



United States Department of the Interior
NATIONAL PARK SERVICE
Intermountain Region Hydrologist
7660 East Broadway Blvd. # 303
Tucson, Arizona 85710
September 30, 2011



To: Mark Ruggiero, Acting Superintendent, Coronado National Memorial

Cc: Carlos Herrera, Chief of Facilities, Coronado National Memorial

From: Colleen Filippone, Intermountain Region Hydrologist

Through: Intermountain Region Natural Resources Physical Science Group and NPS
Water Resources Division

Subject: Report on adequacy of new water supply well and recommendations for water supply at Coronado National Memorial

Purpose

This report was developed in response to a technical assistance request for evaluation of the adequacy of a new water supply well, CORO-WSW-2, at Coronado National Memorial to supply 100-percent of park water requirements. At some point during the post-debris flow discussions about rehabilitation of roads and damaged channel in Montezuma Canyon, the idea of abandoning Headquarters Well, the original water supply well in Montezuma Canyon, was proposed. Since it was not known if CORO-WSW-2 would be a suitable sole source for park water supplies, a technical assistance request, shown in Appendix A, was submitted to the Intermountain Region Natural Resources technical assistance call for FY2011.

Summary

The Headquarters Well in Montezuma Canyon has provided a consistent water supply to the park since 1964. A new well, CORO-WSW-2 was constructed on the hillside adjacent to the park water tank in 2008. Both of these wells have been shown to be capable of supplying park water needs on a day to day basis under current climatic conditions. Neither well has been tested under extended drought conditions, and each well has vulnerabilities that prevent it from being a candidate sole source for the park water supply. There are several factors that bring the long-term reliability of CORO-WSW-2 into question, including location downstream of a potential pollution source and situation on a lens of unconsolidated colluvium immediately adjacent to the path of a recent debris flow at the park. Due to the location of CORO-WSW-2 in a granitic mountainside, its source area and vulnerability to drought conditions are unknown. Claims that the Headquarters Well is interfering with channel function were not supported by review of a channel design analysis and recommendations. Vulnerability of the Headquarters Well to future debris flows is a concern, and a NPS Water Resources Division (WRD) recommendation to seek a suitable alternative water supply (L. Martin, 2000; Appendix B) is still relevant. In the meantime, maintaining both the Headquarters Well and CORO-WSW-2 will provide for increased water supply security at the park.

Background

Coronado National Memorial was supplied with potable water since 1964 (Sanchez et al., 2001) from a well constructed in 1959 in Montezuma Canyon at about 5,250 ft elevation. This well is known as Headquarters Well, and is designated by the State of Arizona as ADWR 55-629139 (location shown in Figure 1). Records relating to this well on file at the State of Arizona Department of Water Resources are shown in Appendix C. Ability of Headquarters Well to meet park water supply needs in the event of extended drought has been a concern to park staff for many years, although the well has always provided an adequate supply to date. An evaluation of the park water supply by WRD staff in 2000 indicated that a supplementary well was needed, and a recommendation was made to connect the water system to an existing well at the former Zalesk Ranch (L. Martin, 2000). The WRD memo specifically recommends against construction of a new well in the area around the existing Headquarters Well and provides an explanation for this recommendation. Coronado National Memorial water usage averaged between 1,500 and 2,000 gpd between 1996 and 2000.

Following the destruction of the existing park chlorination system and well building by debris flow in late July 2006, only the well and a nearby utility pole remained intact (Figure 2). In 2007, a replacement chlorination building was constructed adjacent to an existing 50,000-gallon water storage tank on the southern flanks of Montezuma Peak, above Montezuma Canyon at about 5,425 ft elevation. In September 2008, a new well designated CORO-WSW-2 (ADWR 55-909747) was constructed adjacent to the new chlorination building. The location of the new well is shown in Figure 1, and a photograph of the well is shown in Figure 3. The water tank and chlorination building are immediately uphill of the new well. Approximately 750 feet updrainage from the well, two springs and an inclined mine shaft known as Headquarters mine (93-025) are shown on Figure 1. Another mine, #93-026, is located nearby but not shown. Abandoned mine assessments for these two mining features are included as Appendix D (Karst Solutions, 2009a,b). Both of these features have been gated to prevent entry, but the documented presence of arsenopyrite seepage from the mine openings and flow of highly mineralized discharge from nearby springs, pictured in Figure 4, has not been addressed (Linda Dansby, 4/21/2011, email communication). The proximity of seepage from the abandoned mine features and the ore body may be a potential concern for water quality in the well. When the well was monitored on 2/17/2011, there was a distinct sewage-like sulfur smell coming from inside the casing that was not noticed on previous site visits.

CORO-WSW-2 was drilled and cased in granite to a depth of 685 feet (all depths within the borehole and well in this report are referenced to ground level), with perforated casing installed between 603 and 663 feet. Water was encountered during drilling at a depth of about 194 ft. The driller's log is included in Appendix C, indicating that the top 90 feet of borehole penetrates sandy clay and rocks and weathered granite (colluvium). The remainder of the borehole penetrates granite and quartz veins. The log does not indicate that any fractured or rubblized zones were encountered during drilling. These findings are consistent with the geologic map of the area, shown in Figure 5, which does not indicate the presence of nearby faults. Rock types shown in Figure 5 are summarized in Table 1.

Designation	Symbol	Rock Type	Description
PZI	Light blue	Naco group limestone	Limestone blocks “floating” in massive granite
Qc	Tan	Colluvium	Loose earth material that has accumulated on or at the base of a slope, through the action of gravity
Jhgb	Light yellow-green hatched texture	Huachuca granite	Crystalline granite
Km	Solid green	Morita formation	Sedimentary rocks
Qgy2	Light green; pebbly textured	Stream terrace deposits	Modern gravels

Table 1. Key to rock units shown in Figure 5.

Following the completion of CORO-WSW-2, the driller indicated that the well did not produce sufficient water to meet park water needs and that another well would need to be constructed. A request for assistance was made to Intermountain Region staff and a pumping test of the well was conducted in October 2008 to evaluate the production capability of the well. Figure 6 shows the water level data resulting from this test. This test was sustained for about four hours, with a total of about 2,600 gallons pumped. Following completion of this test, a permanent pump was installed in the well in December 2008. Early in 2009 the new well was registered with the State of Arizona Department of Water Resources (ADWR) and connected into the park water supply. Once the new well was connected into the park water supply, pumping to the park storage tank was switched between Headquarters Well and CORO-WSW-2 on a two-week alternating schedule (C. Herrera, personal communication).

Due to the ongoing discussion of the possibility of abandoning Headquarters Well in Montezuma Canyon, a plan for further evaluation of the new well by pumping only from CORO-WSW-2 and monitoring water levels for a period of one year was developed and implemented beginning in June 2010. Water levels at CORO-WSW-2 were measured and recorded at 30-minute intervals using a recording pressure sensor. These data are shown in Figure 7 together with manual water level measurements. Figure 8 provides a more detailed graph of water levels during a week of the monitoring period in February 2011.

Results and Discussion

Pumping test

Data from the pumping test conducted in October 2008 (Figure 6) show that 2.7 hours of pumping at about 13.5 gpm result in 210 feet of unstabilized drawdown at this well (water levels were still decreasing). Continued pumping at a reduced rate of 11 gpm for 1½ hours resulted in a drawdown of about 188 feet below the initial static level of 194 feet (total depth to water 382 feet).

The specific capacity calculated from the test is low at 0.06 gpm/ft, reflecting the limited ability of the surrounding rock mass to transmit water to the well. The fact that the well produces water indicates that the borehole intercepts some water-bearing fractures, and in

fact cascading water was heard during the pumping test when the water level was drawn below 401 feet from the surface. Due to the low porosity and permeability of crystalline igneous rocks, it can safely be assumed that a negligible amount of the water produced by this well is derived from the rock matrix, and that all of the water produced comes from the dewatering of fractures. Available data do not allow evaluation of water storage volumes within the rock fractures around the well. As a result of the unknown characteristics of the fracture networks intercepted by the borehole, such as their extent and degree of interconnectedness, the ability of this well to provide water consistently in a period of extended drought is unknown and should not be assumed to be reliable.

Long-term monitoring

Depth to water soon after the well was constructed was 194 feet. Figure 7 shows that static water levels measured since pumping began range from 200 to 207 feet. Seasonal variation of static water levels coincide with patterns typical in southeast Arizona, with lowest levels during summer and highest in the winter season. A small amount of discontinuity of the continuous record occurs when the datalogger is removed to download the data and then replaced in the well. Water levels decrease (increased depth to water) during periods of pumping at the well. The figure shows that the well was pumped on approximately a weekly schedule from early June through early November 2010. Following that time, pumping appears to be cycling between the two wells again, with periods of up to seven weeks between pumping at the new well (Figure 7). Figure 8 provides a detailed view of water levels during pumping and recovery.

Pumping water levels at the well vary between a minimum of 280 feet below the surface (February 3-4, 2011) and a maximum of 322 feet below the surface (7/13/2010). All other variables being equal, the decrease in water level (drawdown) is directly related to the pumping rate, with reduced pumping rates resulting in less drawdown within the well. The actual pumping rates at these times are not known, although this might be determined from water meter readings from those time periods if they were available. Water levels on February 3 and 4, 2011, shown in Figure 8 indicate that at lower pumping rates, drawdown will stabilize at higher water levels when pumping periods are long enough in duration. None of the higher-rate pumping periods are sufficiently long for drawdown in the well to stabilize. Recovery in all cases is rapid, with static water levels reached about two hours after pumping ceases.

Proximity of CORO-WSW-2 to debris flow path

A consideration related to the siting of CORO-WSW-2 is its proximity to a known debris flow path, shown in Figure 9, and its situation within a sloping 90-ft thick lens of colluvial material, shown in Figure 5. The debris flow paths shown in Figure 9 were mapped by Arizona Geological Survey staff (Youberg, 2008) following the July 31, 2006 precipitation and debris flow event that heavily impacted the park. The risk of a future debris flow impacting the water tank area cannot be ruled out. Such an event would impact the water tank, the chlorinator building and the new well simultaneously. Since the new well has only a 20-ft steel surface casing, and has PVC casing the remainder of its length, the well would not be expected to survive if the colluvial material were to experience a mass movement. Furthermore, presence of the well discharge piping on the surface introduces additional vulnerability to the water system in the water tank area. Installation of a pitless adapter and subsurface tie-in to the water system would reduce this vulnerability.

Headquarters Well and channel function in Montezuma Canyon

Since there has been discussion of abandoning the long-serving Headquarters Well in Montezuma Canyon based on the suggestion that it is interfering with channel function in the canyon, a review of the 2009 design report “Channel and Stream Crossing Repair Coronado National Memorial Road Repair” by Natural Channel Design, Inc. (NCD) (Natural Channel Design, 2009) was carried out. This report analyzes the Montezuma Canyon channel function and dynamics and recommends a target channel design and long-term management approach developed to work in concert with park road and stream crossing repair and maintenance operations.

The NCD report does not implicate the existing wellhead in Montezuma Canyon as interfering with the recommended channel design and maintenance plan, and does not recommend abandonment of the well. The report does mention the vulnerability of the wellhead to future sediment movement in Montezuma Canyon. The presence of utility poles directly upstream of the wellhead is believed to have helped protect the wellhead from damage during the debris flow event. If these utilities are moved, it is recommended that the base of the poles be left in place to provide protection as long as the well remains. A better solution may be to install a protective bulkhead in the channel upstream of the well to deflect flood debris from the well.

Conclusions and Recommendations

Conclusions based on the information discussed above include:

- Both Headquarters Well and CORO-WSW-2 are capable of supplying park water needs under present conditions
- Both Headquarters Well and CORO-WSW-2 have vulnerabilities that could cause them to become unavailable as a water source on short notice
- By maintaining both wells as functioning water sources to the park, the possibility of interruption of park water supplies is reduced
- The need for a robust permanent water supply still exists

The recommendations are as follows:

- Both the Headquarters Well and CORO-WSW-2 should be retained as functioning park water supply wells until a robust alternative is developed
- Arizona Department of Environmental Quality public water system permitting of CORO-WSW-2 should proceed to completion. This well would be an important alternative water supply in the event of catastrophic loss of the Headquarters Well in Montezuma Canyon
- Water quality at the new well should be monitored at least annually to verify that pollutants from the upgradient mineralized area are not being introduced to the well. IMR staff in Tucson can assist with developing an analyte list and conducting the sampling as needed.
- A baseline evaluation of the presence of bacterial populations that may impact future well productivity at CORO-WSW-2 is recommended. IMR staff in Tucson can assist with this as needed.
- Monitoring of water levels should continue.
- Park staff should implement a system of recording pumping rates on a regular schedule and any time pumping rates are changed. A Standard Operating Procedure for doing this is included as Appendix E.

- In consideration of the vulnerabilities of both the Headquarters Well and CORO-WSW-2, park staff should continue to seek reliable water supply alternatives. Installation of a pipeline from the ranch areas east of headquarters, where more favorable hydrologic conditions exist, to connect with park water supply lines seems to be the major factor impeding use of this resource. This should be a consideration when planning objectives for future road projects that would be amenable to coincident installation of water lines.

This concludes the assessment of the suitability of CORO-WSW-2 to serve as a sole water source for the park. I extend my thanks to Carlos Herrera, Chief of Facilities, and to all park staff for their ongoing support and assistance. Please do not hesitate to contact me with questions or comments on this report.

Acknowledgements

Sincere thanks are extended to Dan Stauning, NPS Sonoran Desert Network Cartographic Data Technician, who developed all of the maps included in this document. Likewise, many thanks to Ann Youberg, State of Arizona Geologic Survey, who generously shared her field work in the debris flow path shapefile, shown in Figure 9. Finally, sincere thanks to Larry Martin, NPS Water Resource Division, for his thoughtful review of and comments on this report.

References

Herrera, C. Personal communication.

Karst Solutions. 2009a. Abandoned Mine Assessment Feature Number 93-025.

Karst Solutions. 2009b. Abandoned Mine Assessment Feature Number 93-026.

Martin, L. 2000. Trip report for travel to Coronado National Memorial on August 2, 2000. L54(2380)

Natural Channel Design, Inc. June 2009. Design Report Channel and Stream Crossing Repair Coronado National Memorial Road Repair. 76 pp.

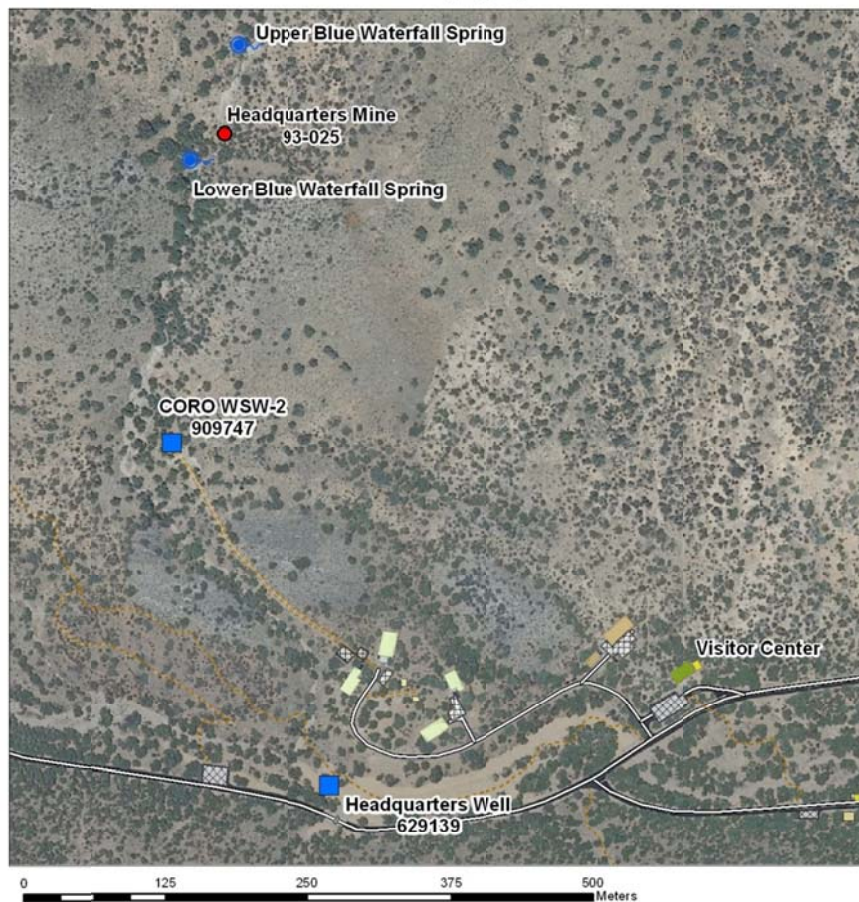
Sanchez, J.P., B.A. Erickson and J.L. Gurule. 2001. Between two countries: The story behind Coronado National Memorial. Spanish Colonial Research Center, Albuquerque, New Mexico. 420 pp.

Youberg, A. 2008. Synopsis of field observations from 5 August 2008. Dated 7 August 2008. 12 pages.

Figures



Location of Water Supply Wells and Other Features



Produced by the Sonoran Desert Network
September 2011

Figure 1. Area map showing the location of the two wells discussed here and features in the area.



Well wrapped in plastic

Figure 2. Headquarters Well following the July 2006 debris flow event.



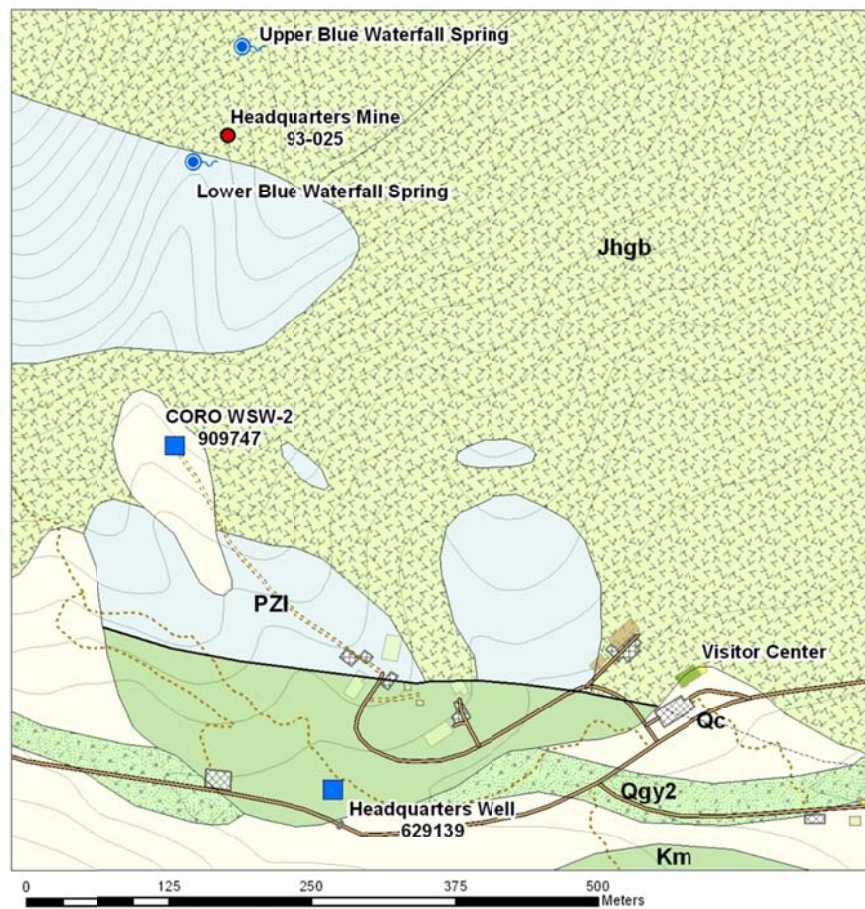
Figure 3. Measuring water level at the CORO-WSW-2 wellhead.



Figure 4. Lower Blue Waterfall Spring discharge.



Geologic Units, Faults and Contacts



Faults

- fault, unknown offset
- fault, unknown offset, concealed (dotted)

CORO - Geologic Contacts

- known or certain
- - - approximate
- concealed
- queried
- - - approximate and queried
- map boundary
- Mines
- Wells
- Springs
- CORO_10m_contours



Produced by the Sonoran Desert Network
September, 2011

Figure 5. Map of surface geology in the area of the water supply wells.

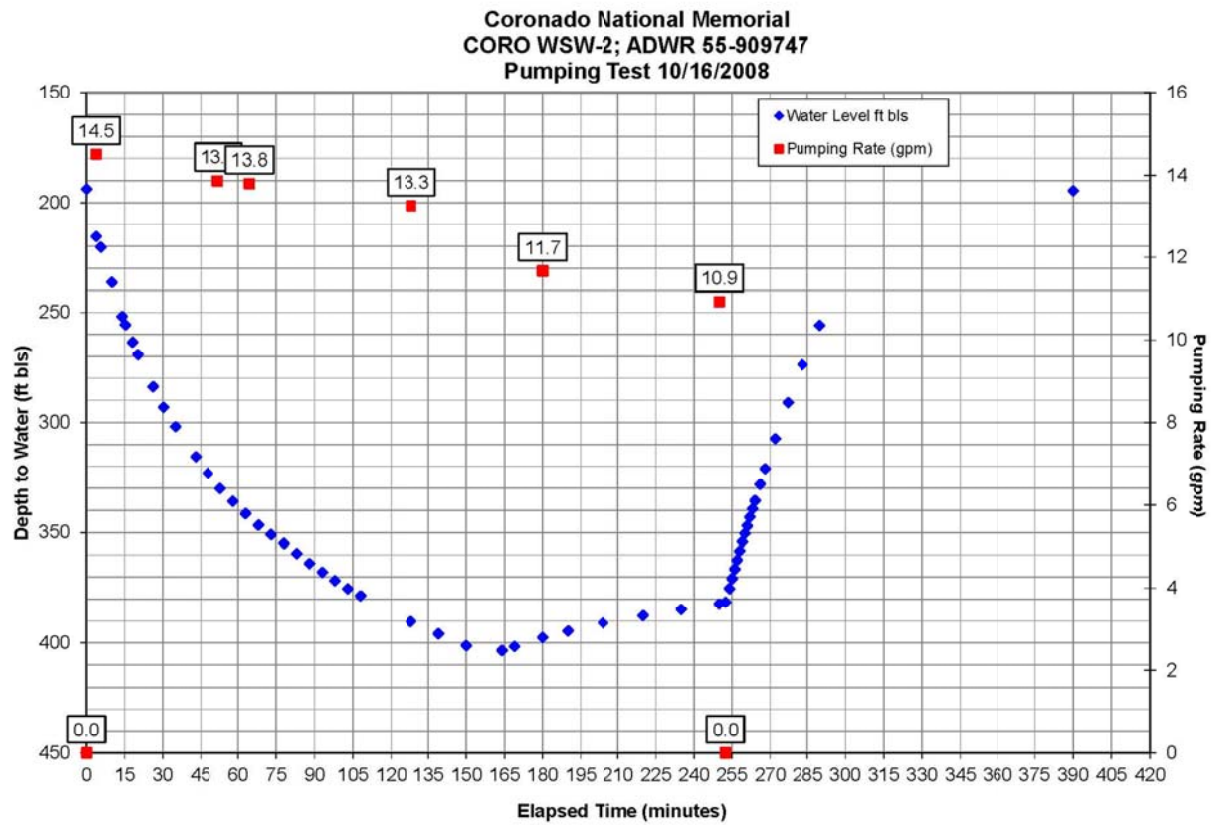


Figure 6. Plot of water levels and pumping rates for test conducted on October 16, 2008.

Coronado National Memorial
CORO WSW-2; ADWR 55-909747
(at the water tank)

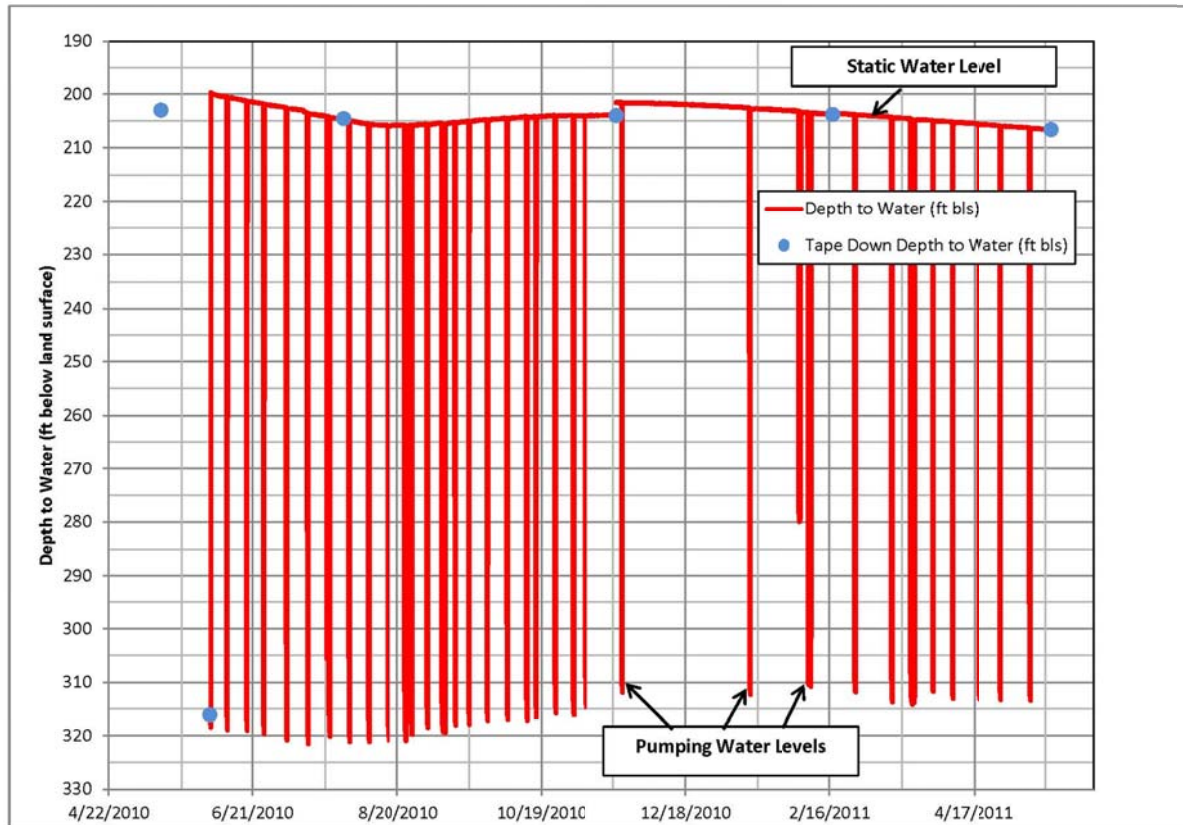
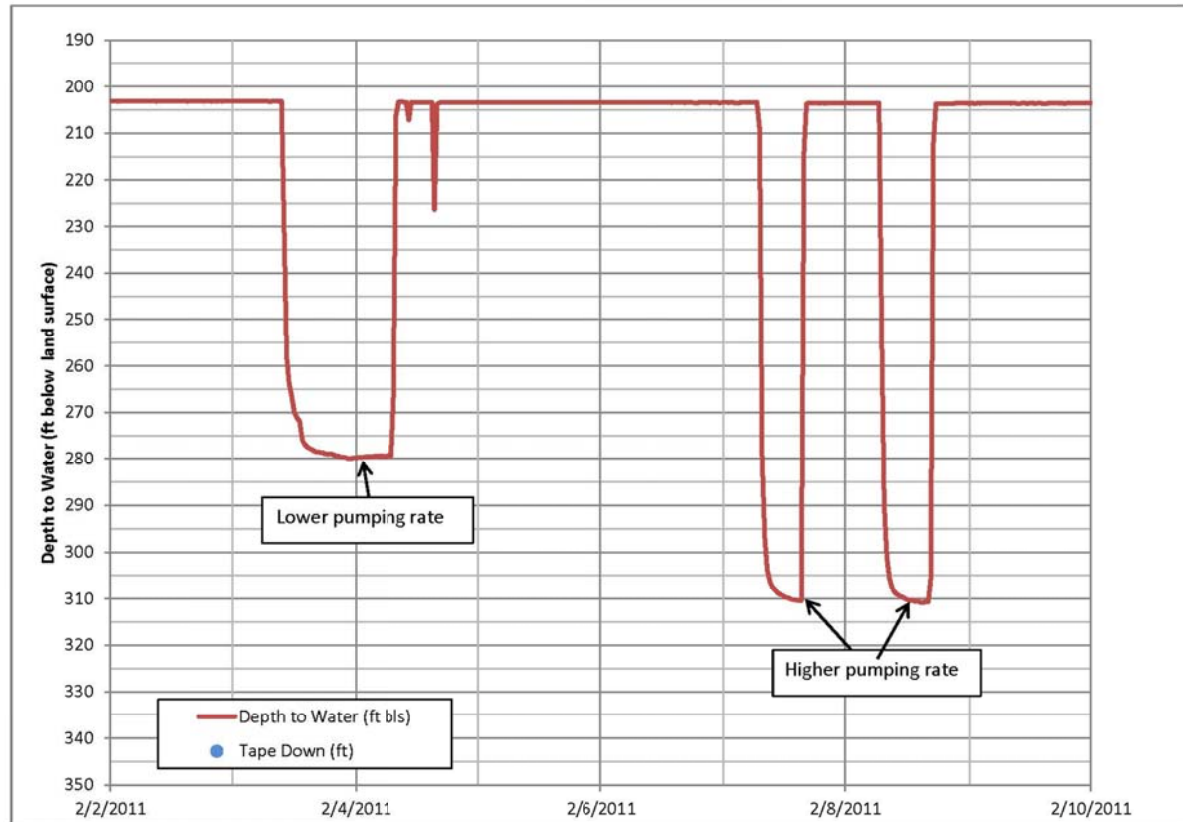


Figure 7. Plot of water level record since May 2010.

CORO-WSW-2; ADWR 55-909747
(at the water tank)

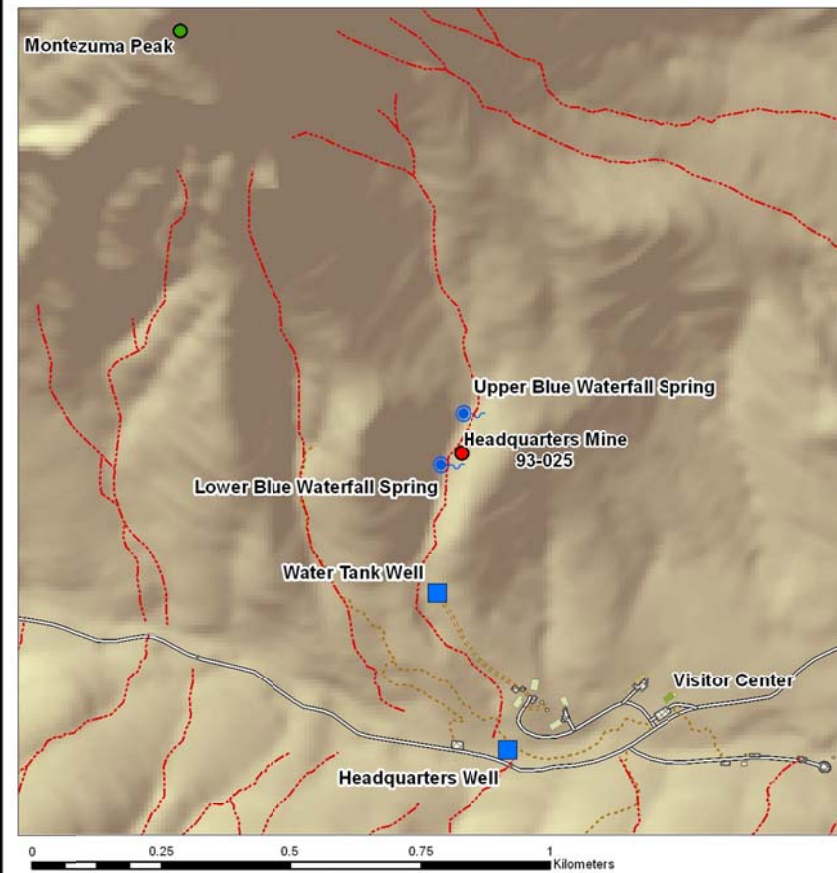


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Figure 8. Detail of water levels February 2 – 10, 2011.



Debris Flow Paths



- Mines
- Springs
- Wells
- Debris Flows
- CORO_trails
- Improved, light-duty
- Unimproved
- Primitive/4wd



Produced by the Sonoran Desert Network
September 2011

Figure 9. Map showing debris flow paths following the July 31, 2006 rainfall event (debris flow paths courtesy of Ann Youberg, AZ Geological Survey).

Appendix A

Technical Assistance Request

FY 2011 Technical Assistance Request Form

Park: Coronado National Memorial	Park Priority: (List request as 1 of 5, 2 of 5, etc.)
Project Title: Report on adequacy of new well to support park water needs	
Park Contacts: (Name[s], telephone number[s], and e-mail address[es]) Carlos Herrera, Chief of Maintenance, 520 366-5515 x2420 / Carlos_Herrera@nps.gov	
Program Area/Target Expertise: Water supply/ hydrology	
Problem Statement: (A brief summary of the issue, including information pertaining to park management prescriptions/management objectives tied to the issue, known resources at risk, etc.) Evaluate adequacy of new water well to supply park needs without backup from Montezuma Canyon well.	
What are you asking to be done? (Tied to already scheduled construction project or GMP? Provide consultation, protocol development, scoping, report writing, position paper, product development, etc.) Ongoing data collection since June 2010 is aimed at evaluation of adequacy of new well to supply park needs. Approximately one year of data are thought to be the minimum needed to evaluate well. Once data collection is adequate, a report summarizing data and interpretation relevant to park needs is needed.	
What alternatives does the park have to accomplish the work? None	
Is this a funded project? (If so, please provide the PMIS # and fund source) No	
When is assistance needed? (Any constraints on when assistance needs to occur? How much time is being requested; estimate FTE hours) As soon as adequate data are available.	
Travel Needs: (Will technical assistance staff need to travel to the site? Are park funds available for travel?) Staff will need to travel to the park to collect data every couple of months through the year.	
Will this request benefit from an integrated resources (NR and CR) approach? No.	

Appendix B

Trip Report for Travel to Coronado National Memorial on August 2, 2000

August 23, 2000

L54(2380)
CORO/General

Memorandum

To: Superintendent, Coronado National Memorial

Through: William L. Jackson, Chief, Water Operations Branch

From: Larry Martin, Hydrologist, Water Operations Branch

Subject: Trip Report for Travel to Coronado National Memorial on August 2, 2000.

PURPOSE: This trip was made to meet with park staff to discuss their concerns regarding the long-term adequacy of the park's potable water supply well.

SUMMARY: Water levels and yield from the existing supply well should be monitored closely. If the yield or water level in the well continues to drop in response to drought conditions, it will be necessary to acquire water from a supplemental source. The most promising supplemental source is from the Baumkirchner Well No. 2 well located on the former Zalesk Ranch. This property was acquired by the Park Service several years ago.

DISCUSSION: The Park's water supply well is located approximately ¼ mile west of the visitor center along the bottom of Montezuma Canyon. The well is completed in rocks of the Morita Formation, which generally have a low permeability. The amount of water available from the well is generally sufficient to supply the visitor center and three homes. The well is constructed in a pocket of sedimentary rocks (Morita Formation) surrounded by relatively impermeable granitic and volcanic rocks. Faulting and fractures in the area underlying Montezuma Canyon have probably increased the permeability of the rock, and possibly resulted in interconnections with other water sources, notably the alluvium of Montezuma Canyon. The faults may effectively separate the aquifer supplying water to the Headquarters Well from aquifers in the terrace gravels of the San Pedro Valley further to the east. The hydrogeology of the aquifer is depicted in the attached figure showing cross-sections through the well site.

Almost all precipitation falling in the drainage basin of Montezuma Canyon runs off the relatively impermeable rocks. In the lower part of the canyon, runoff can recharge the local aquifer system by infiltration into the alluvium. This recharge may be the primary source of water for the Headquarters Well. If this is the case, there could be large variations in the depth to the water table in direct correlation to recharge from rainfall. During extended droughts, water levels in the local aquifer would be expected to drop. Inflow to the local aquifer (during drought) is probably maintained by underflow in the alluvium of the creek, infiltration of water from small springs further up the drainage basin, and groundwater flow along the faults and fracture zones underlying Montezuma Creek.

The Headquarters Well was constructed in 1959 and is 100 feet deep. Static water level at the time of construction was about 30 feet below ground surface. Water level and production from the well have been monitored since 1996. During that time, water use has averaged about 1500-2000 gallons per day. Static water levels have hovered around 60 feet below ground surface except for a period that included most of 1998 (figure 2). In 1998, the static water level rose to 30-35 feet below ground surface in response to rainfall from winter storms.

It appears that during periods of normal rainfall, the local aquifer can be refilled to near pre-development levels. During dry periods, water levels are drawn down to about 60 feet below ground surface, leaving little room for drawdown in the well during pumping. We do not know how long the well can remain a viable source of water during extended droughts. Our only point of reference is that the well has been able to meet the minimal needs of the park to date.

At the park's request, I conducted an investigation to identify potential alternative or supplemental sources of potable water for the park. Alternative sources include:

New well near the existing well - The existing well obtains water from a small local aquifer with a limited recharge area. Infiltration of surface flow in Montezuma Creek replenishes the aquifer during wet periods. Groundwater flow through faults and fractures supplies water to the aquifer during dry periods. Constructing a new well in this aquifer would not appreciably increase the supply of water. The supply is limited by the small recharge area, seasonal variation of rainfall and streamflow, and the limited areal extent of the local aquifer. Constructing a new, deeper well could reduce the risk of pumping the well dry by allowing the pump to be set deeper in the well. However, given the limited size of the local aquifer, there would still be a risk of totally depleting the aquifer. We do not know what hydrogeologic conditions we might encounter in a deeper well, whether there would be any additional water-bearing zones deeper in the aquifer. A dry hole was drilled (total depth = 103½ feet) directly south of the road at the Visitor Center in 1959.

Springs – There are several springs and a shallow hand-dug well further up Montezuma Creek from the existing well. It is very unlikely the springs would be a significant source of water during drought, when supplemental water would be needed. Water from the shallow dug well would not persist as a significant source during drought. Also, water

from a shallow well would need to be treated as a surface water source, requiring expensive treatment.

Brown Allotment well – The Brown Allotment well supplies water for cattle grazing. The well is equipped with a windmill. Records indicate the well might yield 4-5 gpm. The well would likely need to be reconstructed (install an adequate surface seal) and equipped with a pump to comply with public health standards for water supplies. Electrical power and a pipeline would be needed to connect the well with the Headquarters area. We don't know whether the well would provide a reliable source of water during drought, as it is only used to supply small amounts of water for cattle on a seasonal basis.

Wells at Zalesk Ranch – NPS acquired the Zalesk Ranch in 1980. There were three wells on the property. One of the wells, Zalesk Well, was filled in and destroyed. NPS staff conducted aquifer tests on the other two wells, Baumkirchner Well No. 2 and Baumkirchner Well No. 3, in 1983. Well No. 2 was pumped at a rate of 19 gpm for 24 hours, resulting in 36 feet of drawdown. Well No. 3 was pumped at a rate of 13 gpm for 12 hours, resulting in 75 feet of drawdown. Water quality from Well No. 2 was better than from Well No. 3, total dissolved solids of about 260 ppm vs. 450 ppm. Following the testing of these wells in 1983, it was recommended that Well No. 2 be used as a supplemental source of water for the park based on better production and better water quality. Utilization of Baumkirchner Well No. 2 would require construction of about 0.7 miles of pipeline or regular hauling of water by tanker truck from the well to the park's storage tank. Water quality samples should be obtained from this well prior to making any other plans for using the well as a supplemental water source for the park. Several wells completed in the area have had high concentrations of iron and manganese, which gives the water a bad taste.

Wells at Montezuma Ranch There are several wells on the Montezuma Ranch, a property that NPS is in the process of acquiring. We don't have specific information on these wells, but can assume they would be similar to wells on the Zalesk Ranch. Both the Montezuma and Zalesk Ranches overly terrace gravels. These terrace gravels are hydrologically interconnected with the alluvium and other unconsolidated material underlying the San Pedro River Valley. There was apparently enough water available from wells on the Montezuma Ranch to supply a swimming pool and allow extensive irrigation. Providing supplemental water to the Headquarters area from one of these wells would be essentially the same as using one of the wells on the Zalesk Ranch, although a longer pipeline would be needed.

NPS Border Well – NPS constructed the Border Well, a.k.a. Coronado Well No. 4, in 1975. The well was constructed to provide a supplemental supply during dry periods. The well is 742 feet deep and was tested at pumping rates up to 44 gpm. It was determined that an optimal yield from the well would be in the 25-30 gpm range. Water quality was reported to be excellent, although the levels of iron (0.4 ppm) and manganese (0.2 ppm) may impart some objectionable taste to the water. This well was capped after construction and the initial testing. Static water level in the well is about 625 feet below

ground surface. The total lift to pump water from this well would be about 1000 feet. Utilizing this well as a supplemental source would require construction of approximately 2 miles of pipeline and providing electrical service to the well site. Some type of water treatment would probably be required to reduce the concentrations of iron and manganese in water pumped from this well.

CONCLUSIONS: The park is in need of a supplemental water supply source during dry periods of the year. Reliable sources in the immediate vicinity of the Visitor Center are non-existent. The Baumkirchner Well No. 2 was tested and recommended as a supplemental source in 1983. I concur with that recommendation. Water quality samples should be obtained from the well prior to making additional plans to determine if it will be an acceptable supply.

ACTION ITEMS: None at this time.

cc: 479 - Dan Kimball
CORO – Henry Ruiz
SOAR – Phil Clark

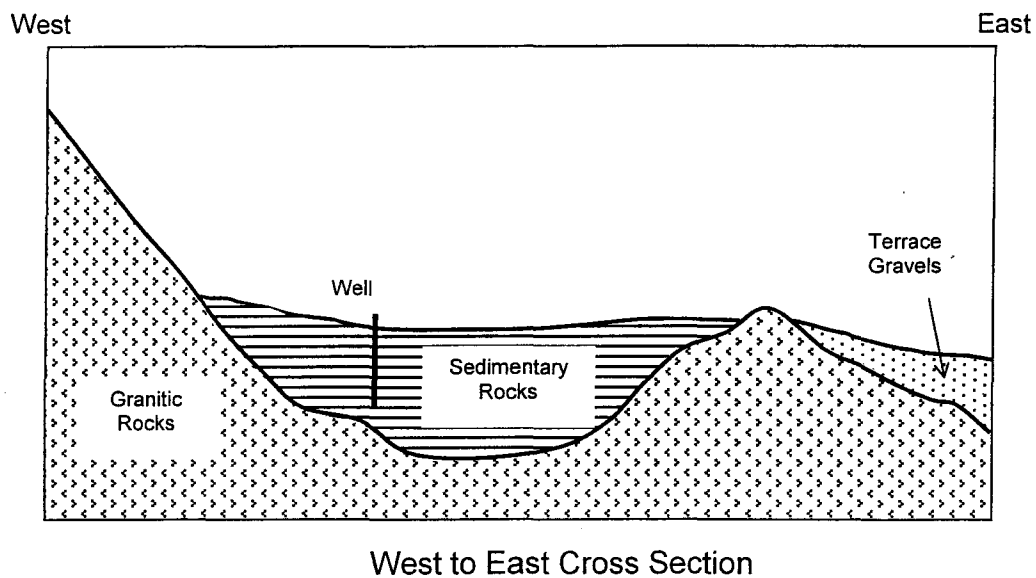
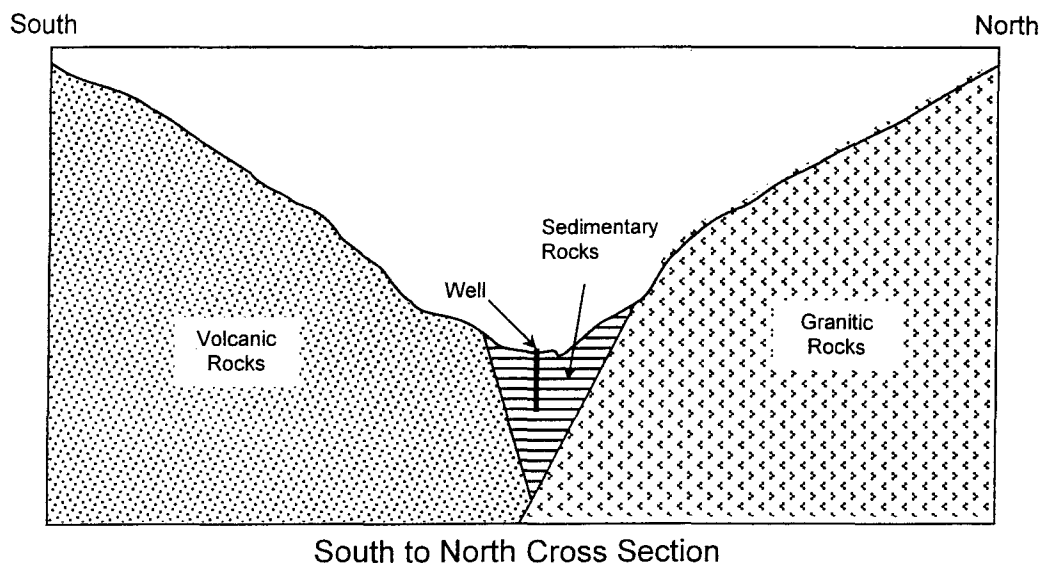
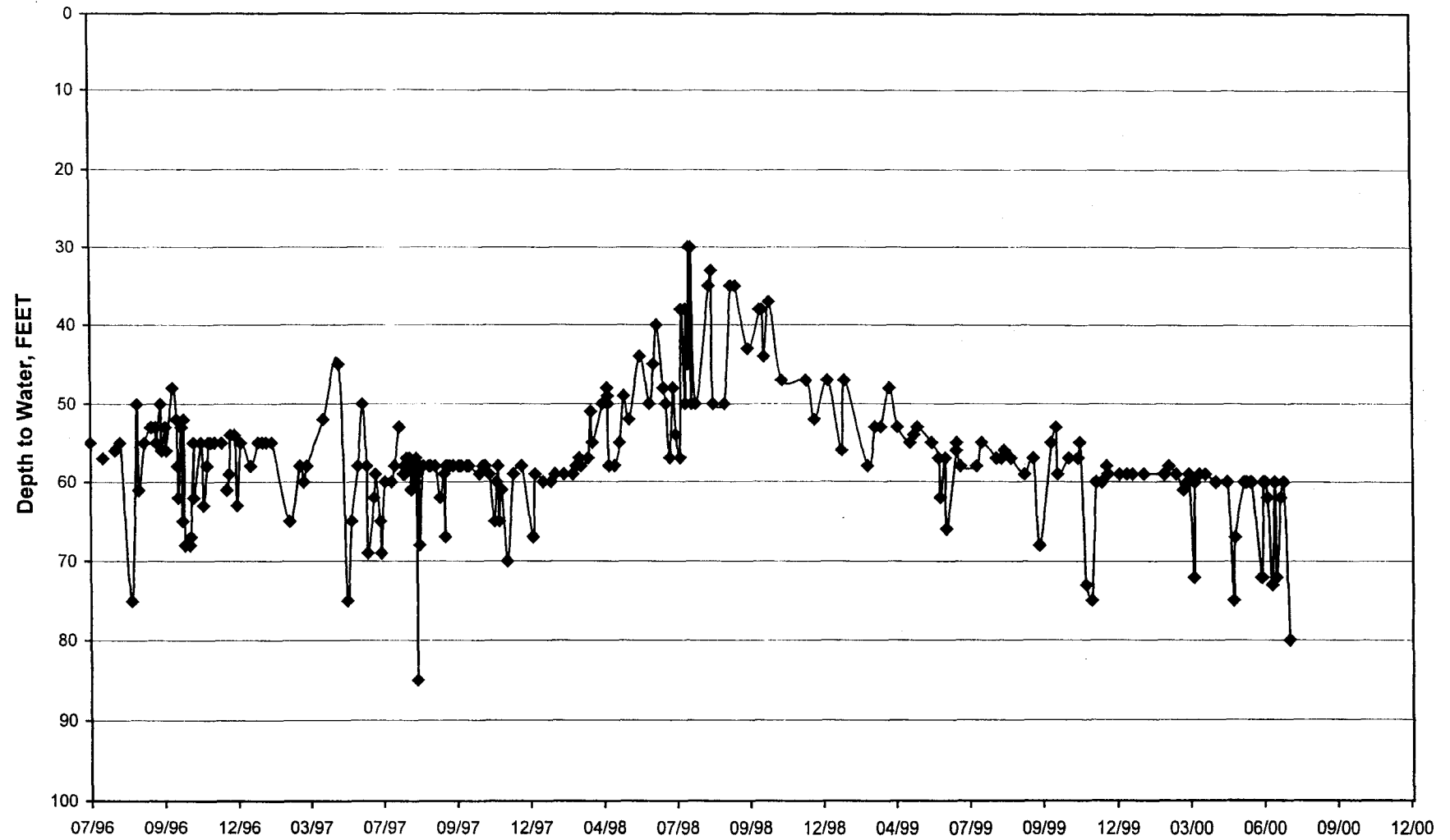


Figure 1. Generalized hydrogeologic cross sections through the Headquarters Well Site at Coronado National Memorial

Coronado National Memorial
Well No. 1



Summary of Wells and Springs
Coronado National Memorial

	Legal Location	
Source	(¼, ¼, ¼, Sec, Twn, Rge)	Notes
Brown Allotment Spring	SE, NE, NE 07 24S 21E	Developed as a water source for stock watering.
Tunnel Mine Spring	SE, NW, SE 11 24S 20E	Developed as a water source for homes near the mines.
Sparks Well #1	SW, NW, NW 13 24S 20E	Hand dug well, 28 feet deep. Supplied water for State of Texas Mine.
Sparks Well #2	SW, NW, NW 13 24S 20E	Reportedly drilled in 1890 to a depth of 365 feet. No casing. Likely filled in by sediment during flooding on Montezuma Creek.
Headquarters Well	NW, SW, NW 18 24S 21E	Water Supply for the park. Constructed in 1959.
Zalesk Well	NW, SW, NW 17 24S 21E	Dug well on Zalesk Ranch. Well has been filled in and destroyed.
Baumkirchner Well #2	NW, SW, NW 17 24S 21E	Water supply at the Zalesk Ranch. Property was acquired by NPS in 1980.
Baumkirchner Well #3	NW, SW, NW 17 24S 21E	Water supply at the Zalesk Ranch. Property was acquired by NPS in 1980.
Brown Allotment Well	NW, SE, SW 08 24S 21E	Equipped with a windmill. Provides water for a seasonal grazing allotment.
Border Well	SE, SE, SW 17 24S 21E	a.k.a. Coronado Well #4. Well was constructed in 1975. Never used due to poor water quality.
Forest Service Well	NE, SE, NW 18 24S 21E	Yields less than ½ gpm. Well has been capped.
Montezuma Ranch		Numerous wells on the property. NPS is in the process of acquiring the property.

Appendix C

ADWR Records for CORO-WSW-2

(ADWR 55-909747)



Arizona Department of Water Resources
Information Management Unit
P.O. Box 33589 • Phoenix, Arizona 85067-3589
(602) 771-8627 • (800) 352-8488
www.water.az.gov

FEB 24 2009

Well Driller Report
and
Well Log

ENTERED
MAR 10 2009

THIS REPORT MUST BE FILED WITHIN 30 DAYS OF COMPLETING THE WELL.

PLEASE PRINT CLEARLY USING BLACK OR BLUE INK

FILE NUMBER
D(24-21)18 BAC
WELL REGISTRATION NUMBER
55 - 909747
PERMIT NUMBER (IF ISSUED)

SECTION 1. DRILLING REGISTRATION

Drilling Firm

Mail To:

NAME

TANNER WELL SERVICE

ADDRESS

7914 NORTH FRONTIER ROAD

CITY / STATE / ZIP

MCNEAL, AZ, 85617-7914

DWR LICENSE NUMBER

133

TELEPHONE NUMBER

520-378 1606

FAX

520-803-7400

SECTION 2. REGISTRY INFORMATION

Well Owner

FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL
Coronado National Memorial

MAILING ADDRESS

4101 E. Montezuma Canyon Rd.

CITY / STATE / ZIP

Hereford, AZ, 85615

CONTACT PERSON NAME AND TITLE

CARLOS HERRERA

TELEPHONE NUMBER

520 366-5515

FAX

EXT 25

Location of Well

WELL LOCATION ADDRESS (IF ANY)

TOWNSHIP (N/S)

24 S

RANGE (E/W)

21 E

SECTION

18

160 ACRE

NW 1/4

40 ACRE

NE 1/4

10 ACRE

SW 1/4

LATITUDE

31

20

888 °N

LONGITUDE

110

15

494 °W

METHOD OF LATITUDE/LONGITUDE (CHECK ONE)

☐ USGS Quad Map

☐ Conventional Survey

☒ *GPS: Hand-Held

☐ *GPS: Survey-Grade

LAND SURFACE ELEVATION AT WELL

5425

Feet Above Sea Level

METHOD OF ELEVATION (CHECK ONE)

☐ USGS Quad Map

☐ Conventional Survey

☒ *GPS: Hand-Held

☐ *GPS: Survey-Grade

*IF GPS WAS USED, GEOGRAPHIC COORDINATE DATUM (CHECK ONE)

☒ NAD-83

☐ Other (please specify)

COUNTY

COCHISE

ASSESSOR'S PARCEL ID NUMBER (MOST RECENT)

BOOK

104

MAP

61

PARCEL

018

SECTION 3. WELL CONSTRUCTION DETAILS

Drilling Method

CHECK ONE

☒ Air Rotary

☐ Bored or Augered

☐ Cable Tool

☐ Dual Rotary

☐ Mud Rotary

☐ Reverse Circulation

☐ Driven

☐ Jetted

☐ Air Percussion / Odex Tubing

☐ Other (please specify)

Method of Well Development

CHECK ONE

☒ Airlift

☐ Bail

☐ Surge Block

☐ Surge Pump

☐ Other (please specify)

Condition of Well

CHECK ONE

☐ Capped

☒ Pump Installed

Method of Sealing at Reduction Points

CHECK ONE

☐ None

☐ Packed

☐ Swedged

☐ Welded

☒ Other (please specify) FORMATION
PACKER - BENTONITE

Construction Dates

DATE WELL CONSTRUCTION STARTED

9-18-08

DATE WELL CONSTRUCTION COMPLETED

12-22-08

I state that this notice is filed in compliance with A.R.S. § 45-596 and is complete and correct to the best of my knowledge and belief.

SIGNATURE OF QUALIFYING PARTY

Matthew L. Tanner

DATE

1-9-09

WELL REGISTRATION NUMBER
000747

Water Level Information			
STATIC WATER LEVEL 195 Feet Below Land Surface	DATE MEASURED 12-22-08	TIME MEASURED 2:33 PM	IF FLOWING WELL, METHOD OF FLOW REGULATION ☐ Valve ☐ Other:

[illegible][illegible]

WELL REGISTRATION NUMBER
55 - 909747

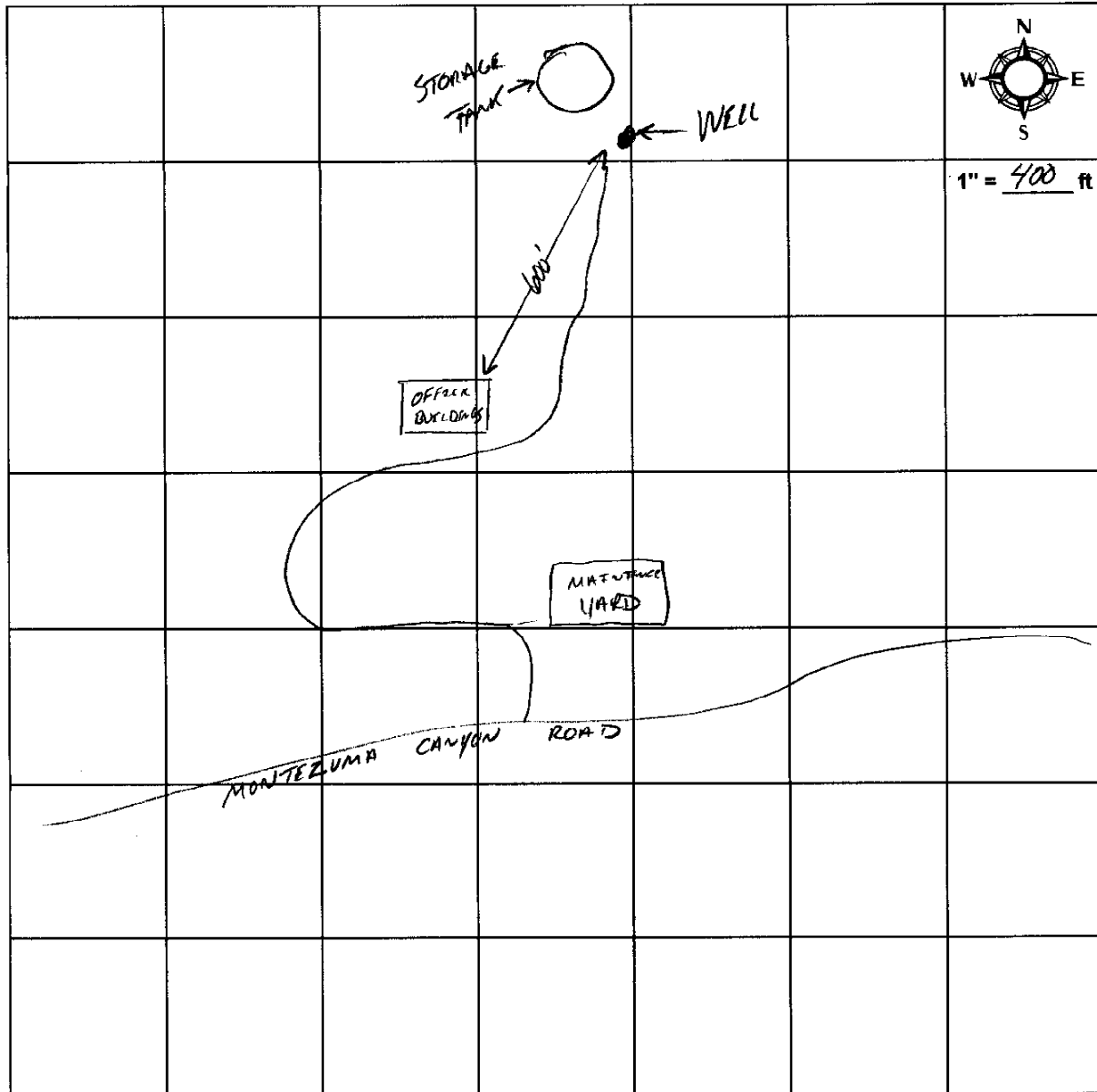
DWR 55-55 (REVISED 03/07/06) PAGE 3 OF 4

Well Driller Report and Well Log

WELL REGISTRATION NUMBER
55 - 909747

SECTION 6. WELL SITE PLAN			
NAME OF WELL OWNER		COUNTY ASSESSOR'S PARCEL ID NUMBER (MOST RECENT)	
Coronado National Memorial		BOOK 104	MAP 61 PARCEL 018

- ❖ Please draw the following: (1) the boundaries of property on which the well was located; (2) the well location; (3) the locations of all septic tank systems and sewer systems on the property or within 100 feet of the well location, even if on neighboring properties; and (4) any permanent structures on the property that may aid in locating the well.
- ❖ Please indicate the distance between the well location and any septic tank system or sewer system.





Arizona Department of Water Resources
Information Management Unit
P.O. Box 33589, Phoenix, AZ 85067-3589
(602) 771-8627 • (800) 352-8488
www.azwater.gov

FEB 27 2009

Pump Installation Completion Report

- ❖ Review instructions prior to completing form in black or blue ink.
- ❖ The registered well owner should file this report with the Department within 30 days following installation of pump equipment.

FILE NUMBER
D(24-21)18 BAC
WELL REGISTRATION NUMBER
55-909747

** PLEASE PRINT CLEARLY **

SECTION 1. REGISTRY INFORMATION

Well Owner		Location of Well			
FULL NAME OF COMPANY, ORGANIZATION, OR INDIVIDUAL		WELL LOCATION ADDRESS (IF ANY)			
CORONADO NATIONAL MEMORIAL					
MAILING ADDRESS		TOWNSHIP (N/S)	RANGE (E/W)	SECTION	160 ACRE
4101 E. MONTEZUMA CANYON RD.		24 S	21 E	18	40 ACRE
CITY / STATE / ZIP CODE		10 ACRE			
HEREFORD AZ 85615		COUNTY ASSESSOR'S PARCEL ID NUMBER (MOST RECENT)			
CONTACT PERSON NAME AND TITLE		BOOK	MAP	PARCEL	
CARLOS HERRERA		104	61	018	
TELEPHONE NUMBER		COUNTY WHERE WELL IS LOCATED			
520-366-5515 EXT 25		COCHISE			
FAX					

SECTION 2. EQUIPMENT INSTALLED

DATE PUMP INSTALLED		Pitless Adaptor	
12-22-08		CHECK ONE (SEE INSTRUCTIONS FOR DEFINITION)	
Pump Type		Was a pitless adaptor installed? ☐ Yes	
CHECK ONE		☒ No	
☐ Air Lift		IF YES, DEPTH BELOW GROUND LEVEL THE DEVICE WAS INSTALLED	
☐ Bucket		Feet	
☐ Centrifugal		Power Type	
☐ Jet		CHECK ONE	
☐ Piston		☐ Diesel Engine	
☐ Rotary		☒ Electric Motor	
☒ Submersible		☐ Gasoline Engine	
☐ Turbine		☐ Hand	
☐ Other (please specify):		☐ Natural Gas	
		☐ Windmill	
		☐ Other (please specify):	
RATED PUMP CAPACITY		HORSE POWER RATING OF MOTOR	
10		2	
Gallons Per Minute			

DLT

SECTION 3. PUMP TEST

Pump Test Data	Method of Discharge Measurement	Method of Measuring Water Level
DATE WELL TESTED	CHECK ONE	CHECK ONE
12-22-08	☐ Bailer	☐ Air Line
STATIC WATER LEVEL (A)	☐ Bucket - Barrel - Stopwatch	☒ Electric Measuring Line (Sonder)
195 Feet Below Land Surface	☐ Current	☐ Steel Tape
PUMPING WATER LEVEL (B)	☐ Estimated - Air Lift	☐ Other (please specify):
389 Feet Below Land Surface	☐ Gauge	
DRAWDOWN [(B) - (A)]	☒ Meter	
194 Feet Below Land Surface	☐ Orifice	
TEST PUMPING RATE	☐ Volume	
13 Gallons Per Minute	☐ Weir - Flume	
DURATION OF PUMP TEST (Minimum 4 Hours)	☐ Other (please specify):	
4 HR 50 MIN		
TOTAL PUMPING LIFT		
600 Feet		
FOR FLOWING WELL, MEASURED SHUT IN HEAD		
☐ FT		
☐ PSI		

I HEREBY CERTIFY that the above statements are true to the best of my knowledge and belief according to A.R.S. § 45-600(B).

SIGNATURE OF WELL OWNER

Carlos C. Herrera

DATE

2/23/09

ARIZONA DEPARTMENT OF WATER RESOURCES
3550 N. Central Avenue Suite 200
Phoenix, Arizona 85012

DLT

DRILLING CARD

THIS AUTHORIZATION SHALL BE IN POSSESSION OF THE DRILLER DURING ALL DRILLING OPERATIONS

WELL REGISTRATION NO: 55-909747

AUTHORIZED DRILLER: TANNER WELL SERVICE

LICENSE NO: 133

NOTICE OF INTENT TO DRILL AN EXEMPT WELL HAS BEEN FILED WITH THE DEPARTMENT BY:

WELL OWNER: Coronado National Memorial

ADDRESS: 4101 E. Montezuma Canyon Rd., Hereford, AZ, 85615

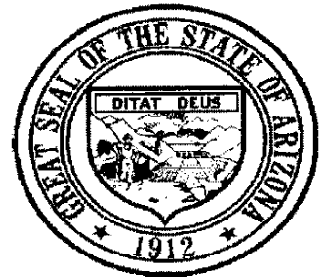
THE WELL(S) IS/ARE TO BE LOCATED IN THE:

SW 1/4 of the NE 1/4 of the NW 1/4 Section 18 Township 24 S Range 21 E

NO. OF WELLS IN THIS PROJECT: 1 ASSESSOR'S PARCEL NO: 104-61-018

THIS AUTHORIZATION EXPIRES AT MIDNIGHT ON THE DAY OF 9/16/2009

THE DRILLER MUST FILE A WELL DRILLER REPORT AND WELL LOG WITHIN 30
DAYS OF COMPLETION OF DRILLING



This drilling or abandonment authority was granted based upon the certifications made by the above-named Driller in the notice of intent to drill or abandon. Those certifications, along with any variances granted, are listed below. By drilling or abandoning the well pursuant to this authorization, the above-named driller acknowledges the accuracy of the driller certifications. If the certifications are in error, this authorization is invalid and driller must contact the Department of Water Resource's NOI Section in writing at the address above to correct.

Variance(s) Granted To Driller: None

Certification(s) Made By Driller:

- ☒ By checking this box, I certify that I have all necessary Registrar of Contractor (ROC) licenses in all necessary license categories for this drilling or abandonment project and that those licenses are current.
- ☒ By checking this box, I certify that the proposed well site is not within 100 feet of any septic tank system, sewage disposal area, landfill, hazardous waste facility, storage area of hazardous materials or petroleum storage areas and tanks.
- ☒ By checking this box, I certify that the proposed well's water use meets the criteria of domestic purposes as outlined in the A.R.S. §45-454 and that the water will be used solely for domestic purposes.
- ☒ By checking this box, I certify that this NOI application is not an application to replace, deepen, or modify an existing well.
- ☒ By checking this box, I certify that I have been authorized by the above-named well owner to submit this Notice of Intent on the well owner's behalf.
- ☒ By checking this box, I certify that the information above is complete and correct, and that the well shall be drilled or abandoned in compliance with all pertinent statutes and rules, including any special standards that may be required to protect the aquifer or other water sources.

☒ By checking this box, I understand that the Authorization to drill this well DOES NOT constitute or guarantee an approval to use the well for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A) without official prior approval from the Department.

ARIZONA DEPARTMENT OF WATER RESOURCES

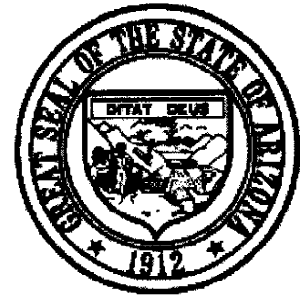
3550 N. Central Avenue Suite 200, Phoenix, Arizona 85012

Telephone (602) 771-8500

Fax (602) 771-8691

Wednesday, September 17, 2008

Coronado National Memorial
4101 E. Montezuma Canyon Rd.
Hereford, AZ 85615



Janet Napolitano
Governor

Herbert R. Guenther
Director

Registration No. 55-909747

File No. D(24-21)18 BAC

Dear Applicant:

Enclosed is a copy of the Notice of Intent to Drill, Deepen, Replace or Modify a Well ("NOI") which you recently filed with this Department pursuant to A.R.S. § 45-596. This is to inform you that the Department has approved the NOI and has mailed (or otherwise provided) a drilling card authorizing the drilling of the well to the well driller identified in the NOI. The driller may not begin drilling until he has received the drilling card, which he must keep in his possession at the well site during drilling. **PLEASE NOTE:** The Authorization to drill this well **DOES NOT constitute or guarantee an approval to use the well for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA)** pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A). Groundwater **may not** be withdrawn from this well for these transportation purposes **without official prior approval from the Department**. Please contact the office in the AMA where the groundwater is to be transported to determine what additional forms are needed and for more information on this process.

Well drilling activities must be completed within one year after the date the NOI was filed with the Department. If drilling is not completed within one year, you must file a new NOI before proceeding with further drilling. If in the course of drilling the well, it is determined that the well cannot be successfully completed as initially intended (dry hole, cave in, lost tools, etc.), the well must be properly abandoned and a Well Abandonment Completion Report filed as required by A.A.C. R12-15-816(F).

If you change drillers, you must notify the Department of the new driller's identity. Please ensure that the new driller is licensed by the Department to drill the type of well you require. A new driller may not begin drilling until he receives a new drilling card from the Department. If you are drilling a new or replacement well and it is necessary to change the location of the well, you may not proceed with drilling until you file a new NOI with the Department and the Department issues an amended drilling card to the driller. If county approval was required for the original well site plan (this applies to domestic wells on parcels that are five acres or less), you must submit a new well site plan with the new well location to your local county health authority for approval prior to filing the new NOI with the Department.

A.R.S. § 45-600 requires the registered well owner to complete and file a Pump Installation Completion Report form (DWR form 55-56) within 30 days after the installation of pumping equipment. A form is enclosed for your use. Also enclosed is a well owner's guide that provides useful information and advice concerning your upcoming well construction project. A.R.S. § 45-600 also requires the driller to file a complete and accurate Well Drillers Report and Well Log (DWR form 55-55) within 30 days after completion of drilling. That form was mailed to your driller with the drilling card. You should insist and ensure that all of the required forms are accurately completed and timely filed with the Department.

Please be advised that A.R.S. § 45-593(C) requires the person to whom a well is registered to notify the Department of a change in ownership of the well and/or information pertaining to the physical characteristics of the well in order to keep this well registration file current and accurate. Any change in well information or a request to change well driller must be filed on a Request to Change Well Information form (DWR form 55-71A) that may be downloaded

from the ADWR Internet website at
http://www.azwater.gov/dwr/Content/Find_by_Category/Permits_Forms_Applications/default.htm.

ARIZONA DEPARTMENT OF WATER RESOURCES

Electronic Filing - NOI Report
3550 N. Central Avenue Suite 200
Phoenix, Arizona 85012

NOI Type: Notice of Intent to Drill, Deepen, Replace or Modify a Well
Well Type: EXEMPT
Date Received at ADWR Website: 9/17/2008 8:04:12 AM

Fee Paid: \$100.00

Order Number: VREE2E738051

Well Registration Number: 55 - 909747
Number of Wells/Holes: 1

Drilling Authority Expires On: 9/16/2009

Driller's ADWR License Number: 133

Authorized Driller: TANNER WELL SERVICE
ROC License Number Entered By Driller: 182725
Qualifying Party License Categories: C-53

Well Owner Name: Coronado National Memorial
Well Owner Address: 4101 E. Montezuma Canyon Rd.
Well Owner City, State - Zip: Hereford, AZ - 85615
Well Owner Phone: 520 366-5515 25

Book: 104 Map: 61 Parcel: 018

Is the Land Owner the same as the Well Owner?: Yes

Well Location: **SW** 1/4 of the **NE** 1/4 of the **NW** 1/4 Section **18** Township **24 S** Range **21 E**

AMA: NOT WITHIN ANY AMA OR INA
County: COCHISE
Contamination Site: NOT IN ANY WQARF SITE

Design Pumping Capacity: <= 35 GPM

Primary Water Use: DOMESTIC
Secondary Water Use(s): N/A

Is the proposed water use for domestic purposes on <= 5 acres?: No

Is any portion of the land, on which the well is to be located, within 100 feet of a designated municipal provider's operating water distribution system as shown on the municipal provider's most recent digitized service area map filed by the municipal provider with the director of ADWR. N/A

Proximity to a designated municipal provider's operating water distribution system exemption type:
N/A

Will the installed pump have a pumping capacity of greater than 35 GPM, or will the well will be used to withdraw greater than 10 Acre Feet per year?: N/A

Is this NOI an application to replace, deepen, or modify an existing well? No

Variance(s) Granted To Driller: **None**

Certification(s) Made By Driller:

- ☒ By checking this box, I certify that I have all necessary Registrar of Contractor (ROC) licenses in all necessary license categories for this drilling or abandonment project and that those licenses are current.
 - ☒ By checking this box, I certify that the proposed well site is not within 100 feet of any septic tank system, sewage disposal area, landfill, hazardous waste facility, storage area of hazardous materials or petroleum storage areas and tanks.
 - ☒ By checking this box, I certify that the proposed well's water use meets the criteria of domestic purposes as outlined in the A.R.S. §45-454 and that the water will be used solely for domestic purposes.
 - ☒ By checking this box, I certify that this NOI application is not an application to replace, deepen, or modify an existing well.
 - ☒ By checking this box, I certify that I have been authorized by the above-named well owner to submit this Notice of Intent on the well owner's behalf.
 - ☒ By checking this box, I certify that the information above is complete and correct, and that the well shall be drilled or abandoned in compliance with all pertinent statutes and rules, including any special standards that may be required to protect the aquifer or other water sources.
 - ☒ By checking this box, I understand that the Authorization to drill this well DOES NOT constitute or guarantee an approval to use the well for the purpose of withdrawing groundwater for transportation to an Active Management Area (AMA) pursuant to A.R.S. § 45-552, 45-553, 45-554 or 45-555(A) without official prior approval from the Department.
-

Denae L. Tak

From: ADWR [wrnoi@azwater.gov]
Sent: Wednesday, September 17, 2008 8:06 AM
To: tannerwell@msn.com
Subject: ADWR Well NOI Confirmation re: Well Registration Number 909747

* Confirmation for Order: VREE2E738051

Thank you for your order, Matthew Tanner.

Should you have any questions concerning your order, please contact us by email at wrnoi@azwater.gov or by phone at (602) 771-8500 and be sure to mention your order number: VREE2E738051.

Thanks again for shopping with Arizona Department of Water Resources!

Best regards,
Arizona Department of Water Resources Management.
Phone: (602) 771-8500
Email: wrnoi@azwater.gov

Order ID: VREE2E738051
Date: 9/17/2008
Status: Approved

Arizona Department of Water Resources
3550 N. Central Avenue Suite 200
Phoenix, AZ 85012 United States
Phone: (602) 771-8500 Fax: (602) 771-8691

Bill To: TANNER WELL SERVICE-Matthew Tanner P.O. Box 2234 Sierra Vista, AZ. 85636
Email: tannerwell@msn.com

000603 - Domestic Outside AMA/INA
qty 1 - price ea. - amount \$100.00

Subtotal:	\$100.00
Tax Total	\$0.00
Shipping	\$0.00
Handling	\$0.00
Total:	\$100.00

Transaction Details

[Help](#)[View Transaction Status](#)

Information for Transaction ID: VREE2E738051

Information for Paypal Transaction ID:

Transaction Result Details

Transaction ID: VREE2E738051	Result Code: 0
PayPal Transaction ID:	
Timestamp: Sep 17, 2008 08:06:37 AM	Response Message: Approved
Transaction Type: Sale	Authorization Code: 088207
Tender Type: Visa	AVS Street Match: Y
Credit Card Number: [REDACTED]	AVS Zip Match : Y
Credit Card Expiration: 09 / 2010	International AVS Indicator: N
Amount: 100.00 USD	Card Security Code Match: Y
Tax Amount: 0.00 USD	ABA #:
Shipping/Freight Amount: 0.00 USD	Cust Ref #:
Duty Amount: 0.00 USD	
Original Amount: 0.00 USD	
Original Transaction ID: N/A	
Batch ID: 744	
Purchase Order Number: VREE2E738051	
Supplier Reference #:	

Comment 1: 909747

Billing Information

Billing Address: Matthew Tanner
P.O. Box 2234
Sierra Vista , AZ 85636
US
Email: tannerwell@msn.com

Shipping Information

Shipping Address:

Additional Information

Client IP Address: 216.113.188.202	Merchant: adwr02
Client Version: 3.07	User: adwr02
Transaction State: 8	
Duration: 0.00	

Transaction History

Transaction ID	Timestamp	Transaction Type	Amount	Result	Details
VREE2E738051	Sep 17, 2008 08:06:37 AM	Sale	100.00 USD	0	--

[View Transaction Status](#)

Appendix D

Abandoned Mine Assessments for #93-025 and #93-026

Abandoned Mine Assessment

Feature Number: 93-025

Park Name: CORO

Mine Name: *Headquarters* Date: 9-18-09 Time of Day: 0848 hrs

Location: (UTM WGS 84) Zone 12 R 570596 3468694 Elevation: 5661'

Gate Entry required (*removable bar*): Yes ☒ No ☐

Feature Type: Adit ☐ Shaft ☐ Inclined shaft ☒ Stope open to surface ☐

Prospect Pit ☐ Trench ☐ Other: _____

Type of Closure Recommended: Adit (wall) Gate ☐ Cupola ☐ PUF ☒ Backfill ☐

Cable netting ☐ Culvert gate ☐ Bat chute ☐ No closure ☐

Hazards on Site: Subsidence ☐ Unstable walls ☒ Unstable ceiling ☐ Water ☐

Unstable Floor ☐ Unstable timbers ☐ Dangerous air ☐ Unstable collar ☐ Open winze, stopes ☐

Hazardous substances ☒ *arsenic* Open shaft ☐

Length of mine workings: *About 25 feet'.*

Map of Mine Available: Yes ☐ No ☒ Air Movement Noted: Yes ☐ No ☒

Does Mine Connect to other surface openings: Yes ☐ No ☒

How many portals connect _____ (List elevations of connecting portals/shafts in notes.)

Bats: Present: Yes ☐ No ☐ Night roost ☐ Hibernaculum ☐ Maternity ☐ Day roost ☐

Bat guano found: Yes ☐ No ☐ Number of bats: _____ Species:

Notes: *A pool of water at the bottom of the shaft may be used by wildlife. This probably contains a high concentration of arsenic and other metals, which are toxic. The shaft should be closed to prevent animals and humans from coming in contact with the water.*

Other wildlife noted (include special closure access needs): *None*

Special area designations that limit access (describe): *None*

Describe site access: (*Road, trail, helicopter, etc., how will materials be transported to the work site*): *Hike up dry stream bed .2 miles from end of water tank service road, elevation gain 195'. It is necessary to climb around several smooth rocky areas in the creek bed to reach the mine'*

Can power equipment be used at the work site: (*i.e. generators, welders*). Yes ☒ No ☐

Adit dimensions: (ft/in): Height 6' Width 8'

Distance to gate from dripline:

Slope angle into Adit, degrees:

Direction adit faces (aspect): ___SW___ Overall stability of adit: *Solid*

Stability of rock at gate placement: Solid ☒ Unstable ☐ Finely fractured, weak ☐

Special Considerations for Closure: Yes ☒ No ☐

Describe: *The acidic condition of oxidizing sulfides at the collar preclude use of mild steel for a closure. Crusts of native sulfur were noted on oxidizing sulfides of the tunnel walls. The sulfuric acid produced when the wall rock becomes wet will attack anything but stainless steel.*

Shafts and Stopes Open to Surface:

Dimensions ft/in: Length _ Width _ Depth _

Surface slope angle: _ _ (Include cross sections in field drawings)

Spoil or loose material depth at collar?

Overall stability of shaft/stope: Surface stable, solid rock ☐ Collapsing shaft, (funnel

Trap) ☐ Collar Stable ☒ Collar Unstable ☐ Shaft lagging present Yes ☐ No ☐

Description of shaft/stope condition: *The inclined shaft slopes northward roughly parallel to the creek bed. The shaft is dug in a sulfide replacement body at the edge of a crystalline marble bed. The sulfides are largely oxidized creating leaving pockets of limonite which upon drying is sloughing into the shaft. This is creating some natural voids in the walls. Natural sulfur creates a crust in patches on the walls. The shaft has a strong sulfur odor. Some un-oxidized sulfide minerals are exposed on the waste pile, in particular arsenopyrite.*

Are there structures over shaft/ stope or at adit: Yes ☐ No ☐

Protect structures with historical value: Yes ☐ No ☐ (Include in notes)

Drawings: Include Cross Sections of Gate Area, Profile of Portal, and/ or a cross section of Shaft/Stope at 90 degrees to profile. (Attach to report.)

Notes: *A 2-foot length of hand drill steel was discovered in the bank of the stream course below the mine dump.*

Some of the waste pile has washed away,(fig.2) distributing sulfide ore down the stream bed. Rock steps in the stream bed below the mine are stained red by iron and green from copper oxide (fig.1). A stagnant pool of water at the bottom of the shaft (fig.3) may be a wildlife water source during periods of drought. The water quality of this pool is questionable. It appears that some acid mine drainage is seeping from the waste pile. This is probably most active during periods of precipitation. The worry comes from the presence of arsenopyrite, which releases arsenic as it oxidizes. This may be feeding into the stream course, as well as tainting the pool at the bottom of the shaft. Since the water source for the administrative compound is a well .2 miles away downstream, there is potential for affecting the domestic water supply as well.

The recommendation is for a PUF closure and backfilling. This will prevent animals and humans from coming in direct contact with the water. The mine dump should be considered for additional remediation outside the scope of this contract. Routine monitoring of the well water for arsenic and other toxic metals should be undertaken if it is not being done.

Assessment Preformed by: Jim Nieland

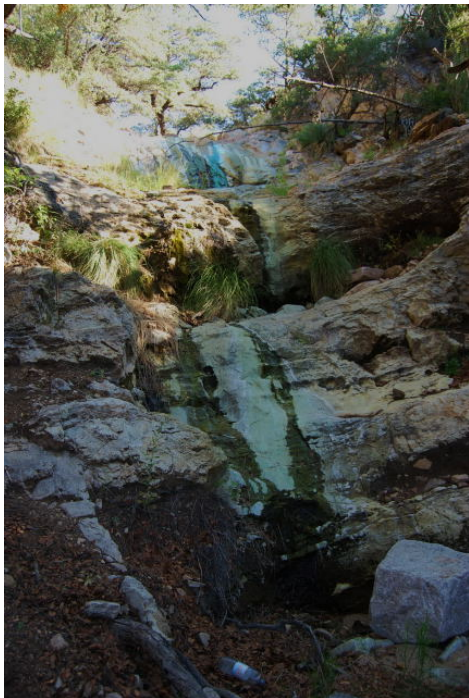
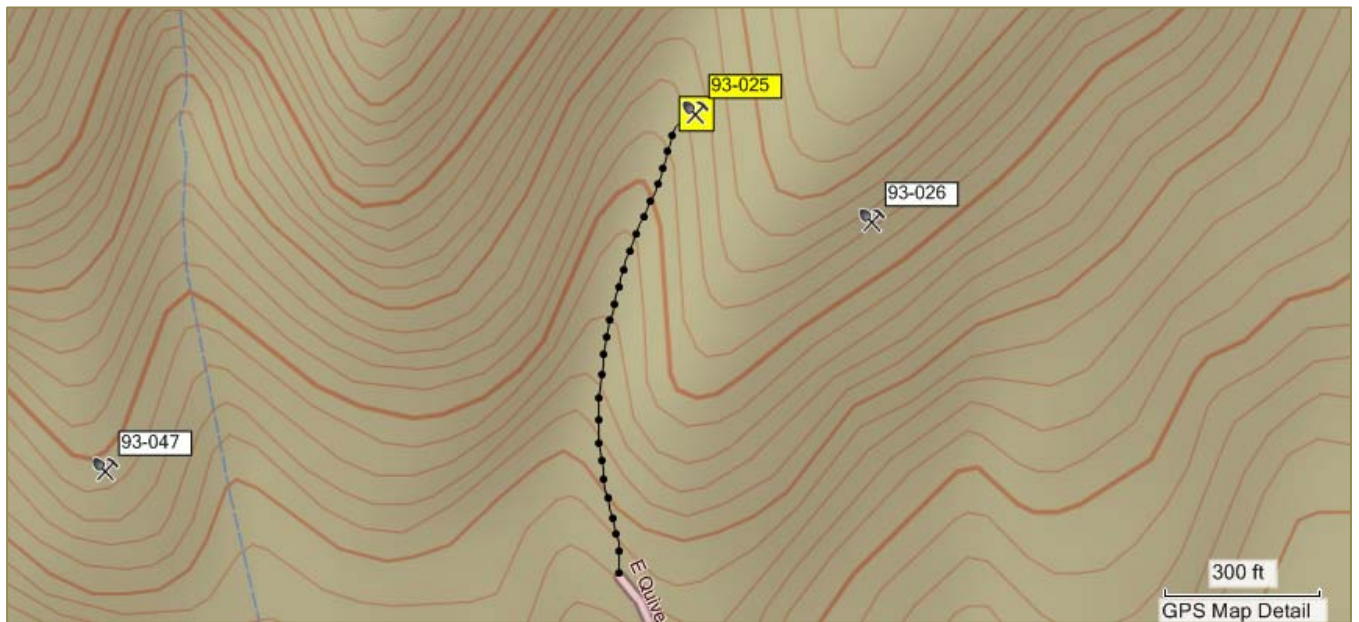


Figure 1. Copper stained creek bed.



Figure 2. Mine waste spilling into creek bed.



Figure 3. Toxic pool at bottom of shaft.



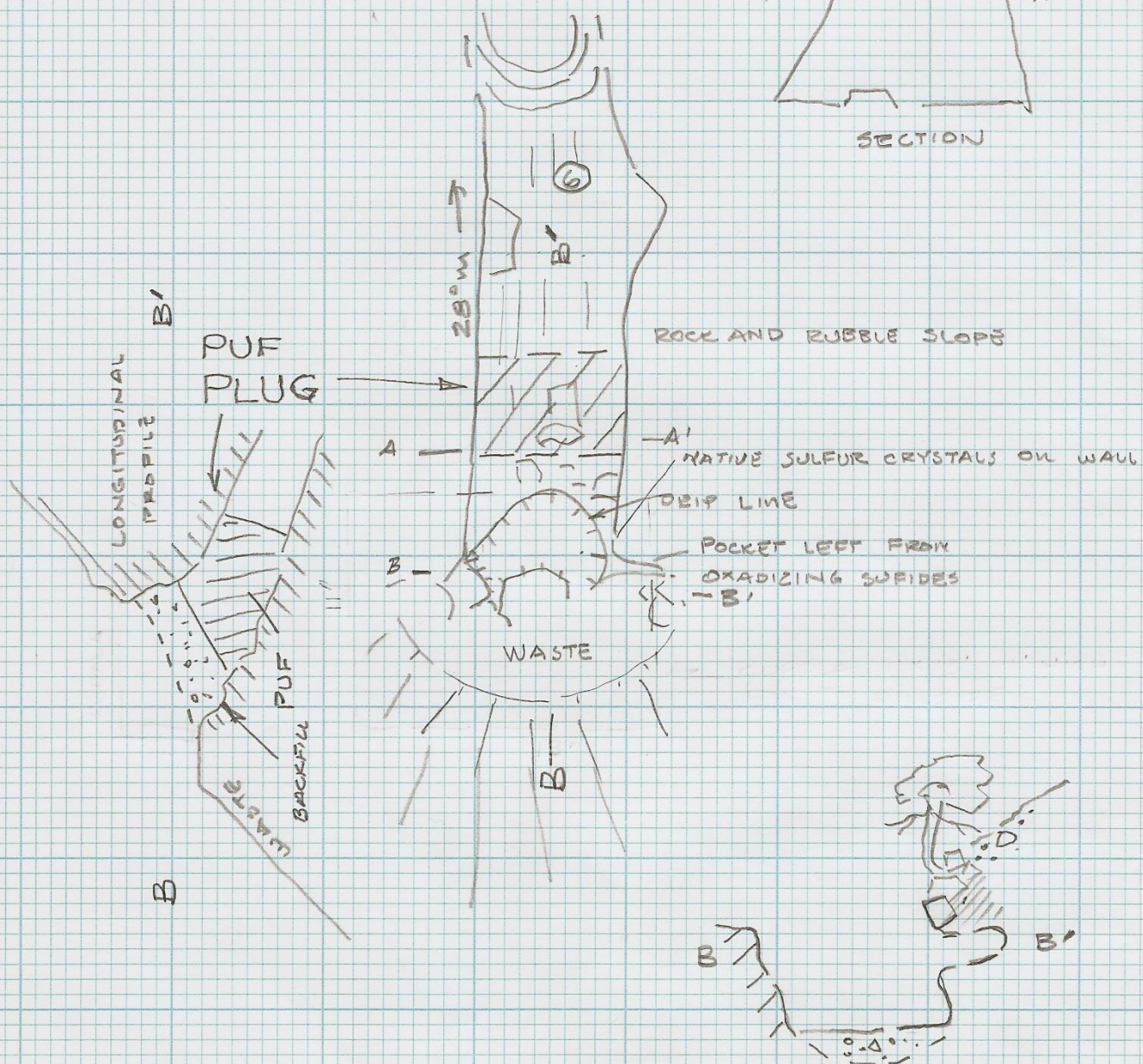
Figure 4. Collar of inclined shaft. High sulfide ore in foreground on mine dump.

93-025

HEADQUARTERS

RECOMMEND:

PUF CLOSURE
AND BACKFILL



Abandoned Mine Assessment

Feature Number: 93-026

Park Name: CORO

Mine Name: *Headquarters* Date: 9-18-09 Time of Day: 1148 hrs

Location: (UTM WGS 84) Zone 12 R 570705 3468632 Elevation: 5697'

Gate Entry required (*removable bar*): Yes ☒ No ☐

Feature Type: Adit ☒ Shaft ☐ Inclined shaft ☐ Stope open to surface ☐

Prospect Pit ☐ Trench ☐ Other: _____

Type of Closure Recommended: Adit (wall) Gate ☒ Cupola ☐ PUF ☐ Backfill ☐

Cable netting ☐ Culvert gate ☐ Bat chute ☐ No closure ☐

Hazards on Site: Subsidence ☐ Unstable walls ☒ Unstable ceiling ☐ Water ☐

Unstable Floor ☐ Unstable timbers ☐ Dangerous air ☐ Unstable collar ☐ Open winze, stopes ☐

Hazardous substances ☒ *arsenic* Open shaft ☐

Length of mine workings: *About 25 feet'.*

Map of Mine Available: Yes ☐ No ☒ Air Movement Noted: Yes ☐ No ☒

Does Mine Connect to other surface openings: Yes ☐ No ☒

How many portals connect _____ (List elevations of connecting portals/shafts in notes.)

Bats: Present: Yes ☐ No ☐ Night roost ☐ Hibernaculum ☐ Maternity ☐ Day roost ☒

Bat guano found: Yes ☐ No ☐ Number of bats: 1 Species: *Macrotus californicus*

Notes: *A pool of water at the bottom of the shaft may be used by wildlife. This probably contains a high concentration of arsenic and other toxic metals. A single macrotus was found roosting just inside the adit and took flight as the team approached. While the pool may contain metal contaminants, humans and larger animals can be kept away with a bat gate, which will preserve roosting habitat.*

Other wildlife noted (include special closure access needs): *None*

Special area designations that limit access (describe): *None*

Describe site access: (*Road, trail, helicopter, etc., how will materials be transported to the work*

site): *Hike up the ridge crest .2 miles north east from the end of water tank service road, elevation gain 231'.*

Can power equipment be used at the work site: (*i.e. generators, welders*). Yes ☒ No ☐

Adit dimensions: (ft/in): Height: *7'-3"* Width: *5'-9"*

Distance to gate from dripline: *2'*

Slope angle into Adit, degrees: *15*

Direction adit faces (aspect): *South* Overall stability of adit: *Solid*

Stability of rock at gate placement: Solid ☒ Unstable ☐ Finely fractured, weak ☐

Special Considerations for Closure: Yes ☒ No ☐

Describe:

Shafts and Stopes Open to Surface:

Dimensions ft/in: Length __ Width __ Depth __

Surface slope angle: __ __ (Include cross sections in field drawings)

Spoil or loose material depth at collar?

Overall stability of shaft/stope: Surface stable, solid rock ☐ Collapsing shaft, (funnel

Trap) ☐ Collar Stable ☐ Collar Unstable ☐ Shaft lagging present Yes ☐ No ☐

Description of shaft/stope condition: *The adit is in a massive sulfide replacement body on the border between quartzite and crystalline marble. This ore body is similar to that of 93-025 with the exception that the waste rock is not near a stream. The adit slopes downward and left to a small residual pool. Animals may use this as a water source during drought, if it persists. The portal is solid and will support a bat gate.*

Are there structures over shaft/ stope or at adit: Yes ☐ No ☐

Protect structures with historical value: Yes ☐ No ☐ (Include in notes)

Drawings: Include Cross Sections of Gate Area, Profile of Portal, and/ or a cross section of Shaft/Stope at 90 degrees to profile. (Attach to report.)

Notes:

Assessment Preformed by: Jim Nieland





Figure 1. Portal at base of red oxidized gossan. Marble exposed, white rock, lower left



Figure 3. Portal viewed looking out.

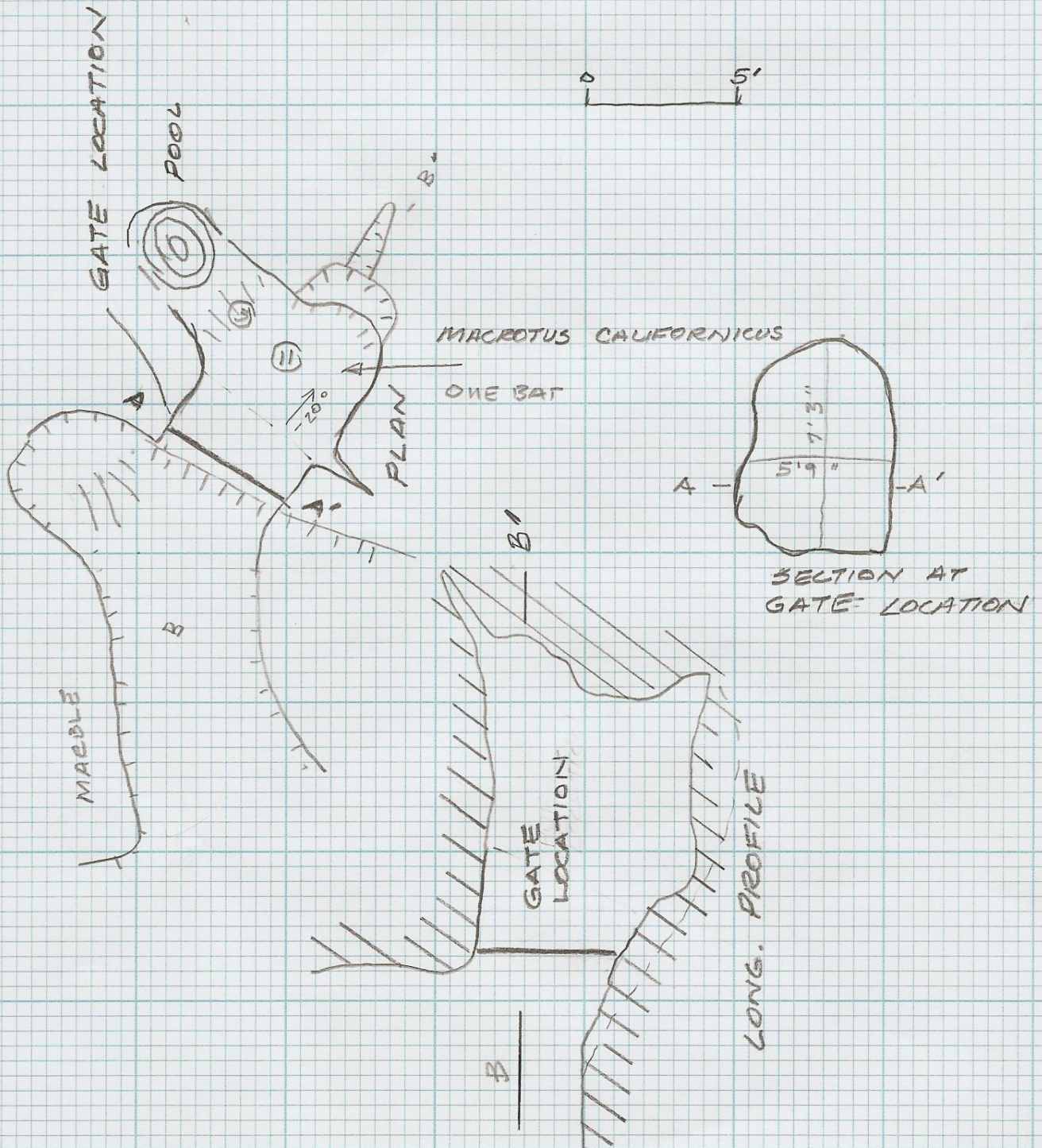


Figure 2. Small pool at bottom of tunnel.



Figure 4. Oxidized sulfide ore sloughing from cavities in the wall.

93-026 HEADQUARTERS



Appendix E

Standard Operating Procedure for Monitoring Pumping Rate

Standard Operating Procedure for Monitoring Pumping Rate at CORO-WSW-2

Materials needed:

Water meter
Stopwatch
Data sheet
Pencil
Calculator
Watch/cell phone or other timepiece

1. Fill in top of data sheet. Estimate the time since pumping began.
2. Write down the actual time of day.
3. Watch moving needle on water meter until it reaches 0.
4. Start the stopwatch.
5. When the meter needle has completed one complete turn around the meter dial, stop the stopwatch and write down the time and the number of gallons pumped on the data sheet.
6. Reset the stopwatch.
7. Repeat steps 2-6 at least once. If the time is substantially different from the first, repeat a third time.
8. Calculate the time in minutes as minutes + seconds/60.
9. Calculate the pumping rate as the total number of gallons divided by the minutes to pump that number of gallons.
10. Fax this data sheet to Colleen Filippone at 520-731-3420 and save with pumping records.

Date _____

Observer _____

Time since pumping began _____

Clock Time	Gallons Pumped*	Stopwatch Time (minutes:seconds)	Time (minutes)	Gallons per Minute

*Assumption: That the water meter is reading correctly. This can be checked independently by closing the valve to the water tank and discharging to a container with a known volume while comparing against the water meter readings.