Case Study
A Comparison of Well Efficiency and Aquifer Test Results Louvered Screen vs. Continuous Wire-Wrapped Screen Big Pine, California

Executive Summary

Aquifer test results demonstrated that the performances of louvered screen and continuous wire-wrapped screen were essentially equal for two high-capacity water supply wells constructed near Big Pine, California. The as-built designs of the two wells, spaced 1,000 feet apart, were equivalent in depth, diameter, and total screen length. Both wells were completed to pump ground water from the same confined, alluvial aquifer. The results of step-drawdown and constant-rate discharge tests showed very minor differences in transmissivity values and well efficiencies between the two wells. The long-term projected yields and permanent pumps selected for the wells were the same. These results clearly show that the properties of high efficiency and long term productivity are offered by either louvered screen or continuous wire-wrapped screen.

Background

Big Pine, California is located in the Owens Valley which lies between the Sierra Nevada Mountains on the west and the Inyo and White Mountain Ranges on the east. The valley is major ground water reservoir filled with alluvium and volcanic deposits that are reservoir materials (i.e., aquifers) that yield ground water to numerous water wells.

The Los Angeles Department of Water and Power (LADWP) constructed two water supply wells (Nos. 374 and 375) at sites located southeast of the town of Big Pine and approximately 1.4 miles east of Highway 395. The two wells were approximately 1,000 feet apart and were located near two monitoring wells previously installed by the United States Geological Survey (USGS).

Well Designs

After drilling the pilot hole with a conventional mud rotary drilling rig and geophysical logging, each well was constructed to a depth of 450 feet. Both wells were constructed with 18-inch diameter blank casing (0.313-inch wall thickness) and gravel packed. The production zone for each well was from a depth of 260 to 440 feet. Well No. 374 was completed with 180 feet of continuous wire-wrapped well screen with an aperture size of 0.080 inches. Well No. 375 had an identical length of Roscoe Moss Company “Ful Flo” louvered screen with an aperture size of 0.080 inches. The as-built design details are presented below.

Parameters	Well No. 374	Well No. 375
Depth	450 feet	450 feet
Diameter	18 inches	18 inches
Aperture Size	0.080 inch	0.080 inch
Screen Type	Wire-wrapped	Louvered

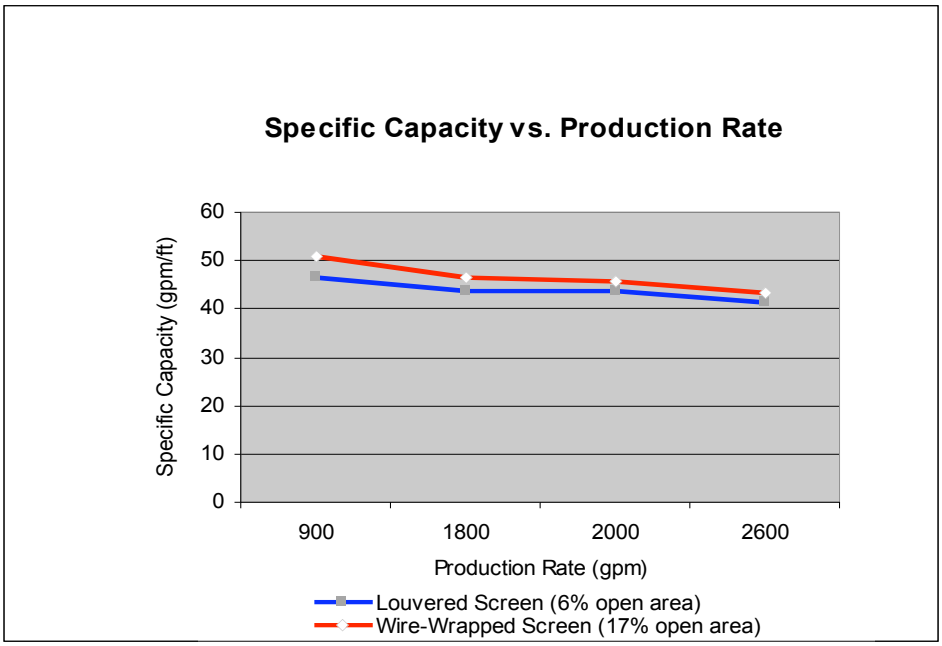
Pump Testing

The pumping tests performed on the two wells were conducted with an engine-driven, right angle line-shaft turbine pump; the bowls were set at a depth of 155 feet. The testing consisted of a short-term step-drawdown test and a long-term constant-rate discharge test. Flow rates were monitored at regular time intervals during the tests and adjusted as needed.

Step-drawdown Tests

The initial pumping test for each well consisted of a step-drawdown test. Well No. 374 was pumped for 90 minutes each at three increasing rates (i.e., steps) of discharge of 873 gallons per minute (gpm), 1,803 gpm, and 2,617 gpm. Likewise, Well No. 375 was pumped for 2 hours each at three increasing steps (883 gpm, 1856, gpm, and 2608 gpm). Water levels were measured in the pumping well and one USGS monitoring well (USGS 14A). Details of the tests and a graphical presentation of the results are presented below.

Parameters	**Well No. 374**	**Well No. 375**
Pumping rates	873, 1803 & 2617 gpm	883, 1856 & 2608 gpm
Static level	30 feet	30 feet
Monitoring wells	14A & Well No. 375	14A & Well No. 374



Constant-rate Tests

After completing each step-drawdown test, the results were evaluated and used to select the pumping rate for the constant rate discharge test. Water levels were measured in the pumping well, the nearby LADWP production well, and USGS wells. Well No. 374 was pumped for 22 ¾ hours at a rate of 2,078 gpm. Well No. 375 was pumped for 22 hours at a

rate of 2,034 gpm. At the completion of each test, water levels were measured during recovery. Details of the tests are summarized below.

Parameters	Well No. 374	Well No. 375
Pumping rate	2078 gpm	2034 gpm
Monitoring wells	14A, B, C & Well No. 375	14A, B, C & 374
Total Drawdown	53.25 ft	54.09 ft

Results

The testing of these two wells, identically designed and constructed except for type of well screen, provides a unique opportunity to compare the actual side-by-side performance of louvered screen and continuous wire-wrapped screen in the same hydrogeologic conditions. Given that both wells pump ground water from the same aquifer thickness, it is reasonable to expect that the aquifer parameters calculated from the pumping test results would be essentially the same. Then, by comparing the efficiencies of the two wells one could evaluate the relative performance of each type of well screen.

Aquifer Parameters

For the purposes of evaluation, we compared three aquifer parameters: transmissivity (T), storativity (S), and permeability (K). Each parameter was calculated from the pumping test results. T, expressed in gallons per day per foot (gpd/ft), is a measure of the ability of ground water to flow through pore spaces. This parameter was calculated by the Modified Theis Method. Storativity (S) is a dimensionless number; it is the amount of water released or added to storage through the aquifer due to decline or increase in average hydraulic head. K was derived by dividing the T value by the estimated thickness of the aquifer as determined from the electric log. The aquifer parameters for the two wells are summarized below.

Parameters	Well No. 374	Well No. 375
Transmissivity	77,000 gpd/ft	73,000 gpd/ft
Average Permeability	430 gpd/ft^2	430 gpd/ft^2
Storativity	2.7×10^{-4}	2.7×10^{-4}

The results above show that the aquifer parameters are essentially equal. The minor difference that was calculated for the transmissivity of the two wells is insignificant.

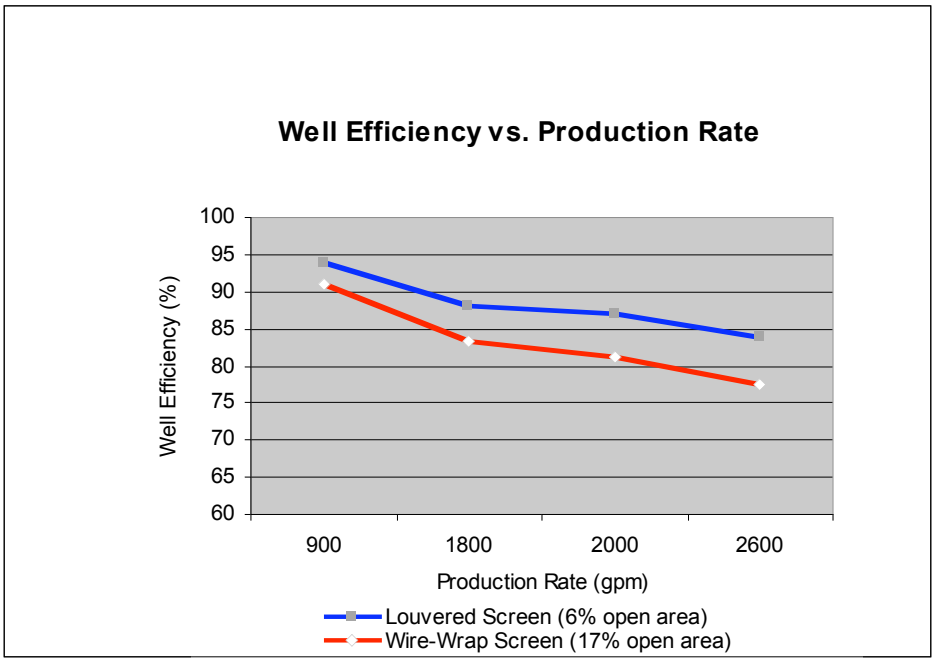
Well Efficiency

Well efficiency, expressed as a percent, is the ratio of theoretical drawdown to observed drawdown for a particular pumping rate. Aquifer losses and well losses combine to contribute to the total drawdown measured in a pumped well. Well losses are controllable by proper well design and construction methods and they are directly related to well diameter, filter pack, and the screen opening. Acceptable well efficiencies range from 70% to 80% in a screened well. In general, highly efficient wells are less costly to operate because they require less power to operate the pump. Based on field test results for the two subject wells, the well efficiency results were as follows:

- Well No. 374 was 74 to 87 percent efficient for pumping rates between 1,350 and 3,140 gpm. The efficiency for the recommended pumping rate of 2,693 gpm was 77 percent.

- Well No. 375 was 81 to 91 percent efficient for pumping rates between 1,350 and 3,140 gpm. The efficiency for the recommended pumping rate of 2,693 gpm was 83.5 percent.

A graphical comparison of well efficiency results for the various pumping rates is presented below.



Summary

The empirical results from the aquifer tests performed on Well Nos. 374 and 375 provided clear evidence that the performances of louvered screen and continuous wire-wrapped well screen for this project were essentially equal. Both wells were highly efficient and were well within the acceptable range of 70 to 80% or exceeded it. Moreover, when the pumping test data were used to calculate the aquifer parameters for each well, there were no significant differences between the two wells. Transmissivity values, storativity, and average aquifer permeability values were for all intents and purposes the same.

Based on these findings, it is reasonable to conclude that one can expect to observe little or no difference in either well efficiency or long-term performance between that of louvered screen or wire-wrapped well screen in a properly constructed and developed well.

References

Handbook of Ground Water Development, 1990, Roscoe Moss Company, John Wiley and Sons, New York, NY

Los Angeles Department of Water and Power, 1986, “Report on Well 374 Aquifer Test, Big Pine Well Field”.

Los Angeles Department of Water and Power, 1986, “Report on Well 375 Aquifer Test, Big Pine Well Field”.