GROUND-WATER STATION DESCRIPTION
TEXAS SPRINGS SYNCLINE WELL NO.1 NEAR FURNACE CREEK
362711116494401
DEATH VALLEY NATIONAL PARK

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LOCATION

Texas Springs Syncline Well No. 1 near Furnace Creek (Well) in Death Valley National Park (DEVA) is located at N 36° 27' 11" and W 116° 49' 44", T. 27 N., R. 1 E, Section 24, SW¼ NW¼, Inyo County, California, within the Hydrologic Unit 18090203.

ACCESS

The Well is located off Highway 190, just southeast of the Furnace Creek Ranch in DEVA, California. To get to Texas Springs Syncline Well No. 1 near Furnace Creek from Las Vegas, NV travel 57 miles on State Road (SR) - 160 to Pahrump, NV (traveling northwest). Turn left (west) onto Bell Vista Road which becomes State Line Road and travel 26 miles. Turn right (north) on to SR-127 and travel 0.2 miles. Turn left (west) on to SR-190 and travel 30 miles to the Texas Springs Campground entrance road. (**Figure 1**).

To access the station, turn east on to the Texas Springs Campground road before reaching the Furnace Creek Ranch. Travel 0.43 miles and turn east on to a gated dirt service road and travel 3.0 miles (**Figure 2 and 3, Route 1**). The dirt service road continues to SR-190 that serves as another access route (**Figure 2 and 3, Route 2**, 0.9 mile). A high clearance vehicle is recommended.

NOTIFICATION

Prior to visiting the station check with DEVA's Hydrologist (Local Park Partners section).

ESTABLISHMENT

Roscoe Mosa Drilling Company drilled the Well on November 20, 1958. The United States Geological Survey (USGS) recorded thickness, character and water yielding properties of the underlying strata (Kunkel, 1959). The National Park Service (NPS) uses the Well to monitor groundwater levels to evaluate regional trends in spring (Texas, Travertine and Nevares) flow and to detect impacts of groundwater pumping.

WELL CHARACTERISTICS

The Well was drilled and cased to a depth of 250 feet with perforations from 100 to 240 feet. The Well casing has a 14-inch inside diameter and extends 2.03 feet above a bolt marking land surface next to the casing. The precision Global Postioning System (GPS)[1] elevation of land-surface datum is 496.75 feet (National Geodetic Vertical Datum 1929[2]).

HYDROLOGIC CONDITIONS

Death Valley is located at the terminus of a vast regional ground-water flow system in the Basin and Range physiographic province. The Death Valley ground-water flow system encompasses an area of about 15,800 mi^2 (Harrill and others, 1988). The primary aquifer types within the regional flow system are Paleozoic carbonate rock, Tertiary volcanic rock and Cenozoic valley-fill aquifers. The carbonate rock aquifer is the principal regional aquifer within the Death Valley ground-water flow system. Ground water moves generally from recharge areas at higher elevations in the north to lower elevation valleys in the south, and ultimately to Death Valley. Because of the

[1] Global Positioning System (GPS) is a system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.
[2] National Geodetic Vertical Datum 1929 (NGVD29) is a fixed reference adopted as a standard geodetic datum for elevations determined by leveling.

immense size and complexity of the flow system, it is often divided into subregions, and the subregions are further divided into ground water basins and sections.

The Alkali-Flat Furnace Creek basin is one of three ground-water basins within the Central Death Valley subregion. Discharge from this basin occurs at the springs in the Furnace Creek area including Texas, Travertine and Nevares Springs. These three springs appear to be related to a major fault zone known as the Furnace Creek fault zone. Low permeability material along the Furnace Creek fault zone may form barriers to flow causing ground water to flow upwards through alluvial deposits where it is discharged at springs. Water is thought to percolate upwards from the regional flow system through Tertiary lacustrine deposits and alluvium.

The climate of DEVA is arid and may be characterized as a rain-shadow desert climate. The summers are extremely hot and dry and the winters are mild. Average summer temperatures are about 100 degrees Fahrenheit and average winter temperatures are about 60^{o} F. Winter storms in the Death Valley region are usually low intensity and account for approximately 65 to 75 percent of the annual precipitation (Fenelon and Moreo, 2002). In the summer, convective rainstorms are typical, as exemplified in the flood of August 2004. Death Valley National Park receives an average of 2.05 inches of precipitation a year (National Park Service [NPS] DEVA website). The potential evapotranspiration is about 150 inches/year.

Vegetation cover is generally sparse but is concentrated in areas where springs and seeps are located. Water discharging from Texas and Travertine Springs supports a riparian area noted for at least eight endemic special-status species and a biologically and culturally significant mesquite bosque. Wetland and riparian areas associated with the springs are the most biologically diverse and rarest habitats in the valley.

GAGE

Ground-water levels and temperature are recorded every 15 minutes by an In-Situ® LevelTroll (0-30 pounds per square inch (PSI)) data logger powered by a lithium battery pack. The cable suspending the logger is attached by carabineer to a bolt installed in the well casing. Goundwater levels are measured from a scratch in the top of casing (TOC)[3] indicating the measurement point (MP)[4]. The MP is located directly above a bolt located on the outside of the casing that marks land surface. A locking lid flips over the TOC to protect the equipment.

HISTORY

November 20, 1958	Well drilled. Ground-water level was 74.51 feet below land surface (USGS well log located in Section 5 of the History Folder).
November 20, 1958 to January 23, 1986	Ground-water levels monitored by the USGS and reported on the National Water Information System (NWIS) website (http://waterdata.usgs.gov/nwis/inventory/?site_no=362711116494401).
February 1, 1991	Mike Ward of the NPS began collecting instantaneous ground-water level measurements.
October 29, 1991	John Stark replaced Mike Ward in collecting instantaneous ground-water level measurements.
July 6, 2000	Jim Roche replaced John Stark collecting instantaneous ground-water level measurements.
August 7, 2000	NPS installed an In-Situ 4000 Troll data logger 30 psi (serial number 10424) to collect continuous ground-water levels.
December 8, 2000	Two reference marks[5] (RM1 and RM2) installed and elevations surveyed.
March 7, 2001	Logger removed from Well for pump test.
April 2, 2001	Logger re-installed and calibrated.

[3] Top of casing (TOC) is the steel casing extended from the hole of the well.
[4] Measurement point (MP) is the location the tape measure is held when determining depth to ground-water level.
[5] A reference mark (RM) is a permanent marker, installed in the ground or on a structure in the vicinity of a gaging station, whose elevation above the gage datum is known.

April 24, 2001	Logger removed from Well for pump test.
March 4, 2002	In-Situ electric ground-water level tape detected a faint and strong signal at two different ground-water levels with a measurement difference of +0.08 foot. Possibly caused by a precipitate on the surface of the ground-water in Well.
June 1, 2002	Logger re-installed in Well.
June 3, 2002	Logger calibrated and started.
October 5, 2002	Data correction of +0.07 feet applied to compensate for measurement error attributed to a ground-water surface precipitate in Well.
October 22, 2002	RM3 and a cement bolt marking land surface were installed.
September 3, 2003 to October 1, 2003	Data correction of +0.07 feet applied to compensate for measurement error attributed to a ground-water surface precipitate in Well.
July 1, 2003	Terry Fisk and Ryan Taylor begin collecting instantaneous ground-water level measurements with Jim Roche.
July 8, 2004	Eileen Hwang assists Terry Fisk in collecting instantaneous ground-water level measurements.
August 15, 2004	Flooding occurred damaging roads, vehicles, power supplies and water supplies.
September 2, 2004	Data correction of +0.08 feet applied to compensate for measurement error attributed to a ground-water surface precipitate in Well.
October 2004	Travertine Springs Well No. 1 near Furnace Creek name was officially changed to Texas Springs Syncline Well No. 1 near Furnace Creek.
October 14, 2004	In-Situ® Troll 4000 logger malfunctions.
October 31,2004	In-Situ® Troll 4000 logger removed from Well.
February 2, 2005	In-Situ® Troll 4000 logger replaced by an In-Situ® miniTroll logger 15 psi (018701) placed in Well.
March 2, 2005	Logger calibrated.
May 15, 2005	Logger removed from Well for a pump test.
May 21, 2005	Logger re-installed in Well and calibrated.
July 5, 2005	Logger inadvertantly set to record at a three second interval. No data was recorded July 7, 2005 through August 1, 2005 because logger memory space was full.
August 1, 2005	Logger recording interval set to a 15 minute interval.
September 2, 2005	In-Situ® miniTroll (018701) began malfunctioning.
October 3, 2005	Clear, viscous fluid notice on In-Situ® miniTroll (018701) batteries.
October 6, 2005	In-Situ® miniTroll (018701) removed for repairs and installed a temporary miniTroll Pro 5 psi (13918).
December 01, 2005	Repaired In-Situ® miniTroll (018701) replaced miniTroll (13918).
February 1, 2006	In-Situ® miniTroll (018701) installed at pressures beyond tollerances and broke.
March 1, 2006	In-Situ® miniTroll (018701) removed from Well.

July 31, 2006 Installed and calibrated In-Situ® LevelTroll 700 30 psi (108897). Logger will not set a reference level to a hundredth.

REFERENCE AND BENCHMARKS

Three reference marks (RMs 1, 2 and 3) have been established and surveyed at the station for elevation control (**Figure 4**). **Table 1** provides a summary of surveyed dates and points at Texas Springs Syncline Well No. 1 near Furnace Creek.

Table 1: Travertine Springs Well level survey elevations.

Date	Personnel	RM1(base)	RM2	RM3	TOC	Land Surface
December 8, 2000	NPS	497.20	496.90	-	498.76	496.73
October 25, 2001	NPS	497.20	496.90	-	498.75	496.72
November 6, 2002	NPS	497.20	496.90	498.05	498.75	496.72
May 28, 2003	NPS	497.20	-	498.05	498.76	496.72
September 23 and 24, 2003	USGS	-	-	-	498.75	*496.67

-Elevation not obtained.
*Location surveyed is unknown and likely not the same as NPS location.

Level surveys conducted prior to September 23-24, 2003 were not initially related to an absolute base[6] elevation. Initially, an arbitrary elevation was selected for RM1, TOC, or land surface to determine the relative elevation of the survey locations. A high precision global positioning system (GPS) survey on September 23-24, 2003 established the absolute elevation of 498.75 feet above sea level (asl) for TOC. The TOC elevation was then used to determine a gage datum[7] and base elevation for future surveys. Previous level surveys were recalculated using the RM1 base elevation to determine station stability (**Table 1**).

The gage datum is the elevation of a bolt representing land surface. The bolt (documented in an October 22, 2002, email from Jim Roche in Section 4: Survey Analysis of WY 2003 folder) is 2.03 feet below TOC, at an elevation of 496.72 feet (asl).

RM1 (a rebar in the ground three paces east of the well) was established base to represent a reliable elevation for correcting recent and past survey elevations. The absolute elevation of RM1 was determined using the December 8, 2000 survey.

REGULATION AND DIVERSION

Ground water has been pumped from the regional flow system to support irrigation and agriculture since 1913. Between 1913 and 1998, about 90 percent of the ground water pumped from the flow system was used for irrigation (Moreo and others, 2003). Mining, public supply and commercial use account for about 8 percent of the pumpage, and domestic use accounted for about 2 percent (Moreo and others, 2003).

Ground water development is currently proposed for growing urban areas like Las Vegas, NV and Pahrump, NV because surface water is seasonal and not a dependable water source. Excessive ground-water pumping has the potential to deplete aquifer storage and reduce spring discharge over time.

ACCURACY

Record accuracy is considered excellent when the station equipment is working. The In-Situ® LevelTroll 700 records ground-water levels with a published accuracy after calibration of 0.1% when operating at 30 PSI and -5^{o} to 50^{o} C (In-Situ®, 2007). The In-Situ® miniTroll records ground-water levels with a published accuracy after calibration of 0.1% when operating at 15 PSI and ± 0.05% when at 15^{o} Celcius (In-Situ®, 1999). Record accuracies may be downgraded due to data corrections applied for equipment settling, unit conversion, seismic events, pump tests, precipitate formation and operator error.

[6] The base is the reference mark on which all reference mark elevations are based. It is considered the most stable.
[7] Gage datum is the datum whose surface is at the zero elevation of all the gages at the station.

Accuracy may also be downgraded due to measuring tape inaccuracies during equipment calibraton. Steel referenced survey measuring tapes are used to check NPS measuring tapes to a mean accuaracy of 0.053 foot (Boucher, 1994). The instantaneous measuring tape (In-Situ tape) was checked against a Lufkin steel tape on January 7, 2004 and agreed within -0.01 foot. Measuring tapes used prior to the In-Situ tape had differences up to +0.13 foot and the record accuracy was downgraded accordingly (Refer to WY Station Analysis).

COOPERATION

The Well is maintained by the NPS Water Resources Branch (WRB) and DEVA staff. DEVA staff visit the station monthly to inspect the logger and collect ground-water level measurements. WRB processes and analyzes the data using ADAPS, collects periodic ground-water level measurements and level survey data, and provides quality assurance and quality control (QA/QC) for all data collection and analysis.

LOCAL PARK PARTNER

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REFERENCES

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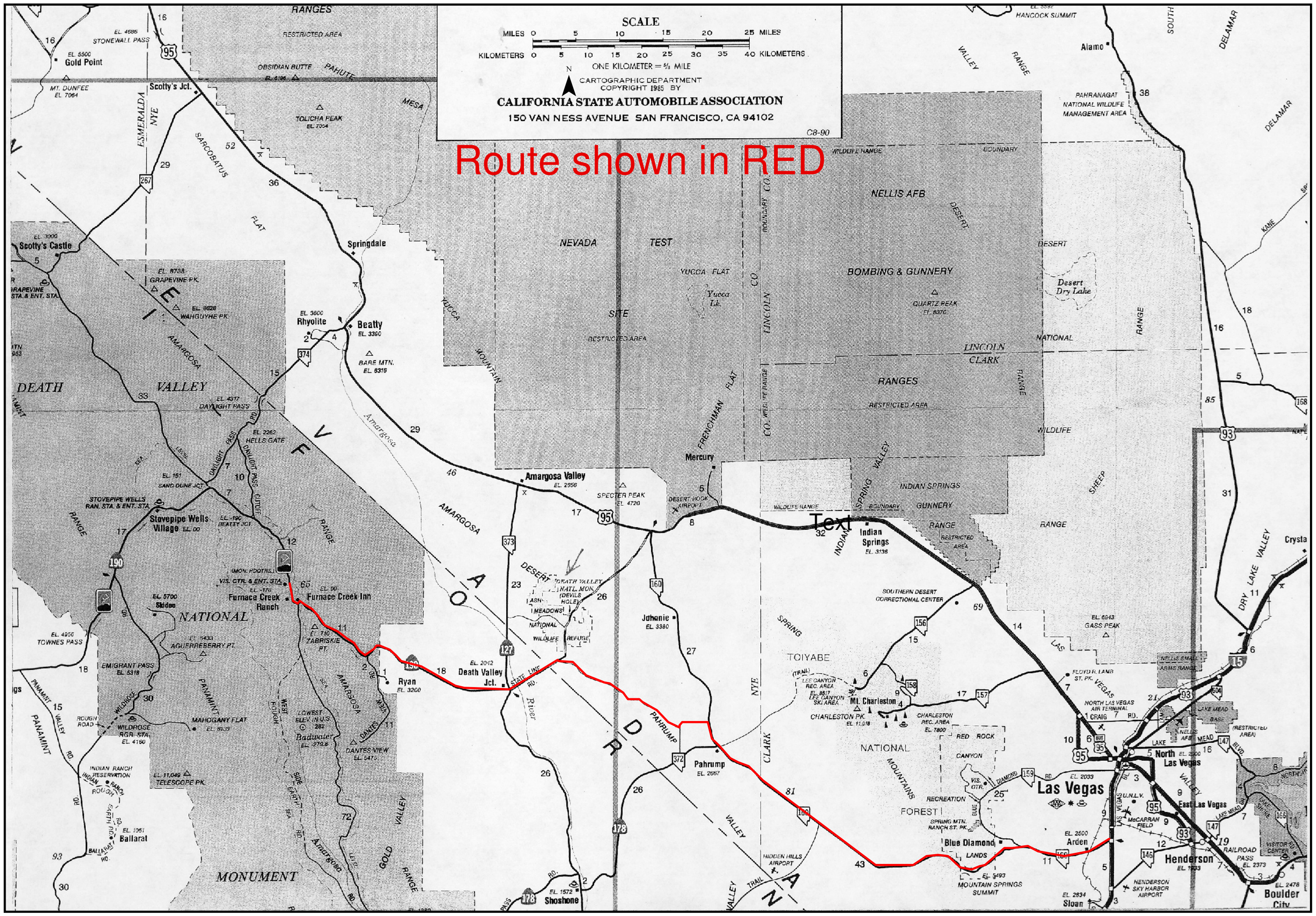
DRIVING DIRECTIONS FROM LAS VEGAS TO DEATH VALLEY NATIONAL PARK



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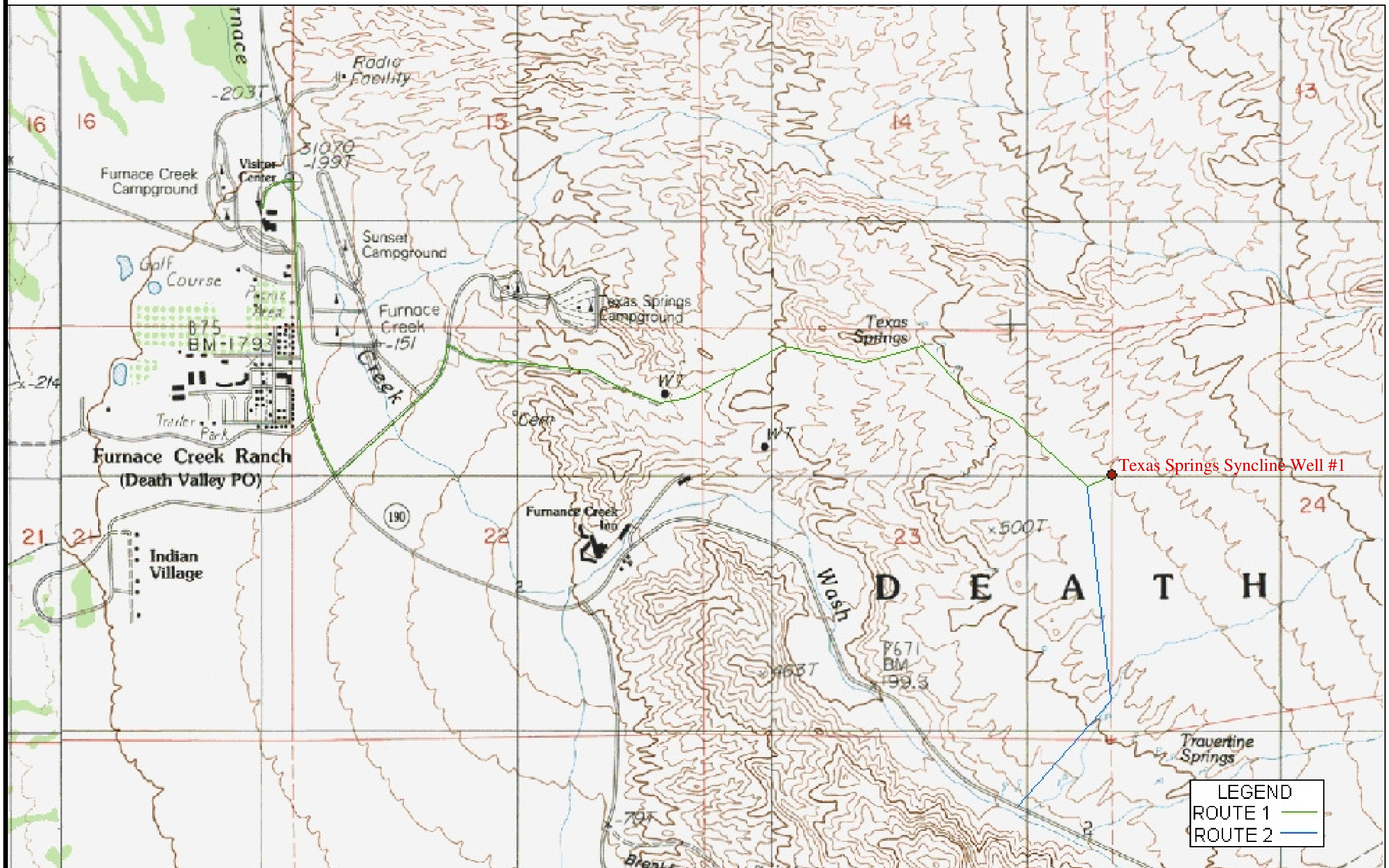
Driving Directions to Texas Springs Syncline Well no. 1 near Furnace Creek 362711116494401



Produced by NPS Water Resources Division - Water Rights Branch
February 15, 2006

FILE: //INP2300FCS12247/Users/Kathryn M Converse/trawell/1999-2003/Documentation/Maps/Trav_driving_directions.mxd

FIGURE 3

DRIVING DIRECTIONS TO TEXAS SPRINGS SYNCLINE WELL no.1 NEAR FURNACE CREEK
362711116494401

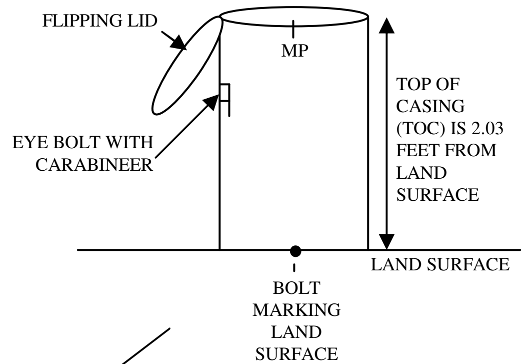
FIGURE 4

SKETCH AND PHOTOGRAPHS OF TEXAS SPRINGS SYNCLINE WELL no. 1 NEAR FURNACE CREEK

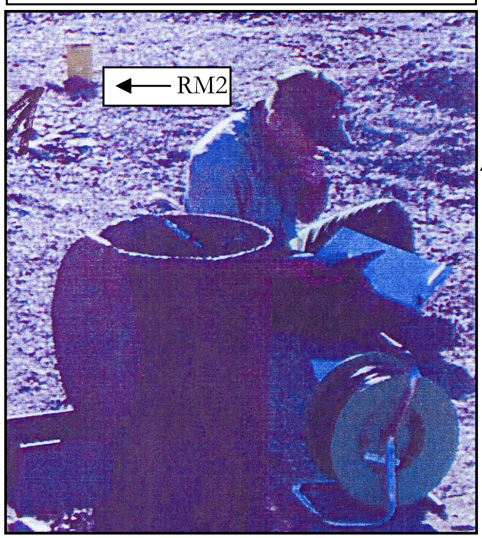
362711116494401

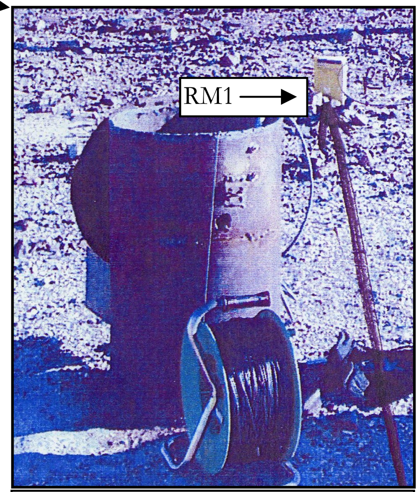
NORTH →

SURVEY LOCATION DESCRIPTIONS	
RM1	Rebar in ground three paces southeast of well.
RM2	Rebar in ground seven paces northeast of well.
RM3	Brass Cap in cement about 20 feet from well.
Land Surface	Bolt set below scratch in well casing to mark land surface elevation
TOC	Measurement point etched on well casing above land surface bolt



Location of RM2.
Photograph taken December 8, 2000





Location of RM1.
Photograph taken December 8, 2000