



United States Department of the Interior

NATIONAL PARK SERVICE
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, CO 80525

IN REPLY REFER TO:

January 15, 1998

L54(2380)
SAGU/General

Memorandum

To: Superintendent, Saguaro National Park

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

From: Larry Martin, Hydrogeologist, Water Operations Branch

Subject: Hydrogeologic Conditions for the Water Supply Well at the Red Hills Visitor Center, Tucson Mountain Unit, Saguaro National Park.

Introduction

Water for the Red Hills Visitor Center, maintenance shop, employee housing, and administrative offices for the Tucson Mountain Unit of Saguaro National Park is supplied by a well approximately a mile west of the facilities. Current demand is about 50,000 gallons per month (1700 gallons per day) with little seasonal fluctuation in the demand. The well is pumped at 9-10 gallons per minute, generally about 3 hours per day in the early morning hours when electric rates are lower.

The well is located about a hundred feet northeast from the intersection of Mile Wide Road and Sandario Road, about one mile southwest of the Red Hills Visitor Center. The legal description of the well is SW $\frac{1}{4}$, SW $\frac{1}{4}$, SW $\frac{1}{4}$ of Section 34, T13S, R11E (D-13-11 34ccc)

Well Construction

The well was constructed in February and March, 1964. The well is 560 feet deep and was drilled with an 8-inch bit. The well is cased with 6-inch steel casing to the total depth. The lower 160 feet (400-560 feet) of the casing was perforated with ¼"x6" cuts, one every 2 feet.

Geologic formations encountered were inferred from the drilling rate. The upper 435 feet of the well was drilled through conglomerate. Below 435 feet, the drilling rate was much slower and was thought to indicate drilling through fractured bedrock.

The well was tested for drawdown and yield by running a step drawdown test on the morning of March 18, 1964. The well was pumped for a total of 6 hours at successive rates of 10, 20, and 30 gpm. The drawdowns measured at these rates are very small and indicate that the well can be safely pumped at much higher rates. Just before the start of the test, the static water level was measured at 441.07 feet below the top of the casing. The water level recovered to the static level within one minute after pumping ceased, and within 3 minutes the water level stabilized at a new static level of 441.02 feet, 0.05 feet higher than before pumping started.

A second test was run with maximum output from the test pump for 24 hours at a rate of 42 gpm. The drawdown was 2.1 feet at the end of 24 hours of pumping, giving a specific capacity of 20 gpm per foot of drawdown.

Hydrogeology

The water level in this well is consistent with water levels in the alluvial aquifer of the Avra Valley. However, the wells in the Avra Valley obtain water from the alluvial deposits, whereas this well obtains water from fractures in the bedrock. The water in the alluvial and bedrock aquifers seems to be hydrologically connected as indicated by uniform water levels between wells completed in different aquifers.

The hydrologic system in the Avra Valley was in approximate equilibrium and ground-water levels generally remained unchanged until about 1940. Ground-water pumping for irrigation began near Marana in 1937, and by 1954 more than 100 irrigation wells were in use in the northern and central parts of the valley. Ground-water levels declined in many areas after 1940 because ground-water pumping exceeded recharge. (Cuff and Anderson, 1987) Agricultural activity was greatest from 1954 to 1977. In 1972, the City of Tucson began to purchase and retire farmland in exchange for municipal ground-water rights in the valley. Gradual retirement of agricultural lands resulted in major reductions of pumping from 1976 through 1984.

Water levels generally remained unchanged in the areas south of T.13 S. from 1940 to 1952 (University of Arizona, 1952). From 1952 to 1975, expansion of the irrigated farmland further south in the valley resulted in increased pumping for irrigation in the vicinity of the park's water supply well, resulting in water table decline of 50 to 100 feet. The exact amount is uncertain because the park's well was not constructed until 1964. Water table decline from 1964 to 1998 is approximately 35 feet. Additional decline occurred prior to construction of the well in 1964.

In January, 1995 maintenance was conducted at the well and the following conditions were noted. Depth to water was 474.9 feet. The pump was set at 514 feet. Total depth of the well was 527 feet. When it was initially constructed the well was 560 feet deep.

Current Conditions

In November, 1997 I visited the site with the intent of measuring the water level in the well and instructing park staff on a regular program of monitoring water levels in the well. We were unable to measure the water level with a meter having 500 feet of wire. We later determined that the probe was getting hung up somewhere in the well as the water level currently is 476 feet below ground surface.

In late-December, 1997 the pump failed and had to be replaced. The motor was still in good shape, but the impellers were worn, indicating that the cause of failure was probably from pumping sand and sediment that had entered the well through the perforated casing. Static water level is at 476 feet below ground surface. The pump is set at 515 feet. Sand and sediment has entered the well, filling it to 525 feet below ground surface.

Arizona Department of Water Resources (ADWR) periodically measures the water table elevation at many wells throughout the Avra Valley. Location of wells which are monitored by ADWR are shown on the attached map. Wells are numbered according to the well numbering and naming system described on an attached page. The park's well is located in T.13 S. The remainder of the wells shown on the map are in T.14 S. All wells are in R.11 E. Wells on the map and corresponding data on the hydrograph are identified by a number followed by 3 letters. The number is the section number where the well is located. The 3 letters (a-d) following the number refer to the $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ section where the well is located.

Data for wells in the vicinity of the park's water supply well were obtained from the ADWR website. These data are plotted on the attached hydrograph. These data show that the rate of water table decline has decreased dramatically since about 1975. From 1955 to 1970, the rate of water table decline was about 4 feet per year. From 1980 to 1995, the rate of decline has been about 0.5 feet per year. This change in the rate of decline can be directly related to purchase and retirement of irrigated farmland in exchange for municipal ground-water rights in the valley by the City of Tucson. Gradual retirement of agricultural lands resulted in major reductions of pumping from 1976 through 1984.

At the current rates of water table decline in the Avra Valley, the park's well will have plenty of water for many (50+) years to come. When, or if, the water table decline does become a problem, the pump could be lowered deeper in the well to alleviate the problem.

Recommendations

1. Park staff should measure the water level in the well on a monthly basis so we will know how much seasonal water table fluctuation occurs and to provide solid information on the current rate (and changes in the rate) of water table decline. These data will provide park staff the information they need to plan for the future.

2. The sand and sediment in the well should be removed by bailing and surging to rehabilitate the well. A local well drilling company can do this as a routine maintenance procedure. Removing the buildup of sand and sediment from the well will create a new sediment trap in the well, reducing the amount of sand pumped from the well and reducing wear and tear on the pump. This maintenance procedure may pay for itself by extending the life of pumps.

References

Cuff, Melinda K., and S.R. Anderson, 1987, Ground-Water Conditions in Avra Valley, Pima and Pinal Counties, Arizona - 1985. U.S. Geological Survey Water Resources Investigations Report 87-4192. 3 sheets.

Hanson, R.T., S.R. Anderson, and D.R. Pool, 1990, Simulation of Ground-Water Flow and Potential Land Subsidence, Avra Valley, Arizona. U.S. Geological Survey Water Resources Investigations Report 90-4178, 41 pp.

University of Arizona, 1952, Approximate lowering of the water table from 1940 to 1952, Avra-Altar Valley. University of Arizona, Agricultural Engineering Department map, 1 sheet.

attachments

cc: SAGU - Greg Johnson, Al Burns
BUFF - David Mott
479 - Kimball, Jackson, Flora, Pettee

Saguaro National Park

Legend

-  Saguaro National Park
-  Tohono O'odham Indian Reservation
-  Tucson Mountain County Park
-  Hydrography
-  Roads
-  Wells
-  Red Hills Visitor Center

Brawley Wash

Mile Wide Road

4400'

4500'

4600'

3000'

Brawley Wash

3000'

3100'

3200'

3300'

3400'

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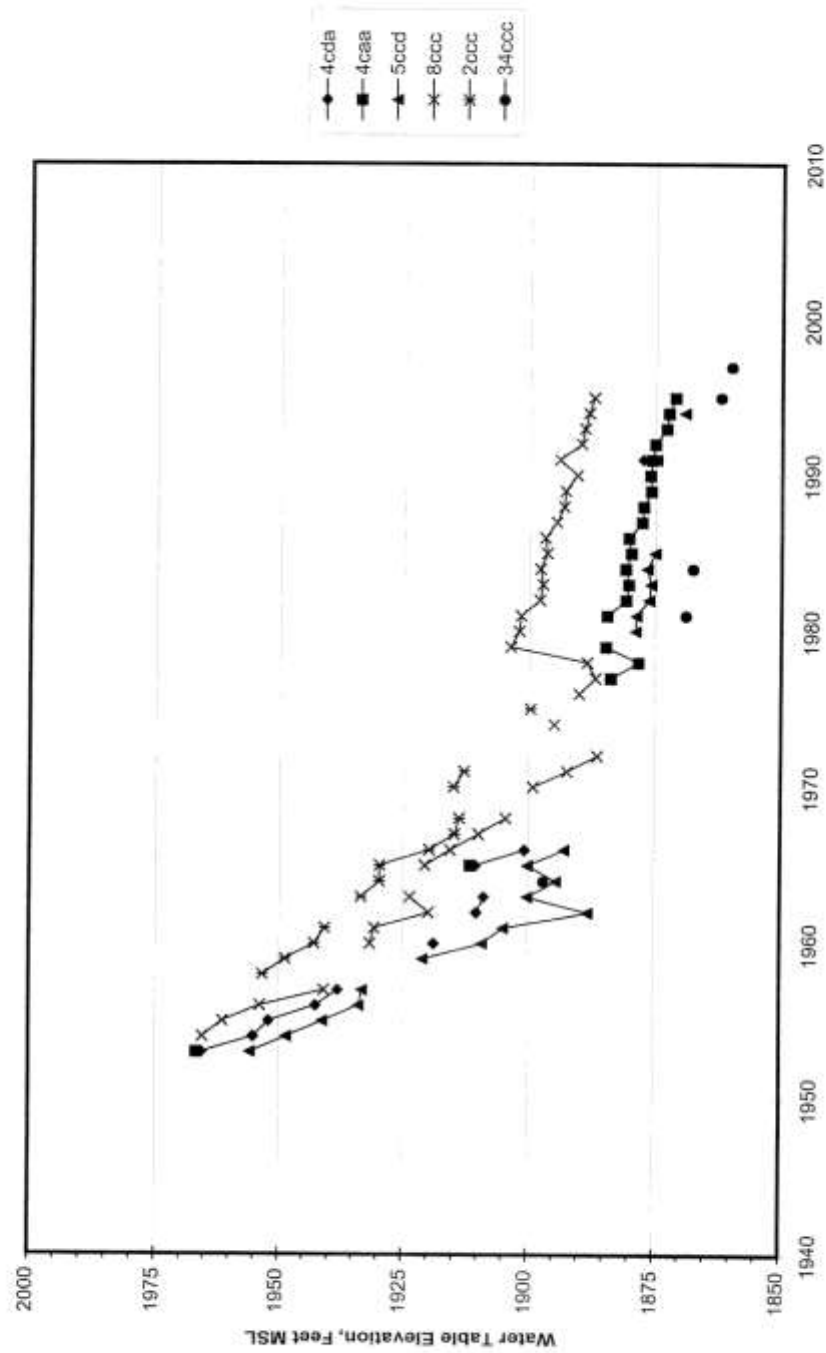
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Water Levels Near SAGU West





United States Department of the Interior
NATIONAL PARK SERVICE
Water Resources Division
1201 Oak Ridge Drive, Suite 250
Fort Collins, CO 80525

IN REPLY REFER TO:

March 29, 2002

L54(2380)
SAGU/General

Memorandum

To: Greg Johnson, Facility Manager, Saguaro National Park

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

From: Larry Martin, Hydrogeologist, Water Operations Branch

Subject: Water supply well at Red Hills Visitor Center, Tucson Mountain District, Saguaro National Park

Summary: The small decline of the water table at the well since October 2001 is not cause for great concern at this time. Continued water level monitoring is recommended. Recommendations are provided for repair/rehab of the well to restore its former productivity.

Discussion: At your request, I reviewed the most recent water level monitoring data for the NPS well near the Red Hills Visitor Center. I visited the well site in November 1997. Subsequently, I prepared a report describing the hydrogeologic conditions for the well. A copy of that report is attached as background information for the current discussion.

In the summer of 2001, Tucson Water began operation of their "Clearwater Renewable Resource Facility" in the Avra Valley. The project uses CAP water to recharge the alluvial aquifer by infiltration at a series of recharge basins. Groundwater is pumped from the alluvial aquifer at nearby wells that are 1000 feet deep. At full operation, the project is expected to provide 54 million gallons per day to the Tucson municipal water system (60,000 acre-feet/year or 19.5 billion gallons). The project is located about a mile southwest of the NPS water supply well for the Red Hills Visitor Center, park housing, and maintenance facilities.

In September 2001, the Park began monthly monitoring of the water level in its well to determine if the Tucson Water project would affect the Park's water supply. Water levels are measured after the pump has not been operated for approximately 24 hours to insure that the measurements represent static water levels in the aquifer. From September 2001 to March 2002 the water level dropped 6 feet, 1 foot per month. While this might seem like cause for alarm, I think it is a little early to declare that these declines are part of a long-term trend.

The attached hydrograph shows that the water level in the well has dropped from 457 to 463 feet below ground surface in the past few months. However, that water level is still higher than any measured water level at the well from 1979-1998. As discussed in my 1998 memo, pumping groundwater for agricultural irrigation in the Avra Valley resulted in a water table decline of about 4 feet/year from the 1950s to the early 1970s. In the 1970s, the City of Tucson began to buy irrigated farmland and retire it to obtain the water rights for municipal use. As a result of decreased irrigation pumping, the water level decline decreased to about ½ foot per year in the 1980s and 1990s.

In January 1998, the pump in the NPS well was replaced. At that time, the water level was 476 feet below ground surface. Sometime between then and September 2001, the water table in the area rose to about 460 feet below ground surface. The water table rise is likely caused by recharge of the aquifer with CAP water at the Tucson Water recharge site.

We should continue to monitor the water level in the NPS well. We should also continue to obtain data from Arizona Department of Water Resources and Tucson Water regarding water levels in the vicinity of the NPS well. These data will provide the information we will need to determine whether the Tucson Water project is affecting water levels at the NPS well. If the Tucson Water project does cause a large decline in the water table, the monitoring data will provide advanced warning and allow time to develop alternative water sources.

There are a large number of private homes and subdivisions between the Park and the Tucson Water project. These homes obtain their water supplies from the same aquifer as the Park and the Tucson Water project. The Park would be just one entity of many that would be affected if the Tucson Water project caused drastic lowering of the water table.

Recommendations for Repair/Rehab of the Well: The NPS well was originally drilled and constructed to a depth of 560 feet. Sediment has filled in the lower part of the well casing below a depth of 525 feet. This sediment should be removed by bailing the well, a common procedure that can be accomplished by any well drilling contractor. Bailing the well would also restore some of the production capacity of the well.

Decreased yield from the well is also caused, in part, by encrustation of the perforated well casing. Encrustation of the perforations is a natural chemical process caused by precipitation of calcium carbonate as the water pressure changes upon entering the well. This encrustation restricts flow of water from the aquifer into the well, and results in larger drawdown in the well to create the pressure differential needed to cause water to flow into the well. Removal of the chemical precipitate to reopen the perforations is a more specialized procedure. There are probably contractors in the Tucson area that can do this work.

When the well was constructed in 1964, test pumping for 24 hours at an average pumping rate of 42 gpm resulted in only 2 feet of drawdown, indicating that this could be a very productive well. Unfortunately, it was not properly constructed. The well was completed with perforated casing rather than well screen. The perforated casing allows sand to freely enter the well, resulting now in filling of the lower 35 feet of the well with sediment. A properly sized well screen, or

well screen with filter pack, would allow increased yield from the well and prevent sand from entering the well.

Simple bailing of the well would restore the full depth of the well, but it is likely that it would fill with sediment again within a few years. It may be possible to install PVC well screen and casing as a liner inside the 6-inch steel casing. If properly sized, the well screen would prevent sand from entering the well. Alternatively, it may be necessary to construct a new well with properly sized well screen and filter pack to provide a reliable source of water for the Park.

Action Items:

1. WRD staff will continue to assist the Park in analyzing water level data for potential impacts of groundwater pumping at the Tucson Water "Clearwater Renewable Resource Facility" in the Avra Valley.
2. WRD staff can also provide advice on repair/rehab of the NPS well to restore the full depth and increase production capability of the well.

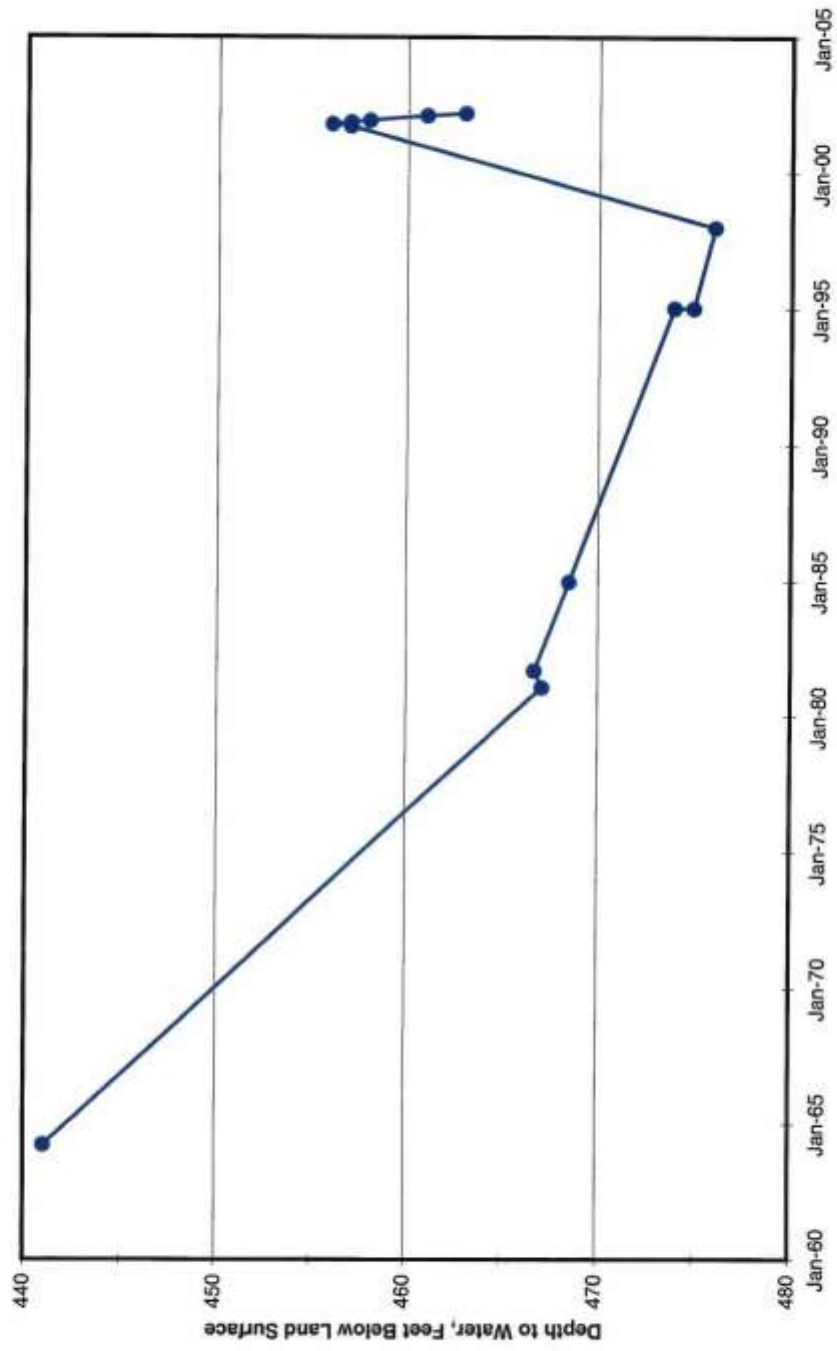
If you have any questions regarding information in this memo, please contact Larry Martin at (970)-225-3515.

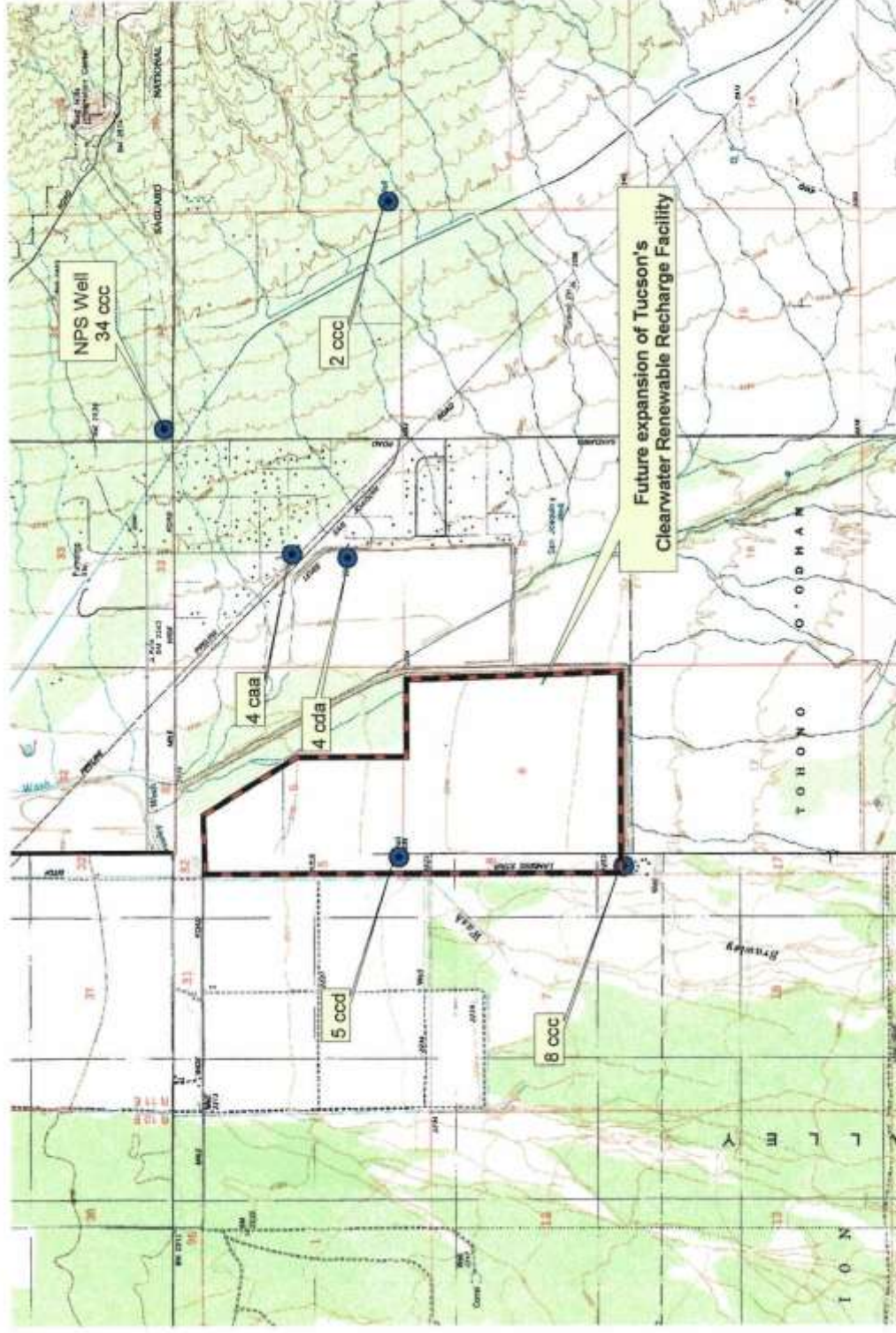
cc: IMR – John Reber

Attachments

Hydrograph of NPS Well
Map of area
Jan. 15, 1998 Memo

NPS Well near Red Hills Visitor Center





Water Level Monitoring Wells in the Vicinity of Saguaro National Park