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:

May 10, 2002

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BIBE/General

Memorandum

To: Superintendent, Big Bend National Park

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

From: Larry Martin, Hydrogeologist, Water Operations Branch

Subject: Trip Report for Travel to Big Bend National Park on April 22-29, 2002
Rehabilitation of water wells at Castolon

PURPOSE: This trip was made to oversee the rehabilitation of water supply wells in the Castolon area. The wells were redeveloped to improve yield and new pumps were installed. Wells were then tested to determine the potential yield of each well. Wells at Panther Junction were inspected and tested for potential yield.

SUMMARY: Redevelopment and repair of the wells in the Castolon area has resulted in three functioning wells. Well No. 1 can produce 30,000 gallons per day. Well No. 2 can produce 15,000 gallons per day; with a larger pump it could produce 30,000 gallons per day. Well No. 3 can produce 2500 gallons per day. Water levels and pumping rates at each of the wells should be monitored monthly so we will be able to detect future problems before a complete failure occurs and to provide data to assess the impact of pumping on groundwater resources.

1. The water supply for the Panther Junction can be effectively increased by repairing the pump in Well PJ-4 and installing a larger pump in Well K-Bar 5. There appears to be no change in the water supply from the aquifer or the ability of the wells to produce water since they were tested in 1961 and 1984. The problem lies with undersized and broken pumping equipment. When all three wells in the Panther Junction area are operating, the system should be able to produce a maximum of 72,000 gallons per day.

DISCUSSION:

Castolon Area Wells

Three wells in the Castolon area were redeveloped by jetting with a high-volume, high-pressure air compressor. Jetting was conducted in an effort to clean the inside of the wells and remove some of the fine-grained sediments from outside the well screen to increase the flow of water into the wells. All new equipment was installed in the wells including pumps, drop pipe, electrical cable, airlines, torque arrestors and water level electrodes.

Well No. 1 is equipped with a 25-gpm pump. The pumping rate must be restricted to about 20 gallons per minute by partially closing the valve at the wellhead to prevent drawing the water level down to the pump intake. When the pump needs to be replaced, a 20-gpm pump should be installed.

Well No. 2 is equipped with a 10-gpm pump. The well will produce more water tan that. When the pump needs to be replaced, a 20-gpm pump can be installed if more water is needed for the area.

Well No. 3 is equipped with a 5-gpm pump. This pump will dewater the well in 15-20 minutes. High- and low-water sensors were installed in the well to cause the pump to turn off when the water level is drawn down to the pump, and turn on when the water level in the well has recovered. The well will produce about 2500 gallons per day when allowed to automatically cycle on and off in response to high and low water levels in the well.
PVC pipe could be used for the drop pipe in all three wells in the Castolon area. This would eliminate the corrosion problems that have interfered with the long-term reliability of these wells.

A detailed report of the redevelopment and testing of the Castolon area wells has been provided to DSC and Park staff.

Panther Junction Wells

Water for the Panther Junction area is supplied from wells at three sites; Panther Junction Well 4 (PJ-4), K-Bar 2, and K-Bar 5.

The Panther Junction Well 4 is not currently used because it doesn't pump water. The motor can be heard and the vibration of the pipe felt when it is turned on, but no water is pumped. Water levels in the PJ-4 well and adjacent monitor wells were measured and found to be about 5 feet deeper than they were when measured by Bill Werrell in April 1984. The water level in PJ-4 is 162 feet below ground surface. The well was last serviced in June 2000. At that time the depth to water was 165 feet and the pump was set at 188 feet. The pump is at least 26 feet below the water level in the well. The problem may be with the pump, or it may be a hole in the drop pipe. It will be necessary to pull the pump to determine the cause of and solution to the problem.

During the 1984 testing, the pumped well was PJ-5. It was tested at various pumping rates and determined that the long-term pumping rate should be kept below 15 gpm. Pumping at higher rates would draw the water level down to the pump intake. Because Wells PJ-4 and PJ-5 are completed to about the same depth and are only 60 feet apart, it is reasonable to assume that the water-

producing characteristics of the two wells will be similar. Well PJ-4 has been used as a water supply in the past at a pumping rate of 13 gpm.

If Well PJ-4 is repaired, the well should be capable of providing 10-15 gpm to the water system.

Well K-Bar 2 currently produces about 9 gpm. It is generally used one day a week. The well is 145 feet deep and was constructed as an open borehole from 95-145 feet below ground surface. The well is cased to 95 feet below ground surface. The water level was estimated (based on the water level in nearby Well K-Bar 6 observation well) to be 111 feet below the concrete floor of the well house. This corresponds to an airline reading of 16.5 feet of water above the bottom of the airline.

In 1984, testing at this site consisted of pumping Well K-Bar 6 at varying rates of 5-8 gpm. Water levels in the pumped well were drawn down 10-15 feet. Water levels in the nearby wells K-Bar 2 (46 feet away) and K-Bar 6 observation well (59 feet away) changed less than 1 foot during this testing.

In April 2002, a short test was conducted using Well K-Bar 2 as the pumped well and the 3-inch PVC K-Bar 6 Well as an observation well. The K-Bar 6 Well constructed with 6-inch steel casing has filled in to a depth of 88 feet and is dry. Well K-Bar 2 was pumped at 9 gpm for 2 hours, resulting in a stable water level drawdown of 5 feet, or 116 feet below ground surface. The water level in the K-Bar 6 observation well was drawn down about ¼ foot during the test. A graph showing water level response during this test is attached.

Well K-Bar 2 was last serviced in June 2000. A new pump was installed at a depth of 137 feet. The static water level was reportedly 120 feet. Well K-Bar 2 might be capable of producing a little more water, but the pumping rate should probably not exceed 10 gpm to insure long-term production from the well, unless additional testing is conducted to determine the potential yield of the well.

If additional production is desired from Well K-Bar 2, it should be tested using a larger pump. A temporary 20-gpm pump could be installed in the well and a series of step-drawdown tests conducted at pumping rates between 5-20 gpm to determine the maximum sustainable pumping rate for the well. Water levels should be monitored in both Well K-Bar 2 and the K-Bar 6 PVC observation well during the testing.

Well K-Bar 5 is the primary water supply for the Panther Junction area. It produces 15 gpm with the current pump. The well is 109 feet deep and was constructed in 1961 with 5-inch steel casing that was perforated with 3/8" holes from 87-105 feet. The well was gravel packed from 10-109 feet with ½" clean gravel. When the well was last serviced in June 2000, the static water level was reportedly 90 feet below ground surface. A new pump was installed at a depth of 105 feet.

In the initial testing of this well (1961), the well reportedly was pumped at 29 gpm for 12 hours resulting in 2½ feet of drawdown.

In 1984, a test was conducted at the site using Well K-Bar 5 as the pumping well and monitoring water levels in Well K-Bar 7 and the K-Bar 7 PVC observation well. Water levels were not measured in Well K-Bar 5 during this test. Well K-Bar 5 was pumped at 27 gpm for 15 hours,

resulting in less than 1 foot of drawdown at the two observation wells located 76 and 120 feet from the pumped well. A graph showing water level response during this test is attached.

In May 1984, the static water level in Well K-Bar 7 was 73 feet below the cement slab surrounding the well. In April 2002, the static water level in Well K-Bar 7 was 70.6 feet below the cement slab. We don't know how much the water level fluctuates in this area on a seasonal or annual basis, but the water level now is higher than it was 18 years ago. Precipitation, and therefore groundwater recharge, has been below average for the past couple of years. Well K-Bar 5 has been pumped as the main water supply for the Panther Junction area. Despite the drought conditions and heavy use of Well K-Bar 5, it appears that the aquifer remains a reliable source of water for the Panther Junction area.

In April 2002, a short test was conducted using Well K-Bar 5 as the pumped well and monitoring water levels in all three wells; Well K-Bar 5, Well K-Bar 7, and the K-Bar 7 Observation Well. Pumping15 gpm from Well K-Bar 5 resulted in a stable drawdown of about 1½ feet in the pumped well and less than ¼ foot drawdown in the observation wells located 76 and 120 feet from the pumped well. A graph showing water level response during this test is attached.
The data clearly indicate that Well K-Bar 5 can be pumped at a rate greater than 15 gpm. We don't know how much the well can produce on a sustained basis, but it apparently was capable of producing 25-30 gpm when tested in 1961 and 1984. A larger pump would need to be installed and a series of step-drawdown tests conducted to determine the maximum sustainable yield of Well K-Bar 5. If such testing is desired, the test pump should be capable of producing at least 50 gpm. Alternatively, the next time the pump needs servicing, it could be replaced with a 25-30 gpm pump.

There was some discussion regarding redeveloping the wells in the Panther Junction area by jetting, as was done at Castolon. Jetting the wells at Panther Junction would be an unnecessary expense and is not likely to increase the yield of the wells. The wells at Castolon are constructed in sand and gravel sediments. It was necessary to jet those wells to remove the fine-grained sediments that had worked their way into the well and the gravel pack immediately outside the well. The wells at Panther Junction are constructed in bedrock formations and obtain water from fractures in the bedrock; there are no fine-grained sediments to remove. Well K-Bar 2 is completed as an open borehole; jetting it may cause large rock fragments to fall into the borehole. Well K-Bar 5 is completed with perforated casing and ½" gravel between the casing and borehole. It is unlikely that jetting could affect the permeability of the gravel pack. Although the construction records for well PJ-4 are not very clear, it appears that it was also completed as an open borehole, with casing to a depth of 150 feet. Well PJ-4 should not be jetted because large rock fragments may be knocked loose during the jetting process.

Generally, jetting is conducted when the screen or perforations become partially plugged and it is difficult for water to flow into the well. This condition is diagnosed by observing an increase in the amount of drawdown needed in the pumped well to achieve the same pumping rate, or a large amount of drawdown in the pumped well relative to the observation wells. Neither of these conditions exists in the wells in the Panther Junction area.

The water supply for the Panther Junction Area could be increased by repairing the pump in Well PJ-4 and installing larger pumps in Well K-Bar 5 and Well K-Bar 2. Currently, the supply is

limited by the capacities of the pumps; PJ-4 produces 0 gpm, Well K-Bar 2 produces 9 gpm, and Well K-Bar 5 produces 15 gpm. Repair and replacement of pumps could result in increasing the pumping capacities to 15 gpm at Well PJ-4, 10 gpm at Well K-Bar 2, and 25 gpm at Well K-Bar 5. This would allow a theoretical pumping capacity of 50 gpm, or 72,000 gallons per day.

CONCLUSIONS:

1. There are now three functioning wells in the Castolon Area. Well No. 1 will produce 20 gpm, Well No. 2 will produce 13 gpm, and Well No. 3 will produce 2500 gallons per day.

2. Well PJ-4 at Panther Junction should be capable of providing up to 15 gpm if the pump or drop pipe is repaired or replaced.

3. Additional testing at the K-Bar 2 Well would be required to determine if the well can provide a sustainable yield of more than 10 gpm.

4. Well K-Bar 5 can probably produce a sustainable yield of 25 gpm. Larger yields may be possible, but additional pumping with a larger pump would be necessary to determine the maximum sustainable yield.

5. New airlines should be installed on the wells in the Panther Junction area when the pumps are serviced to allow monitoring of water levels in the wells.

6. Basic monitoring should be conducted at all wells on a monthly basis. Monitoring should include the pumping rate and both non-pumping and pumping water levels in each well.

ACTION ITEMS:

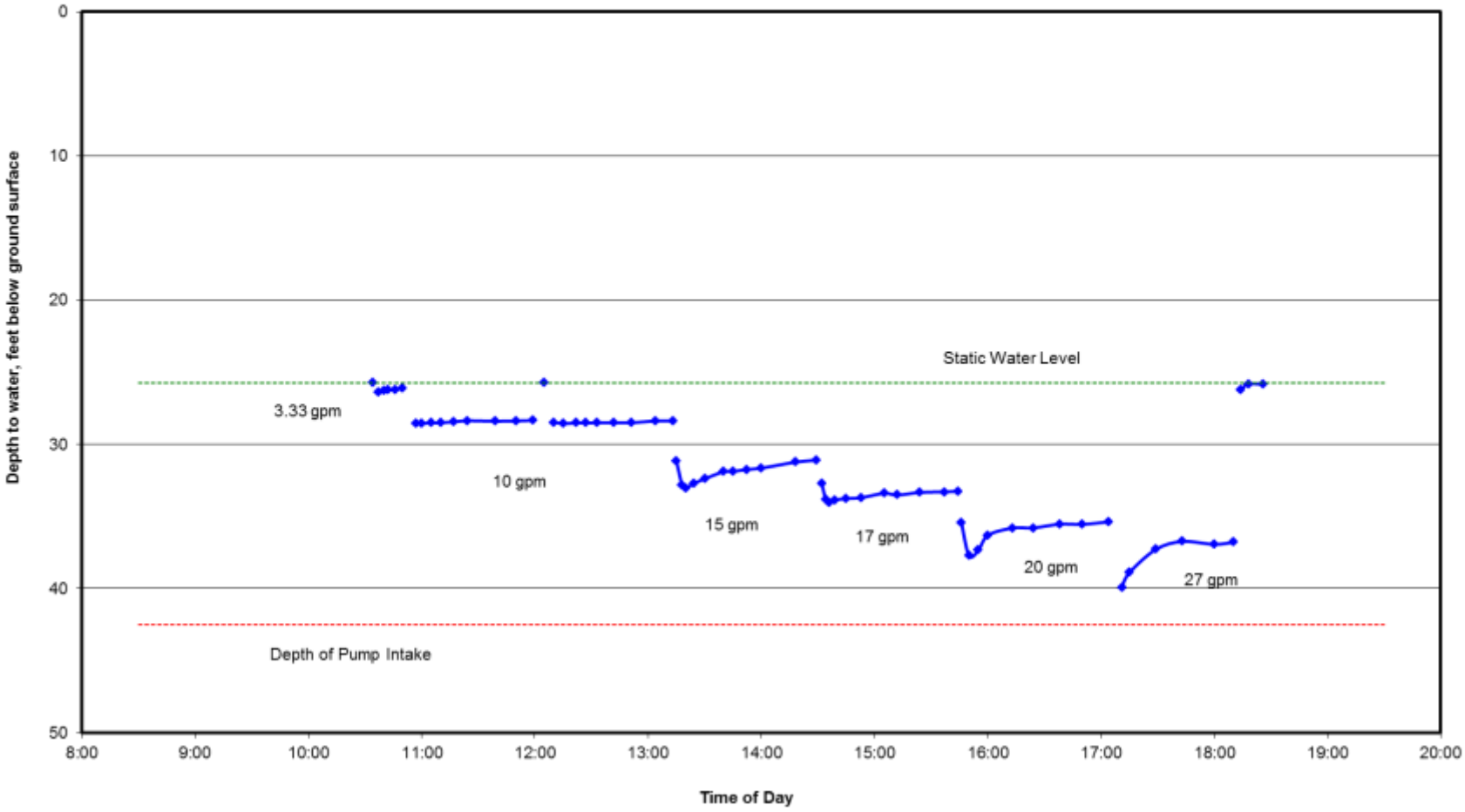
1. Install new pumps in wells at Panther Junction to increase production capabilities. Responsible Party: Park staff. To be completed by: As desired by park staff.

cc:

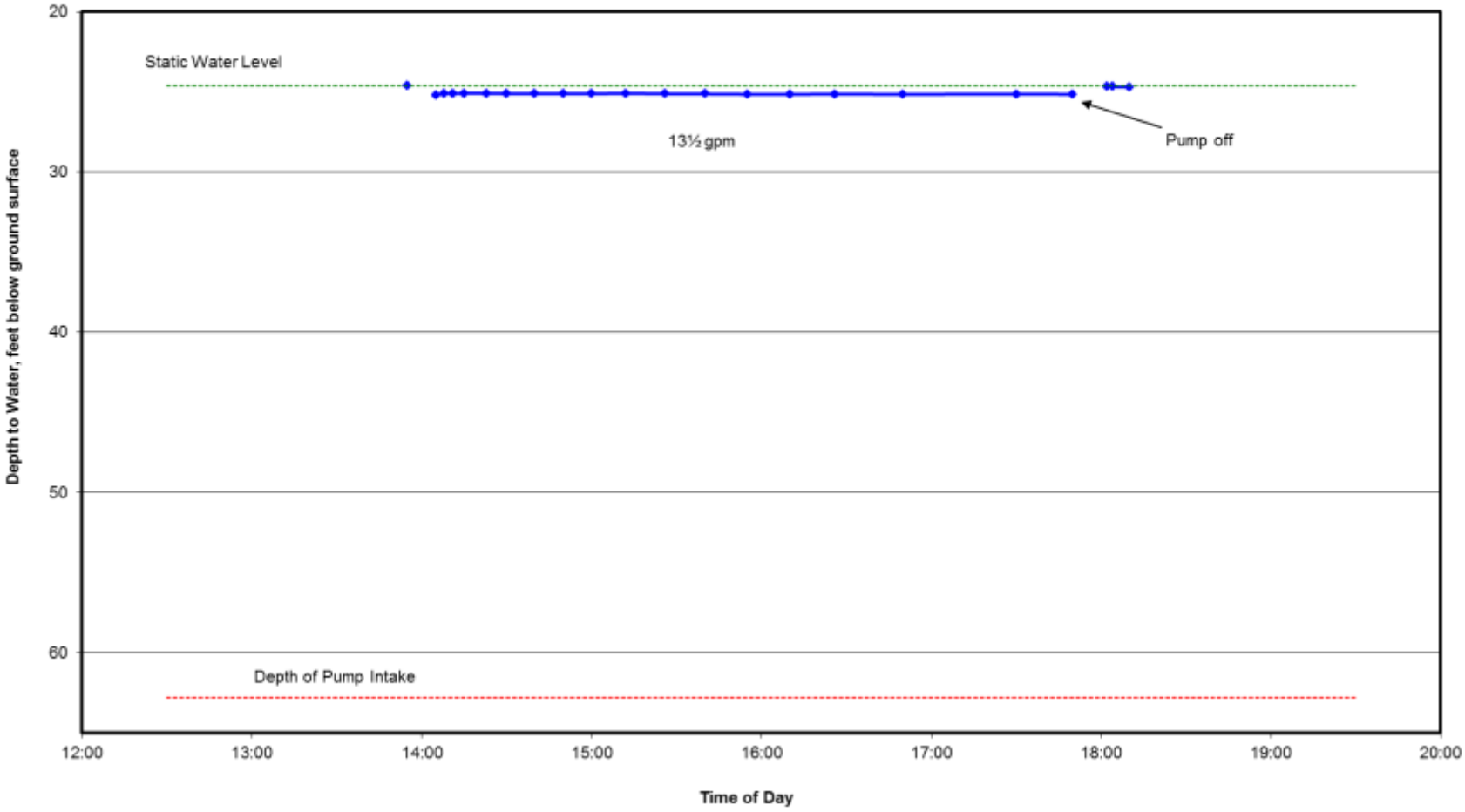
BIBE – Jim Erickson, John Lowe, Carol Purchase, Mark Libby, Frank Aguirre
IMR – John Reber
DSC – Ken Franc, Jim Pennington, Bill Shelley

Attachments – Three hydrographs

BIBE Castolon Area
Well No. 1
April 28, 2002



BIBECastolon Area
Well No. 2
April 27, 2002



BIBE Castolon Area
Well No. 3
April 29, 2002