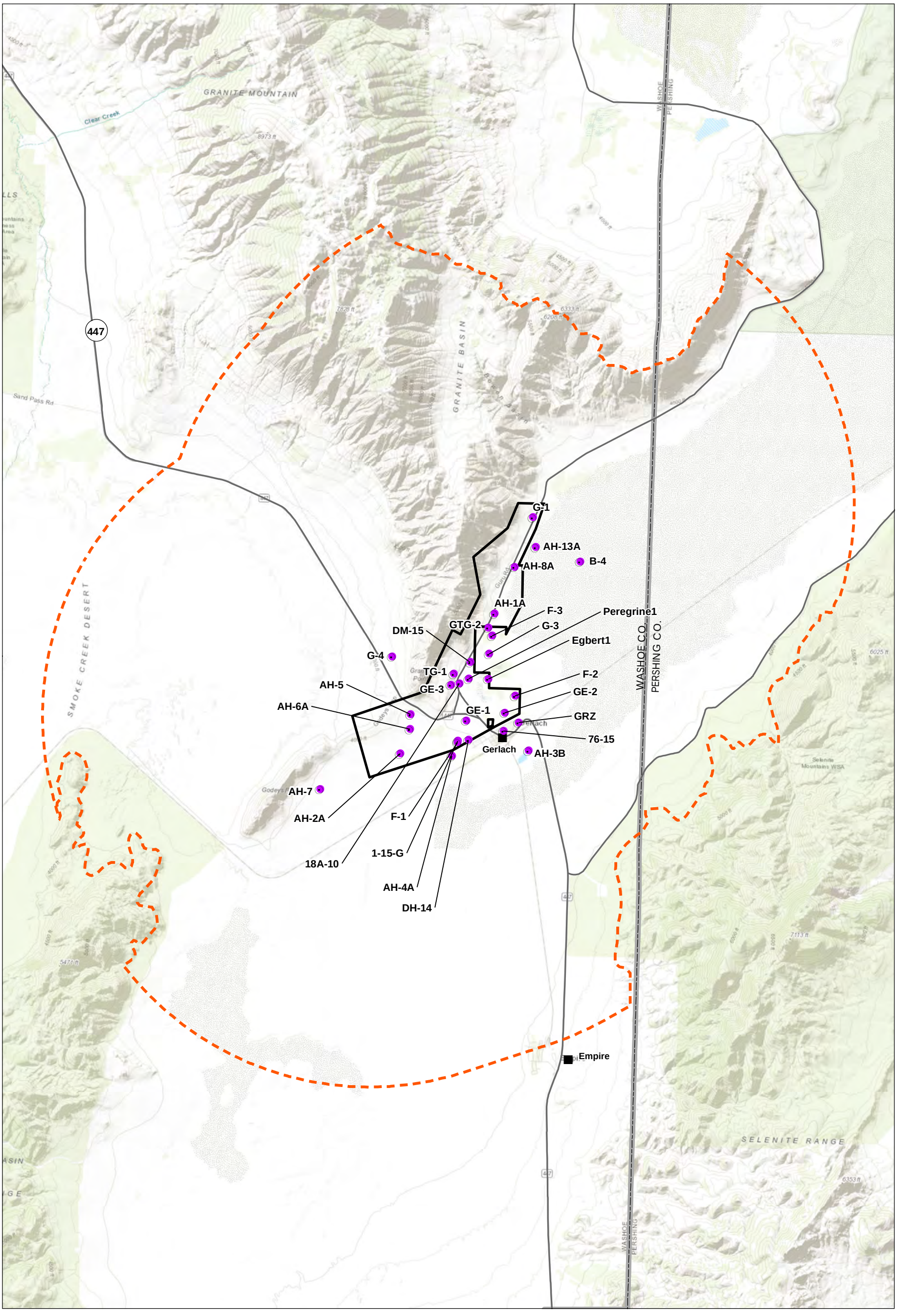
DATE: 1/20/2022 | PROJECT NO: 203721766

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 14
Potentiometric Surface

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_14_Potentiometric_Surface_11x17P.mxd Revised: 2022-01-20 By: chjohnson

Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Project AOI

Hydrologic Evaluation Study Area

Thermal Gradient Borehole

Nevada Cities/Towns

Major Roads

N

Stantec

Feet

0 4,000 8,000 1 in = 8,000 feet

Washoe County, NV
NAD 1983 UTM Zone 11N

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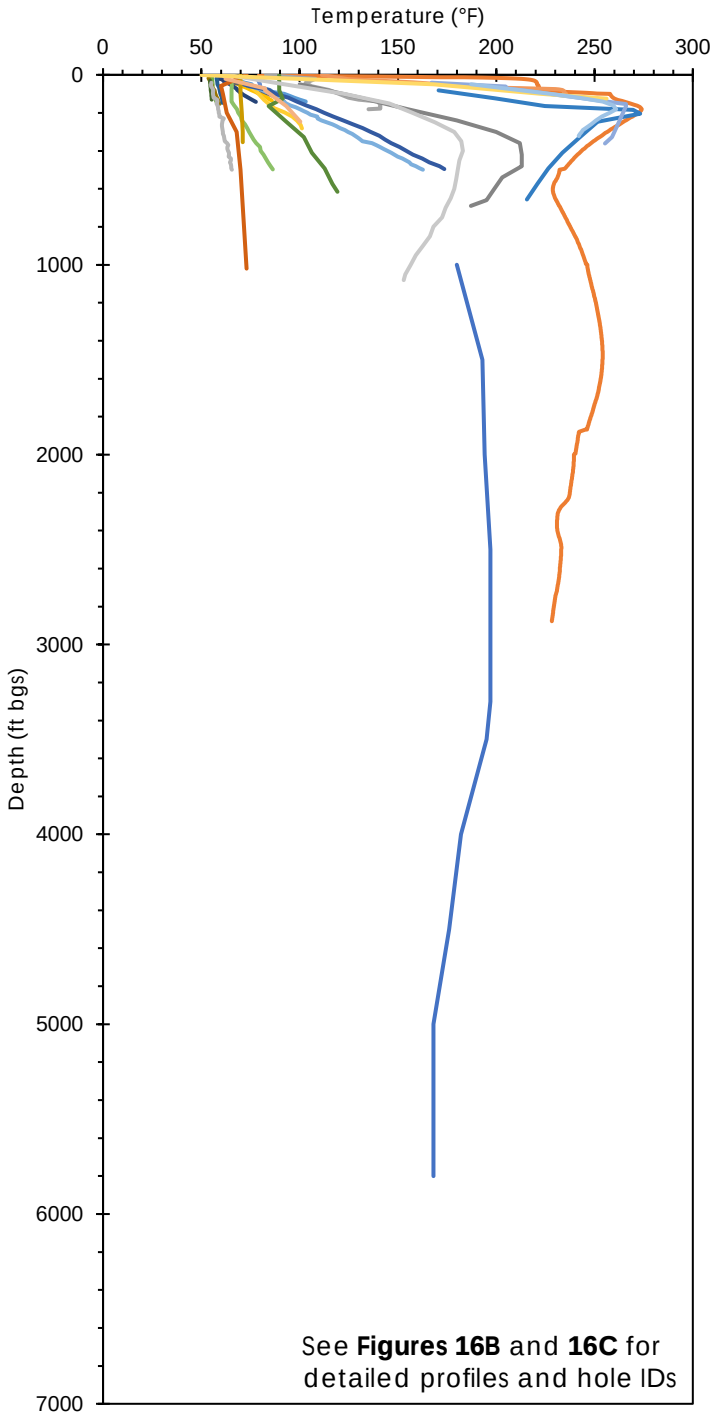
DATE: 1/21/2022	PROJECT NO: 203721766	

ORMAT NEVADA INC.
GERLACH EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Figure 15
Thermal Gradient
Borehold Inventory

V:\2037\Active\203721766\03_data\gis_cad\gis\mxds\Fig_15_Thermal_Gradient_inventory_11x17P.mxd Revised: 2022-01-21 By: chrjohnson

Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



Source: Ormat Well Log Database

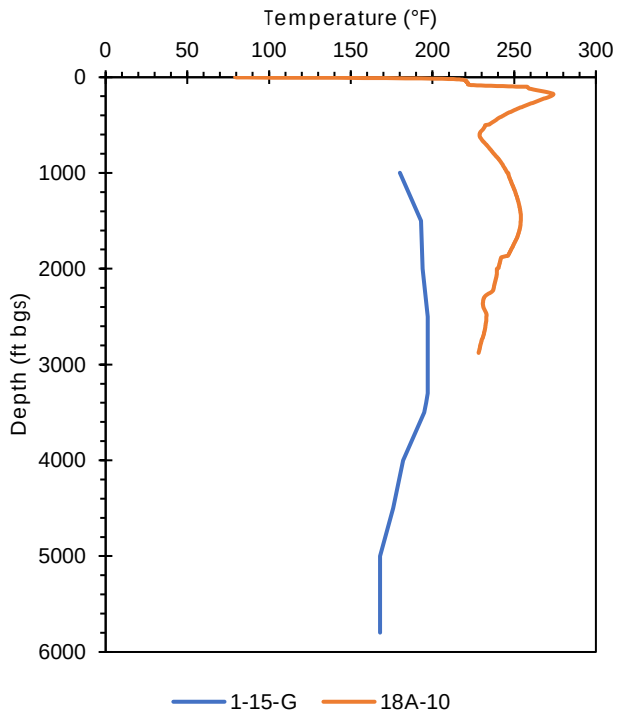
Stantec

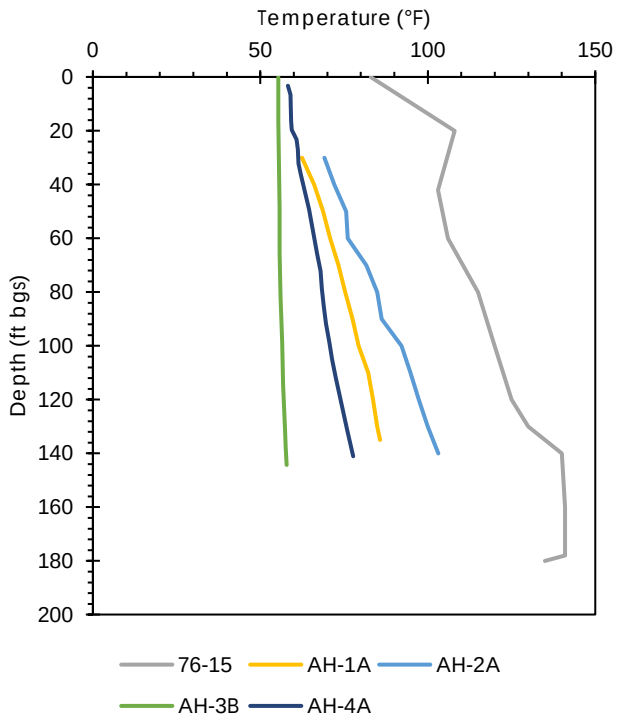
ORMAT NEVADA INC.
GERLACH GEOTHERMAL
EXPLORATION PROJECT
HYDROLOGIC EVALUATION

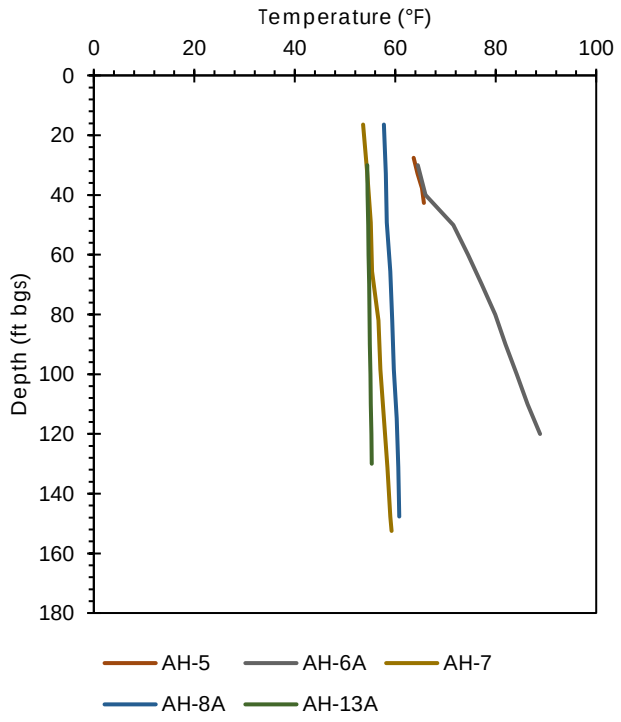
Washoe County, NV

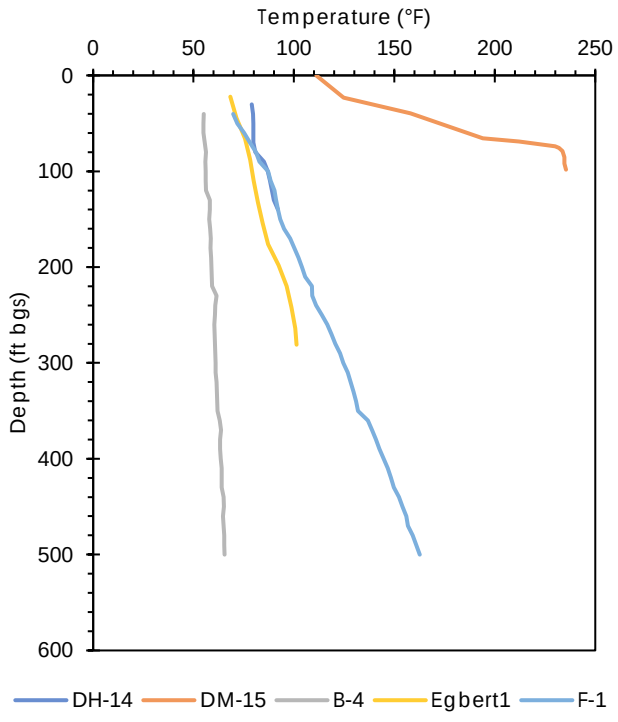
DRAWN BY: CJ	1ST REVIEW: SS	2ND REVIEW: CS
DATE: 1/20/2022	PROJECT NO: 203721766	

Figure 16A
Downhole Temperature Profiles









Source: Ormat Well Log Database

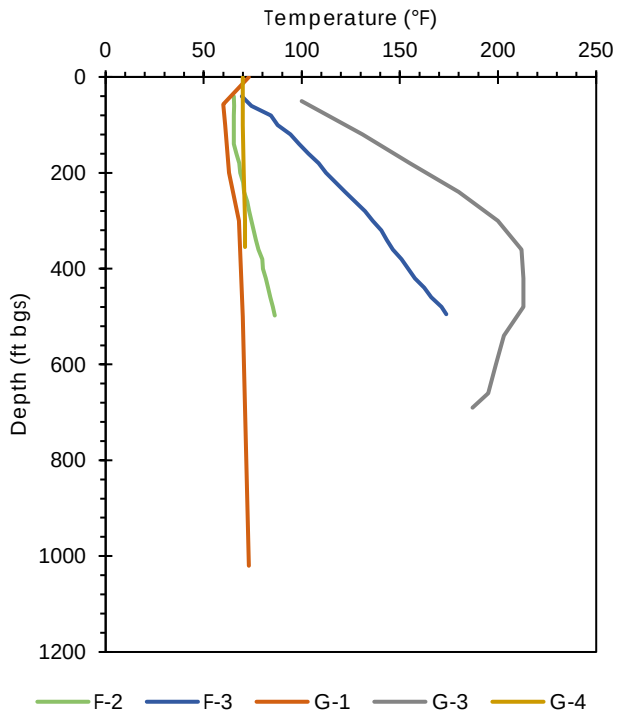
Stantec

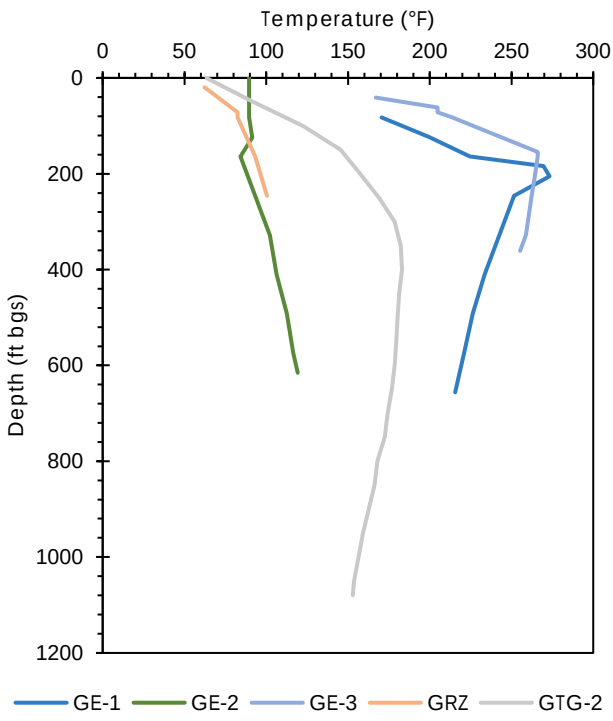
ORMAT NEVADA INC.
GERLACH GEOTHERMAL
EXPLORATION PROJECT
HYDROLOGIC EVALUATION

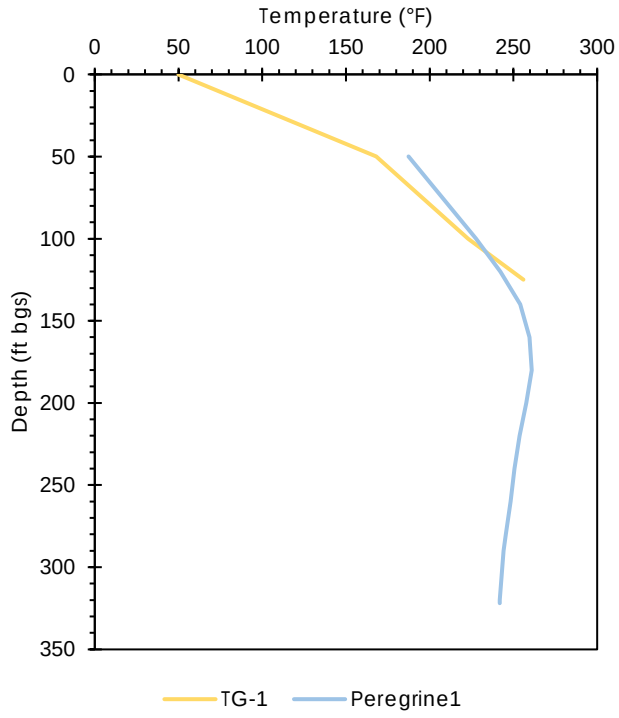
Washoe County, NV

DRAWN BY: CJ	1ST REVIEW: SS	2ND REVIEW: CS
DATE: 1/20/2022	PROJECT NO: 203721766	

Figure 16B
Downhole Temperature Profiles







Source: Ormat Well Log Database

Stantec

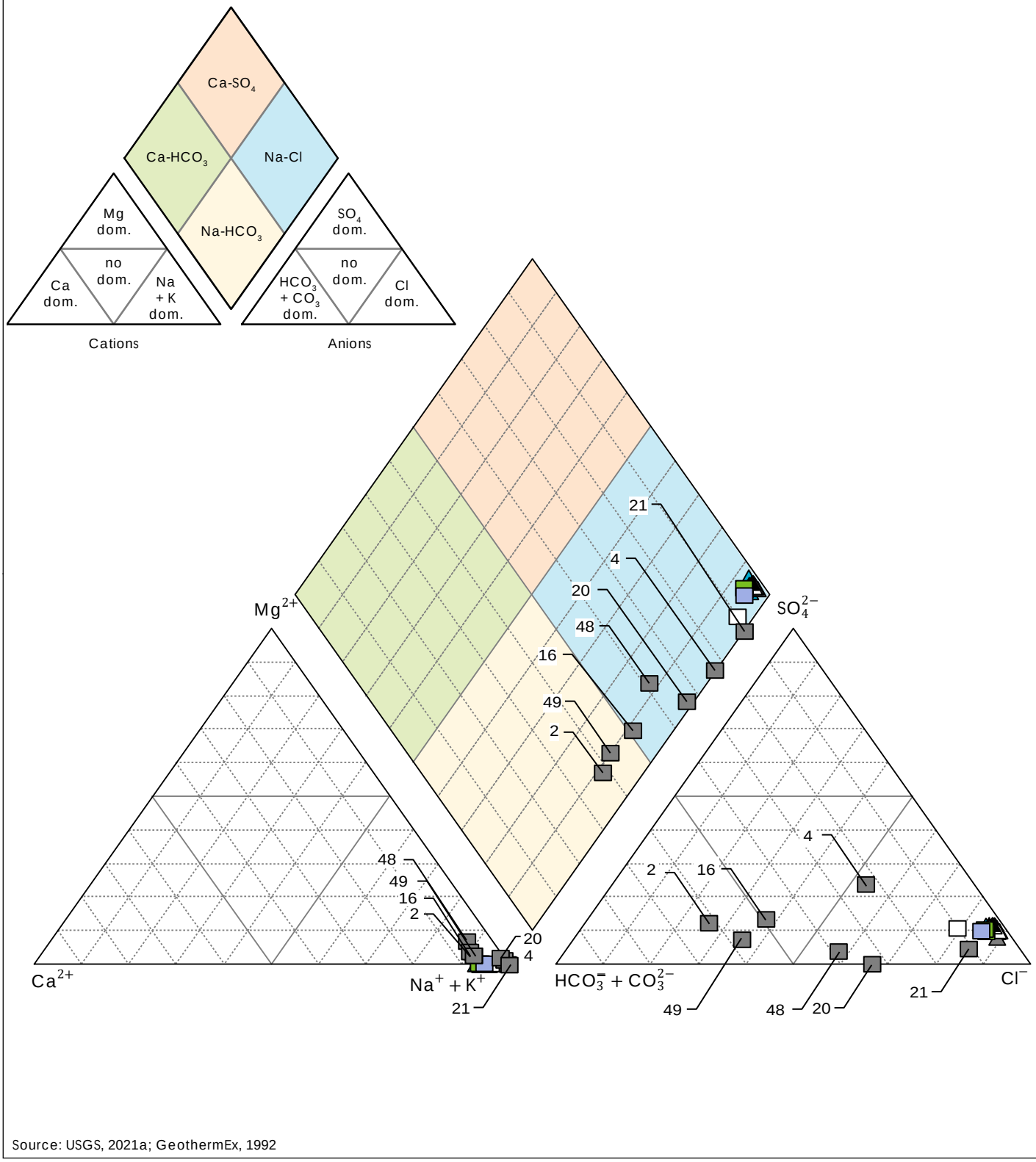
ORMAT NEVADA INC.
GERLACH GEOTHERMAL
EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV

DRAWN BY: CJ | 1ST REVIEW: SS | 2ND REVIEW: CS

DATE: 1/20/2022 | PROJECT NO: 203721766

Figure 16C
Downhole Temperature Profiles



Source: USGS, 2021a; GeothermEx, 1992

Legend

- Great Boiling Springs
- Mud Spring
- Ditch Spring
- Horse (Corral) Spring
- G-3 Well
- GGID Hot Pool Well
- GGID Community Center Well
- Cold Wells*

*Cold Wells labeled with Stantec Well ID (**Table 6**)

Stantec

ORMAT NEVADA INC.
GERLACH GEOTHERMAL EXPLORATION PROJECT
HYDROLOGIC EVALUATION

Washoe County, NV

DRAWN BY: CJ	1ST REVIEW: SS	2ND REVIEW: CS
DATE: 1/21/2022	PROJECT NO: 203721766	

Figure 17
Piper Diagram

APPENDIX A

Well Logs

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Log No. 4279
Rec. Oct. 20 1958
Well No.
Permit No.
Do not fill in

Owner L.J.JONES Driller M.Artlip
Address Box 154, Empire, Nev. Address Sun Valley, Nev. Lic. No. 287

Location of well: ¼ ¼ Sec. 10, T. 21 N/S, R. 23 E, in Washoe County
or

Water will be used for domastic Total depth of well 120'

Size of drilled hole 6" Weight of casing per linear foot 7lbs.

Thickness of casing 12 ga. Temp. of water cold

Diameter and length of casing 6"O.D. X 120'
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 85'

If flowing well describe control works
(Type and size of valve, etc.)

Date of commencement of well Sept.15 Date of completion of well Sept 21,1958

Type of well rig cable tool

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	22	22	Hard sand
22	24	2	boulders
24	71	47	fine sand, some clay
71	105	34	coarse sand, some clay
105	120	15	fine to coarse sand, water

(OVER)

Water-bearing Formation, Casing Perforations, Etc.

Chief aquifer (water-bearing formation)
from 105 to 120 ft.

Other aquifers none

First water at 105 feet.

Casing perforated
from 80 to 120 ft.

Size of perforations
6" X 1/16"

LOG OF FORMATIONS—*Continued*

From feet	To feet	Thickness	Type of material

CASING RECORD

Diam. casing	From feet	To feet	Length	"Remarks"—Seals, Grouting, Etc.
6"	1	0	119	steel casing

GENERAL INFORMATION—Pumping Test, Quality of Water, Etc.

Bail test at 50 gal. per min.

WELL DRILLER'S STATEMENT

This well was drilled under my jurisdiction and the above information is true to my best information and belief.

Signed.....
Well Driller

By.....

License No.....

Dated....., 19.....

(Not to be filled in by Driller)

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Log No. 8535
Rec. June 16 1965
Well No.
Permit No. 21115
Do not fill in.

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner C. M. Tuyenmiller — Driller Ray Wygenbockan
Address Lovelock Nevada — Address — Lic. No.
Location of well NW 1/4 SE 1/4 Sec 26, T. 33 N/S, R 23 E, in Humboldt County
or At a point from which North 1/4 corner of said sect 26 bears N1°30'W 2841.64'
Water will be used for Irrigation — Total depth of well 208
Size of drilled hole 24" — Weight of casing per linear foot 42.05
Thickness of casing .250 — Temp. of water Cold
Diameter and length of casing 15 3/4 - I.D. - 208
(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)
If flowing well give flow in c.f.s. or g.p.m. and pressure
If nonflowing well give depth of standing water from surface 7'
If flowing well describe control works
(Type and size of valve, etc.)
Date of commencement of well 8/3/64 — Date of completion of well 8/13/64
Type of well rig Rotary

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	24	24	Sand & Top Soil DG
24	53	29	Brown Clay
53	208	155	Clay - Brown Yellow Blue
			This clay area had spots where the bit dropped as much as four feet

Water-bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)
from .... to .... ft.
Other aquifers water must have come from the spots that the bit dropped

First water at 53 feet.

Casing perforated
from 208 to 148 ft.

Size of perforations
1/4 x 2 mach Slot

(OVER)

919

LOG OF FORMATIONS—Continued

From feet	To feet	Thickness	Type of material

CASING RECORD

Diam. casing	From feet	To feet	Length	REMARKS—Seals, Grouting, etc.
16	0	208	208	Hole was drilled 24" and gravel packed between wall and Casing.

GENERAL INFORMATION—Pumping Test, Quality of Water, etc.

Well was blown with 1000 CFM Compressor and an estimated 1000 GPM was available

WELL DRILLER'S STATEMENT

This well was drilled under my jurisdiction and the above information is true to my best information and belief.

Signed Woods Drilling Co
Well Driller

By E J Fuchs

License No. 439

Dated 8-15-, 19 64

(Not to be filled in by Driller)

Log No. [illegible]
Rec. Sept 8 19 66
Well No.
Permit No.
Do not fill in.

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner Nellie Lincolnfelter Driller Denny M. McCloud

Address Gerlach, Nev. Address Gerlach, Nev. Lic. No. 470

Location of well: SW 1/4 NE 1/4 Sec. 36, T. 33 N/S, R. 22 E, in Washoe County

Permit No.

Water will be used for Domestic & Stock Total depth of well 120 ft 6 in

Size of drilled hole 8" Weight of casing per linear foot

Thickness of casing 3/16 Temp. of water Cold

Diameter and length of casing 8" X 120-6

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface 15 ft

If flowing well describe control works

(Type and size of valve, etc.)

Date of commencement of well 8-2-66 Date of completion of well 8-4-66

Type of well rig Cable

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material
0	5	5	Sand + Clay Brown
5	30	25	" " " " "
30	36	6	" " " " "
36	38	2	Small Gravel Coming Water
38	75	37	Clay & Sand
75	110	35	Clay Black
110	120	10	Sand Coming Some Water

Water-bearing Formation, Casing Perforations, etc.

Gravel

Chief aquifer (water-bearing formation)

from 36 to 38 ft.

Other aquifers Sand from 110 - 120

First water at 36 feet.

Casing perforated

from 120 to 100 ft.

Size of perforations

1/4 X 6 in perforated with cutting torch Staged

(OVER)

919

LOG OF FORMATIONS—Continued

From feet	To feet	Thickness	Type of material

CASING RECORD

Diam. casing	From feet	To feet	Length	REMARKS—Seals, Grouting, etc.

GENERAL INFORMATION—Pumping Test, or Boiling Test, Quality of Water, etc.

WELL DRILLER'S STATEMENT

This well was drilled under my jurisdiction and the above information is true to my best information and belief.

Signed Henry W. McClure
Well Driller

By H. McC

License No. 470

Dated 8-7-, 1966

(Not to be filled in by Driller)

Basin 028

WELL LOG AND REPORT TO THE STATE ENGINEER OF NEVADA

Log No. 9152
Rec. Sept 8 1966
Well No.
Permit No.
Do not fill in.

PLEASE COMPLETE THIS FORM IN ITS ENTIRETY

Owner Nellie Lincoln Foster Driller Denny McClure

Address Gerlach, Nev. Address Gerlach, Nev. Lic. No. 470

Location of well: S ¼ SE ¼ Sec. 26, T. 33 N/S, R. 23 E, in Washoe County

Permit No.

Water will be used for Irrigation Total depth of well 207 ft.

Size of drilled hole 16" Weight of casing per linear foot

Thickness of casing Temp. of water

Diameter and length of casing

(Casing 12" in diameter and under give inside diameter; casing 12" in diameter give outside diameter.)

If flowing well give flow in c.f.s. or g.p.m. and pressure

If nonflowing well give depth of standing water from surface

If flowing well describe control works

(Type and size of valve, etc.)

Date of commencement of well 7-27-66 Date of completion of well 7-30-66

Type of well rig

LOG OF FORMATIONS

From feet	To feet	Thickness feet	Type of material

(OVER)

Water-bearing Formation, Casing Perforations, etc.

Chief aquifer (water-bearing formation)

from to ft.

Other aquifers

First water at feet.

Casing perforated

from 207 to 80 ft.

Size of perforations

¼ X 3

919

LOG OF FORMATIONS—Continued

From feet	To feet	Thickness	Type of material

CASING RECORD

Diam. casing	From feet	To feet	Length	REMARKS—Seals, Grouting, etc.
				Cleaned out Well and perforated Casing. from 207 to 30 ft 1/4 x 3. State Water 30 ft.

GENERAL INFORMATION—Pumping Test, or Boiling Test, Quality of Water, etc.

WELL DRILLER'S STATEMENT

This well was drilled under my jurisdiction and the above information is true to my best information and belief.

Signed Denny M. McClane
Well Driller

By D. M. C

License No. 470

Dated 7-29-, 1977

(Not to be filled in by Driller)

1936 SEP 8 PM 4 17

STATE ENGINEER

OFFICE

Log. - 12574

Basin. Black Rock Des.

Cordero Gerlach No. 1 Temperature test hole.
Washoe Co., Nev., 32 N., 23 E., sec. 15, 2565 NSL, 825 EWL
Elev. 3965 G Boyles Bros. Drlg. Co.
Spud 5-23-72, Comp. 5-27-72 TD 660 clay
Csg.: 6-in. @ 19 ft cem., 1 1/4-in. black iron pipe to 660 ft capped btm & top not cem.

0- 70	Sand, gray, med to very crse, angular, poorly sorted, 90% qtz, Lake Lahontan beach
70-115	Sand & gravel, granitic, poorly sorted
115-145	Clay, gray, lacustrine
145-190	Sand, gray, med to crse, poorly sorted, 75% qtz, streaks of clay
190-220	Sand, gray, fine, granitic
220-325	Sand, gray, med to crse, granitic, poorly sorted, 80% qtz, pyrite blebs
325-340	Sand, gray, med, fair sorting
340-475	Sand, gray, med to crse, granitic, 80% qtz
475-520	Clay, gray, lacustrine
520-595	Sand, gray, med to crse, poorly sorted, granitic
595-610	Gravel, gray, 70% qtz
610-630	Sand, gray, med to crse, poorly sorted
630-660	TD Clay, gray, lacustrine

Log - 12575

Basin - Black Rock Des

Cordero Gerlach No. 2 Temperature test hole.
Washoe Co., Nev., 32 N., 23 E., sec. 15, 1948 SNL, 1175 WEL
Elev. 3950 G Boyles Bros. Drlg. Co.
Spud 5-30-72, Comp. 6-5-72 TD 660 sand
1 1/4-in. black iron pipe to 660, 11 sx cem pumped down and displaced with water. Top cem. calculated @ 360.

0- 70	Sand & clay. Sand, med to crse, poorly sorted, 90% qtz, frosted. Clay, gray.
70-115	Clay, gray
115-145	Sand, gray, med, fair sorting, clean, angular, glassy
145-160	Sand, gray, crse, rounded, frosted, aquifer
160-175	Clay, gray
175-205	Sand, gray, med to crse, poor sorting
205-250	Clay, gray
250-280	Sand, gray, med to crse, poor sorting
280-355	Clay, gray
355-370	Sand, gray, med to crse, poor sorting
370-475	Clay, gray
Core No. 1	487-497. rec. 7 ft gray clay
497-550	Clay & sand. Clay, gray. Sand, med to crse
550-640	Clay, gray
640-650	Clay & silt, gray
Core No. 2	650-660 TD rec. 5 ft gray clay & fine sand

0730 6-6-72 after standing open without pipe 60 hr. hole flowing clear water (assumed from ~150 ft), measured 6 gpm, 80°F, odor S.

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

STATE OF NEVADA
DIVISION OF WATER RESOURCES

OFFICE USE ONLY
Log No. 2435
Permit No.
Basin

WELL DRILLERS REPORT

Please complete this form in its entirety

1. OWNER SUNEDCO ADDRESS 12700 PARK CENTRAL PLACE, SUITE 1500 DALLAS, TEXAS 75251

2. LOCATION SW ¼ SW ¼ Sec. 15 T. 32N N/S R. 23 E. WASHOE County
PERMIT NO. 35305

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

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

5. TYPE WELL
Cable ☐ Rotary XX
Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
Valley Fill Deposit	No*	0	3270	3270
Cretaceous Granodiorite	No	3270	5871	2601

Date started December 17, 19 78
Date completed February 6, 19 79

7. WELL TEST DATA

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

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 hole 8 3/4 inches Total depth 5,871 feet*
Casing record See Attachment
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 Cement
Depth of seal 2,120 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 None Feet below land surface .....
Flow No G.P.M. .....
Water temperature None ° F. Quality .....

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

Name Barry L. McFall
Address 2204 Newcastle Circle, Plano, Tx

Nevada contractor's license number .....

Nevada driller's license number 1,093

Signed B. L. McFall

Date 3/2/79

USE ADDITIONAL SHEETS IF NECESSARY

5471

20" Casing, 94# per ft., H-40 Grade, set at 330'

Cemented with 2,289 cu. ft. of Class G cement with 2% $CaCl_2$, Cir. cement

13 3/8" casing = 61# per ft., K55 Grade = set at 2,120'

Cement with 1,066 sacks, class G cement with 1-1 Pearlite + 40% SSA-1 + .05% CFR2% + .3% gel, tailed in with 216 sacks of G cement = with 40% SSA-1 + .05% CFR = Cir. cement.

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

STATE OF NEVADA
DIVISION OF WATER RESOURCES

OFFICE USE ONLY
Log No. 22036
Permit No.
Basin

WELL DRILLERS REPORT

Please complete this form in its entirety

1. OWNER Sunedco ADDRESS 12700 Park Central Place, Suite 1500
Dallas, TX 75251
HOLLAND LIVESTOCK RANCH 1-15-G

2. LOCATION SW ¼ SW ¼ Sec. 15 T. 32N N/S R. 23E E. Washoe County
PERMIT NO. 35305

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
PLUGGING & ABANDONMENT				
On May 10, 1979, we ran 2 3/8" tubing in the well to a depth of 2,180' and plug with 72 sacks of Type G cement from 2,180' to 2,004', pull tubing out of well and cut casing off 4 ft. below ground level and weld on a plate on the 13 3/8" casing.				

Date started ....., 19.....
Date completed ....., 19.....

7. WELL TEST DATA

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

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 hole .....inches Total depth .....feet
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. .....
Water temperature .....° F. Quality .....

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

Name Barry L. McFall
Address 2204 Newcastle Circle, Plano, TX
Nevada contractor's license number .....
Nevada driller's license number 1093
Signed B. L. McFall
Date 5/14/79

USE ADDITIONAL SHEETS IF NECESSARY

5471

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

STATE OF NEVADA
DIVISION OF WATER RESOURCES

OFFICE USE ONLY
Log No. 25437
Permit No.
Basin 028

WELL DRILLERS REPORT

PRINT OR TYPE ONLY

Please complete this form in its entirety

NOTICE OF INTENT NO. 2859

1. OWNER Gerlach Hot Springs ADDRESS AT WELL LOCATION Same
MAILING ADDRESS Gerlach Nev.

2. LOCATION N.W ¼ S.E ¼ Sec. 15 T. 32 N/S R. 23 E County
PERMIT NO. Issued by Water Resources | Parcel No. | Subdivision Name

3. TYPE OF WORK: New Well ☑ Recondition ☐ Deepen ☐ Other ☐

4. PROPOSED USE: Hot-Water — Domestic ☐ Irrigation ☐ Test ☐ Municipal ☐ Industrial ☐ Stock ☐

5. TYPE WELL: Cable ☑ Rotary ☐ Other ☐

6. LITHOLOGIC LOG

Material	Water Strata	From	To	Thickness
Sandie Clay		0	60	
Clay		60	100	
Sand with Streaks of Clay		100	150	
Clay		150	155	
Set 52 ft of 8" Blank Casing Cemented In	8"			

Date started 5-23-84
Date completed 5-27-84

7. WELL TEST DATA

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

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 hole 6" inches Total depth 155 feet
Casing record
Weight per foot Thickness

Diameter	From	To
6" inches	0 feet	115 feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet
inches	feet	feet

Surface seal: Yes ☑ No ☐ Type Cement
Depth of seal 52 feet
Gravel packed: Yes ☐ No ☐
Gravel packed from feet to feet

Perforations:
Type perforation Factory
Size perforation 6"
From 115 feet to 155 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 50 G.P.M. P.S.I.
Water temperature 195 ° F. Quality

10. DRILLERS CERTIFICATION
This well was drilled under my supervision and the report is true to the best of my knowledge.
Name McKay Drilling Inc. (Contractor)
Address 730 Rosewood Dr. Reno (Contractor)
Nevada contractor's license number 14170
Nevada contractor's drillers number 514
Nevada driller's license number 786
Signed Ray Higginbotham (Actual Driller / Contractor)
Date 6/10/84

USE ADDITIONAL SHEETS IF NECESSARY

(Rev. 6-81) 0-627 CR434

REPORT NO. A04.047

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

LOG NO. 93950
PERMIT NO.
BASIN 21

NOTICE OF INTENT NO. 52125

1. OWNER John Bogard
MAILING ADDRESS P.O. Box 4 Gerlach, NV 89412

ADDRESS OF WELL 8100 Hwy 447
Gerlach, NV 89412

2. WELL LOCATION SW 1/4 SW 1/4 SEC. 26 T 33 R 22 E Washoe COUNTY

PERMIT NO 51640 PARCEL NO 071-180-08 SUBDIVISION NAME

3. TYPE OF WORK
[X] New Well [X] Replace [ ] Recondition
[ ] Deepen [ ] Plug [ ] Other

4. PROPOSED USE
[X] Domestic [X] Irrigation [ ] Test
[ ] Municipal/Industrial [ ] Monitor [ ] Stock

5. WELL TYPE
[ ] Cable [X] Rotary [ ] RVC
[ ] Air [X] Mud

6. LITHOLOGIC LOG

MATERIAL	STRATA	FROM	TO	THICKNESS
Dirt & Clay		0	20	20
Yellow Clay		20	30	10
Heavy Green Clay		30	35	5
Green & Black Clay		35	45	10
Green Black Clay & Sand		45	110	65
Coarse Sands	X	110	135	25
Sand & Clay		135	160	25

RECEIVED
04 JUL 12 PM 2:41
STATE ENGINEERS OFFICE

Notes :

Date Started 6/1/04 Date Completed 6/3/04

7. WELL TEST DATA

TEST METHOD [ ] Bailer [ ] Pump [X] Air Develop

	GPM	DRAWDOWN	TIME (HRS)
Pump	267	7'	

8. WELL CONSTRUCTION

Depth Drilled 160 Depth Cased 160

HOLE DIAMETER (BIT SIZE)

15 Inches 0 Feet 30 Feet
12 1/4 Inches 30 Feet 50 Feet
10 5/8 Inches 50 Feet 160 Feet

CASING SCHEDULE

Size OD	Weight/Ft	Wall Thickness	From	To
8 5/8	16.94	.188	140	160
10 3/4	28.04	.250	+3	17

PERFORATIONS:
Type Perforation FAC SAW Size Perforation Double P
From 120 Feet to 160 Feet
From Feet to Feet
From Feet to Feet

SURFACE SEAL: [X] Yes [ ] No
Seal Depth 50
PLACEMENT METHOD: [X] Pumped [ ] Poured

SEAL TYPE:
[X] Neat Cement
[ ] Cement Grout
[ ] Concrete Grout
[ ] Bentonite

GRAVEL PACKED: [X] Yes [ ] No
From 50 Feet to 160 Feet

9. WATER LEVEL
Static Water Level Flowing Feet Below Land Surface
Artesian Flow 170 GPM 3 PSI
Water Temperature Cool F Quality Clear

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of m knowledge.

Name Aqua Drilling & Well Service, Inc.
Address 675 Edison Way
Reno, NV 89502

NV. CONTRACTOR'S LIC. NO 15291 DRILLER'S LIC. NO. ON SITE 1981

Signed Roger Mitchell
By driller performing actual drilling on site or contractor

Dated June 3, 2004

REPORT NO. A04.048

STATE OF NEVADA
DIVISION OF WATER RESOURCES

WELL DRILLER'S REPORT

LOG NO. 95147
PERMIT NO.
BASIN 21
NOTICE OF INTENT NO. 52125

1. OWNER John Bogard
MAILING ADDRESS P.O. Box 4 Gerlach, NV 89412
ADDRESS OF WELL 8100 Hwy 447
Gerlach NV, 89412

2. WELL LOCATION SW 1/4 SW 1/4 SEC. 26 T 33 R 22 E Washoe COUNTY
PERMIT NO 51640 PARCEL NO 071-180-08 SUBDIVISION NAME

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

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

5. WELL TYPE
☐ Cable ☐ Rotary ☐ RVC
☐ Air ☐ Mud

6. LITHOLOGIC LOG

MATERIAL	STRATA	FROM	TO	THICKNESS

RECEIVED
04 JUL 12 PM 2:42
STATE ENGINEERS OFFICE

Notes: Flowing well was checked for total depth of 42 feet. Aqua's 5" perforated was used to perforate from bottom up to ground level. Then tremmie tube was ran to total depth and neat cement pumped to the surface. RSRM ticket # 823728

Date Started 6/3/04 Date Completed 6/3/04

7. WELL TEST DATA

TEST METHOD ☐ Bailer ☐ Pump ☐ Air Develop

	GPM	DRAWDOWN	TIME (HRS)

8. WELL CONSTRUCTION

Depth Drilled 42 Depth Cased

HOLE DIAMETER (BIT SIZE)
Inches Feet Feet
Inches Feet Feet
Inches Feet Feet

CASING SCHEDULE

Size OD	Weight/Ft	Wall Thickness	From	To
6"		.188	+1	-1
5 1/2			-1	42

PERFORATIONS:
Type Perforation Size Perforation
From Feet to Feet
From Feet to Feet
From Feet to Feet

SURFACE SEAL: ☐ Yes ☐ No
Seal Depth
PLACEMENT METHOD: ☐ Pumped ☐ Poured
SEAL TYPE: ☐ Neat Cement ☐ Cement Grout ☐ Concrete Grout ☐ Bentonite
GRAVEL PACKED: ☐ Yes ☐ No
From Feet to Feet

9. WATER LEVEL
Static Water Level Feet Below Land Surface
Artesian Flow 2 GPM 2 PSI
Water Temperature 60 F Quality

10. DRILLER'S CERTIFICATION
This well was drilled under my supervision and the report is true to the best of m knowledge.
Name Aqua Drilling & Well Service, Inc.
Address 675 Edison Way
Reno, NV 89502
NV. CONTRACTOR'S LIC. NO. 15291 DRILLER'S LIC. NO. ON SITE 1132T1
Signed
By driller performing actual drilling on site or contractor
Dated June 3, 2004

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

OFFICE USE ONLY
Log No. 103925
Permit No.
Basin 028

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. ND 081

1. OWNER BRIGHT HOLLAND
MAILING ADDRESS

ADDRESS AT WELL LOCATION BOWEN CANYON
Subdivision Name: County: WASHOE

2. LOCATION NW ¼ SW ¼ Sec 23 T 33N N/S R 23 E
PERMIT/WAIVER No. 71828 (Issued by Water Resources) Parcel No.

Latitude 40.722619 Longitude 119.343932
UTM E 302030 N 4510401 ☒ NAD 27 ☐ NAD 83/WGS 84

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

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
TOP SOIL		0	1	1
SAND & GRAVEL		1	18	17
SAND GRAVEL		18	35	17
BOULDERS & COBBLES		35	200	165
GRANITE ROCK		200	250	50

Date started: 31-Oct , 20 2006
Date completed: 1-Nov , 20 2006

9. WELL CONSTRUCTION
Depth Drilled 250 Feet Depth Cased 60 Feet

HOLE DIAMETER (BIT SIZE)

		From		To	
6 1/8	Inches	0	Feet	250	Feet
	Inches		Feet		Feet
	Inches		Feet		Feet

CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
6 5/8	12.9	.188	+3	60

Perforations:
Type of perforation
Size of perforation
From feet to 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	to	☐ Pumped	☐ Poured
☐ Concrete Grout	to	☐ Pumped	☐ Poured
☐ ≥30% Bentonite Grout	to	☐ Pumped	☐ Poured

Gravel Pack: ☐ Yes ☒ No to ☐ Pumped ☐ Poured
Type:
Bentonite Chips: ☐ Yes ☐ No to ☐ Pumped ☐ Poured
Type:

7. Water Level
Static water level: DRY 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 WELSCO CORP. (Contractor)
Address P. O. BOX 888 (Contractor)
FALLON, NV 89406
Nevada contractor's license number issued by the State Contractor's Board 11752
Nevada driller's license number issued by the Division of Water Resources, the on-site driller 772
Signed (By driller performing actual drilling on site or contractor)
Date 19-Nov-06

USE ADDITIONAL SHEETS IF NECESSARY

(Rev. 05-05)

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

OFFICE USE ONLY
Log No. 10624O
Permit No.
Basin 028

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. 6063

1 OWNER Bright. Holland
MAILING ADDRESS SF
ADDRESS AT WELL LOCATION Bowen Canyon.
Subdivision Name: County: Washoe

2 LOCATION NW ¼ SW ¼ Sec. 23 T 33 N/S R 23 E
PERMIT/WAIVER No. 71828 Issued by Water Resources
Parcel No.
Latitude 40.722619
Longitude 119.343437
UTM E 302029
N 4510398
☑ 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?
If yes, what is replacement well NOI?

Is there an existing well log? yes
If yes, what is NDWR well log #?

4 EXISTING WELL CONSTRUCTION
Depth Drilled 250 Feet Depth Cased 60 Feet

EXISTING CASING SCHEDULE

Size O.D. (Inches)	Weight/Ft. (Pounds)	Wall Thickness (Inches)	From (Feet)	To (Feet)
6⅝	+2.9	.188	+2	58

Existing Perforations:
Type of perforation
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 dry feet below land surface
Artesian flow G.P.M. P.S.I
Water temperature °F Quality

6 Additional Notes or Comments
Hole abandoned to meet state engineer order.

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: Holte perforator

From 0	feet to 58	feet	Number of perfs per linear foot	8
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

		Material Used		
From 58	feet to 250 feet	Hole plug	☐ Pumped	☑ Poured
From 0	feet to 58 feet	Neat cement	☐ Pumped	☑ Poured
From	feet to feet		☐ Pumped	☐ Poured
From	feet to feet		☐ Pumped	☐ Poured
From	feet to feet		☐ Pumped	☐ Poured
From	feet to feet		☐ Pumped	☐ Poured

Neat Cement Fluid Weight lbs/gal
Bentonite Grout % bentonite
Date Started 5.20.08
Date Completed 6.20.08

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 Welsco Corp (Contractor)
Address Box 888 (Contractor)
Fallon.
Nevada contractor's license number issued by the *State Contractor's Board* 11752
Nevada driller's license number issued by the Division of Water Resources, the *on-site driller* 2199.
Signed (By driller performing actual drilling on site or contractor)
Date June 13-08

(Rev. 05-06)
USE ADDITIONAL SHEETS IF NECESSARY