Contract Report 624

# Dewatering Well Assessment for the Highway Drainage System at Four Sites in the East St. Louis Area, Illinois

## FY 93 (Phase 10)

by

Ellis W. Sanderson, P.E., and Robert D. Olson

Prepared for the
Illinois Department of Transportation
Division of Highways

March 1998

Illinois State Water Survey
Hydrology Division
Champaign, Illinois

A Division of the Illinois Department of Natural Resources

# DEWATERING WELL ASSESSMENT FOR THE

# HIGHWAY DRAINAGE SYSTEM

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Illinois State Water Survey
2204 Griffith Drive
Champaign, IL 61820-7495

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## ABSTRACT

In the East St. Louis vicinity, the Illinois Department of Transportation (IDOT) owns 52 wells that are used to maintain the elevation of the ground-water table below the highway surface in areas where the highway is depressed below the original land surface. The dewatering systems are located at four sites in the alluvial valley of the Mississippi River in an area known as the American Bottoms. The alluvial deposits at the dewatering sites are about 90 to 115 feet thick and consist of fine sand, silt, and clay in the upper 10 to 30 feet, underlain by medium to coarse sand about 70 to 100 feet thick.

The condition and efficiency of a number of the dewatering wells became suspect in 1982 on the basis of data collected and reviewed by IDOT staff. Since 1983, IDOT and the Illinois State Water Survey (ISWS) have conducted a cooperative investigation to more adequately assess the operation and condition of the wells, to attempt to understand the probable causes of well deterioration, and to evaluate rehabilitation procedures used on the wells.

During FY 93 (Phase 10), 14 step tests were performed, the rehabilitation of two wells was reviewed, sand pumpage in ten dewatering wells was investigated, and the chemical quality of water discharged from the pumping stations that handle the flow from the dewatering system was examined. Eleven of the step tests were conducted to assess the present condition of wells to either determine their need for chemical treatment in the future or to monitor the results of previous chemical treatments. Three of the wells were in acceptable to good condition with an average specific capacity of about 93 gallons per minute per foot (gpm/ft). Four wells were in poor condition with an average specific capacity of about 33 gpm/ft, and treatment was recommended.

Pre- and posttreatment step tests were used to help document the rehabilitation of two dewatering wells (I-70 Well 8A and 25th Street Well 8) during FY 93 (Phase 10). Chemical treatments used to restore the capacity of these two wells were moderately successful. The improvement in specific capacity per well averaged about 62 percent based on data from pre- and posttreatment step tests. The specific capacity of I-70 Well 8A was restored to about 79 percent of the average specific capacity of wells in good condition at the I-70 site, and 25th Street Well 8 was restored to about 81 percent of the average specific capacity of wells in good condition at the 25th Street site.

The sand pumpage investigation conducted during 11 step tests revealed that I-70 Wells 8A and 10 and Venice Well 1 are pumping sand. These conditions may pose a threat to the long-

term operation of these wells. Little or insignificant amounts of sand were found following step tests on I-70 Well 7A, 25th Street Well 8, and Venice Well 6A.

Results from a detailed initial screening of the chemical quality of water discharged from the Bowman drainage system, which handles flow from the dewatering system, revealed that the water at the time of sampling contained only five volatile organic compounds (VOCs) included in the analysis using U.S. Environmental Protection Agency (USEPA) Method 502.2. These compounds were at very low concentrations. No VOCs were detected in the water samples collected from the 25th Street or the Venice combined well discharge. Results for the metals and other inorganic parameters indicate concentrations characteristic of those that have been reported for the samples collected from the dewatering wells at the time of the step tests and of those reported for ground water in the American Bottoms.

## INTRODUCTION

### Background

The Illinois Department of Transportation (IDOT) operates 52 high-capacity water wells at four sites in the East St. Louis area. The wells are used to control and maintain ground-water levels at acceptable elevations to prevent depressed sections of interstate and state highways from becoming inundated by ground water. When the interchange of three interstates (I-55/I-70 and I-64) was originally designed, ground-water levels were at lower elevations because of large withdrawals by the area's industries. Due to a combination of water conservation, production cutbacks, and conversion from ground water to river water as a source, industrial ground-water withdrawals have decreased at least 50 percent since 1970. As a result, ground-water levels in many areas have recovered to early development levels, which exacerbates IDOT's need to keep ground-water levels below the areas of depressed highways.

### Scope of Study

IDOT first installed 12 dewatering wells in 1973, followed by an additional 30 wells in 1975. By 1977, the initial 12 wells were showing signs of loss of capacity. As a result, all 42 wells in use then were chemically treated to restore capacity. Although good results were obtained for most of the wells, routine monitoring by IDOT showed that deterioration problems were continuing to develop. Isolated wells were chemically treated by IDOT personnel as required. Six more wells were installed in 1982. In October 1982, IDOT asked the Illinois State Water Survey to begin an investigative study to learn more about the condition of the dewatering wells, to determine efficient monitoring and operating procedures, and to determine suitable methods of well rehabilitation.

Phase 1 of the work, conducted from March 1983 through February 1984, included an assessment of the condition of 14 selected wells, a review of the IDOT monitoring program, a model study to outline efficient operating schemes, recommendations on wells to be treated, and recommendations for chemical treatment procedures.

Phase 2, conducted from March 1984 through June 1985, included an assessment of the condition of 12 selected wells; testing of a noninvasive, portable flowmeter; and an initial study of the chemistry of the ground water as it moved toward an operating well.

Phase 3, begun in July 1985 (FY 86), included an assessment of the condition of six wells; demonstration of a noninvasive, portable flowmeter; continued study of ground-water chemistry; and documentation of the rehabilitation of seven dewatering wells, along with follow-up step tests.

Phase 4, begun in July 1986 (FY 87), included ten step tests; documentation of the treatment of five wells; documentation of the construction of I-70 Well 14 (7A); investigation of I-70 Well 9 to determine the probable cause of gravel-pack settlement; specific-capacity testing using the noninvasive, portable flowmeter; and installation of piezometers at two underpass sites in East St. Louis.

Phase 5, begun in July 1987 (FY 88), included nine step tests, documentation of the treatment of four wells, investigation of possible sand pumpage at three wells, and initial investigation of the condition of relief wells at two detention ponds near the intersection of I-255 and I-70/I-55.

Phase 6, begun in July 1988 (FY 89), included 12 step tests, review of the chemical treatment of four wells, investigation of possible sand pumpage at nine wells, continued investigation of the relief wells at the two detention ponds along I-255, and documentation of the installation of two replacement wells (I-70 Wells 8A and 9A).

Phase 7, begun in July 1989 (FY 90), included 12 step tests, review of the chemical treatment of five wells, investigation of possible sand pumpage at ten wells, and the conclusion of the investigation of the condition of relief wells at the two detention ponds near the intersection of I-255 and I-55/I-70.

Phase 8, begun in July 1990 (FY 91), included 20 step tests, review of the chemical treatment of four wells, documentation of the construction of four new wells (I-70 Wells 13 and 14, and Venice Wells 6A and 7), investigation of possible sand pumpage at 17 wells, and implementation of a ground-water-level measurement program.

Phase 9, begun in July 1991 (FY 92), included 16 step tests, review of the chemical treatment of three wells, documentation of the construction of five new or replacement wells (I-70 Wells 1A, 2A, 3A, 11A, and 15), downhole video inspection of I-70 Well 3 and 25th Street Well 6 to determine the probable cause of sand pumpage and settlement, and continuation of the ground-water-level measurement program implemented in FY 90.

Phase 10, begun in July 1992 (FY 93), included 14 step tests, review of the chemical treatment of two wells, investigation of possible sand pumpage at ten wells, continuation of the ground-water-level measurement program, and an investigation of the chemical quality of the ground water being discharged from the pumping stations that handle the discharge from the dewatering system. Data collected during the field investigations are included in appendices A-G of this report.

## Physical Setting of Study Area

The study area is located in the alluvial valley of the Mississippi River in East St. Louis, IL, in an area known as the American Bottoms (see figure 1). The geology of the area consists of alluvial deposits overlying limestone and dolomite of Mississippian and Pennsylvanian Age. The alluvium varies in thickness from zero to more than 170 feet, averaging about 120 feet. The region is bounded on the west by the Mississippi River and on the east by upland bluffs. The regional ground-water hydrology of the area is well documented (Bergstrom and Walker, 1956; Schicht, 1965; Collins and Richards, 1986; Ritchey et al., 1984; Kohlhase, 1987; Schicht and Buck, 1995). Except where it is diverted by pumpage or drainage systems, ground water generally flows from the bluffs toward the river.

Detailed location maps of the four dewatering sites operated by IDOT are shown in figures 2 and 3. The geology at these sites is consistent with regionally mapped conditions. The land surface lies at about 410 to 415 feet above mean sea level (ft-msl). Alluvial deposits are about 90 to 115 feet thick, which means the bedrock surface lies at approximately 300 to 320 ft-msl. The alluvium becomes progressively coarser with depth. The uppermost 10 to 30 feet consists of extremely fine sand, silt, and clay, underlain by the aquifer, which is about 70 to 100 feet thick. The elevation of the top of the aquifer is about 390 to 395 ft-msl.

## Acknowledgments

This phase of the assessment of the condition of the highway dewatering well systems in the American Bottoms was funded by the Illinois Department of Transportation, Division of Highways, Kirk Brown, Secretary. Barry Roberts, Pump Technician, District 8, reviewed and coordinated the investigation. He and maintenance personnel provided field support during step-drawdown tests on the selected wells. Mark Anliker and Randy Locke, Assistant Hydrologists, ably assisted the authors with field data collection. Joe Karny, Assistant Hydrologist, provided technical and field support in collecting water samples for the investigation of the discharge water quality.

Analytical work by the Water Survey's Chemistry Division, Office of Analytical and Water Treatment Services, was performed under the direction of Loretta Skowron, with Brian Kaiser, Lauren Sievers, and Daniel Webb performing the lab analyses. Eva Kingston edited the manuscript, Linda Hascall prepared the illustrations, and Pamela Lovett provided word processing support.

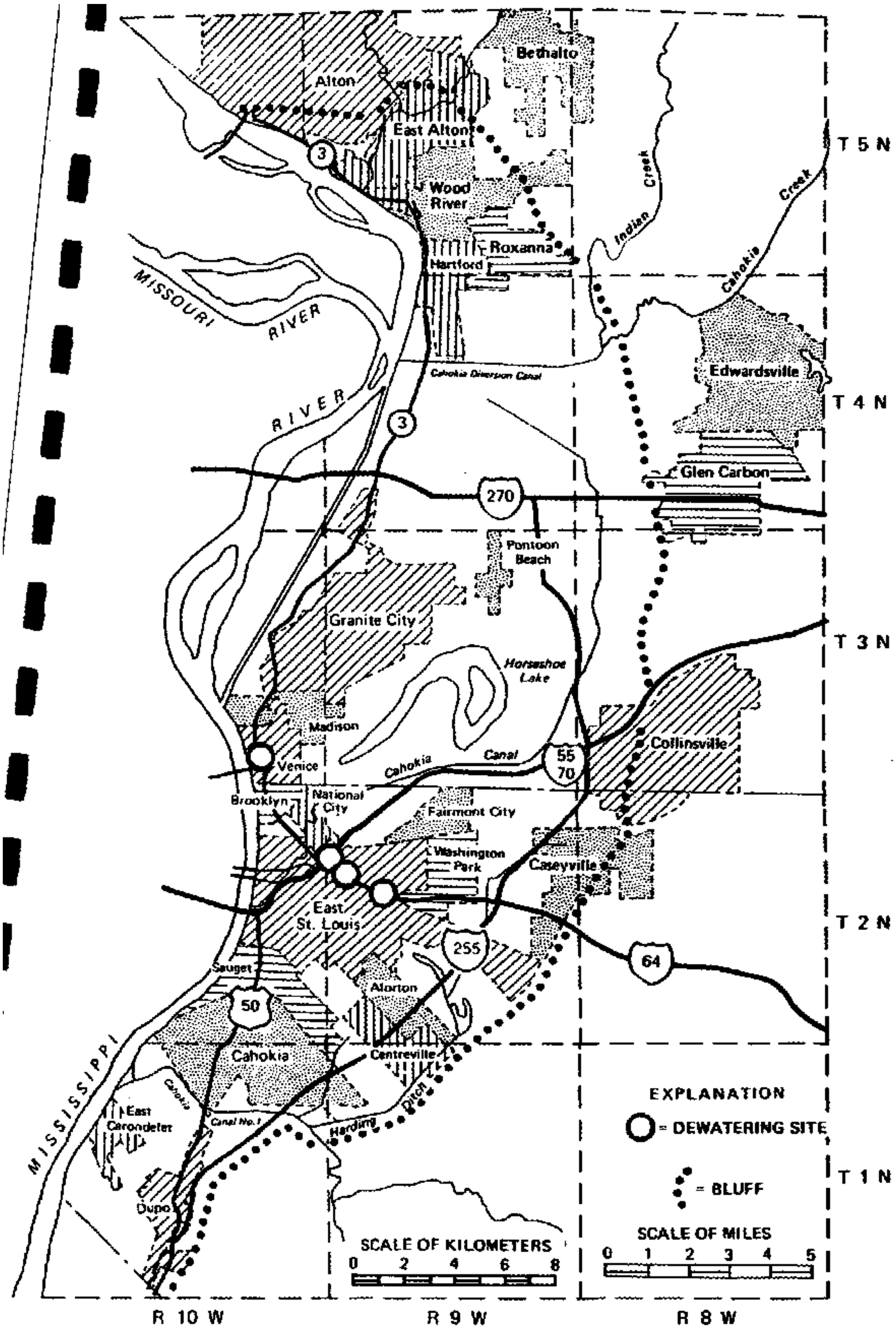


Figure 1. Location of the East St. Louis area

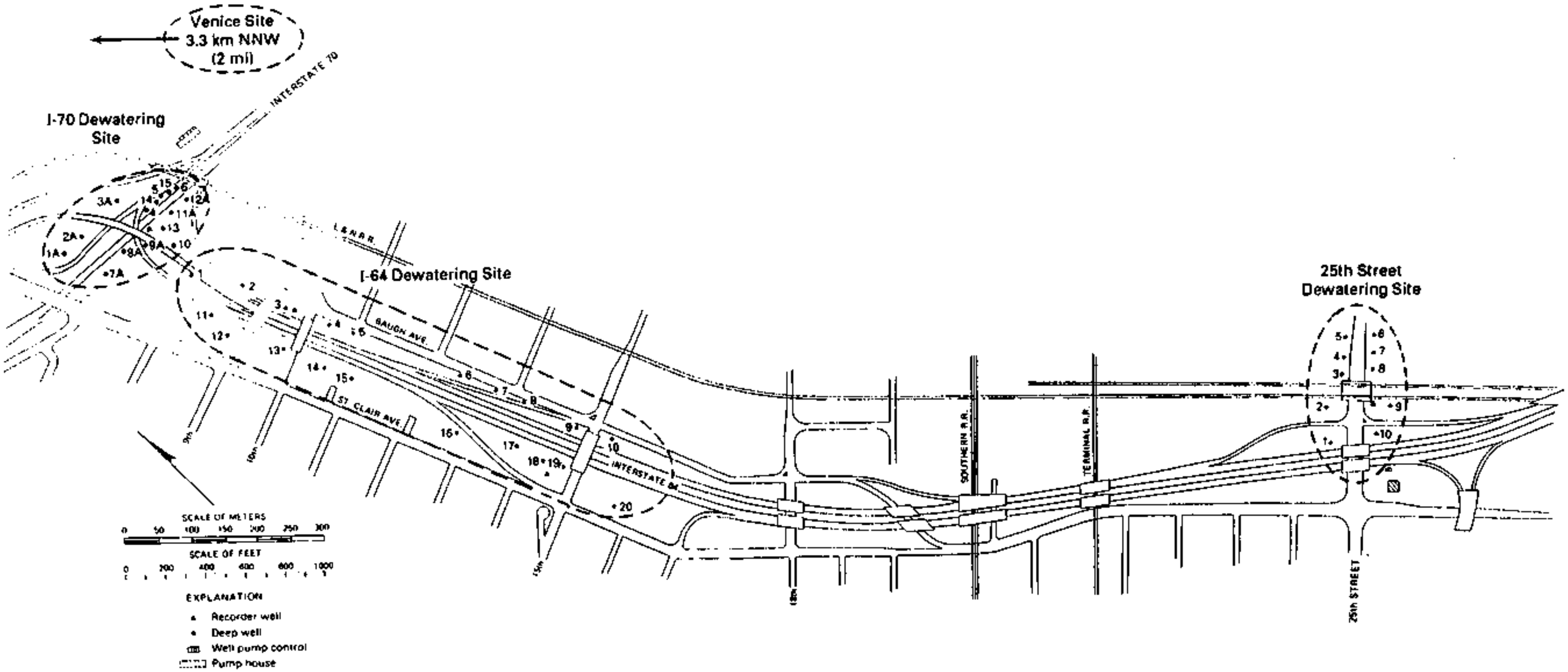


Figure 2. Locations of dewatering wells at the I-70 Tri-level Bridge, I-64, and 25th Street

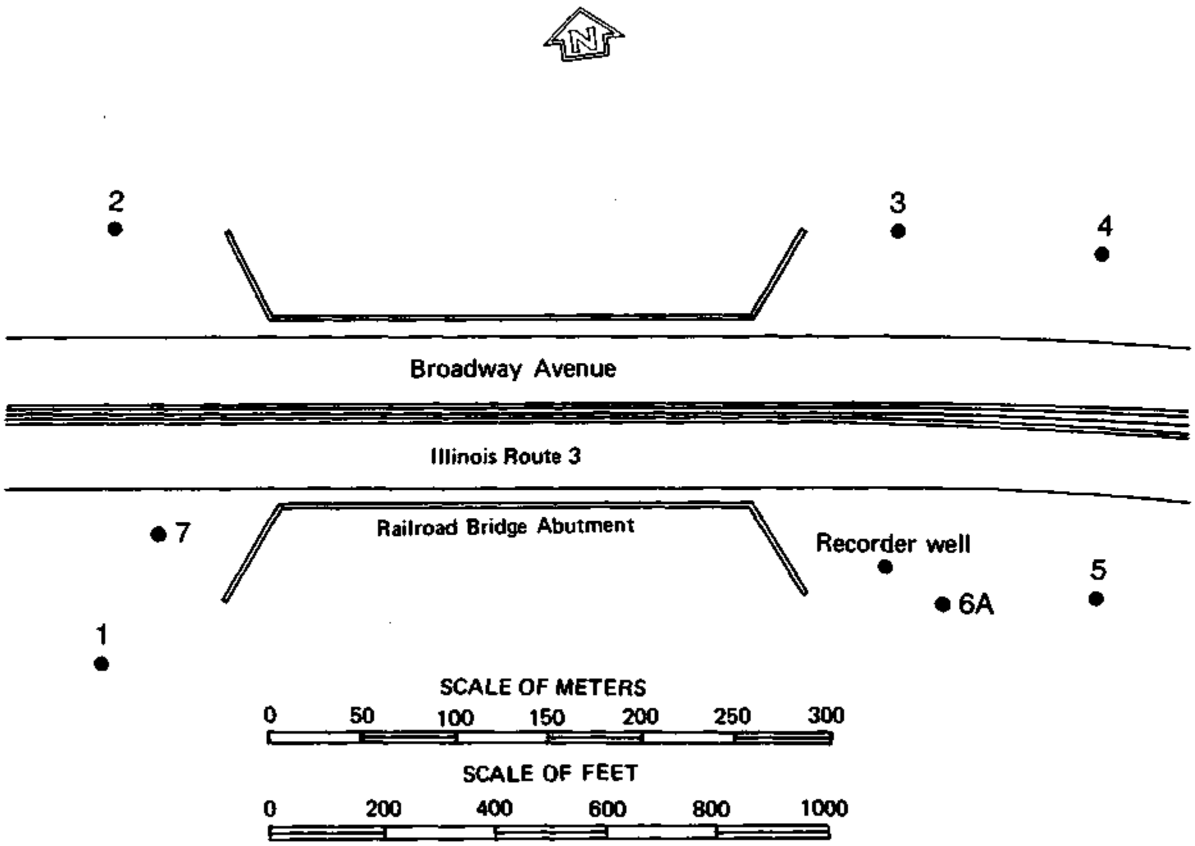


Figure 3. Locations of dewatering wells at the Venice Subway (Dlinois Route 3)

## HISTORICAL SUMMARY OF DEWATERING DEVELOPMENT

The eastbound lanes of I-70 below the Tri-Level Bridge between St. Clair and Bowman Avenues in East St. Louis dip to an elevation 383.5 feet above mean sea level (ft-msl), or approximately 32 feet below natural ground surface. When the highway was designed in 1958, the ground-water levels were near an elevation of 390 ft-msl, or about 6.5 feet above the planned highway (McClelland Engineers, Inc., 1971). Highway construction occurred in 1961-1962.

### Horizontal Drain System

A horizontal French drain system was designed to control the ground-water levels along an 800-foot reach of depressed highway. However, for highway construction, the excavation area was temporarily dewatered by pumping from seven wells 100 feet deep and 16 inches in diameter. The wells were equipped with 1800-gallon-per-minute (gpm) turbine pumps. The temporary construction dewatering system was designed to maintain the ground-water level at the site near an elevation of 370 ft-msl.

The French drain system failed shortly after the temporary construction dewatering system was turned off in the fall of 1962. This failure was attributed to the fact that the filter sand around the perforated diagonal drains and collector pipes was too fine for the ¼-inch holes in the drain pipes. A sieve analysis on the filter sand showed that 98.5 percent of the filter sand was finer than the ¼-inch perforations in the drain pipes. As a result, when the temporary construction dewatering system was turned off and ground-water levels rose above the drains, filter sand migrated through the holes into the drain pipes. The very fine "sugar" sand used as the pavement foundation was then free to move downward to the drains, resulting in development of potholes above the drains. Further migration of sand into the French drain system was halted by operating the temporary construction dewatering system to lower the ground-water table. Since it was very likely that the foundation sands had been piped from beneath the pavement, the diagonal drains beneath the pavement were cement-grouted to prevent any further loss of support beneath the pavement (McClelland Engineers, Inc., 1971).

### Horizontal and Vertical Well Drainage System

A new drainage system was designed and installed in early 1963. It consisted of 20 vertical wells and 10-inch- to 12-inch-diameter horizontal drain pipes. The 20 wells (10 wells on each side of the highway) were spaced about 75 feet apart. They were 6 inches in diameter, about 50 feet deep, and equipped with 32 feet of stainless steel well screen (Doerr) with 0.010-inch slots. Horizontal drains were sized for a flow of about 1 gpm/ft of drain, perforated with 3/8-inch-diameter holes on 3-inch centers, and surrounded with 6 inches of gravel-and-sand filter. A total of six 2-inch-diameter piezometers were installed for ground-water-level measurements.

Tests immediately after the installation indicated that the new system was performing satisfactorily, with a discharge of about 1,200 to 2,000 gpm, compared to a computed design flow of 4,500 gpm. Ground-water levels were lowered to an elevation of ±375.5 ft-msl, about 2 feet below the design ground-water elevation of 377.5 ft-msl, or about 8 feet below the top of the concrete pavement.

The system performed efficiently until March 1965, when a gradual rise in ground-water levels was detected. By July 1967 a 1-foot rise had occurred, and from July 1967 to April 1969 an additional 4-foot rise was observed. No additional rise was observed between August 1969 and August 1970.

Visual inspection during the late 1960s revealed some sinking of the asphalt shoulders and areas around the storm drainage inlets. Several breaks and/or blockages of the horizontal transit drain pipes were noted on both sides of the pavement, and a break in the steel tee in Well 17 was also observed. Depressions were noticed in the earth slopes immediately adjacent to the curb and gutter sections. Loss of foundation sands through the transit pipe breaks appeared to be the cause of these depressions. One manhole had settled a total of 15 inches. The attempt to correct this condition was suspended with the detection of a shift in the bottom of this manhole.

A thorough field investigation was begun to correct the damages to the underground system or to replace it if necessary. During the cleaning process (using a hydrojet at the rate of 100 gpm under pressure of about 800 pounds per square inch or psi), a significant amount of scale was removed from inside the mild steel collector pipes, indicating serious corrosion. Nearly all the transit drain pipes also showed signs of stress. Some drains were broken and filled with sand. Attempts to clean or restore the drain pipes were abandoned in favor of a complete replacement of the system.

The field investigation also showed that the tees in the manholes, the collector pipes, and the aluminum rods on the check valves were badly corroded. Sinks, potholes, and general settlement of the road shoulders required immediate attention. Television inspection of the vertical wells showed no damage to the stainless steel well screens.

Excessive corrosion of the mild steel tees, well risers, and collector pipes was one of the major causes or contributors to the overall failure of the drainage system. The investigations concluded that the corrosion was caused primarily by galvanic action between the stainless steel (cathode) and mild steel (anode) components of the drainage system, with anaerobic bacteria and carbonic acid attack from the carbon dioxide ($CO_2$) dissolved in the well water. Galvanic action was magnified by the lack of oxygen and the high chloride content of the water. Chemical analysis showed the extremely corrosive quality of the ground water as evidenced by:

- Extremely high concentrations of dissolved $CO_2$: 160 to 240 parts per million (ppm)
- Complete lack of oxygen: 0 ppm

- High chloride: 54 to 128 ppm; sulfates: 294 to 515 ppm; and iron concentrations: 12 ppm
- Biological activity

To withstand the possibility of severe corrosion caused by the chemical contents of ground water and to prevent galvanic action between different metals, the field investigators recommended the use of 304 stainless steel pipes throughout any replacement system (McClelland Engineers, Inc., 1971).

**Individual Deep Well Systems**

Experience during highway construction in 1961-1962 and during the 1963 drainage system replacement showed that individual deep wells were effective in temporarily maintaining ground-water levels at desired elevations. This alternative was, therefore, given further study as a permanent system. A consultant's report (Layne-Western Company, Inc., 1972) showed that water levels at the I-70 Tri-Level Bridge site could be maintained at desired elevations with 10 deep wells equipped with 600 gpm pumps. Two additional wells were included to permit well rotation and maintenance. These 12 wells were constructed in 1973 and the new system placed in service in April 1974 (I-70 site). The 16-inch gravel-packed (42-inch borehole) wells had an average depth of about 96 feet, and they were equipped with 60 feet of Layne stainless steel well screen. Pumps with 600-gpm capacity and 6-inch-diameter stainless steel (flanged coupling) column pipe were set in the wells.

A recorder well, 8 inches in diameter and constructed of stainless steel casing and screen, was included in the well dewatering system to monitor ground-water levels near the critical elevation of the highway. A Leupold-Stevens Type F recorder is in use. Additionally, 2-inch-diameter piezometers with 3-foot-long screens were placed about 5 feet from each dewatering well to depths corresponding to the upper third point of each dewatering well screen. These piezometers provide information on ground-water levels and monitor the performance of individual wells by measuring water-level differences between the wells and the piezometers.

In the late 1970s, the exit ramp from the I-64 westbound lanes onto the I-55/I-70 northbound lanes was relocated, necessitating the abandonment of I-70 Well 12. Replacement Well 12A was then constructed at a nearby location using components similar to those in the original wells. The well screen in I-70 Well 7 reportedly failed in the 1970s, and an attempt was made to rehabilitate the well by inserting a new screen inside the old screen. The well's pumping capacity remained unsatisfactory following this modification, so the well was used only on an emergency basis until it was replaced in 1986. The replacement well (7A) was constructed using components similar to those used in the original wells, with the exception of a continuous slot well screen designed on the basis of the sieve data from the nearest original test boring (Wilson et al., 1990).

In late 1986, loss of gravel pack was discovered at I-70 Well 9, and subsequent investigation revealed pumpage of fine sand, apparently from the upper 5 to 10 feet of well screen. In 1987, sand pumpage was also discovered at I-70 Wells 2 and 8, and at Venice Well 6. Replacement wells were constructed in the spring of 1989 for I-70 Well 8 (now Well 8A) and I-70 Well 9 (now Well 9A). Continuous-slot well screens were also designed and used in these wells as in I-70 Well 7A (Olson et al., 1992).

In 1990 (FY 91), two new wells were added at the I-70 site to provide greater flexibility in operation, maintenance, treatment, and repair of the other wells at the site. These wells (I-70 Wells 13 and 14) were located on either side of the eastbound lanes of I-55/I-70 near the lowest point of the highway. The wells were similar in construction to the replacement wells (7A, 8A, and 9A) that were drilled in 1987 and 1989.

In 1991-1992 (FY 92), four replacement wells and one new well were added to the I-70 site. Because of various sand pumpage, settlement, and potential operational problems, replacement wells were constructed for Wells 1, 2, 3, and 11 (new Wells 1A, 2A, 3A, and 11A). The new well (Well 15) was placed between Wells 5 and 6. The wells were similar in construction to the new wells drilled in 1987, 1989, and 1990.

The western terminal of I-64 joins I-70 at the Tri-Level Bridge site. A 2,200-foot stretch of this highway also is depressed below the original land surface as it approaches the Tri-Level Bridge site. To maintain ground-water levels along I-64, a series of 20 wells was added to the dewatering system (I-64 site). The wells were built in 1975 and are essentially identical to the original wells constructed for the Tri-Level Bridge site.

About 6,200 feet southeast of the Tri-Level Bridge, at the interchange with I-64, East St. Louis 25th Street was designed to pass below the interstate highway and adjacent railroad tracks (now abandoned). As a result, the 25th Street pavement is about 3.5 feet below ground-water levels. Ten wells were installed in 1975 to control ground-water levels at the 25th Street site. These wells are identical in design to the original I-70 wells. Pumps installed in the wells along I-64 and at 25th Street have nominal pumping capacities of 600 gpm. Two 8-inch observation wells, located near each end of the I-64 depressed section, are used to monitor ground-water levels. An 8-inch observation well was also installed near the critical location at the 25th Street underpass. As at the I-70 wells, each dewatering well for I-64 and 25th Street has a piezometer located approximately 5 feet away to monitor performance at the installation.

Approximately 2¼ miles north of the I-70 Tri-Level Bridge, Illinois Highway 3 passes beneath the Norfolk and Western, Illinois Central Gulf, and Conrail railroad tracks. When the highway was constructed, ground-water levels were controlled with a horizontal drain system placed 3 feet below the pavement. Problems with the pavement and drainage system were noted in May 1979 and were attributed to the above-normal ground-water levels resulting from three to four months of continuous flood stage in the Mississippi River (about 2,000 feet west). Subsequent investigation showed deterioration of the drainage system, and the consultants recommended installation of six wells to control ground-water levels at the site (Johnson, Depp, and Quisenberry, 1980). The wells were installed in 1982. They are 16 inches in diameter with

50 feet of well screen (Venice site), range in depth from 78 to 89 feet below grade, and are equipped with submersible turbine pumps with nominal capacities of 600 gpm. One recorder well for the site and piezometers at each dewatering well were constructed to monitor system performance.

Problems were encountered with Venice Well 6 after chemical treatment in FY 88 (Phase 5). The well pumped sand-formation and gravel-pack particles, indicating a possible split or weld failure of the well screen or well casing. Replacement Well 6A was drilled and a new Well 7 was added at the Venice site in FY 91 (Phase 8). District Highway staff considered the additional well desirable because of operational problems maintaining appropriate ground-water levels in 1984 when the Mississippi River was at high stages for several months.

The highway dewatering operation in the American Bottoms presently consists of 52 individual dewatering wells fully penetrating the water-bearing sand-and-gravel aquifer. The wells are distributed at four sites as follows:

| | | |
|---|---|---|
| I-70 (Tri-Level Bridge) | - | 15 wells |
| I-64 | - | 20 wells |
| 25th Street | - | 10 wells |
| Venice (Route 3) | - | 7 wells |

The wells are of similar construction, with 16-inch-diameter stainless steel casing and screen, and 6-inch-diameter stainless steel column pipe (figure 4). Each well is equipped with a 600-gpm submersible pump with bronze impellers, bowls, and jacket motors. IDOT's early experience with severe corrosion problems showed that corrosion-resistant materials are required to maximize service life. Five 8-inch recorder wells are available to monitor ground-water elevations near critical locations at the four sites. Each of the 52 wells has a 2-inch-diameter piezometer to help monitor individual well performance.

Usually, about one-third of the wells operate simultaneously. Total pumpage was estimated to be about 11.2 million gallons per day (mgd) in 1992.

## DEWATERING SYSTEM MONITORING

When originally constructed, the well installations at I-70, I-64, and 25th Street included pitot-tube flow-rate meters. A combination of corrosion and chemical deposition caused premature failure of these devices. Flow rates were occasionally checked with a pitot-tube meter temporarily inserted, but the field crew reported erratic results. The six installations at Venice in 1982 included a venturi tube coupled to a bellows-type differential pressure indicator to measure the flow rate. However, the water quality and environment in the well pits also adversely impacted the operation of these instruments. Accurate flow measurements became impossible within a few years, and the field crew reported at least one direct failure of the venturi tube. These meters were subsequently disconnected.

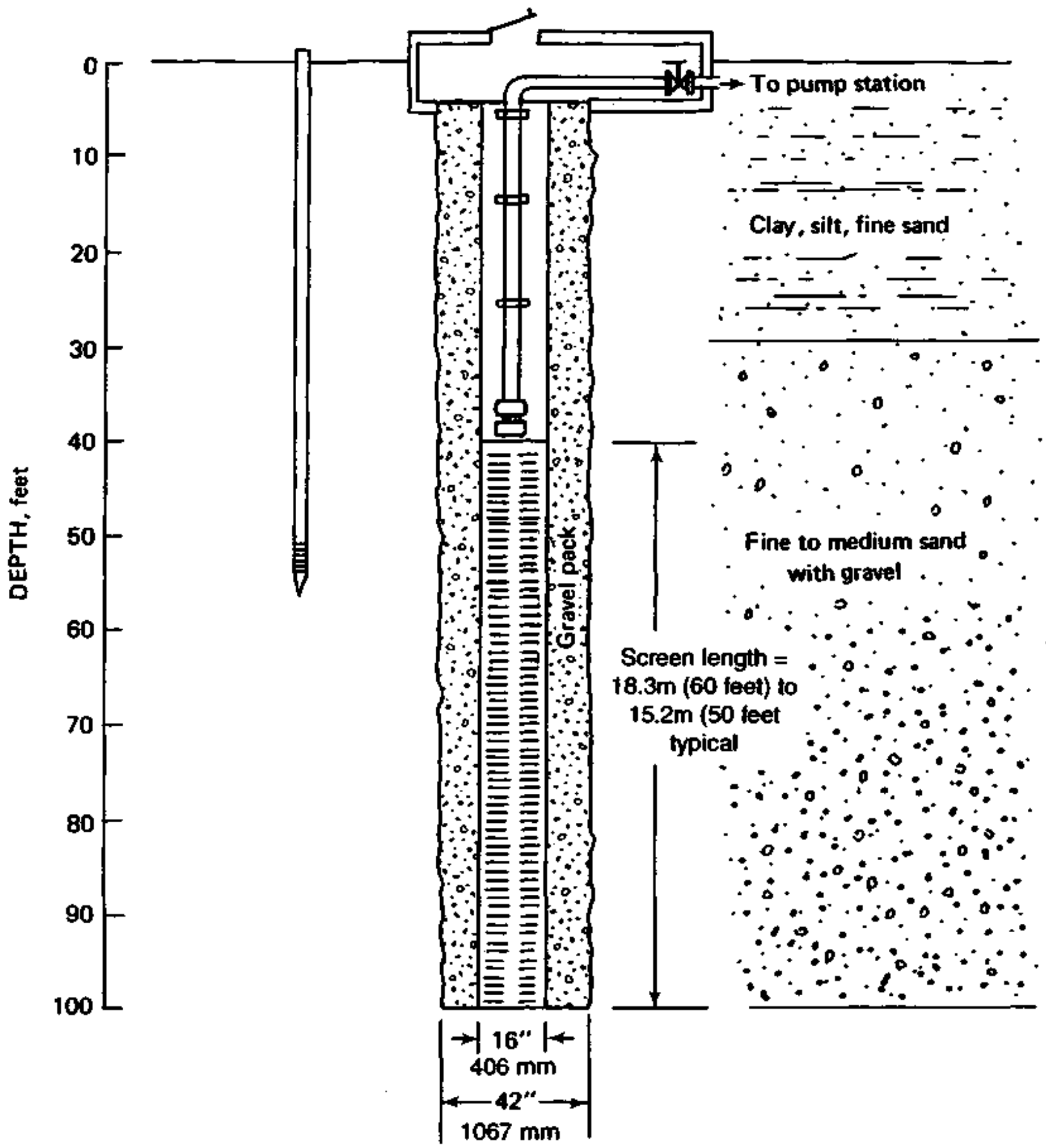


Figure 4. Typical features of a dewatering well

As part of the scope of work in FY 85-FY 87 (Phases 2-4), a noninvasive, portable ultrasonic flowmeter was tested, calibrated, and used to check the specific capacity of 21 dewatering wells. Although the application of this meter was found to be limited in some cases, it was turned over to IDOT for use in their routine monitoring program.

Operational records have shown that wells are pumped for periods of about two to nine months and then not pumped for longer periods while another set of wells is operated. No standard sequence of pumping rotation is followed because of maintenance and rehabilitation requirements. Annual withdrawals currently are calculated on the basis of pumping time and estimated pumping rates.

Until November 1989, IDOT highway maintenance personnel periodically measured water levels at each dewatering well to monitor the overall performance of the dewatering system. Due to internal reorganization of the highway maintenance staff in District 8, Water Survey staff began monitoring ground-water levels at the dewatering sites at the end of February 1990. Water levels are measured every two months in each dewatering well and in the adjacent piezometer of each pumping well. Data collected during FY 93 (Phase 10) have been tabulated (appendix G).

Each dewatering well site also includes at least one observation well (two at the I-64 site) equipped with a Leupold-Stevens Type F water-level recorder. Recorder charts are changed monthly and provide a continuous record of water levels near the critical location at each dewatering site. Because of the District 8 reorganization activities mentioned above, the Water Survey also assumed responsibility for the monthly servicing of the recorders beginning at the end of November 1989.

Each time measurements are collected, the Water Survey forwards to IDOT a report of the ground-water level data, including any recommendations. This information is used to monitor ground-water levels in relation to the pavement elevation for determining whether any adjustments in pumpage are necessary. The data are also useful for assessing the condition of individual dewatering wells. Water-level differences of 3 to 5 feet between the pumping wells and the adjacent piezometers are considered normal by IDOT. Greater differences are interpreted to indicate that well deterioration is occurring.

## INVESTIGATIVE METHODS AND PROCEDURES

### Well Loss

When a well is pumped, water is removed from storage within the aquifer, causing water levels to decline over time in the vicinity of the well. This effect, referred to as drawdown, is most pronounced at the pumped well and gradually diminishes at increasing distances away from the well. Drawdown is the distance that the water level declines from its nonpumping stage. Under ideal conditions, drawdown is a function of pumping rate, time, and the aquifer's hydraulic properties. Aquifer boundaries, spatial variation in aquifer thickness or hydraulic properties, interference from nearby wells, and partial-penetration conditions all can affect observed drawdowns at both pumping and observation wells. On the other hand, well loss or additional drawdown inside the pumped well due to turbulent flow of water into and inside the well is a measure of the hydraulic efficiency of the pumping well only, reflecting the unique flow geometry of the borehole, well screen, and pump placement.

Because of well loss, the observed drawdown in a pumped well is usually greater than that in the aquifer formation outside the borehole. In addition to considerations of flow geometry, as noted above, the amount of well loss can also depend on the materials used (screen openings, gravel-pack size distribution, and drilling fluids, etc.) and the care taken in constructing and developing the well using mechanical and hydraulic means to remove drilling fluids from the borehole. Some well loss is natural because of the physical blocking of the aquifer interstices caused by the well screen and the disturbance of aquifer material around the borehole during construction. However, an improperly designed well and/or ineffective well construction and development techniques can result in excessive well losses. In addition, well losses often reflect a deterioration in the condition of an existing well, especially if well losses increase over time.

Specific capacity, the quotient of pumping rate divided by the drawdown observed after a given time period, is often used in the field as an indicator of well performance. However, specific capacity combined with an analysis of well loss provides a more complete picture of the condition of the well that allows for normalization and comparison at various pumping rates.

Well loss is a function of pumping rate but ideally not of time. It is associated with changes in flow velocity in the immediate vicinity of the well, resistance to flow through the well screen, and changes in flow path and velocity inside the well, all of which cause the flow to change from laminar to turbulent in form. Head losses under turbulent conditions are nonlinear; that is, drawdowns increase more rapidly with increases in pumping rate than under laminar conditions, as discussed below.

While it is possible to have turbulent flow within the aquifer and laminar flow within a pumping well, under near-ideal conditions the observed drawdown ($s_o$) in a pumping well is made up of two components: the formation loss ($s_a$), resulting from laminar flow head loss within the aquifer; and well loss ($s_w$), resulting from the turbulent flow of water into and inside the well, as shown in equation 1.

$$s_o = s_a + s_w \qquad (1)$$

Jacob (1947) devised a technique for separating well losses from formation losses, assuming that all formation losses are laminar and all well losses are turbulent. These components of theoretical drawdown, s, in the pumped well are then expressed as being proportional to pumping rate, Q, in the following manner:

$$s = BQ + CQ^2 \qquad (2)$$

where B is the formation-loss coefficient per unit discharge, and C is the well-loss coefficient. For convenience, s is expressed in feet and Q in cubic feet per second ($ft^3$/sec). Thus, the well-loss coefficient C is expressed as $sec^2/ft^5$.

Rorabaugh (1953) suggested that the well-loss component be expressed as $CQ^n$, where n is a constant greater than 1. He thus expressed the drawdown as

$$s = BQ + CQ^n \qquad (3)$$

To evaluate the well-loss component of the total drawdown, one must know the well-loss coefficient (if using equation 2) or both the coefficient and the exponent (if using equation 3). These analyses require a controlled pumping test, called a step drawdown test (described below), in which total drawdown is systematically measured while pumping rates are varied in a stepwise manner.

## Methodology for Determining Well Loss

If Jacob's equation is used to express drawdown, then the coefficients B and C must be determined. A graphical procedure can be employed after first modifying equation 2 as:

$$s/Q = B + CQ \qquad (4)$$

A plot of *sJQ* versus Q can then be prepared on arithmetic graph paper from data collected during a step drawdown test, substituting the observed drawdown, $s_o$, for s. The slope of a line fitted to these data is equal to C, while the y-intercept is equal to B, as shown in figure 5. If the data do not fall within a straight line, but instead curve concavely upward, the curvature of the plotted data indicates that the second-order relationship between Q and $s_o$ is invalid, and that the Rorabaugh method of analysis usually is appropriate.

Occasionally the data plot of $s_o/Q$ versus Q may yield a straight-line fit with essentially zero slope or with a negative slope, or the data may be too scattered to allow a reasonable fit to be made at all. In these instances, the well-loss parameters are immeasurable. Possible explanations for this are: 1) turbulent well loss was negligible for the range of pumping rates used during the test; 2) inadequate data collection or test methods were used during the test; 3) the hydraulic condition of the well was unstable, as is the case during well development; or 4) the contribution of water from the aquifer was not uniform along the entire length of well screen over the range of pumping rates, as might occur due to the pump setting in relation to the screen or to vertical heterogeneity of the aquifer materials.

If Rorabaugh's equation is used, then coefficients B and C as well as the exponent n must be determined. To facilitate the graphical procedure, equation 3 is rearranged as:

$$(s/Q) - B = CQ^{n-1} \qquad (5)$$

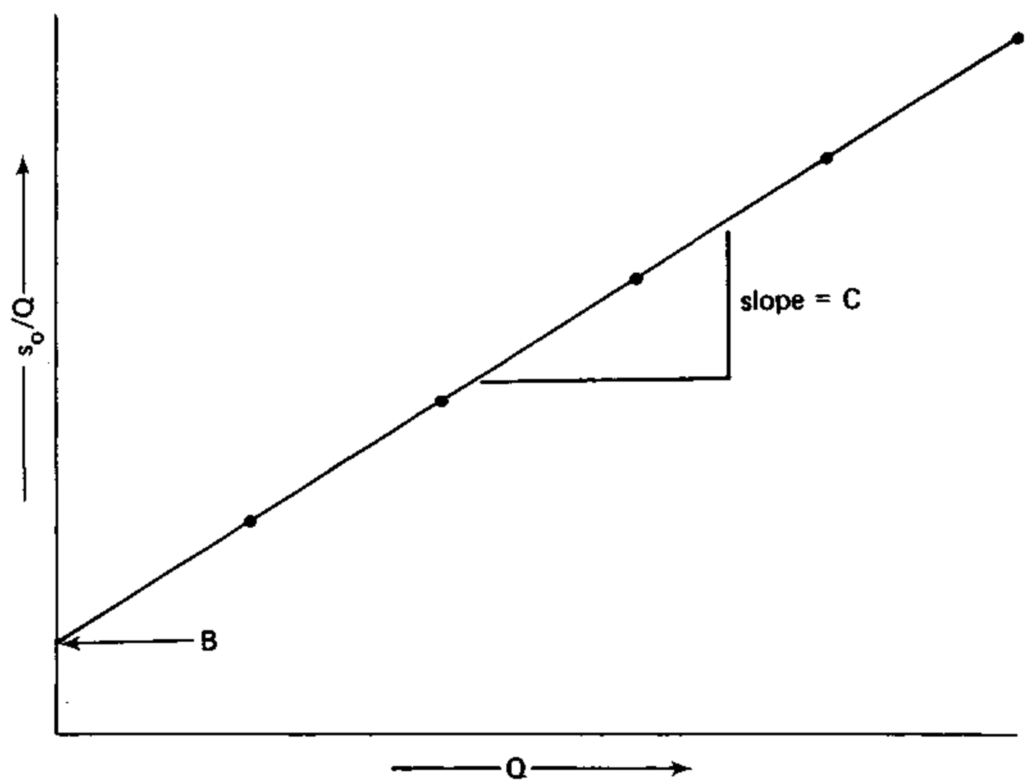


Figure 5. Graphical solution of Jacob's equation for well-loss coefficient, C

Taking logs of both sides of the equation,

$$\log [(s/Q) - B] = \log C + (n - 1) \log Q \qquad (6)$$

A plot of $(s_o/Q) - B$ versus Q can be made on logarithmic graph paper from step-test data by replacing s with $s_o$. Values of B are determined by trial and error until the data form a straight line (figure 6). The slope of the line equals n - 1, from which n can be found. The value of C is determined from the y-intercept at Q = 1. In the example shown, plotting the data is facilitated if Q is plotted as cubic feet per second ($ft^3$/sec), and $(s_o/Q) - B$ is plotted as seconds per foot squared (sec/$ft^2$). It is also convenient (although not mandatory) to use these same units in the Jacob method.

**Step-Test Procedure**

The primary objective of a step drawdown test (or step test) is to determine the well-loss coefficient (and exponent, if Rorabaugh's method is used). With this information, the turbulent well-loss portion of drawdown for any pumping rate of interest can be estimated. During the test, the well is pumped successively at several selected pumping rates. Equally spaced pumping rates are selected to facilitate the data analysis. Each pumping period at a given rate is called a step, and all steps are of equal time duration. Generally, the pumping rates increase from step to step, but the test also can be conducted by decreasing pumping rates. Conducting the steps at decreasing rates has been found to be the most efficient procedure at the dewatering well sites.

During each step, pumpage is held constant. If data are collected manually, water-level measurements are made every minute for the first six minutes, every two minutes for the next ten minutes, and then every four to five minutes thereafter until the end of the step. For the step tests in this study, data were collected using the Water Survey's Micro-computer Data Acquisition System (McDAS), an Omnidata datalogger, an InSitu Hermit datalogger, or an electric dropline. Generally, the dataloggers were programmed to collect water-level data at least once each minute during the step test. Water levels were measured for 30 minutes per step for this investigation. At the end of each 30-minute interval, the pumping rate was immediately changed, and water levels were monitored for another 30-minute interval, until a wide range of pumping rates within the capacity of the pump was tested.

Schematically, the relationship between time and water level resembles that shown for a five-step test in figure 7. Drawdowns for each step (shown as $\Delta s_i$) are measured as the distance between the extrapolated water levels from the previous step and the final water level of the current step. For step 1, the nonpumping water-level trend prior to the start of the test is extrapolated, and As, is measured from this datum. All data extrapolations should be performed on semilog graph paper for the most accurate results. For the purpose of plotting $s_o/Q$ versus Q or $(s_o/Q) - B$ versus Q, values of observed drawdown $s_o$ are equal to the sum of $\Delta S_i$ for the step of interest. Thus, for step 3, $s_o = \Delta s_1 + \Delta s_2 + \Delta s_3$.

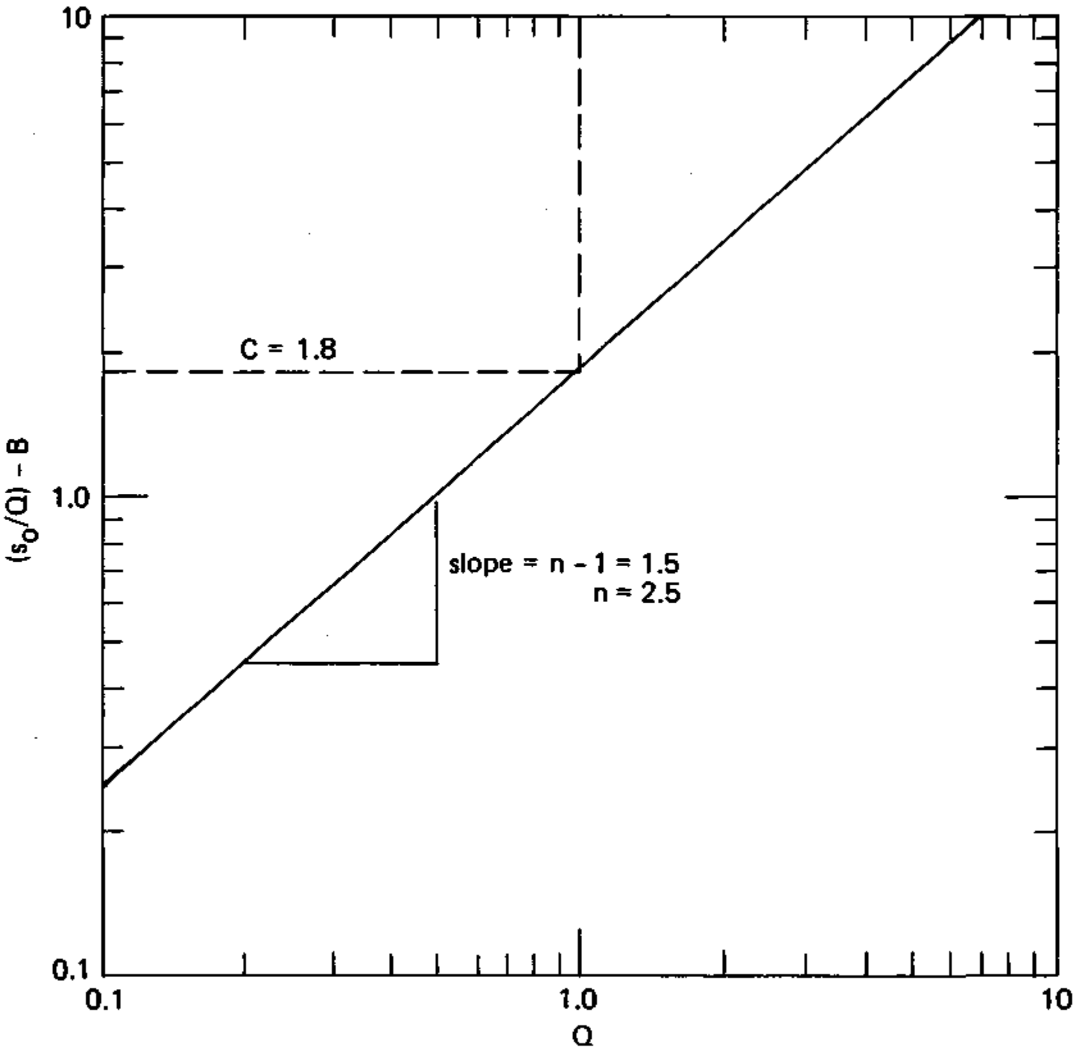


Figure 6. Graphical solution of Rorabaugh's equation for well-loss coefficient, C, and exponent, n

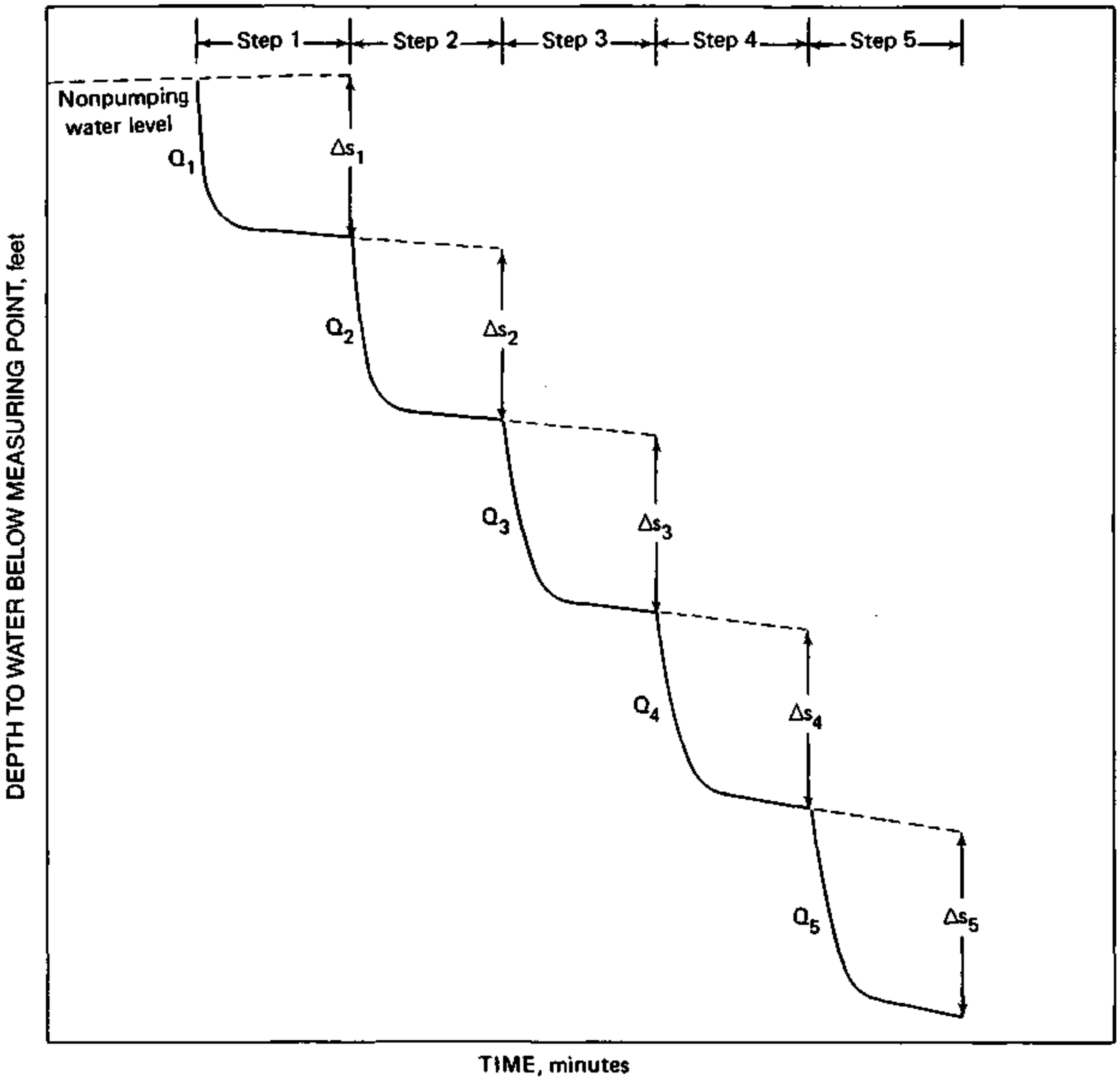


Figure 7. Relationship between time and water-level during a five-step drawdown test

## Piezometers

Piezometers—small-diameter wells with a short length of screen—are used to measure water levels (head) at a point in space within an aquifer and are often used in clustered sets to measure variations in water levels with depth. In the case of well-loss studies, piezometers can be employed to measure head losses across a well screen, gravel pack, or well bore. As previously described, all 52 of the IDOT dewatering wells have piezometers drilled approximately 5 feet from the center line of each well and finished at a depth corresponding to approximately the upper third point of the screen in the pumping well. Historical monitoring of the difference in head (Ah) between water levels in the well and in the adjacent piezometer has been used to help detect and track well deterioration problems.

Measuring piezometer water levels continuously during each step test also allows an indication of turbulent well losses in the pumped well to be found by plotting the Ah data over a large range of pumping rates. If turbulent losses exist within that range, the head differences should be nonlinear with increasing pumping rate. In addition, it can sometimes be useful to simply plot depth to water (or drawdown) in the piezometer versus pumping rate. If turbulence extends outward from the well to the piezometer, then this relationship will be nonlinear.

# FIELD RESULTS

## Well Selection for Step Tests

Thirteen wells were step-tested in FY 93 (Phase 10). Eleven wells were selected for step tests to assess their condition, and three step tests were conducted on the two wells treated chemically to restore production capacity (a total of 14 step tests). A pretreatment step test was conducted on one well, and a posttreatment step test was conducted on each of the two treated wells.

The eleven wells selected for condition assessment step tests were:

| | |
|---|---|
| I-70 | Wells 4, 6, 7A, 9A, 10, 13, and 14 |
| 25th St. | Well 4 |
| Venice | Wells 1, 6A, and 7 |

A pretreatment step test was conducted on:

| | |
|---|---|
| I-70 | Well 8A |

The two wells treated and then tested in posttreatment step tests were:

| | |
|---|---|
| I-70 | Well 8A |
| 25th St. | Well 8 |

## Step Tests

### *Field Testing Procedure*

Water Survey staff conducted field work with the assistance of the IDOT Bureau of Maintenance crew under the supervision of Barry Roberts. The DOT crew made all necessary wellhead pipe modifications and provided special piping adapters that allowed connection of the Water Survey's flexible hose and orifice tube to measure the flow rate. Discharge from the orifice tube was directed to nearby stormwater drains.

Orifice tubes are standard equipment for accurately measuring flow rates. The orifice tube and orifice plate used to measure the range of flow rates was previously calibrated at the University of Illinois Hydraulics Lab under discharge conditions similar to those expected in the field.

The objective of each step test on the selected wells was to control the flow rate at increments of 50 gpm and to include as many 30-minute steps as possible at 300 gpm or greater for each well. Early experience with the step tests showed that at rates of less than about 300 gpm, well-loss coefficients rarely could be determined from the collected data. Also such a low pumping rate often results from a very low specific capacity, indicating a well in poor condition. When there is a maximum pumping rate less than about 300 gpm during a step test for a dewatering well, the drawdown in water levels is observed for a period of 30 to 60 minutes to obtain an approximate specific capacity for later comparison, and this is then called a drawdown test instead of a step test.

Prior to the start of each test, the nonpumping water levels in the well and piezometer were measured with a steel tape or electric dropline. Pressure transmitters coupled to one of the previously mentioned dataloggers were placed in the pumped well and piezometer to measure water levels during the step tests.

During the step tests, the discharge from each well was also checked for the presence of sand (unless the site accessibility or site condition precluded set-up of the testing equipment) by directing the open flow from the orifice tube into a 1,000-gallon portable tank. The tank acts as a sedimentation basin, allowing sand grains to be caught, collected at the end of the step test as the tank is drained, and delivered to the geotechnical laboratory for analysis.

Wells were tested in July 1992 (25th Street Well 4), December 1992 (I-70 Well 8A), March 1994 (Venice Well 1), May 1994 (I-70 Wells 7A and 9A and Venice Well 7), June 1994 (I-70 Well 14 and Venice Well 6A), April 1995 (I-70 Well 13), May 1995 (I-70 Wells 4 and 6), and August 1995 (I-70 Well 10). Two wells, 25th Street Well 8 and I-70 Well 8A, were rehabilitated between February 15 and March 10, 1993, with posttreatment step tests in November 1993 and March 1994.

Data for the 14 step tests are included in appendix A. Water samples were collected at the time of each test and analyzed for chemical/mineral content and nuisance bacteria. The results from the water sample analyses are described in the following sections and presented in appendix B.

*Results of Step Tests*

Step-test data were analyzed by using the Jacob method, as described earlier in this report. Table 1 summarizes results of the analyses of data from the 14 step tests conducted for the FY 93 investigation. Because the amount of drawdown due to well loss is proportional to the pumping rate squared, the well loss reported in table 1 has been calculated for a *standardized* rate of 600 gpm using the well-loss coefficient determined from the analysis of the step-test data. This enables comparison among dewatering wells that operate at different rates. The *standardized* well loss also is reported in table 1 as a percentage of total drawdown calculated using equation 2 ($s = BQ + CQ^2$) at the base rate of 600 gpm. Likewise, the Ah values reported in table 1 also have been observed or estimated for the *standardized* rate of 600 gpm. However, comparisons of Ah values are only valid among step tests on the same well because of the varying distances of the piezometers from the individual dewatering wells. All step tests conducted in FY 93 were run with steps at decreasing rates so the observed specific capacities included in table 1 were calculated based on the total observed drawdown at the end of the first step when the highest pumping rate was used. Thus, observed specific capacity values are calculated after 30 minutes of pumping but are *not* standardized to the 600 gpm rate.

Step tests were scheduled to assess the condition of 11 existing wells during FY 93. However, highway construction projects at the I-70 Tri-Level Bridge site and record flood conditions during the summer of 1993 on the nearby Mississippi River delayed all but one of the step tests to 1994 and 1995. For the FY 93 work, the condition of several wells was checked: I-70 Wells 4, 6, 7A, 9A, 10, 13, and 14; 25th Street Well 4; and Venice Wells 1, 6A, and 7. (For results of the pretreatment and posttreatment step tests conducted on I-70 Well 8A and the posttreatment step test on 25th Street Well 8, see the section "Well Rehabilitation-Chemical Treatment Results.")

The condition of I-70 Well 4 was previously checked on January 8, 1987, during a posttreatment step test. The observed specific capacity of the well was about 102 gpm/ft. Well loss could not be determined, and a plugged piezometer prevented Ah measurements. Results of the step test conducted for FY 93 on May 11, 1995 (delayed due to highway construction) showed an observed specific capacity of about 90 gpm/ft. Again the well loss could not be determined and Ah values could not be determined as the piezometer had been destroyed to allow construction of a sign foundation. I-70 Well 4 was in good condition with an observed specific capacity of about 94 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2).

The previous step test on I-70 Well 6 was a posttreatment step test on October 29, 1991. The specific capacity of the well was about 122 gpm/ft and well loss was about 3.8 percent. The piezometer was buried during highway construction. Results of the step test conducted for FY 93 on May 12, 1995 (delayed due to highway construction) showed an observed specific capacity of about 89 gpm/ft and a Ah value of about 2.5 feet. Well loss could not be determined from the

## TabTable 1. Results of SWS Step Tests on IDOT Wells, FY 93 (Phase 10)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *Ah*@ 600 gpm (ft)* | *Observed $Q_{max}$ gpm* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| I-70 | | | | | | | | |
| No. 4 | 5/11/95 | ** | 6.70 | ** | 89.7 | P | 685 | |
| No. 6 | 5/12/95 | ** | 6.72 | ** | 89.3 | 2.5 | 610 | |
| No. 7A | 5/5/94 | 0.54 e | 11.1 e | 4.8 e | 54.5 | 2.9 e | 465 | |
| No. 8A | 12/17/92 | 0.17 e | 9.8 e | 1.2 e | 61.1 | 5.3 e | 590 | Pretreat |
| No. 8A | 3/16/94 | 0.27 e | 7.9 e | 3.4 e | 76.0 | 2.5 e | 588 | Posttreat |
| No. 9A | 5/12/94 | 0.13 e | 7.7 e | 1.6 e | 78.3 | 3.1 e | 470 | |
| No. 10 | 8/1/95 | ** | 6.2 e | ** | 57.9 | P | 455 | |
| No. 13 | 4/25/95 | ** | 20.1 e | ** | 29.9 | 4.4 e | 208 | Drawdown test |
| No. 14 | 6/22/94 | ** | 16.0 e | ** | 34.0 | 14.6 e | 396 | |
| 25th St. | | | | | | | | |
| No. 4 | 7/24/92 | ** | 6.24 | ** | 98.8 | P | 820 | |
| No. 8 | 11/15/93 | ** | 6.23 | ** | 96.3 | 4.81 | 620 | Posttreat |
| Venice | | | | | | | | |
| No. 1 | 3/29/94 | 2.9 | 17.4 | 16.6 | 34.5 | P | 680 | |
| N0.6A | 6/23/94 | ** | 9.9 | ** | 61.5 | 6.1 | 825 | |
| No. 7 | 5/4/94 | ** | 17.5 | ** | 35.2 | 13.9 e | 845 | |

Notes:

* Head difference between pumped well and adjacent piezometer.

** Coefficient immeasurable. Turbulent well loss negligible over the pumping rates tested.

e = Estimate based on interpolated values adjusted to 600 gpm

P = Piezometer plugged or partially plugged

**Table 2. Average Observed Specific Capacity of Dewatering Wells Based on Step-Test Data from 132 Tests Since FY 84**

| | *I-70* | *I-64* | *25th St.* | *Venice* | *All sites* |
|---|---|---|---|---|---|
| All wells: | | | | | |
| Number of step tests | 66 | 16 | 25 | 25 | 132 |
| Average specific capacity, gpm/ft | 70 | 99 | 94 | 78 | 80 |
| Wells in good condition or post-treatment: | | | | | |
| Number of step tests | 33 | 14 | 16 | 16 | 79 |
| Average specific capacity, gpm/ft | 96 | 105 | 119 | 99 | 103 |
| Wells in poor condition or pretreatment: | | | | | |
| Number of step tests | 33 | 2 | 9 | 9 | 53 |
| Average specific capacity, gpm/ft | 44 | 58 | 49 | 43 | 45 |

collected data. I-70 Well 6 appeared to be in good condition with an observed specific capacity of about 93 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2) and an acceptable Ah value.

The previous step test on I-70 Well 7A was a posttreatment step test on August 6, 1991. The observed specific capacity was about 70 gpm/ft, well loss was about 3.7 percent, and the Ah value was about 1.4 feet. The step test conducted for FY 93 on May 5, 1994 (delayed due to highway construction) showed an observed specific capacity of about 55 gpm/ft, a well loss of about 4.8 percent, and an estimated Ah value of about 2.9 feet. I-70 Well 7A appeared to be in fair condition with an observed specific capacity of about 57 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2) and increased well loss and Ah values since the previous test.

The previous step test on I-70 Well 9A on July 23, 1992, showed an observed specific capacity of about 79 gpm/ft, a well loss of about 3.1 percent, and an estimated Ah value of 2.9 feet at 600 gpm. The specific capacity observed during a step test for FY 93 on May 12, 1994 (delayed due to highway construction) was about 78 gpm/ft, the well loss was about 1.6 percent, and the estimated Ah value was about 3.1 feet. I-70 Well 9A appeared to be in fair condition with an observed specific capacity of about 81 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2) and a somewhat increased Ah value.

The previous step test on I-70 Well 10 was a posttreatment step test on August 8, 1991, that showed a specific capacity of about 65 gpm/ft and a well loss of about 10 percent. The Ah was not determined because of a plugged piezometer. The step test conducted for FY 93 on August 1, 1995 (delayed due to highway construction) showed an observed specific capacity of about 58 gpm/ft. The well loss could not be determined from the collected data and the plugged piezometer prevented a Ah value from being determined. I-70 Well 10 appeared to be in fair condition with an observed specific capacity of about 60 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2).

The previous step test on new I-70 Well 13 was the initial step test conducted on April 25, 1991. The observed specific capacity was about 80 gpm/ft, the well loss was about 6.2 percent, and the estimated Ah was about 2.9 feet at 600 gpm. The step test conducted for FY 93 on April 25, 1995 (delayed due to highway construction) showed an observed specific capacity of about 30 gpm/ft with an estimated Ah value of about 4.4 feet. The well loss could not be determined from the collected data. I-70 Well 13 appeared to be in poor condition with an observed specific capacity of about 31 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2) and an increased Ah value.

The previous step test on new I-70 Well 14 was the initial step test conducted on December 20, 1990. The observed specific capacity was about 101 gpm/ft, the well loss about 2.2 percent, and the estimated Ah was about 3.0 feet. The step test conducted for FY 93 on June 22, 1994 (delayed due to highway construction) showed an observed specific capacity of about 34 gpm/ft and a very high estimated Ah value of about 14.6 feet. The collected data did not allow determination of well loss. I-70 Well 14 appeared to be in poor condition with an observed specific capacity of about 35 percent of the average observed specific capacity of wells at the I-70 site in good condition (table 2) and a very high Ah value.

A condition assessment step test was conducted on one well at the 25th Street site during FY 93. The previous step test for 25th Street Well 4 was a posttreatment step test on November 19, 1991, that showed an observed specific capacity of about 120 gpm/ft and a well loss of about 13 percent. A plugged piezometer precluded Ah measurements. The observed specific capacity during the FY 93 step test conducted on July 24, 1992, was about 99 gpm/ft. The well loss could not be determined, and Ah values are not available because of the plugged piezometer. 25th Street Well 4 was in fair condition with an observed specific capacity of about 83 percent of the average observed specific capacity of other wells at the 25th Street site in good condition (table 2).

Three wells at the Venice site were step-tested in FY 93 for condition assessment. Venice Well 1 showed an observed specific capacity of about 85 gpm/ft during the previous step test conducted on September 6, 1989. The well loss was about 12 percent, and the Ah value was about 1.9 feet. The step test conducted for FY 93 on March 29, 1994 (delayed due to record flood conditions) showed an observed specific capacity of about 35 gpm/ft and a well loss of about 17 percent. A plugged piezometer precluded Ah measurements. Venice Well 1 was in poor condition with an observed specific capacity of about 35 percent of the average observed specific capacity of other wells in good condition at the Venice site (table 2) and a very high percent of well loss.

The previous step test on Venice Well 6A was the initial step test conducted on March 20, 1991. The observed specific capacity of Venice Well 6A was about 79 gpm/ft, the well loss was about 28 percent, and the Ah was about 3.7 feet. The FY 93 step test conducted on June 23, 1994 (delayed due to record flood conditions) showed an observed specific capacity of about 62 gpm/ft, a Ah of about 6.1 feet, and the well loss could not be determined. Venice Well 6A was in fair condition with an observed specific capacity of about 63 percent of the average observed specific capacity of other wells in good condition at the Venice site (table 2) and an increased Ah value.

The previous step test on Venice Well 7 was the initial step test conducted on February 27, 1991. Venice Well 7 showed an observed specific capacity of about 80 gpm/ft, Ah was about 4.1 feet, and the well loss could not be determined. The FY 93 step test conducted on May 4, 1994 (delayed due to record flood conditions) showed an observed specific capacity of about 35 gpm/ft and a very high estimated Ah value of about 13.9 feet. Venice Well 7 was in poor condition with an observed specific capacity about 35 percent of the average observed specific capacity of other wells in good condition at the Venice site (table 2) and a very high Ah value.

Chemical treatment is recommended for the four wells in poor condition: I-70 Wells 13 and 14 and Venice Wells 1 and 7. Video inspection of these wells for excessive buildup of incrusting minerals also may be considered.

Since FY 84 (Phases 1-10), 132 step tests have been completed at all sites. Results are included (appendix C), and the observed specific capacity data are summarized (table 2). The average observed specific capacity for all 132 step tests is about 80 gpm/ft. By excluding the results from 53 pretreatment step tests and other step tests that show wells in poor condition, the average observed specific capacity of 79 step tests was about 103 gpm/ft. The highest observed specific capacities are generally found at the 25th Street site where 25 step tests have been completed. Observed specific capacities for all step tests at the 25th Street site averaged about 94 gpm/ft, 119 gpm/ft without eight pretreatment step tests. At the I-70, I-64, and Venice sites, respectively, 66, 16, and 25 step tests have been completed with average observed specific capacities of about 70, 99, and 78 gpm/ft. Without the pretreatment step tests and other step tests on wells in poor condition at these sites, the observed specific capacities were about 96, 105, and 99 gpm/ft, respectively.

## Well Rehabilitation

### *Chemical Treatment Procedure*

Specifications for the well rehabilitation work initially were developed in FY 86 by IDOT and the Water Survey based on chemical treatment practices in common use. Revisions to the specifications have been made periodically based on results and experience from chemical treatment of the dewatering wells. Similar treatment procedures were used for all wells treated in FY 93, although adjustments occurred as specific conditions were encountered from day to day and from well to well. Table 3 summarizes the treatment procedure as required by IDOT specifications. The actual procedure used by the contractor, Brotcke Engineering Company, Inc., varied in some instances, and the significant changes are noted in the table.

**Table 3. Outline of Typical Well Rehabilitation**

<u>Day 1</u>

1. Pretreatment specific capacity test (contractor orifice tube, open to free discharge, used for flow measurements).
   a. Measurement of SWL (static water level) following 30 or more minutes of well inactivity.
   b. Measurement of PWL (pumping water level) and orifice piezometer tube following 60 or more minutes of pumping.

2. Polyphosphate application, 400 pounds, and displacement with 16,000 gallons water containing at least 500 ppm (mg/L) chlorine.
   a. Initial chlorination of well with 2,500 gallons water containing 500 ppm or more chlorine injected at a minimum rate of 750 gpm.
   b. Injection of polyphosphate solution at a minimum rate of 2,000 gpm (actual rate 1,600 gpm, when reported) in two 1,800-gallon batches, each batch containing 200 pounds polyphosphate, at least 500 ppm chlorine.
   c. Injection of 16,000 gallons water chlorinated to at least 500 mg/l in 2,000-gallon batches at a minimum rate of 1,500 gpm.
   d. Time allowance for chemicals to react, 1 to 2 hours.

3. Pump to waste and check specific capacity.
   a. Pump continuously 6 or more hours to clear well of chemicals (actual time, when reported: 6 hours).
   b. Same procedure for specific capacity check as step 1 above.

<u>Day 2</u>

1. Acidization with 1,000 gallons 20° Baume-inhibited muriatic (hydrochloric) acid and displacement with 4,000 to 5,000 gallons water (not chlorinated).
   a. Pump 1,000 gallons of bulk-inhibited acid into well within 1 hour, 17 gpm minimum (actual rate: 33 to 40 gpm).
   b. Allowance time for acid to react, 1 hour.
   c. Injection of 4,000 to 5,000 gallons water at 1,000 to 2,000 gpm.
   d. Allowance for reaction, 2 to 3 hours.

2. Pump to waste and check specific capacity.
   a. Pump continuously 3 hours or more (actual time: 17 to 18 hours) to clear well of acid.
   b. Same procedure for specific capacity check as Day 1, step 1 above.

**Table 3. Concluded**

Day 3

1. Polyphosphate application, 600 pounds, and displacement with 30,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above, except three batch injections (actual rates, when reported: 1,400 to 1,700 gpm) of 1,800 gallons (5,400 gallons total) with 200 pounds phosphate each in part b, and injection of 30,000 gallons in part c.

2. Pump to waste and check specific capacity.

   a. Pump continuously 6 or more hours to clear well of chemicals (actual time: 20 to 116.5 hours).
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Day 4 (Optional)

1. Polyphosphate application, 600 pounds, and displacement with 54,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above, except three batch injections of 1,800 gallons (5,400 gallons total) with 200 pounds phosphate each in part b, and injection of 54,000 gallons in part c.

2. Pump to waste and check specific capacity.

   a. Pump continuously 6 or more hours to clear well of chemicals.
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Day 5 (Optional)

1. Polyphosphate application, 400 pounds, and displacement with 16,000 gallons water containing at least 500 ppm chlorine.

   Same procedure as Day 1, step 2 above.

2. Pump to waste and final specific capacity test.

   a. Pump continuously 6 or more hours to clear well of chemicals.
   b. Same procedure for specific capacity check as Day 1, step 1 above.

Figure 8 schematically shows the typical injection assembly/discharge apparatus used by the contractor to inject solutions and acid into the wells, to pump spent solutions to waste, and to conduct drawdown pumping tests during the treatment work.

Water Survey staff periodically observed the well rehabilitation work. Water Survey staff also reviewed documentation developed by the resident engineer and the contractor as the treatment work progressed. Appendix D includes the field notes for each well treated in FY 93.

*Chemical Treatment Results*

The wells were selected for chemical treatment on the basis of data from the most recent Water Survey step tests and available water-level difference (Ah) information. Step tests completed for FY 92 and FY 91 indicated that two dewatering wells (I-70 Well 8A and 25th Street Well 8) were in poor condition and should be chemically treated. During FY 93 (Phase 10) Brotcke Engineering Company, Inc. chemically treated the two dewatering wells from February 15-March 10, 1993.

When I-70 Well 8A was step-tested on October 1, 1991, the observed specific capacity was only about 52 gpm/ft, the well loss was about 2.5 percent, and the Ah was about 6.4 feet. A pretreatment step test conducted on December 17, 1992, showed the observed specific capacity was about 61 gpm/ft, the well loss was about 1.2 percent, and estimated Ah was about 5.3 feet (see table 1). After I-70 Well 8A had been chemically treated, the posttreatment step test on March 16, 1994, showed an observed specific capacity of about 76 gpm/ft, a well loss of about 3.4 percent, and an estimated Ah of about 2.5 feet. The relative success of this treatment is difficult to judge because the posttreatment step test was delayed due to the 1993 flood conditions and to highway construction. Based on the step tests, treatment was only moderately successful; however, the data collected by the contractor at the time of treatment (table 4) indicates that the treatment was very successful. It is possible that new deterioration occurred after treatment and before the posttreatment step test.

At the 25th Street site, Well 8 had been tested during FY 92 (Phase 9) on April 24, 1991. The observed specific capacity was only about 46 gpm/ft and the estimated Ah was about 9.5 feet. A pretreatment step test was not conducted because of interposing work by other IDOT contractors and unsuccessful efforts to schedule the cooperative work effort. The posttreatment step test conducted on November 15, 1993, showed an observed specific capacity of about 96 gpm/ft and a Ah value of about 4.8 feet. The well loss could not be determined. Based on the step tests, the treatment was judged to be moderately successful with 25th Street Well 8 having a specific capacity of about 81 percent of the average specific capacity of other wells in good condition at the Venice site. The Ah value was reduced significantly.

As indicated in table 3, the chemical treatment procedure required the treatment contractor to conduct 60-minute drawdown tests to measure the specific capacity after each successive treatment step. Table 4 summarizes these drawdown pumping test data collected as part of the field documentation during the chemical treatment of each dewatering well. The table shows the measured specific capacity before treatment and after each step in the treatment

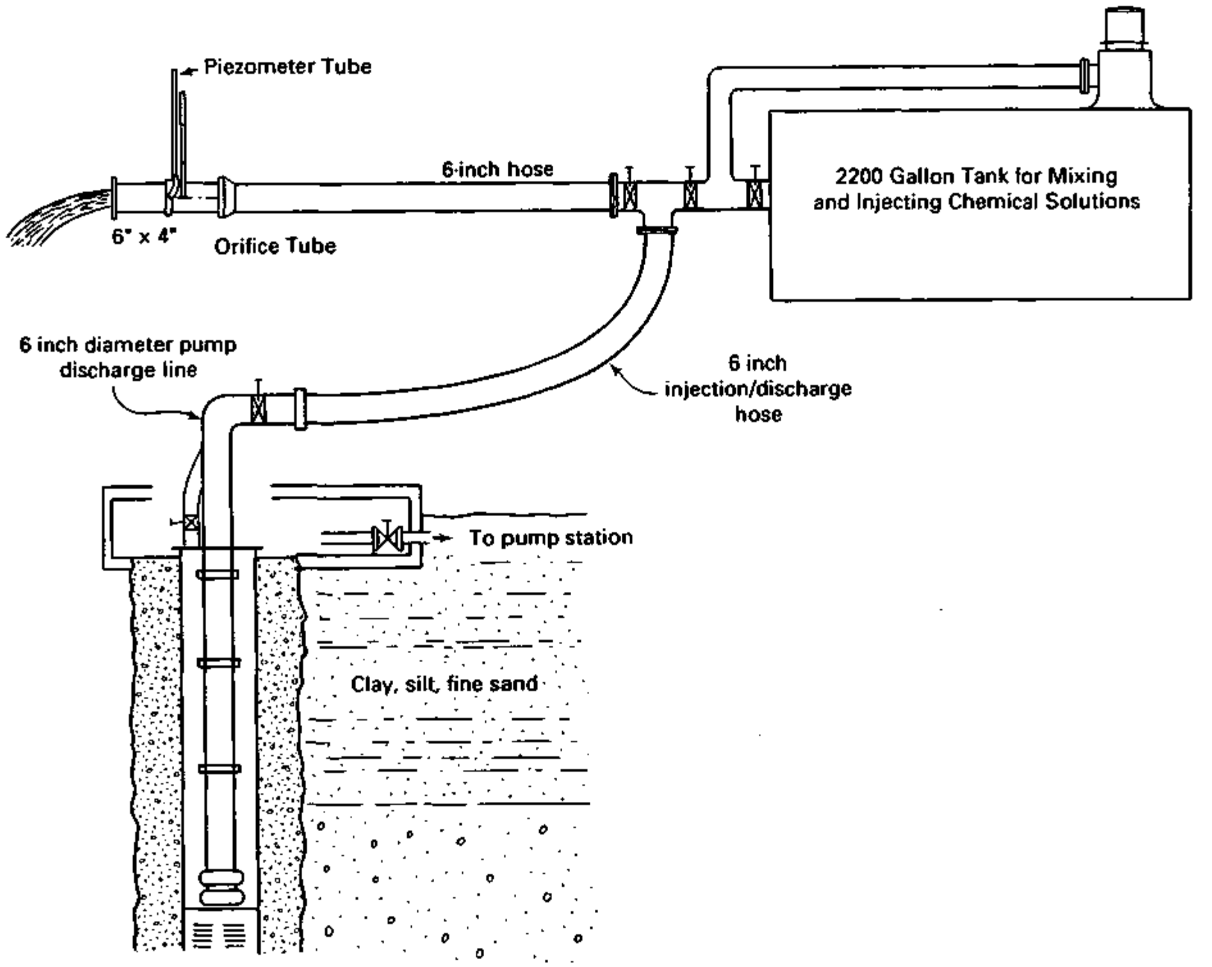


Figure 8. Schematic diagram of equipment used in well rehabilitation

## Table 4. Drawdown Test Data Collected by Contractor during Well Rehabilitation

| | *Pretreatment* | *1st PPP treatment* | *Acid treatment* | *2nd PPP treatment* | *3rd PPP treatment* | *4th PPP treatment* |
|---|---|---|---|---|---|---|
| I-70 Well 8A | | | | | | |
| Date ('93) | 3/5 a.m. | 3/8 a.m. | 3/9 a.m. | 3/10 a.m. | None | None |
| SWL | 10.3 | 10.4 | 12.1 | 13.0 | | |
| PWL | 27.8 | 24.0 | 23.4 | 23.5 | | |
| s | 17.5 | 13.6 | 11.3 | 10.5 | | |
| Q | 1023 | 996 | 960 | 988 | | |
| Q/s | 58.5 | 73.2 | 85.0 | 94.1 | | |
| 25th St. Well 8 | | | | | | |
| Date ('93) | 2/15 p.m. | 2/23 a.m. | 2/24 a.m. | 3/1 a.m. | None | None |
| SWL | 15.2 | 14.2 | 14.8 | 13.4 | | |
| PWL | 21.5 | 24.2 | 24.2 | 22.2 | | |
| s | 6.3 | 10.0 | 9.4 | 8.8 | | |
| Q | 528 | 1030 | 1026 | 1023 | | |
| Q/s | 83.8 | 103.0 | 109.1 | 116.3 | | |
| Averages | | | | | | |
| Q/s | 71.1 | 88.1 | 97.1 | 105.2 | | |
| ΔQ/s | | 17.0 | 9.0 | 8.1 | | |
| % increase over original Q/s | | 23.9 | 12.7 | 11.4 | | |
| % of total improvement | | 49.9 | 26.4 | 23.8 | | |

Notes:

Total ΔQ/s = 34.1 gpm/ft (48 percent improvement over initial Q/s)

SWL - Static (nonpumping) water level, feet
PWL - Pumping water level, feet
s - Drawdown (PWL-SWL), feet
Q - Pumping rate, gpm
Q/s - Specific capacity, gpm/ft
PPP - Polyphosphate

process (polyphosphate or acid injection episode). The average specific capacity for both wells at each step in the treatment process is given at the end of the table, along with an analysis of the improvement between steps. In general, the percent improvement in specific capacity diminishes with each successive step of the treatment. This trend also has been noted in the results of the chemical treatment in some prior years. In FY 93, about 50 percent of the total improvement occurred with the first polyphosphate treatment and about 24 percent during the second polyphosphate treatment (following acidization). Based on the water level and pumping rate data collected by the contractor during chemical treatment, the observed specific capacities for the wells were about 98 percent of the average specific capacity for wells in good condition at the respective sites.

A trend of reduced improvement for successive treatment steps has been shown by the results of the treatment for each of the eight years that this general well treatment procedure has been followed. For the six years prior to FY 92, from about 76 to 96 percent of the improvement occurred after the second polyphosphate treatment step. Depending on the specific response of each well, it is possible to eliminate treatment steps if expectations for specific capacity have been achieved. An overall reduction in the treatment cost may thus be realized by eliminating any unnecessary treatment steps. To do this, progress and results from each step in the rehabilitation work must be closely monitored in the field.

Following the chemical treatments in FY 93, the Water Survey conducted step tests on each treated well to evaluate its condition and response to treatment as well as to provide results for comparison with the contractor's drawdown tests conducted during the well treatment. Table 5 summarizes the results of these tests. Improvement in 25th Street Well 8 was the better of the two wells treated, with an increase of about 112 percent based on the step tests. The other well, I-70 Well 8A, had an increase of only about 24 percent in specific capacity. However, the posttreatment step test occurred a year after the well was treated due to extended use of the dewatering system during the record flood conditions on the Mississippi River during the summer of 1993. This delay probably allowed for some new deterioration to occur.

Twenty-seven wells have now been rehabilitated in eight years with a total of 34 chemical treatments (7 wells in FY 86, 5 in FY 87, 4 in FY 88, 4 in FY 89, 5 in FY 90, 4 in FY 91, 3 in FY 92, and 2 in FY 93). Three contractors performed the treatments: Aylor Aqua Services, Inc., during FY 86, FY 87, and FY 89; Brotcke Engineering Co., Inc. during FY 88, FY 90, FY 91, and FY 93; and Layne-Western Company, Inc., during FY 92.

## Sand Pumpage Investigation

### *Field Procedure*

Prior occurrences of sand pumpage from the dewatering wells have resulted in the standard practice of checking for the presence of sand in the discharge during each step test unless precluded by site conditions and available equipment. To continue to address these concerns, the possibility of sand pumpage was investigated during 11 of the 14 step tests

**Table 5. Results of Chemical Treatment, FY 93 (Phase 10)**

| | | | *Pretreatment* | | *Posttreatment* | | |
|---|---|---|---|---|---|---|---|
| *Site* | *Well* | | *Date* | *Q/s (gpm/ft)* | *Date* | *Q/s (gpm/ft)* | *% change* |
| I-70 | Well 8A | ISWS | 12/17/92 | 61.1 | 03/16/94 | 76.0 | +24 |
| | | BEC | 03/08/93 | 58.4 | 03/10/93 | 94.1 | +61 |
| 25th St. | Well 8 | ISWS | 04/24/91 | 45.5 | 11/15/93 | 96.3 | +112 |
| | | BEC | 02/15/93 | 83.8 | 03/01/93 | 116.3 | +39 |
| Average | | ISWS | | 53.3 | | 86.2 | +62 |
| | | BEC | | 71.1 | | 105.2 | +48 |

**Notes:**
Q/s = Specific capacity, gpm/ft
ISWS = Illinois State Water Survey
BEC = Brotcke Engineering Company, Inc.

conducted on 13 wells in FY 93 (Phase 10). The other three wells, I-70 Wells 4, 6, and 14, would have also been checked but were not because of either site conditions or that the portable tank was required to divert discharged water into a drainage system manhole to prevent water on the pavement.

During each step test, water is discharged from the orifice tube into a portable 1,000-gallon tank (figure 9). Siphon tubes are used as necessary to help control the discharge from the tank. The tank itself acts as a sedimentation basin that, under ideal conditions, should allow sand with grain diameters of about 0.1 millimeter (mm) and larger to settle out at the design pumping rates of the wells (600-800 gpm). Usually 80 to 90 percent or more of the aquifer material in the screened interval of the wells exceeds the 0.1 mm grain size.

*Sand Pumpage Results*

Samples were collected after the step tests whenever a sufficient amount of sediment remained in the tank to allow analysis of the grain size distribution. Samples were prepared and sieved at the Quaternary Materials Laboratory of the Dlinois State Geological Survey. In all, 4 of the 11 step tests in which the portable sand tank was used generated a sample large enough for collection. Appendix E contains the data for these samples. The other three wells, I-70 Wells 4, 6, and 14, would have also been checked but were not because the portable tank was required to divert discharged water into a drainage system manhole to prevent water on the pavement. A discussion of the results for each well follows.

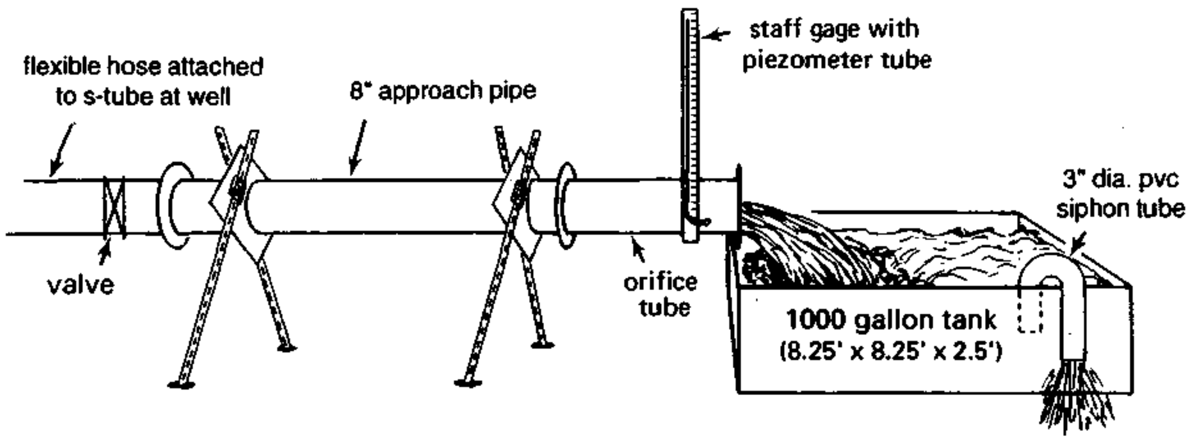


Figure 9. Sand pumpage test setup

I-70 Well 4:

The settling tank was used to divert the discharged water into a manhole. This would have allowed settlement of some sand, but only a few grains of sand were detected after the step test on May 11, 1995. No sample was collected. The previous step test on Well 4 was on January 8, 1987, prior to use of the portable settling tank.

I-70 Well 6:

The settling tank was used to divert the discharged water into a manhole. This would have allowed settlement of some sand, but only a few grains of sand were detected after the step test on May 12, 1995. No sample was collected. A sample of medium to coarse sand had been collected during the posttreatment step test on October 29, 1991. Olson and Sanderson (1997) noted that the pumping of sand after chemical treatment might be only temporary.

I-70 Well 7A:

A very small amount (<1 teaspoon) of fine sand was detected in the settling tank after the step test on May 5, 1994. The amount was insufficient for sample collection. A very small sample of very fine sand had been collected after the posttreatment step test on August 6, 1991.

I-70 Well 8A:

A sample of very fine sand and some encrustation particles were collected from the tank after the pretreatment step test on December 17, 1992. The sample amounted to about ½ cup and was probably about 75 percent of the material in the settling tank. Figure 10 shows the results of the sieving of the sample. As much as 60 to 65 percent of the sample was fine sand. A sample of sand also was collected during the previous step test on this well on October 1, 1991, although no sand was found in the settling tank after the initial step test on October 4, 1989. The sand being pumped may be the result of problems encountered during construction of the well in 1989. As described by Olson et al. (1992), the drilling was stopped short of the target depth due to large cobbles, and the borehole collapsed during placement of the gravel pack. These problems likely resulted in native aquifer material against the upper part of the installed well screen (0.020-inch slot openings). About 85 to 90 percent of the collected sample could pass through the well screen.

I-70 Well 8A:

A sample of fine sand and encrustation material was collected from the settling tank after the posttreatment step test on March 16, 1994. The amount of the material was about ½ to 1 cup. Figure 11 shows results of the sieving of the sample. As much as 70 to 75 percent of the sample was medium to coarse sand. This sample was coarser grained than the sample collected during the pretreatment step test on December 17, 1992. In addition to the situation described above, it is possible that the chemical treatment of the well disturbed the gravel pack and native aquifer material enough to allow sand to be pumped. Pumping coarser grained material may be only temporary but should be monitored.

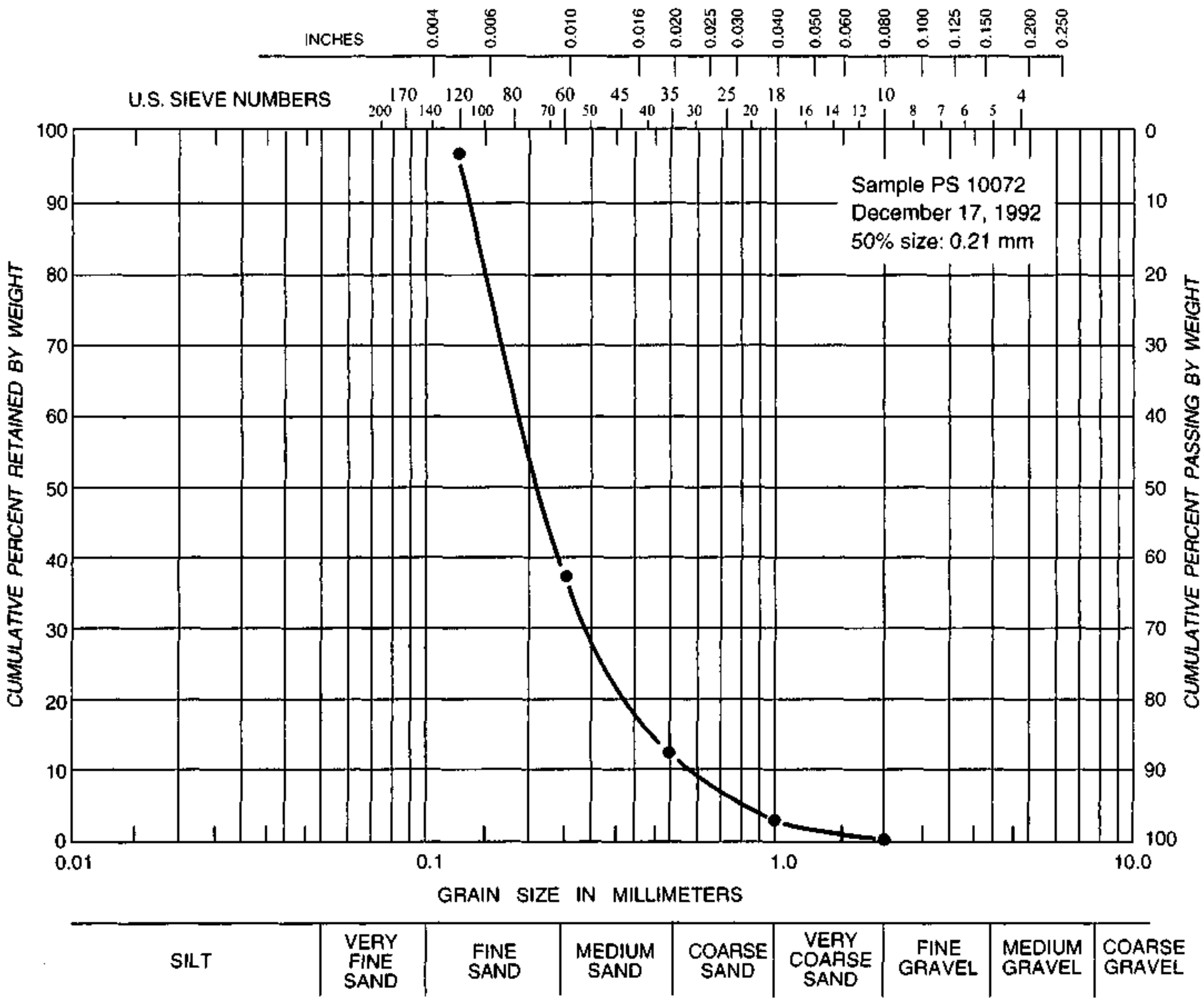


Figure 10. Sieve analysis of material pumped from I-70 Well 8A (12/17/92)

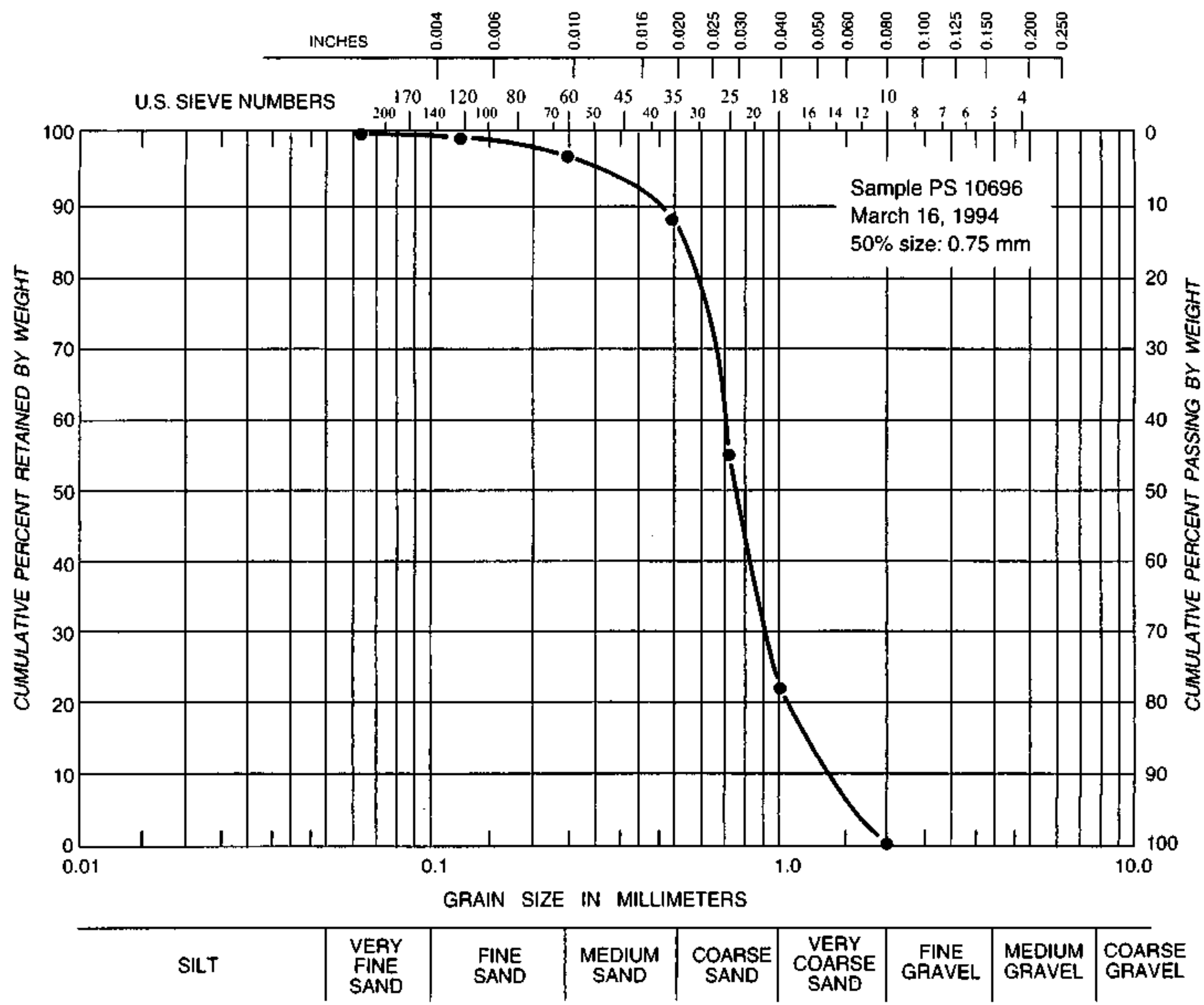


Figure 11. Sieve analysis of material pumped from I-70 Well 8A (3/16/94)

I-70 Well 9A:

Some encrustation material was found in the tank after the step test on May 12, 1994. No sand was detected. No sand was detected in the settling tank after the condition assessment step test on July 23, 1992.

I-70 Well 10:

A substantial amount of fine sand and some gravel pack were found in the settling tank after the step test on August 1, 1995. A sample volume of about 2 cups was collected, representing about 75-80 percent of the material in the tank. Figure 12 shows results of the sieving of the sample. About 80 percent of the sample was very fine to medium sand. A sample of sand also was collected from Well 10 during both the pre- and posttreatment step tests on February 7, 1991, and August 8, 1991, respectively. This sample was similar in texture to the sample collected on February 7, 1991. It appears that migration of the coarse sand fraction of the aquifer material through the gravel pack and well screen ceased after the posttreatment step test although the fine sand fraction continued to move through the gravel pack.

I-70 Well 13:

Several large chunks of encrustation material were found in the settling tank after the step test on April 25, 1995. No sand was detected. Only a trace amount of sand was found in the tank after the initial step test on April 25, 1991.

I-70 Well 14:

The settling tank was not used during the step test on June 22, 1994; no sample was collected. The initial step test on Well 14 on December 20, 1990, provided a sample of material. Sanderson and Olson (1993) indicated that the high pumping rate during the step test and the short length of time the well had been in service may have contributed to the occurrence of material in the discharge.

25th St. Well 4:

No sand was detected in the settling tank after the step test on July 24, 1992. A large sample of sand had been collected after the posttreatment step test conducted on November 19, 1991. It appears that disturbance of the gravel pack and native aquifer material during the chemical treatment was the cause of pumping sand at that time.

25th St. Well 8:

Only a few grains of sand and some soft incrustation material remained in the tank after the posttreatment step test on November 15, 1993. No sample was collected. A very small sample of incrustation material with fine sand also had been collected after the condition assessment step test on April 24, 1991.

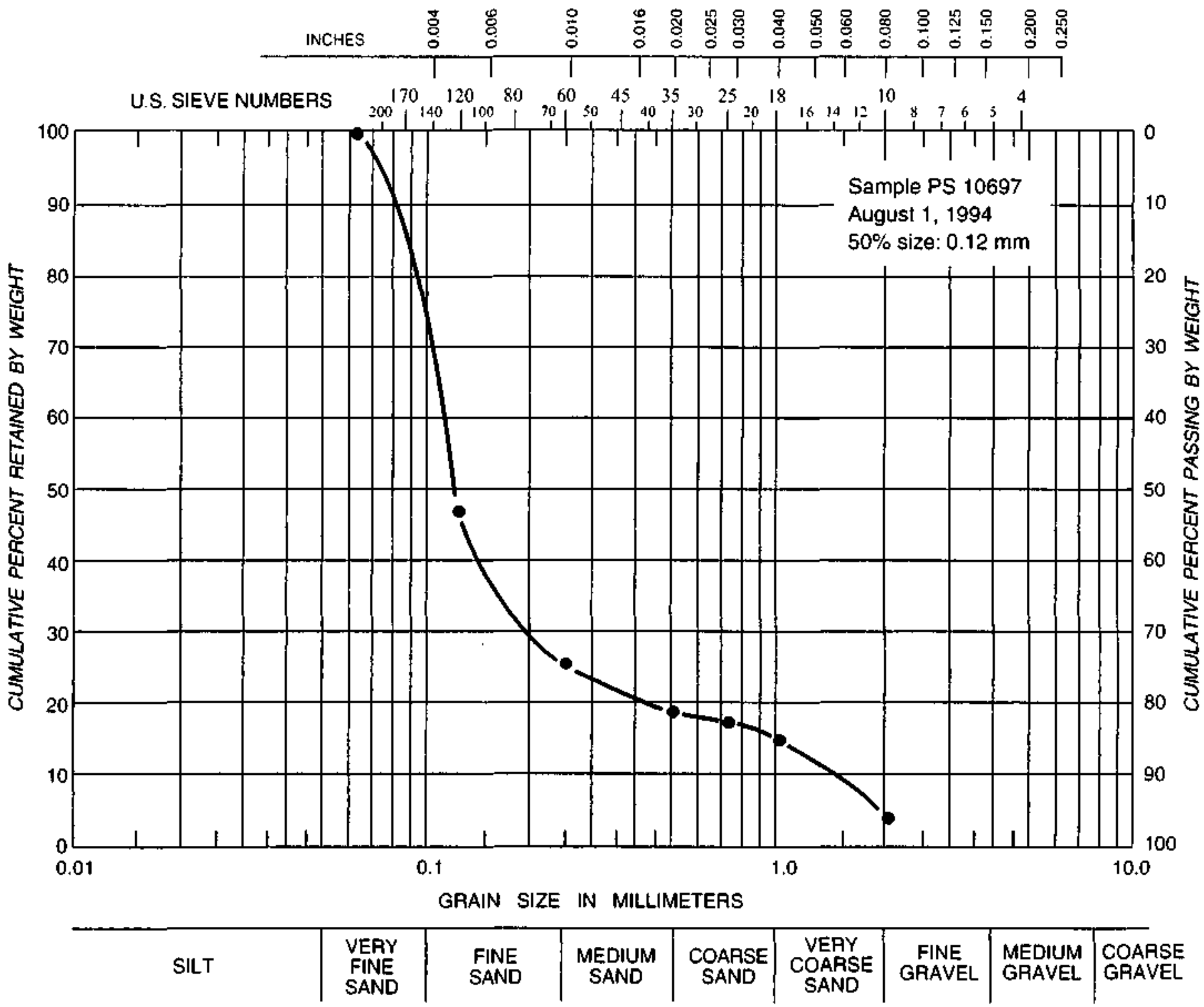


Figure 12. Sieve analysis of material pumped from I-70 Well 10 (8/1/95)

Venice Well 1:

A significant amount of sand was collected from the settling tank after the condition assessment step test on March 29, 1994. Figure 13 shows sieve data for the sample. More than 95 percent of the sample consists of fine to very fine sand. It is possible that the sample could have migrated through the pack material into the well. This cannot be concluded, however, because the grain size distribution of the gravel pack installed in this well is unknown. Because the volume of the collected sample was large compared to that of other samples, the situation should be closely monitored in the future.

A sample of sand also was collected from Well 1 after the condition assessment step test on September 6, 1989. Sanderson and Olson (1993) tentatively concluded that the fine-to-medium sand in the 1989 sample could easily have migrated through the gravel pack and well screen into the well. The 1994 sample was mostly fine sand that also could migrate through the gravel pack and well screen. It is possible that this well has always pumped sand and will continue to do so because of the gravel pack selected for use.

Venice Well 6A:

A very small amount (<1 teaspoon) of fine sand was detected in the settling tank after the step test on June 23, 1994. The amount was insufficient for sample collection. A small sample had been collected from the settling tank after the initial step test on March 20, 1991. Sanderson and Olson (1993) suggested that the sample might have been the result of abnormally high pumping rates during the step test.

Venice Well 7:

No sand was detected in the settling tank after the condition assessment step test on May 4, 1994. No sand was found in the tank after the initial step test on February 27, 1991.

Results of the tests for sand pumpage from the dewatering wells have yielded interesting information. It appears that chemical treatment of some wells to restore production rates influences the tendency for a dewatering well to pump sand. In some cases it appears that the treatment may cause sufficient disturbance of the gravel pack and native aquifer material to allow the well to either pump sand for some period of time after treatment or to pump sand of a somewhat coarser grain size than is pumped in routine operation. Examples include I-70 Well 6, I-70 Well 8A, I-70 Well 10, and 25th Street Well 4.

It appears that sand may be pumped from Venice Well 1 on a continuing basis in routine operation. As indicated, the gravel pack selected for use in this well was likely inappropriate for the grain size of the aquifer present at the well site, or the gravel pack inappropriately came in contact with fine materials above the well screen. Chemical treatment of the well in August 1985 is not believed to have contributed significantly to the sand pumping situation in this case.

Since sand pumpage tests began in FY 87 (Phase 4), a total of 38 dewatering wells have been checked for sand pumpage. Nineteen of these wells have pumped an amount of sand judged to be significant during at least one step test, and five of those wells have been abandoned and replaced with new wells. Sand has been pumped on at least one occasion in nine of 20

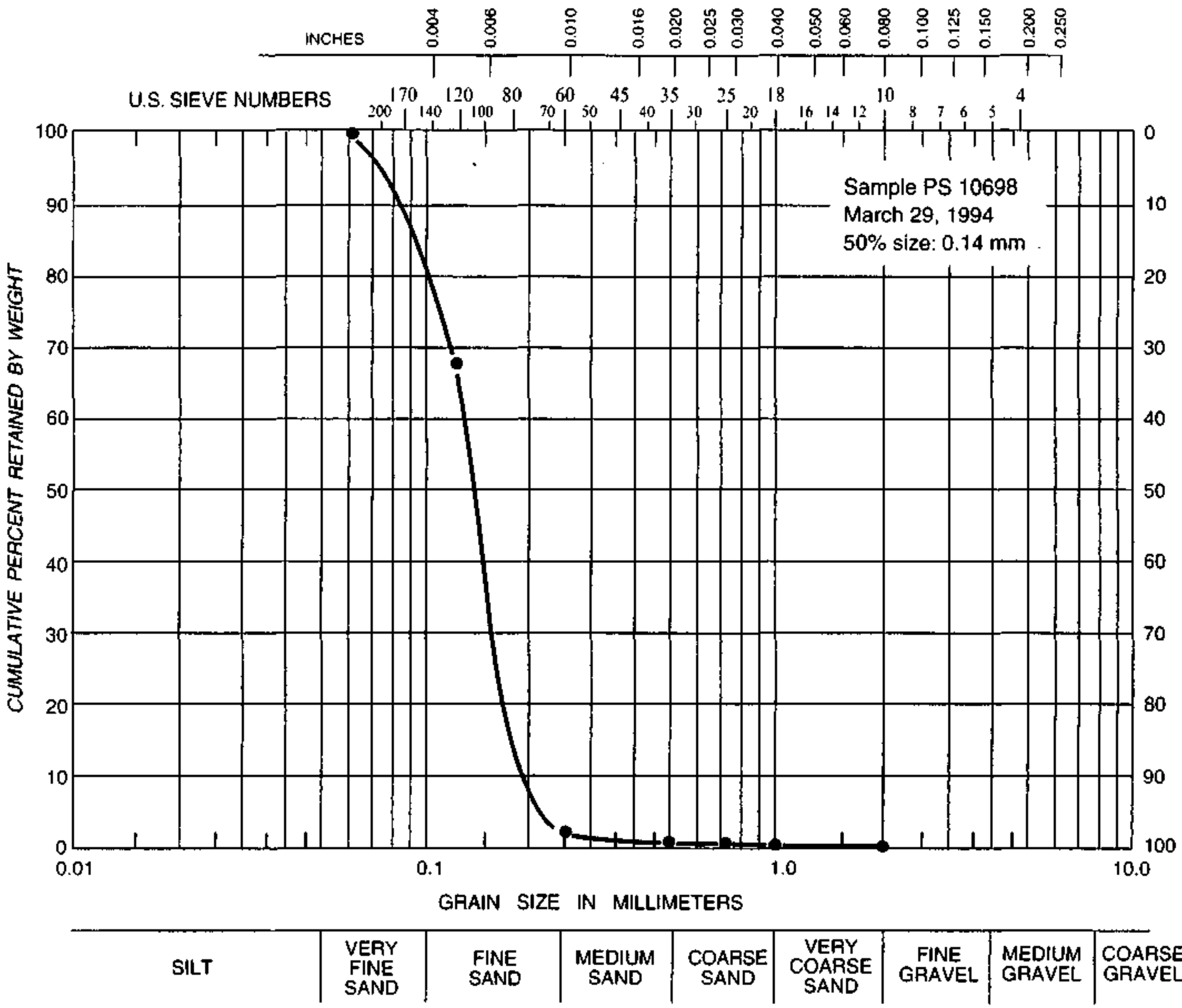


Figure 13. Sieve analysis of material pumped from Venice Well 1 (3/29/94)

different dewatering wells tested at the I-70 site, three of eight different wells tested at the 25th Street site, and six of the eight wells at the Venice site. Only two wells have been tested at the I-64 site, with one well pumping sand.

## Evaluation of Ground-Water Quality

The Water Survey's Office of Analytical & Water Treatment Services analyzed water samples collected during all 14 of the step tests on 13 dewatering wells. Appendix B reports the results. Analytical methods used conform to the latest procedures certified by the U.S. Environmental Protection Agency (USEPA). Samples were preserved with acid for determining iron, calcium, and magnesium concentrations. The sample temperature was determined at each well site, and pH of samples was determined in the laboratory. Table 6 presents the range of concentrations and potential influence of the major water quality parameters analyzed.

**Table 6. Range of Concentrations and Potential Influence of Common Dissolved Constituents**

| *Parameter* | *Concentration. mg/L* | | *Potential influence* |
|---|---|---|---|
| | *Minimum* | *Maximum* | |
| Iron (Fe) | 2.97 | 18.94 | Major - incrustative |
| Manganese (Mn) | 0.45 | 1.37 | Major - incrustative |
| Calcium (Ca) | 152 | 239 | Major - incrustative |
| Magnesium (Mg) | 38.1 | 61.4 | Minor - incrustative |
| Sodium (Na) | 22.7 | 261 | Neutral |
| Silica ($SiO_2$) | 16.4 | 39.4 | Minor - incrustative |
| Nitrate ($NO_3$) | <0.02 | 0.46 | Neutral |
| Chloride (Cl) | 35.8 | 93.5 | Moderate - corrosive |
| Sulfate ($SO_4$) | 153 | 902 | Major - corrosive |
| Alkalinity (as $CaCO_3$) | 349 | 491 | Major - incrustative |
| Hardness (as $CaCO_3$) | 538 | 836 | Major - incrustative |
| Total dissolved solids | 682 | 1880 | Major - corrosive |
| pH | 7.1 | 7.9 | Major - incrustative |

Although the ground-water samples vary in water chemistry, generally the ground water can be described as highly mineralized, very hard, and alkaline, with unusually high concentrations of soluble iron. The water quality is consistent with that of previously analyzed samples from the dewatering wells.

A total of 128 water samples have been analyzed since our studies began in FY 84 (Phase 1). Appendix F contains results from all of the analyses, grouped according to site, and these results are summarized in table 7. There appear to be few important differences between

## Table 7. Ground-Water Chemical Quality Summary, FY 84-FY 93 (Phases 1-10)

| *Site* | | *Iron Fe (mg/L)* | *Manganese Mn (mg/L)* | *Calcium Ca (mg/L)* | *Magnesium Mg (mg/L)* | *Sodium Na (mg/L)* | *Silica SiO2 (mg/L)* | *Nitrate NO3-N (mg/L)* | *Chloride Cl (mg/L)* | *Sulfate SO4 (mg/L)* | *Alkalinity CaCO3 (mg/L)* | *Hardness CaCO3 (mg/L)* | *TDS (mg/L)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I-70 | Average | 11.8 | 0.76 | 191 | 45.3 | 75.0 | 32.3 | 0.47 | 97 | 303 | 417 | 662 | 1046 |
| | Minimum | 2.97 | 0.44 | 131 | 35.2 | 26.2 | 20.0 | <0.02 | 39 | 151 | 316 | 507 | 736 |
| | Maximum | 18.8 | 1.49 | 239 | 63.8 | 230 | 38.0 | 3.7 | 230 | 694 | 593 | 834 | 1642 |
| | No. of samples | 64 | 48 | 64 | 64 | 64 | 56 | 33 | 64 | 64 | 64 | 64 | 64 |
| I-64 | Average | 16.2 | 0.55 | 232 | 58.0 | 103 | 33.7 | 0.6 | 79 | 540 | 447 | 821 | 1403 |
| | Minimum | 12.30 | 0.47 | 202 | 44.3 | 29.8 | 30.5 | <0.1 | 41 | 350 | 412 | 725 | 974 |
| | Maximum | 20.0 | 0.60 | 277 | 74.1 | 269 | 35.6 | 2.3 | 390 | 787 | 512 | 998 | 1997 |
| | No. of samples | 15 | 6 | 15 | 15 | 15 | 14 | 6 | 15 | 15 | 15 | 15 | 15 |
| 25th St. | Average | 12.2 | 0.58 | 177 | 51.0 | 123.6 | 34.2 | 0.1 | 34 | 520 | 397 | 651 | 1235 |
| | Minimum | 4.50 | 0.36 | 123 | 35.4 | 14.2 | 31.2 | <0.1 | 21 | 122 | 331 | 467 | 612 |
| | Maximum | 22.9 | 0.82 | 250 | 73.1 | 314.0 | 39.4 | 0.2 | 49 | 1171 | 477 | 898 | 2335 |
| | No. of samples | 24 | 20 | 24 | 24 | 24 | 17 | 10 | 24 | 24 | 24 | 24 | 24 |
| Venice | Average | 17.2 | 0.56 | 208 | 50.6 | 41.3 | 32.4 | 0.2 | 62 | 338 | 434 | 726 | 1032 |
| | Minimum | 8.28 | 0.39 | 180 | 42.2 | 28.9 | 24.4 | <0.02 | 25 | 218 | 387 | 635 | 890 |
| | Maximum | 25.7 | 0.72 | 261 | 61.2 | 65.1 | 39.6 | 0.8 | 124 | 490 | 476 | 890 | 1241 |
| | No. of samples | 25 | 18 | 25 | 25 | 25 | 22 | 9 | 25 | 25 | 25 | 25 | 25 |

the sites in terms of these water-quality parameters. Iron concentration is indicated to be higher in the water from the I-64 and Venice sites, and the water from the I-64 and 25th Street sites contains more dissolved minerals, but these trends probably do not matter much from a practical standpoint, since the concentrations are already very high at all locations.

**Nuisance Bacteria Sampling**

Nuisance bacteria (e.g., iron bacteria, sulfate-reducing bacteria, etc.) that inhabit wells, gravel packs, and the aquifer matrix often produce well-plugging biofilms, as well as an environment favorable for chemical deposition and corrosion processes. To explore in as many of the dewatering wells as possible the chance that such bacteria might be present, water samples were collected from the well discharge at the time of the step tests and checked for the presence of nuisance bacteria with the Biological Activity Reaction Test (BART) systems developed by Droycon Bioconcepts, Inc., Regina, Saskatchewan. The BART tests are customized to detect three general classes of nuisance bacteria commonly associated with problems in wells: iron-related bacteria (IRB), slime-forming bacteria (SLYM), and sulfate-reducing bacteria (SRB). The BART system was previously used during FY 90 to identify the presence of nuisance bacteria in the I-255 Detention Pond relief wells and in conjunction with 14 step-tested dewatering wells during FY 91 (Sanderson et al., 1993) and 16 step-tested dewatering wells during FY 92 (Olson and Sanderson, 1997).

The testing protocol requires placing a water sample in the test vial for examination over a period of days, and documenting any reactions that may occur. The bacterial population or activity in the water sample is inversely related to the length of time before reactions occur. Reaction types and patterns of occurrence depend on the dominant bacterial groups present in the water (Cullimore, 1990). Thus, the type and size of bacterial community can be inferred from this reaction signature. Multiple sets of samples collected at time intervals of pumping are recommended for detailed analysis of the bacterial activity (Mansuy et al., 1990).

BART samples were collected during 13 step tests on 12 dewatering wells step-tested for FY 93 (BART samples are missing for the 14th FY 93 step test on a 13th well because the well-head piping adapter failed during the test), all using the same procedure. Since the purpose was to simply determine whether nuisance bacteria are present in the wells, only one sample set, consisting of IRB, SLYM, and SRB samples, was collected for each step-tested well. Samples were collected from the orifice tube discharge, usually in sequence with the other water samples being collected for analysis of the dissolved constituents, near the end of the test.

The results for most of the BART samples indicated high to moderate amounts of nuisance bacteria activity in the discharge water from the wells. Generally, the SRB tests appeared to showed positive reactions somewhat later than the IRB and SLYM tests. In all but two wells, the IRB and SLYM tests showed high to moderate bacterial activity; whereas, the SRB tests indicated this level in about half of the wells. At the other end of the spectrum, bacterial activity was indicated as low by only one SLYM test, two SRB tests, and no IRB tests. None of the tests indicated low bacterial activity in more than one sample in a set from a well.

These results were similar to those reported in FY 91 and FY 92, the first years that these tests were used on the dewatering wells.

There continues to be little correlation between the indication of well conditions from the step tests and reaction response signatures from the BART samples. BART samples collected from the wells in the poorest hydraulic condition showed similar response patterns in a comparable time frame to samples collected from wells in very good condition.

BART samples were collected during the pre- and posttreatment step tests on two wells that received chemical treatment during FY 93 (although samples for one of the pretreatment steps tests was from FY 91. Although some differences in the reactions occurred before and after treatment, no meaningful conclusions can be drawn at this time from such a small data set. When compared to the BART results from all of the nontreated wells, results for the nine wells treated in FY 91, FY 92, and FY 93 fall within the same range of high to moderate bacterial activity.

Since the samples have been collected near the end of the step tests after many well volumes of water have been pumped from the wells, it is safe to assume that the water sampled is being derived totally from the aquifer. Therefore, the rapid bacterial activity usually observed means that there is substantial biomass development within the well casing and screen that is slowly sloughing off during the step-test pumping on most of the wells, or a significant population of the bacteria is present in the aquifer, or both.

When taking into consideration that all of the dewatering well-heads are located in pits that can be readily subjected to contamination from pit seepage or spill water, the high degree of nuisance bacteria activity is not that surprising. Although nuisance bacteria can be present in ground water, most of these types of bacteria are ubiquitous in the surface environment. Using sanitary well heads and taking precautions such as disinfection after performing maintenance activities on the wells are good preventative measures for keeping the wells free of bacterially induced problems.

## Chemical Quality of Water Discharged from the Drainage System

Water from the dewatering wells (at all but the Venice site) enters the storm water drainage system of the depressed section of interstate highway and collects at the Bowman pump station where it is discharged to Schoenberger Creek, flows through Cahokia Canal, and on to the Mississippi River. Dewatering wells at Venice discharge via a separate collection system into the Metro East Sanitation District storm water grid where it is routed into the Mississippi River. As discussed earlier, the chemical content of the water discharged from the individual wells during the step tests has been checked for a number of inorganic and metal constituents. However, for IDOT's long-range planning purposes, the FY 93 scope of work included an initial screening of the quality of the combined well discharges that flows from the drainage systems at the outfalls to Schoenberger Creek/Cahokia Canal and the Mississippi River. The quality screening included the determination of the concentration of heavy metals and volatile organics in the water, along with the other inorganics included in the Illinois Effluent Standards (Illinois Administrative Code, 1994).

Three locations in the interstate storm water system were selected for sample collection as shown in figure 14:

- Inlet to the Bowman pump station
- Bowman pump station outfall to Schoenberger Creek
- Combined well discharge from 25th Street entering the Bowman storm water drainage system at the junction chamber near 18th Street

The combined well discharge point samples water discharged from the 25th Street Wells through a force main as it enters the Bowman storm water drainage system. The other two sample points provide water from the dewatering wells that has traveled by gravity flow through the storm water system and may have commingled with any other waters entering the system. The inlet location samples this water prior to its pumpage through the pump station, whereas the outfall location samples the water after it is pumped and discharged from the pump station into the creek.

Sampling of the combined discharge from the Venice wells occurred through an air relief valve in the 14-inch-diameter header pipe as it passed over the top of a levee (figure 14).

Two sets of samples, taken 7 weeks apart, were collected from these four sites at times intended to minimize the surface water contribution to the storm water system. In addition, a third set of samples was to be collected near the end of a significant rainfall event from the Bowman Station inlet and outfall, but this was abandoned after several unsuccessful attempts.

*Sampling Methodology*

Simple grab samples were collected at the Bowman pump station inlet by dipping water directly from the incoming flow with a sample container as it exited the 72-inch-diameter inlet pipe. A peristaltic pump was used to collect samples from the Bowman outfall, 25th Street, and Venice discharges. Samples were filtered and preserved in the field, packed in ice, and transported to the Water Survey laboratory, in Champaign, within 24 hours for analysis. To maintain quality assurance/quality control, trip blanks, and spiked and duplicate samples were included in the sample collection runs as part of the Quality Assurance Plan.

The first set of samples was collected on September 21-22, 1992, the second set on November 9, 1992. Table 8 identifies the dewatering wells pumping at the time of the sampling events as reported by IDOT.

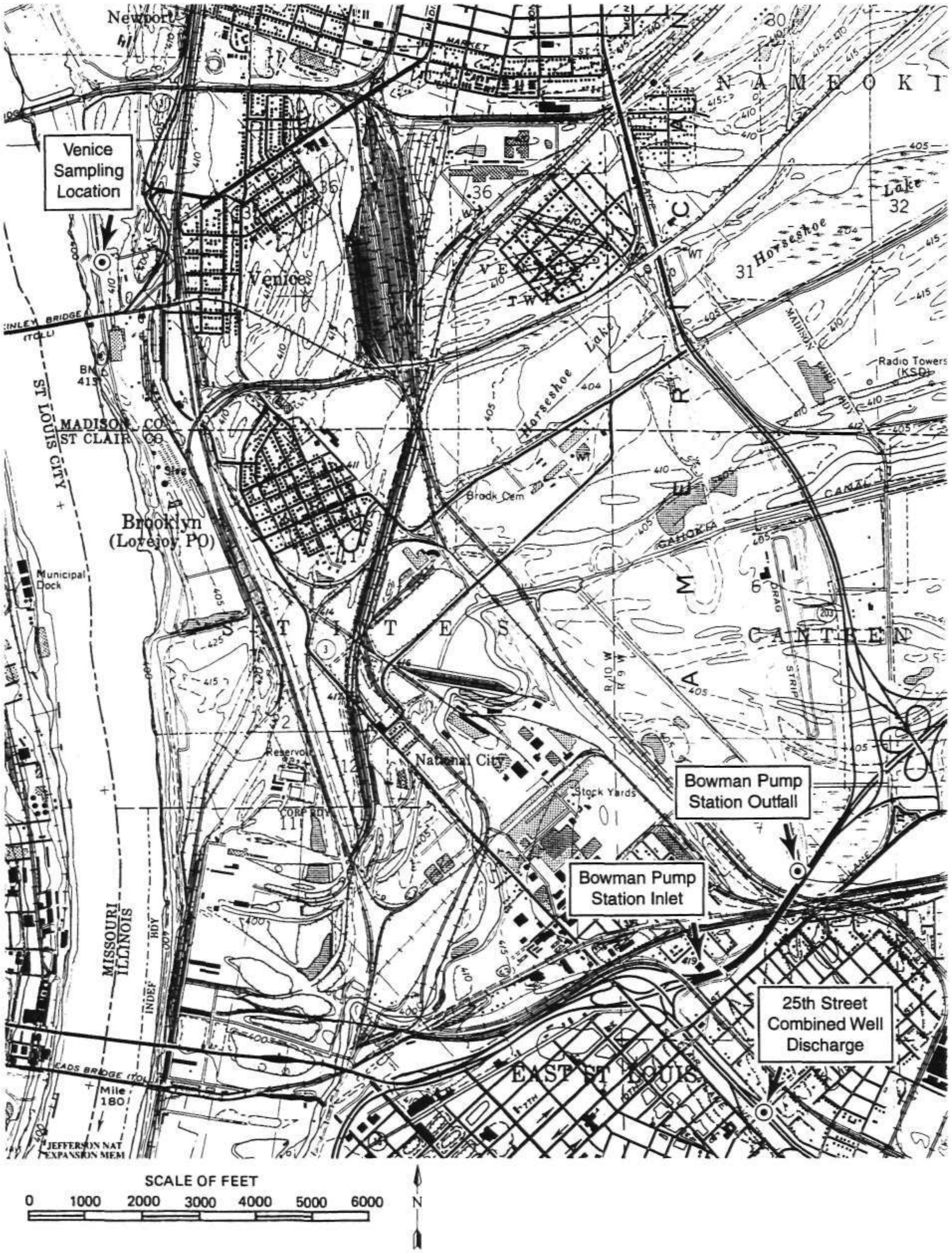


Figure 14. Drainage system sampling locations

**Table 8. Dewatering Wells in Operation at Time of Sampling**

| *Site* | *September 21-22, 1992* | *November 9, 1992* |
|---|---|---|
| I-70 Wells | 2A, 3A, 4, 6, 10, 11A, 12A, 13, 14, 15 | 2A, 3A, 4, 5, 7A, 8A, 10, 11A, 12A, 13, 14, 15 |
| I-64 Wells | 6,8,9, 18 | 6,8,9, 18 |
| 25th Street Wells | 1, 9 | 2, 4, 7, 9 |
| Venice Wells | 4 | 1,3,5 |

*Results*

Gas chromatography (GC) was used to measure 56 volatile organic compounds (VOCs), using USEPA Method 502.2 (U.S. Environmental Protection Agency, 1988), including the drinking-water-regulated VOCs and total trihalomethanes. Inductively coupled argon plasma emission spectrometry was used to measure the concentrations of 32 metals. Sixteen additional inorganic parameters were measured using standard laboratory methods. Most of these parameters are unregulated, but the Dlinois Environmental Protection Agency routinely analyzes for many of them. Appendix H presents the results of the analyses.

Only five of the VOCs had concentrations above the laboratory method detection limit (MDL) at the inlet and outfall to the Bowman pump station. Neither the 25th Street or Venice discharges, which are strictly pumped water under pressure from the dewatering wells, had measurable amounts of any VOCs. Furthermore, the amounts detected were very low-well below the maximum contaminant level (MCL) set by the Safe Drinking Water Act, except for 1,2,4-trimethylbenzene, which does not have an established MCL.

In all cases, the VOC concentrations were equal to or slightly lower at the outfall than at the inlet to the pump station. Two compounds, 1,2,4-trimethylbenzene and trichloroethylene, were only detected in samples collected on September 21-22, 1992.

Results for metals and other inorganic parameters indicate concentrations very similar to those reported for water samples collected from individual dewatering wells during step tests and peculiar to ground water in this part of Illinois. Most notable was the unusually high concentration of iron, which is regarded as an aesthetic nuisance above 0.3 mg/L. The water also contains significant amounts of manganese and total dissolved minerals, and is very hard, qualities that are undesirable for some water use purposes. The total suspended solids concentration from the Bowman outfall was elevated substantially above concentrations determined for other sampling locations. Concentrations of the metals not previously tested for in water from the dewatering wells were low, probably within normal background limits.

## CONCLUSIONS AND RECOMMENDATIONS

### Condition of Wells

Results of the step tests conducted to assess the condition of 11 existing wells show that I-70 Wells 4 and 6 and 25th Street Well 4 are in acceptable to good condition. I-70 Wells 7A, 9A, and 10, and Venice Well 6A are in fair condition, with specific capacities about 57 to 81 percent of the average specific capacities of wells in good condition at the respective sites.

Four wells are in poor condition. I-70 Wells 13 and 14, and Venice Wells 1 and 7 have observed specific capacities about 31 to 35 percent of the average specific capacity of wells in good condition at the respective sites and Ah values of 4.4 to 14.6 feet at 600 gpm where values could be determined. Chemical treatment is recommended to improve the condition of these four wells. Video inspection of these wells for excessive buildup of incrusting minerals also should be considered.

On the basis of data collected by the contractor at the time of treatment, I-70 Well 8A and 25th Street Well 8 appear to be restored to acceptable condition. Step test data for 25th Street Well 8 confirm the acceptable condition. However, the step test on I-70 Well 8A was delayed for more than a year after treatment and does not confirm the condition information collected by the contractor. It is likely that new deterioration of the hydraulic condition of I-70 Well 8A occurred before the posttreatment step test was conducted.

### Well Rehabilitation

Chemical treatments used to restore well capacity in FY 93 (Phase 10) were moderately successful. Drawdown data collected during treatment by the contractor indicate that an average increase in specific capacity of the four wells of about 48 percent, while the Water Survey step-test data show improvement of about 62 percent. Posttreatment specific capacities of I-70 Well 8A and 25th Street Well 8 are about 79 percent and 81 percent of the average specific capacity of wells in good condition at the respective sites.

The change in chemical treatment specifications made in FY 90 to provide for optional polyphosphate treatment steps after the second application reduced the total number of polyphosphate treatments applied to these two wells. Optional third and fourth polyphosphate treatment steps were dropped at both treated wells on the basis of the field observations made at the time of the treatment.

### Sand Pumpage Investigation

Discharge from 10 dewatering wells was tested for sand pumpage during 11 step tests. The other three wells, I-70 Wells 4, 6, and 14, would also have been checked but were not because the portable tank was required to divert discharged water into a drainage system manhole to prevent water on the pavement. Sediment collected after four of the step tests on 10 wells was visually inspected for the presence of sand and gravel pack, and sieved to determine grain size distribution.

Results of the tests for sand pumpage from the dewatering wells have yielded some interesting information. It appears that the chemical treatment of some wells to restore production rates does influence the tendency for a dewatering well to pump sand. In some cases, it appears that the treatment may cause sufficient disturbance of the gravel pack and native aquifer material to allow the well to either pump sand for some period of time after treatment or to pump sand of a somewhat coarser grain size than is pumped in routine operation. Examples include I-70 Well 6,I-70 Well 8A, I-70 Well 10, and 25th Street Well 4.

It appears that sand may be pumped from Venice Well 1 on a continuing basis in routine operation. As indicated, the gravel pack selected for use in this well was likely inappropriate for the aquifer grain size present at the well site. Chemical treatment of the well in August 1985 is not believed to have significantly contributed to the sand pumping situation in this case.

It is recommended that a check for the presence of sand in the discharge be continued during future step tests. This will continue to allow a qualitative assessment of the sand pumpage problem. It is possible that some of the wells produce sand occasionally because of well development, as might occur immediately after an idle well is restarted. This can be verified as more wells are repeatedly checked during step tests.

### Nuisance Bacteria Sampling

BART samples were collected during 13 step tests on 12 dewatering wells step-tested in FY 93, all using the same procedure. Results from limited testing in FY 91-FY 93 can only be considered preliminary. Even though the relatively high level of nuisance bacteria identified in the dewatering wells represents a significant potential for causing well plugging, the data clearly show that even wells in good condition contain the bacteria. It also appears that chemical treatments used to rehabilitate the wells do not eliminate the nuisance bacteria from the wells. Widespread bacteria in the wells sampled might mean that they are indigenous to the ground water, or that they are being regularly introduced into the wells from some other source. In either case, the problems associated with their presence will need to be managed on a continual basis. It is recommended that more background data be collected using the BART sets, as additional dewatering wells are step-tested. Although the use of BART sets for more detailed analysis of some of the wells probably is not warranted now, it may be considered in the future.

### Chemical Quality of Water Discharged from the Drainage System

Results from the detailed initial screening of the chemical quality of water discharged from the Bowman drainage system revealed that the water at the time of sampling contained only five VOCs included in the analysis using USEPA Method 502.2, and these compounds were at very low concentrations. No VOCs were detected in the water samples collected from the 25th Street or Venice combined well discharge.

Results for metals and other inorganic parameters indicate concentrations characteristic of those that have been reported for the samples collected from the dewatering wells at the time of the step tests and of those reported for ground water in this part of Illinois. The water is very hard. It also contains significant amounts of manganese, total dissolved minerals, and an unusually high concentration of iron. Concentrations of heavy metals and other inorganic parameters are low or within normal background limits.

### Future Investigations

A program of continued investigation of the condition of the dewatering wells is recommended. Measuring the difference between water levels in a well and the adjacent piezometer will continue to be an important first step in determining whether a well is a candidate for future step tests or treatment. In addition, if a well is pumping sand, this points out a potentially major problem with the well. A sand pumpage investigation is recommended as a standard part of each step test.

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## Appendix A.

### Step Test Data, FY 93 (Phase 10)

| | | |
|---|---|---|
| I-70 | Well 4 | 05/11/95 |
| | Well 6 | 05/12/95 |
| | Well 7A | 05/05/94 |
| | Well 8A | 12/17/92 |
| | Well 8A | 03/16/94 |
| | Well 9A | 05/12/94 |
| | Well 10 | 08/01/95 |
| | Well 13 | 04/25/95 |
| | Well 14 | 06/22/94 |
| 25th St. | Well 4 | 07/24/92 |
| | Well 8 | 11/15/93 |
| Venice | Well 1 | 03/29/94 |
| | Well 6A | 06/23/94 |
| | Well 7 | 05/04/94 |

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W4* | *Piezometer No. Destroyed* |
|---|---|---|
| Date Drilled: | 1973 | - |
| Casing | | |
| Top elevation: | na | - |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | na | na |
| Screen | | |
| Bottom elevation: | 303.13 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 60 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 389.1 | - |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 19.77 | - |
| Height of temp. MP (ft): | 7.5 | - |
| Depth below perm. MP (ft): | 12.27 | - |
| Elevation: | 376.83 | - |
| Date of Step Test: | 5/11/95 | - |
| Water Sample | | |
| Time: | 2:30 pm | - |
| Temperature: | 57.7° F | - |
| Laboratory No.: | 228699 | - |
| Distance and Direction to Piez. from PW: | | na |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Hermit Lin 1 (1 min.) sample rate
Sand tank used as collection basin to direct water into manhole
na-information not available

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 4
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 05/11/95 | | | | | | |
| 12:02 pm | 0 | 19.77 | | | | Solinst dropline |
| 12:15 pm | 0 | 19.76 | | | | Data logger started |
| 12:16 pm | 1 | 19.75 | | | | Water level trend |
| 12:17 pm | 2 | 19.75 | | | | Piezometer destroyed |
| 12:18 pm | 3 | 19.75 | | | | |
| 12:19 pm | 4 | 19.75 | | | | |
| 12:20 pm | 5 | 19.76 | | | | |
| 12:21 pm | 6 | 19.75 | | | | |
| 12:22 pm | 7 | 19.74 | | | | |
| 12:23 pm | 8 | 19.74 | | | | |
| 12:24 pm | 9 | 19.74 | | | | |
| 12:25 pm | 10 | 19.74 | | | | |
| 12:26 pm | 11 | 19.74 | | | | |
| 12:27 pm | 12 | 19.74 | | | | |
| 12:28 pm | 13 | 19.73 | | | | |
| 12:29 pm | 14 | 19.73 | | | | |
| 12:30 pm | 15 | 19.74 | | | | |
| 12:31 pm | 16 | 19.74 | | | | |
| 12:32 pm | 17 | 19.74 | | | | |
| 12:33 pm | 18 | 19.73 | | | | |
| 12:34 pm | 19 | 19.73 | | | | |
| 12:35 pm | 20 | 19.73 | | | | |
| 12:36 pm | 21 | 19.73 | | | | |
| 12:37 pm | 22 | 19.73 | | | | |
| 12:38 pm | 23 | 19.73 | | | | |
| 12:39 pm | 24 | 19.73 | | | | |
| 12:40 pm | 25 | 19.72 | | | | |
| 12:41 pm | 26 | 19.72 | | | | |
| 12:42 pm | 27 | 19.72 | | | | |
| 12:43 pm | 28 | 19.72 | | | | |
| 12:44 pm | 29 | 19.72 | | | | |
| 12:45 pm | 30 | 19.71 | | | | |
| 12:46 pm | 31 | 19.71 | | | | |
| 12:47 pm | 32 | 19.71 | | | | |
| 12:48 pm | 33 | 19.71 | | | | |
| 12:49 pm | 34 | 19.71 | | | | |
| 12:50 pm | 35 | | | | | Pump On |
| 12:51 pm | - 1 | 25.74 | | 4.25 | 685 | Step 1; Max rate |
| 12:52 pm | 2 | 26.65 | | | | |
| 12:53 pm | 3 | 27.03 | | | | |
| 12:54 pm | 4 | 26.66 | | 3.81 | 650 | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 12:55 pm | 5 | 26.67 | | | | |
| 12:56 pm | 6 | 26.66 | | | | |
| 12:57 pm | 7 | 26.70 | | | | |
| 12:58 pm | 8 | 26.74 | | | | |
| 12:59 pm | 9 | 26.77 | | | | |
| 01:00 pm | 10 | 26.78 | | 3.79 | 650 | |
| 01:01 pm | 11 | 26.76 | | | | |
| 01:02 pm | 12 | 26.76 | | | | |
| 01:03 pm | 13 | 26.83 | | 3.79 | 650 | |
| 01:04 pm | 14 | 26.80 | | | | |
| 01:05 pm | 15 | 26.83 | | | | |
| 01:06 pm | 16 | 26.85 | | | | |
| 01:07 pm | 17 | 26.84 | | | | |
| 01:08 pm | 18 | 26.83 | | | | |
| 01:09 pm | 19 | 26.89 | | | | |
| 01:10pm | 20 | 26.85 | | 3.78 | 650 | Adjust rate |
| 01:11 pm | 21 | 26.89 | | 3.79 | 650 | |
| 01:12 pm | 22 | 26.87 | | | | |
| 01:13pm | 23 | 26.93 | | | | |
| 01:14 pm | 24 | 26.94 | | | | |
| 01:15 pm | 25 | 26.91 | | 3.79 | 650 | |
| 01:16pm | 26 | 26.91 | | | | |
| 01:17pm | 27 | 26.95 | | | | |
| 01:18pm | 28 | 26.93 | | | | |
| 01:19pm | 29 | 26.95 | | 3.78 | 650 | |
| 01:20 pm | 30 | 26.92 | | 3.78 | 650 | Decrease rate |
| | - | | | | | |
| 01:21 pm | 1 | 26.44 | | 3.22 | 600 | Step 2 |
| 01:22 pm | 2 | 26.39 | | | | |
| 01:23 pm | 3 | 26.39 | | | | |
| 01:24 pm | 4 | 26.41 | | | | |
| 01:25 pm | 5 | 26.45 | | | | |
| 01:26 pm | 6 | 26.41 | | | | |
| 01:27 pm | 7 | 26.40 | | | | |
| 01:28 pm | 8 | 26.45 | | | | |
| 01:29 pm | 9 | 26.40 | | | | |
| 01:30 pm | 10 | 26.46 | | | | |
| 01:31 pm | 11 | 26.42 | | 3.22 | 600 | |
| 01:32 pm | 12 | 26.47 | | | | |
| 01:33 pm | 13 | 26.44 | | | | |
| 01:34 pm | 14 | 26.42 | | | | |
| 01:35 pm | 15 | 26.42 | | | | |
| 01:36 pm | 16 | 26.45 | | 3.22 | 600 | |
| 01:37 pm | 17 | 26.49 | | | | |

## WATER-LEVEL MEASUREMENTS (Continued)
### I-70 Well No. 4

| *Hour* | *Time {min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:38 pm | 18 | 26.47 | | | | |
| 01:39 pm | 19 | 26.42 | | | | |
| 01:40 pm | 20 | 26.44 | | | | |
| 01:41 pm | 21 | 26.45 | | | | |
| 01:42 pm | 22 | 26.44 | | | | |
| 01:43 pm | 23 | 26.49 | | | | |
| 01:44 pm | 24 | 26.48 | | 3.22 | 600 | |
| 01:45 pm | 25 | 26.51 | | | | |
| 01:46 pm | 26 | 26.51 | | | | |
| 01:47 pm | 27 | 26.51 | | | | |
| 01:48 pm | 28 | 26.46 | | | | |
| 01:49 pm | 29 | 26.45 | | | | |
| 01:50 pm | 30 | 26.45 | | 3.22 | 600 | Decrease rate |
| 01:51 pm | 1 | 25.96 | | 2.70 | 550 | Step 3 |
| 01:52 pm | 2 | 26.28 | | | | |
| 01:53 pm | 3 | 26.28 | | | | |
| 01:54 pm | 4 | 26.35 | | | | |
| 01:55 pm | 5 | 26.35 | | 2.68 | 550 | |
| 01:56 pm | 6 | 26.33 | | 2.70 | 550 | |
| 01:57 pm | 7 | 26.43 | | | | |
| 01:58 pm | 8 | 26.45 | | | | |
| 01:59 pm | 9 | 26.40 | | | | |
| 02:00 pm | 10 | 26.45 | | | | |
| 02:01 pm | 11 | 26.40 | | | | |
| 02:02 pm | 12 | 26.47 | | | | |
| 02:03 pm | 13 | 26.47 | | | | |
| 02:04 pm | 14 | 26.47 | | 2.70 | 550 | |
| 02:05 pm | 15 | 26.45 | | | | |
| 02:06 pm | 16 | 26.49 | | | | |
| 02:07 pm | 17 | 26.49 | | | | |
| 02:08 pm | 18 | 26.47 | | | | |
| 02:09 pm | 19 | 26.52 | | | | |
| 02:10 pm | 20 | 26.51 | | 2.70 | 550 | |
| 02:11 pm | 21 | 26.52 | | | | |
| 02:12 pm | 22 | 26.49 | | | | |
| 02:13 pm | 23 | 26.50 | | | | |
| 02:14 pm | 24 | 26.54 | | | | |
| 02:15 pm | 25 | 26.52 | | 2.70 | 50 | |
| 02:16 pm | 26 | 26.52 | | | | |
| 02:17 pm | 27 | 26.56 | | | | |
| 02:18 pm | 28 | 26.51 | | | | |
| 02:19 pm | 29 | 26.55 | | | | |
| 02:20 pm | 30 | 26.56 | | 2.70 | 550 | Decrease rate |

## WATER-LEVEL MEASUREMENTS (Continued)
## I-70 Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| | - | | | | | |
| 02:21 pm | 1 | 26.03 | | 2.23 | 500 | Step 4 |
| 02:22 pm | 2 | 26.05 | | | | |
| 02:23 pm | 3 | 26.00 | | | | |
| 02:24 pm | 4 | 26.03 | | | | |
| 02:25 pm | 5 | 26.04 | | | | |
| 02:26 pm | 6 | 26.00 | | | | |
| 02:27 pm | 7 | 26.05 | | | | |
| 02:28 pm | 8 | 26.05 | | | | |
| 02:29 pm | 9 | 26.06 | | | | |
| 02:30 pm | 10 | 26.05 | | 2.22 | 500 | Water sample collected, |
| 02:31 pm | 11 | 26.03 | | | | T=57.7°F |
| 02:32 pm | 12 | 26.02 | | | | |
| 02:33 pm | 13 | 26.01 | | | | |
| 02:34 pm | 14 | 26.06 | | | | |
| 02:35 pm | 15 | 26.01 | | | | |
| 02:36 pm | 16 | 26.07 | | | | |
| 02:37 pm | 17 | 26.08 | | | | |
| 02:38 pm | 18 | 26.10 | | | | |
| 02:39 pm | 19 | 26.03 | | | | |
| 02:40 pm | 20 | 26.05 | | | | BART samples collected |
| 02:41 pm | 21 | 26.10 | | | | |
| 02:42 pm | 22 | 26.09 | | | | |
| 02:43 pm | 23 | 26.05 | | | | |
| 02:44 pm | 24 | 26.04 | | | | |
| 02:45 pm | 25 | 26.06 | | | | |
| 02:46 pm | 26 | 26.10 | | | | |
| 02:47 pm | 27 | 26.10 | | | | |
| 02:48 pm | 28 | 26.11 | | | | |
| 02:49 pm | 29 | 26.05 | | | | |
| 02:50 pm | 30 | 26.00 | | | | Decrease rate |
| | - | | | | | |
| 02:51 pm | 1 | 25.57 | | | | Step 5 |
| 02:52 pm | 2 | 25.59 | | | | |
| 02:53 pm | 3 | 25.59 | | | | |
| 02:54 pm | 4 | 25.53 | | | | |
| 02:55 pm | 5 | 25.53 | | | | |
| 02:56 pm | 6 | 25.55 | | | | |
| 02:57 pm | 7 | 25.51 | | | | |
| 02:58 pm | 8 | 25.54 | | | | |
| 02:59 pm | 9 | 25.52 | | | | |
| 03:00 pm | 10 | 25.52 | | | | |
| 03:01 pm | 11 | 25.57 | | | | |
| 03:02 pm | 12 | 25.57 | | | | |

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:03 pm | 13 | 25.56 | | | | |
| 03:04 pm | 14 | 25.54 | | | | |
| 03:05 pm | 15 | 25.57 | | | | |
| 03:06 pm | 16 | 25.54 | | | | |
| 03:07 pm | 17 | 25.52 | | | | |
| 03:08 pm | 18 | 25.57 | | | | |
| 03:09 pm | 19 | 25.54 | | | | |
| 03:10 pm | 20 | 25.57 | | | | |
| 03:11 pm | 21 | 25.57 | | | | |
| 03:12 pm | 22 | 25.54 | | | | |
| 03:13 pm | 23 | 25.57 | | | | |
| 03:14 pm | 24 | 25.57 | | | | |
| 03:15 pm | 25 | 25.53 | | | | |
| 03:16 pm | 26 | 25.58 | | | | |
| 03:17 pm | 27 | 25.57 | | | | |
| 03:18 pm | 28 | 25.51 | | | | |
| 03:19 pm | 29 | 25.58 | | | | |
| 03:20 pm | 30 | 25.55 | | | | End of S/T |

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W6* | *Piezometer No. I-70 P6* |
|---|---|---|
| Date Drilled: | 1973 | 1973 |
| Casing | | |
| Top elevation: | 385.9 | 391.9 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 22.4 | na |
| Screen | | |
| Bottom elevation: | 303.45 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 60 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 386.6 | 391.9 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 11.90 | - |
| Height of temp. MP (ft): | 5.1 | - |
| Depth below perm. MP (ft): | 6.80 | 12.11 |
| Elevation: | 379.80 | 379.79 |
| Date of Step Test: | 5/12/95 | - |
| Water Sample | | |
| Time: | 10:46 am | - |
| Temperature: | 58.1° F | - |
| Laboratory No.: | 228701 | - |
| Distance and Direction to Piez. from PW: | | 5.5 ft North |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Hermit Lin 1 (1 min.) sample rate
Sand tank used to divert water into storm sewer manhole
na-information not available

SWS Crew: E. Sanderson, R. Olson

WATER LEVEL MEASUREMENTS
I-70 Well No. 6
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 05/12/95 | | | | | | |
| 08:35 am | 0 | 11.90 | | | | Dropline |
| 08:36 am | 0 | | 12.11 | | | Dropline |
| 08:45 am | 0 | 11.90 | 12.14 | | | Datalogger started |
| 08:46 am | 1 | 11.90 | 12.16 | | | Water level trend |
| 08:47 am | 2 | 11.90 | 12.17 | | | |
| 08:48 am | 3 | 11.90 | 12.17 | | | |
| 08:49 am | 4 | 11.91 | 12.19 | | | |
| 08:50 am | 5 | 11.91 | 12.18 | | | |
| 08:51 am | 6 | 11.90 | 12.18 | | | |
| 08:52 am | 7 | 11.90 | 12.19 | | | |
| 08:53 am | 8 | 11.90 | 12.18 | | | |
| 08:54 am | 9 | 11.90 | 12.19 | | | |
| 08:55 am | 10 | 11.91 | 12.19 | | | |
| 08:56 am | 11 | 11.91 | 12.18 | | | |
| 08:57 am | 12 | 11.90 | 12.18 | | | |
| 08:58 am | 13 | 11.91 | 12.18 | | | |
| 08:59 am | 14 | 11.90 | 12.18 | | | |
| 09:00 am | 15 | 11.90 | 12.19 | | | |
| 09:01 am | 16 | 11.91 | 12.19 | | | |
| 09:02 am | 17 | 11.90 | 12.19 | | | |
| 09:03 am | 18 | 11.90 | 12.18 | | | |
| 09:04 am | 19 | 11.90 | 12.18 | | | |
| 09:05 am | 20 | 11.90 | 12.19 | | | |
| 09:06 am | 21 | 11.90 | 12.18 | | | |
| 09:07 am | 22 | 11.90 | 12.19 | | | |
| 09:08 am | 23 | 11.90 | 12.18 | | | |
| 09:09 am | 24 | 11.90 | 12.19 | | | |
| 09:10 am | 0 | 14.08 | 12.22 | | | Pump On |
| 09:11 am | 1 | 18.41 | 13.30 | 3.30 | 610 | Step 1; Q max |
| 09:12 am | 2 | 18.43 | 14.25 | 3.23 | 600 | |
| 09:13 am | 3 | 18.38 | 14.83 | 3.21 | 600 | |
| 09:14 am | 4 | 18.40 | 15.23 | | | |
| 09:15 am | 5 | 18.42 | 15.51 | 3.21 | 600 | |
| 09:16 am | 6 | 18.45 | 15.71 | | | |
| 09:17 am | 7 | 18.45 | 15.85 | | | |
| 09:18 am | 8 | 18.48 | 15.96 | | | |
| 09:19 am | 9 | 18.48 | 16.04 | | | |
| 09:20 am | 10 | 18.48 | 16.10 | 3.20 | | |
| 09:21 am | 11 | 18.49 | 16.15 | | | |
| 09:22 am | 12 | 18.50 | 16.19 | | | |
| 09:23 am | 13 | 18.51 | 16.22 | | | |
| 09:24 am | 14 | 18.52 | 16.24 | 3.20 | | Adjust rate |

## WATER LEVEL MEASUREMENTS (Continued)
## I-70 Well No. 6

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 09:25 am | 15 | 18.55 | 16.27 | 3.22 | 600 | |
| 09:26 am | 16 | 18.58 | 16.29 | | | |
| 09:27 am | 17 | 18.58 | 16.30 | | | |
| 09:28 am | 18 | 18.57 | 16.31 | | | |
| 09:29 am | 19 | 18.55 | 16.32 | | | |
| 09:30 am | 20 | 18.58 | 16.33 | | | |
| 09:31 am | 21 | 18.58 | 16.33 | 3.22 | 600 | |
| 09:32 am | 22 | 18.60 | 16.35 | | | |
| 09:33 am | 23 | 18.60 | 16.36 | | | |
| 09:34 am | 24 | 18.60 | 16.36 | | | |
| 09:35 am | 25 | 18.60 | 16.36 | | | |
| 09:36 am | 26 | 18.60 | 16.37 | 3.22 | 600 | |
| 09:37 am | 27 | 18.60 | 16.37 | | | |
| 09:38 am | 28 | 18.60 | 16.38 | | | |
| 09:39 am | 29 | 18.62 | 16.38 | | | |
| 09:40 am | 30 | 18.60 | 16.39 | 3.22 | 600 | Decrease rate |
| 09:41 am | 1 | 18.06 | 16.33 | 2.69 | 550 | Step 2 |
| 09:42 am | 2 | 18.09 | 16.27 | 2.71 | 550 | |
| 09:43 am | 3 | 18.09 | 16.23 | | | |
| 09:44 am | 4 | 18.08 | 16.20 | | | |
| 09:45 am | 5 | 18.09 | 16.17 | | | |
| 09:46 am | 6 | 18.08 | 16.15 | 2.72 | 550 | |
| 09:47 am | 7 | 18.09 | 16.15 | | | |
| 09:48 am | 8 | 18.11 | 16.14 | | | |
| 09:49 am | 9 | 18.09 | 16.12 | | | |
| 09:50 am | 10 | 18.09 | 16.11 | | | |
| 09:51 am | 11 | 18.09 | 16.11 | | | |
| 09:52 am | 12 | 18.11 | 16.12 | | | |
| 09:53 am | 13 | 18.11 | 16.12 | | | |
| 09:54 am | 14 | 18.11 | 16.12 | | | |
| 09:55 am | 15 | 18.12 | 16.12 | 2.72 | 550 | |
| 09:56 am | 16 | 18.11 | 16.12 | | | |
| 09:57 am | 17 | 18.10 | 16.12 | | | |
| 09:58 am | 18 | 18.11 | 16.12 | | | |
| 09:59 am | 19 | 18.10 | 16.12 | | | |
| 10:00 am | 20 | 18.11 | 16.12 | 2.72 | 550 | |
| 10:01 am | 21 | 18.13 | 16.12 | | | |
| 10:02 am | 22 | 18.12 | 16.12 | | | |
| 10:03 am | 23 | 18.12 | 16.11 | | | |
| 10:04 am | 24 | 18.13 | 16.12 | 2.71 | 550 | |
| 10:05 am | 25 | 18.12 | 16.12 | | | |
| 10:06 am | 26 | 18.12 | 16.13 | | | |
| 10:07 am | 27 | 18.13 | 16.12 | | | |

WATER LEVEL MEASUREMENTS (Continued)
I-70 Well No. 6

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:08 am | 28 | 18.13 | 16.12 | | | |
| 10:09 am | 29 | 18.13 | 16.14 | | | |
| 10:10 am | 30 | 18.11 | 16.14 | 2.71 | 550 | Decrease rate |
| 10:11 am | 1 | 17.56 | 16.06 | | | Step 3 |
| 10:12 am | 2 | 17.56 | 16.01 | 2.22 | 500 | |
| 10:13 am | 3 | 17.56 | 15.95 | | | |
| 10:14 am | 4 | 17.52 | 15.90 | | | |
| 10:15 am | 5 | 17.52 | 15.87 | | | |
| 10:16 am | 6 | 17.52 | 15.86 | | | |
| 10:17 am | 7 | 17.55 | 15.85 | | | |
| 10:18 am | 8 | 17.53 | 15.83 | | | |
| 10:19 am | 9 | 17.53 | 15.81 | | | |
| 10:20 am | 10 | 17.56 | 15.83 | 2.21 | 500 | |
| 10:21 am | 11 | 17.55 | 15.83 | | | |
| 10:22 am | 12 | 17.55 | 15.82 | | | |
| 10:23 am | 13 | 17.53 | 15.80 | | | |
| 10:24 am | 14 | 17.57 | 15.80 | | | |
| 10:25 am | 15 | 17.57 | 15.81 | | | |
| 10:26 am | 16 | 17.53 | 15.80 | 2.21 | 500 | |
| 10:27 am | 17 | 17.55 | 15.80 | | | |
| 10:28 am | 18 | 17.56 | 15.80 | | | |
| 10:29 am | 19 | 17.56 | 15.81 | | | |
| 10:30 am | 20 | 17.56 | 15.80 | | | |
| 10:31 am | 21 | 17.56 | 15.80 | | | |
| 10:32 am | 22 | 17.56 | 15.81 | | | |
| 10:33 am | 23 | 17.57 | 15.80 | | | |
| 10:34 am | 24 | 17.57 | 15.80 | | | |
| 10:35 am | 25 | 17.56 | 15.80 | | | |
| 10:36 am | 26 | 17.57 | 15.80 | 2.21 | 500 | |
| 10:37 am | 27 | 17.56 | 15.80 | | | |
| 10:38 am | 28 | 17.57 | 15.80 | | | |
| 10:39 am | 29 | 17.57 | 15.80 | | | |
| 10:40 am | 30 | 17.54 | 15.80 | 2.21 | 500 | Decrease rate |
| 10:41 am | 1 | 17.09 | 15.75 | 1.83 | | Step 4 |
| 10:42 am | 2 | 17.08 | 15.70 | | | |
| 10:43 am | 3 | 17.07 | 15.66 | | | |
| 10:44 am | 4 | 17.06 | 15.62 | 1.82 | 450 | |
| 10:45 am | 5 | 17.07 | 15.60 | | | |
| 10:46 am | 6 | 17.07 | 15.58 | 1.82 | 450 | |
| 10:47 am | 7 | 17.05 | 15.55 | | | |
| 10:48 am | 8 | 17.07 | 15.56 | | | |
| 10:49 am | 9 | 17.06 | 15.55 | | | |

## WATER LEVEL MEASUREMENTS (Continued)
## I-70 Well No. 6

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:50 am | 10 | 17.07 | 15.54 | 1.82 | 450 | |
| 10:51 am | 11 | 17.06 | 15.54 | | | |
| 10:52 am | 12 | 17.08 | 15.54 | | | |
| 10:53 am | 13 | 17.08 | 15.52 | | | |
| 10:54 am | 14 | 17.08 | 15.53 | 1.82 | 450 | |
| 10:55 am | 15 | 17.07 | 15.53 | | | |
| 10:56 am | 16 | 17.08 | 15.52 | | | |
| 10:57 am | 17 | 17.07 | 15.53 | | | |
| 10:58 am | 18 | 17.08 | 15.52 | | | |
| 10:59 am | 19 | 17.07 | 15.52 | | | |
| 11:00 am | 20 | 17.07 | 15.52 | 1.82 | 450 | |
| 11:01 am | 21 | 17.07 | 15.52 | | | |
| 11:02 am | 22 | 17.08 | 15.52 | | | |
| 11:03 am | 23 | 17.07 | 15.51 | | | |
| 11:04 am | 24 | 17.08 | 15.52 | | | |
| 11:05 am | 25 | 17.08 | 15.50 | | | |
| 11:06 am | 26 | 17.08 | 15.51 | | | |
| 11:07 am | 27 | 17.08 | 15.51 | 1.82 | 450 | |
| 11:08 am | 28 | 17.09 | 15.51 | | | |
| 11:09 am | 29 | 17.09 | 15.53 | | | |
| 11:10am | 30 | 17.03 | 15.51 | 1.82 | 450 | Decrease rate |
| 11:11 am | 1 | 16.56 | 15.46 | 1.43 | 400 | Step 5 |
| 11:12am | 2 | 16.53 | 15.39 | | | |
| 11:13 am | 3 | 16.52 | 15.34 | 1.43 | 400 | |
| 11:14 am | 4 | 16.54 | 15.32 | | | |
| 11:15 am | 5 | 16.54 | 15.29 | | | |
| 11:16am | 6 | 16.53 | 15.27 | | | Water sample collected; T=58.1°F |
| 11:17 am | 7 | 16.55 | 15.26 | | | |
| 11:18 am | 8 | 16.53 | 15.24 | | | |
| 11:19am | 9 | 16.53 | 15.23 | | | |
| 11:20 am | 10 | 16.54 | 15.22 | | | |
| 11:21 am | 11 | 16.53 | 15.22 | 1.43 | 400 | |
| 11:22 am | 12 | 16.53 | 15.21 | | | |
| 11:23 am | 13 | 16.53 | 15.20 | | | |
| 11:24 am | 14 | 16.52 | 15.19 | 1.43 | 400 | BART samples collected |
| 11:25 am | 15 | 16.53 | 15.20 | | | |
| 11:26 am | 16 | 16.54 | 15.20 | | | |
| 11:27 am | 17 | 16.55 | 15.21 | 1.43 | 400 | |
| 11:28 am | 18 | 16.54 | 15.19 | | | |
| 11:29 am | 19 | 16.53 | 15.19 | | | |
| 11:30 am | 20 | 16.54 | 15.19 | | | |
| 11:31 am | 21 | 16.54 | 15.19 | | | |
| 11:32 am | 22 | 16.52 | 15.19 | | | |

WATER LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 6

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11 33 am | 23 | 16.54 | 15.19 | | | |
| 11 34 am | 24 | 16.53 | 15.17 | | | |
| 11 35 am | 25 | 16.53 | 15.19 | | | |
| 11 36 am | 26 | 16.55 | 15.18 | 1.43 | 400 | |
| 11 37 am | 27 | 16.53 | 15.19 | | | |
| 11 38 am | 28 | 16.55 | 15.19 | 1.43 | 400 | |
| 11 39 am | 29 | 16.54 | 15.19 | | | |
| 11 40 am | 30 | 16.54 | 15.17 | 1.43 | 400 | End of Step Test |

## DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W7A* | *Piezometer No. I-70 P7A* |
|---|---|---|
| Date Drilled: | 11/24/86 | 1986 |
| Casing | | |
| Top elevation: | 383.7(?) | 393.7(?) |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 21.5 | na |
| Screen | | |
| Bottom elevation: | 302.2 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 30 | 3 |
| Slot size, lower: | 0.055-in. | na |
| Length, upper (ft): | 30 | - |
| Slot size, upper: | 0.025-in. | - |
| Measuring Point Elevation: | na | na |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 11.23 | - |
| Height of temp. MP (ft): | 5.14 | - |
| Depth below perm. MP (ft): | 6.09 | 11.35 |
| Elevation: | - | - |
| Date of Step Test: | 5/5/94 | - |
| Water Sample | | |
| Time: | 10:21 am | - |
| Temperature: | 60° F | - |
| Laboratory No.: | 227595 | - |
| Distance and Direction to Piez. from PW: | | 5.2 ft East |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test*: | | Wells 8A, 11A, 12A, 13 |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
McDAS
*Operation based upon IDOT records
na-information not available

SWS Crew: M. Anliker, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 7A
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 05/05/94 | | | | | | |
| 08:52 am | | | 11.35 | | | Solinst dropline |
| 08:53 am | | 11.23 | | | | Solinst dropline |
| 09:46 am | 0 | 11.21 | 11.31 | | | Datalogger started |
| 09:47 am | 1 | 11.21 | 11.31 | | | |
| 09:48 am | 2 | 11.21 | 11.33 | | | |
| 09:49 am | 3 | 11.20 | 11.32 | | | |
| 09:50 am | 4 | 11.20 | 11.33 | | | |
| 09:51 am | 5 | 11.21 | 11.33 | | | |
| 09:52 am | 6 | 11.21 | 11.34 | | | |
| 09:53 am | 7 | 11.20 | 11.34 | | | |
| 09:54 am | 8 | 11.20 | 11.34 | | | |
| 09:55 am | 9 | 11.20 | 11.33 | | | |
| 09:56 am | 10 | 11.20 | 11.31 | | | |
| 09:57 am | 11 | 11.20 | 11.33 | | | |
| 09:58 am | 12 | 11.20 | 11.34 | | | |
| 09:59 am | 13 | 11.20 | 11.34 | | | |
| 10:00 am | -0 | 11.83 | 11.49 | | | Pump On |
| 10:01 am | 1 | 19.16 | 17.09 | 1.93 | 465 | Step 1; Q max |
| 10:02 am | 2 | 19.31 | 17.30 | | | Adjust rate |
| 10:03 am | 3 | 18.99 | 17.10 | 1.80 | 450 | |
| 10:04 am | 4 | 19.05 | 17.14 | 1.79 | 450 | |
| 10:05 am | 5 | 19.12 | 17.21 | 1.80 | 450 | |
| 10:06 am | 6 | 19.16 | 17.26 | | | |
| 10:07 am | 7 | 19.20 | 17.29 | | | |
| 10:08 am | 8 | 19.23 | 17.31 | | | |
| 10:09 am | 9 | 19.25 | 17.33 | | | |
| 10:10 am | 10 | 19.27 | 17.34 | | | |
| 10:11 am | 11 | 19.29 | 17.37 | 1.80 | 450 | |
| 10:12 am | 12 | 19.30 | 17.39 | | | |
| 10:13 am | 13 | 19.31 | 17.41 | | | |
| 10:14 am | 14 | 19.32 | 17.42 | | | |
| 10:15 am | 15 | 19.34 | 17.43 | | | |
| 10:16 am | 16 | 19.35 | 17.43 | | | |
| 10:17 am | 17 | 19.36 | 17.44 | | | |
| 10:18 am | 18 | 19.37 | 17.45 | 1.80 | 450 | BART samples collected |
| 10:19 am | 19 | 19.38 | 17.45 | | | |
| 10:20 am | 20 | 19.37 | 17.45 | | | |
| 10:21 am | 21 | 19.39 | 17.45 | | | |
| 10:22 am | 22 | 19.39 | 17.45 | | | |
| 10:23 am | 23 | 19.40 | 17.47 | | | |
| 10:24 am | 24 | 19.41 | 17.48 | 1.79 | 450 | Adjust rate |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 7A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:25 am | 25 | 19.44 | 17.51 | 1.80 | 450 | |
| 10:26 am | 26 | 19.43 | 17.51 | | | |
| 10:27 am | 27 | 19.43 | 17.50 | | | |
| 10:28 am | 28 | 19.44 | 17.51 | | | |
| 10:29 am | 29 | 19.44 | 17.51 | | | |
| 10:30 am | 30 | 19.45 | 17.52 | 1.80 | 450 | Reduce rate |
| 10:31 am | 1 | 18.60 | 16.94 | 1.42 | 400 | Step 2 |
| 10:32 am | 2 | 18.59 | 16.92 | | | |
| 10:33 am | 3 | 18.58 | 16.92 | | | |
| 10:34 am | 4 | 18.58 | 16.91 | | | |
| 10:35 am | 5 | 18.57 | 16.90 | | | |
| 10:36 am | 6 | 18.57 | 16.90 | 1.42 | 400 | Water sample collected; |
| 10:37 am | 7 | 18.57 | 16.90 | | | T=60.1°F |
| 10:38 am | 8 | 18.57 | 16.90 | | | |
| 10:39 am | 9 | 18.57 | 16.91 | | | |
| 10:40 am | 10 | 18.57 | 16.92 | | | |
| 10:41 am | 11 | 18.57 | 16.92 | | | |
| 10:42 am | 12 | 18.56 | 16.92 | 1.42 | 400 | |
| 10:43 am | 13 | 18.57 | 16.90 | | | |
| 10:44 am | 14 | 18.57 | 16.90 | | | |
| 10:45 am | 15 | 18.57 | 16.91 | | | |
| 10:46 am | 16 | 18.56 | 16.90 | | | |
| 10:47 am | 17 | 18.57 | 16.89 | 1.42 | 400 | |
| 10:48 am | 18 | 18.57 | 16.89 | | | |
| 10:49 am | 19 | 18.56 | 16.90 | | | |
| 10:50 am | 20 | 18.57 | 16.91 | | | |
| 10:51 am | 21 | 18.58 | 16.92 | | | |
| 10:52 am | 22 | 18.58 | 16.92 | 1.42 | 400 | |
| 10:53 am | 23 | 18.59 | 16.92 | | | |
| 10:54 am | 24 | 18.58 | 16.93 | | | |
| 10:55 am | 25 | 18.58 | 16.94 | | | |
| 10:56 am | 26 | 18.59 | 16.94 | | | |
| 10:57 am | 27 | 18.59 | 16.93 | | | |
| 10:58 am | 28 | 18.58 | 16.93 | | | |
| 10:59 am | 29 | 18.59 | 16.94 | | | |
| 11:00 am | 30 | 18.59 | 16.94 | 1.42 | 400 | Reduce rate |
| 11:01 am | 1 | 17.78 | 16.38 | 1.08 | 350 | Step 3 |
| 11:02 am | 2 | 17.76 | 16.36 | | | |
| 11:03 am | 3 | 17.75 | 16.34 | | | |
| 11:04 am | 4 | 17.75 | 16.33 | | | |
| 11:05 am | 5 | 17.74 | 16.33 | | | |
| 11:06 am | 6 | 17.74 | 16.32 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 7A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11:07 am | *1* | 17.74 | 16.31 | | | |
| 11:08 am | 8 | 17.74 | 16.32 | 1.08 | 350 | |
| 11:09 am | 9 | 17.74 | 16.32 | | | |
| 11:10 am | 10 | 17.74 | 16.33 | | | |
| 11:11 am | 11 | 17.73 | 16.32 | | | |
| 11:12am | 12 | 17.73 | 16.31 | | | |
| 11:13am | 13 | 17.73 | 16.30 | | | |
| 11:14 am | 14 | 17.73 | 16.30 | | | |
| 11:15 am | 15 | 17.73 | 16.29 | 1.08 | 350 | |
| 11:16am | 16 | 17.74 | 16.30 | | | |
| 11:17 am | 17 | 17.73 | 16.31 | | | |
| 11:18am | 18 | 17.74 | 16.32 | | | |
| 11:19 am | 19 | 17.74 | 16.33 | 1.08 | 350 | |
| 11:20 am | 20 | 17.74 | 16.34 | | | |
| 11:21 am | 21 | 17.74 | 16.34 | | | |
| 11:22 am | 22 | 17.74 | 16.34 | | | |
| 11:23 am | 23 | 17.73 | 16.32 | | | |
| 11:24 am | 24 | 17.74 | 16.31 | | | |
| 11:25 am | 25 | 17.73 | 16.32 | | | |
| 11:26 am | 26 | 17.73 | 16.32 | 1.08 | 350 | |
| 11:27 am | 27 | 17.73 | 16.31 | | | |
| 11:28 am | 28 | 17.73 | 16.30 | | | |
| 11:29 am | 29 | 17.74 | 16.30 | | | |
| 11:30 am | 30 | 17.74 | 16.31 | 1.08 | 350 | Reduce rate |
| 11:31 am | 1 | 16.88 | 15.72 | 0.79 | 300 | Step 4 |
| 11:32 am | 2 | 16.87 | 15.71 | | | |
| 11:33 am | 3 | 16.86 | 15.67 | | | |
| 11:34 am | 4 | 16.86 | 15.58 | 0.79 | 300 | |
| 11:35 am | 5 | 16.86 | 15.63 | | | |
| 11:36 am | 6 | 16.84 | 15.65 | | | |
| 11:37 am | 7 | 16.85 | 15.68 | | | |
| 11:38 am | 8 | 16.84 | 15.68 | | | |
| 11:39 am | 9 | 16.84 | 15.69 | 0.79 | 300 | |
| 11:40 am | 10 | 16.84 | 15.70 | | | |
| 11:41 am | 11 | 16.84 | 15.71 | | | |
| 11:42 am | 12 | 16.84 | 15.69 | | | |
| 11:43 am | 13 | 16.84 | 15.68 | 0.79 | 300 | |
| 11:44 am | 14 | 16.84 | 15.68 | | | |
| 11:45 am | 15 | 16.84 | 15.67 | | | |
| 11:46 am | 16 | 16.83 | 15.69 | | | |
| 11:47 am | 17 | 16.84 | 15.70 | | | |
| 11:48 am | 18 | 16.83 | 15.70 | | | |
| 11:49 am | 19 | 16.84 | 15.70 | | | |

# WATER-LEVEL MEASUREMENTS (Concluded)
## I-70 Well No. 7A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11:50 am | 20 | 16.83 | 15.67 | | | |
| 11 51 am | 21 | 16.84 | 15.66 | 0.79 | 300 | |
| 11 52 am | 22 | 16.83 | 15.66 | | | |
| 11 52 am | 22 | | 15.70 | | | Solinst DL Check |
| 11 53 am | 23 | 16.83 | 15.67 | | | |
| 11 53 am | 23 | 16.84 | | | | Solinst DL Check |
| 11 54 am | 24 | 16.83 | 15.68 | | | |
| 11 55 am | 25 | 16.83 | 15.67 | | | |
| 11 56 am | 26 | 16.84 | 15.67 | | | |
| 11 57 am | 27 | 16.84 | 15.64 | | | |
| 11 58 am | 28 | 16.83 | 15.64 | | | |
| 11 59 am | 29 | 16.83 | 15.67 | | | |
| 12 00 pm | 30 | 16.84 | 15.67 | 0.79 | 300 | End of Step Test |

**Notes:** Trace of fine sand (teaspoon or less) in settling tank following step test.
No sample collected.

DEWATERING WELL DATA
Pretreatment Step Test

| | *Well No. I-70 W8A* | *Piezometer No. I-70 PSA* |
|---|---|---|
| Date Drilled; | 4/10/89 | 4/14/89 |
| Casing | | |
| Top elevation: | 382.25 | (57 ft deep) |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 14.85 | na |
| Screen | | |
| Bottom elevation: | 306 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, overall (ft): | 61.4 | 3 |
| Slot size, lower 30 ft: | 0.055-in. | na |
| Slot size, upper 30 ft: | 0.020-in. | - |
| Measuring Point Elevation: | 387.46 | - |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 12.86 | - |
| Height of temp. MP (ft): | 5.12 | - |
| Depth below perm. MP (ft): | 7.74 | 13.40 |
| Elevation: | 374.51 | - |
| Date of Step Test: | 12/17/92 | - |
| Water Sample | | |
| Time: | 1:56 pm | - |
| Temperature: | 60° F | - |
| Laboratory No.: | 226432 | - |
| Distance and Direction to Piez. from PW: | | 6.4 ft East |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
McDAS w/transmitters No. 3 (5 psi) and No. 5 (6 psi)
Sand sample collected from settling tank
na-information not available

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 8A
Pretreatment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 12/17/92 | | | | | | |
| 10:17 am | | 12.86 | | | | Solinst dropline |
| 10:19 am | | | 13.40 | | | Solinst dropline |
| 10:59 am | 0.0 | 12.82 | 13.41 | | | McDAS started |
| 11:00 am | 0.9 | 12.81 | 13.41 | | | Water Level Trend |
| | 2.1 | 12.80 | 13.42 | | | |
| | 3.0 | 12.81 | 13.40 | | | |
| | 3.9 | 12.81 | 13.41 | | | |
| | 5.1 | 12.81 | 13.41 | | | |
| | 6.0 | 12.81 | 13.41 | | | |
| | 8.1 | 12.81 | 13.41 | | | |
| | 9.9 | 12.80 | 13.40 | | | |
| | 12.0 | 12.80 | 13.39 | | | |
| | 14.1 | 12.81 | 13.38 | | | |
| 11:15am | 15.9 | 12.79 | 13.38 | | | |
| | 18.0 | 12.80 | 13.39 | | | |
| | 20.1 | 12.79 | 13.39 | | | |
| | 21.9 | 12.80 | 13.39 | | | |
| | 24.0 | 12.80 | 13.39 | | | |
| | 26.1 | 12.80 | 13.38 | | | |
| | 27.9 | 12.78 | 13.37 | | | |
| 11:29 am | 30.0 | 12.79 | 13.38 | | | |
| | 30.6 | 12.79 | 13.37 | | | |
| 11:30 am | 0.0 | | | | | Pump On |
| 11:31 am | 1.0 | 21.63 | 17.04 | 3.14 | | Step 1; Max rate |
| | 2.0 | 21.87 | 17.25 | 2.70 | 550 | |
| | 3.0 | 21.15 | 16.99 | | | |
| | 4.0 | 21.20 | 17.07 | | | |
| | 5.0 | 21.28 | 17.11 | | | |
| | 6.0 | 21.32 | 17.15 | | | |
| | 6.5 | 21.35 | 17.16 | 2.68 | | Adjust rate |
| | 7.0 | 21.36 | 17.19 | 2.70 | 550 | |
| | 8.0 | 21.43 | 17.22 | | | |
| 11:40 am | 10.0 | 21.46 | 17.29 | | | |
| | 12.0 | 21.52 | 17.33 | | | |
| | 14.0 | 21.57 | 17.38 | 2.67 | | |
| | 15.0 | 21.63 | 17.40 | 2.70 | 550 | |
| | 16.0 | 21.64 | 17.43 | | | |
| | 18.0 | 21.68 | 17.46 | | | |
| 11:50 am | 20.0 | 21.71 | 17.48 | 2.70 | 550 | |
| | 22.0 | 21.74 | 17.51 | | | |
| | 24.0 | 21.74 | 17.52 | | | |
| | 25.0 | 21.75 | 17.53 | | | |

## WATER-LEVEL MEASUREMENTS (Continued)
## I-70 Well No. 8A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| | 26.0 | 21.77 | 17.54 | | | |
| | 27.0 | 21.77 | 17.54 | 2.70 | 550 | |
| | 28.0 | 21.78 | 17.56 | | | |
| | 29.0 | 21.79 | 17.56 | | | |
| | 29.7 | 21.79 | 17.56 | | | |
| 12:00 pm | 30.0 | | | | | Reduce rate |
| 12:01 pm | 1.0 | 21.04 | 17.28 | 2.22 | 500 | Step 2 |
| | 2.0 | 21.02 | 17.27 | | | |
| | 3.0 | 21.02 | 17.27 | | | |
| | 4.0 | 21.03 | 17.27 | | | |
| | 5.0 | 21.02 | 17.27 | | | |
| | 6.0 | 21.03 | 17.27 | 2.22 | 500 | |
| | 8.0 | 21.03 | 17.28 | | | |
| 12:10pm | 10.0 | 21.02 | 17.27 | | | |
| | 12.0 | 21.03 | 17.27 | | | |
| | 14.0 | 21.03 | 17.29 | | | |
| | 15.0 | 21.05 | 17.29 | 2.22 | 500 | |
| | 16.0 | 21.04 | 17.29 | | | |
| | 18.0 | 21.05 | 17.29 | | | |
| 12:20 pm | 20.0 | 21.06 | 17.30 | 2.22 | 500 | |
| | 22.0 | 21.06 | 17.30 | | | |
| | 24.0 | 21.06 | 17.31 | | | |
| | 25.0 | 21.06 | 17.31 | | | |
| | 26.0 | 21.07 | 17.32 | | | |
| | 27.0 | 21.07 | 17.31 | 2.22 | 500 | |
| | 28.0 | 21.06 | 17.31 | | | |
| | 29.0 | 21.05 | 17.32 | | | |
| | 29.7 | 21.07 | 17.31 | | | |
| 12:30 pm | 30.0 | | | | | Reduce rate |
| 12:31 pm | 1.0 | 20.33 | 17.02 | 1.81 | 450 | Step 3 |
| | 2.0 | 20.32 | 17.02 | 1.79 | | Adjust rate |
| | 3.0 | 20.33 | 17.01 | 1.81 | 450 | |
| | 4.0 | 20.30 | 17.01 | | | |
| | 5.0 | 20.33 | 17.01 | | | |
| | 6.0 | 20.30 | 17.01 | 1.81 | 450 | |
| | 8.0 | 20.31 | 17.01 | | | |
| 12:40 pm | 10.0 | 20.31 | 17.01 | | | |
| | 12.0 | 20.31 | 17.00 | 1.81 | . 450 | |
| | 14.0 | 20.32 | 17.01 | | | |
| | 16.0 | 20.32 | 17.01 | | | |
| | 18.0 | 20.31 | 17.00 | | | |
| | 19.0 | 20.31 | 17.01 | 1.81 | 450 | |
| 12:50 pm | 20.0 | 20.32 | 17.01 | | | |
| | 22.0 | 20.32 | 17.01 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 8A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| | 24.0 | 20.32 | 17.01 | | | |
| | 25.0 | 20.31 | 17.01 | | | |
| | 26.0 | 20.32 | 17.02 | 1.81 | 450 | |
| | 27.0 | 20.32 | 17.02 | | | |
| | 28.0 | 20.33 | 17.02 | | | |
| | 29.0 | 20.33 | 17.03 | | | |
| | 29.5 | 20.33 | 17.02 | | | |
| | 29.7 | 20.32 | 17.01 | | | |
| 01:00 pm | 30.0 | | | | | Reduce rate |
| 01:01 pm | 1.0 | 19.56 | 16.71 | 1.42 | 400 | Step 4 |
| | 2.0 | 19.55 | 16.71 | 1.44 | | Adjust rate |
| | 3.0 | 19.51 | 16.69 | 1.42 | 400 | |
| | 4.0 | 19.51 | 16.68 | | | |
| | 5.0 | 19.50 | 16.68 | | | |
| | 6.0 | 19.51 | 16.69 | | | |
| | 8.0 | 19.51 | 16.68 | 1.41 | 400 | |
| 01:10pm | 10.0 | 19.50 | 16.68 | | | |
| | 12.0 | 19.51 | 16.67 | | | |
| | 14.0 | 19.49 | 16.68 | 1.41 | 400 | |
| | 16.0 | 19.50 | 16.68 | | | |
| | 18.0 | 19.51 | 16.68 | 1.41 | 400 | |
| 01:20 pm | 20.0 | 19.51 | 16.68 | | | |
| | 22.0 | 19.51 | 16.68 | 1.41 | 400 | |
| | 24.0 | 19.51 | 16.68 | | | |
| | 25.0 | 19.52 | 16.68 | 1.41 | 400 | |
| | 26.0 | 19.50 | 16.68 | | | |
| | 27.0 | 19.50 | 16.68 | | | |
| | 28.0 | 19.52 | 16.70 | | | |
| | 29.0 | 19.52 | 16.69 | 1.41 | 400 | |
| | 29.7 | 19.51 | 16.69 | | | |
| 01:30 pm | 30.0 | | | | | Reduce rate |
| 01:31 pm | 1.0 | 18.80 | 16.40 | 1.10 | 350 | Step 5 |
| | 2.0 | 18.78 | 16.39 | 1.09 | 350 | |
| | 3.0 | 18.78 | 16.39 | | | |
| | 4.0 | 18.76 | 16.38 | | | |
| | 5.0 | 18.75 | 16.37 | | | |
| | 6.0 | 18.76 | 16.37 | | | |
| | 8.0 | 18.74 | 16.36 | 1.09 | 350 | |
| 01:40 pm | 10.0 | 18.75 | 16.35 | | | |
| | 12.0 | 18.74 | 16.34 | 1.09 | 350 | |
| | 14.0 | 18.75 | 16.36 | | | |
| | 16.0 | 18.75 | 16.36 | 1.09 | 350 | |
| | 18.0 | 18.74 | 16.35 | | | |
| 01:50 pm | 20.0 | 18.75 | 16.36 | 1.09 | 350 | BART samples collected |

## WATER-LEVEL MEASUREMENTS (Concluded)
## I-70 Well No. 8A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| | 22.0 | 18.74 | 16.36 | | | |
| | 24.0 | 18.75 | 16.36 | 1.09 | 350 | |
| | 25.0 | 18.76 | 16.36 | | | |
| | 26.0 | 18.74 | 16.36 | | | Water sample collected; |
| | 27.0 | 18.74 | 16.36 | | | T=60°F |
| | 28.0 | 18.75 | 16.36 | | | |
| | 29.0 | 18.74 | 16.37 | 1.09 | 350 | |
| 02:00 pm | 30.0 | 18.75 | 16.36 | 1.09 | 350 | End of Test |

DEWATERING WELL DATA
Posttreatment Step Test

| | *Well No. I-70 W8A* | *Piezometer No. I-70 P8A* |
|---|---|---|
| Date Drilled: | 4/10/89 | 4/14/89 |
| Casing | | |
| Top elevation: | 382.2 | Depth=57 ft |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 14.85 | na |
| Screen | | |
| Bottom elevation: | 306 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, overall (ft): | 61.4 | 3 |
| Length, upper (ft): | 30 | - |
| Slot size: | 0.020-in. | na |
| Length, Lower (ft): | 30 | - |
| Slot size: | 0.055-in. | - |
| Measuring Point Elevation: | 387.46 | |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 8.99 | - |
| Height of temp. MP (ft): | 5.12 | - |
| Depth below perm. MP (ft): | 7.74 | 9.24 |
| Elevation: | 379.72 | |
| Date of Step Test: | 3/16/94 | - |
| Water Sample | | |
| Time: | 3:54 pm | - |
| Temperature: | 60.3° F | - |
| Laboratory No.: | 227449 | - |
| Distance and Direction to Piez. from PW: | | 6.4 ft East |
| Time PW Off Before Step Test: | | na |
| Wells in Operation at Site at Time of Step Test*: | | |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Manual measurements - McDAS wouldn't work
*Operation based upon IDOT records
na-information not available

SWS Crew: R. Locke, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 8A
Posttreatment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03/16/94 | | | | | | |
| 12:11 pm | 0 | | 9.24 | | | Dropline |
| 12:12 pm | 0 | 8.99 | | | | Dropline |
| 01:10 pm | 0 | | 9.23 | | | Steel tape |
| 01:11 pm | 0 | 8.97 | | | | Dropline |
| | 0 | 8.98 | | | | |
| 01:30 pm | 0 | | 9.23 | | | Pump On |
| 01:31 pm | 1 | | | 3.10 | 588 | Step l; Max Q |
| 01:34 pm | 4 | | | 2.70 | 550 | |
| McDAS datalogger not functioning properly; cascading water will not allow water-level measurements with dropline. | | | | | | |
| 01:50 pm | 20 | | | | | Pump Off<br>Let well vault drain |
| 02:43 pm | 0 | 9.08 | | | | Using dropline in PW |
| 02:44 pm | 0 | | 9.30 | | | Using steel tape in Piez |
| 02:45 pm | 0 | | | | | Pump On |
| 02:46 pm | 1 | | | | | Step 1 |
| 02:47 pm | 2 | 15.52 | | 2.70 | 550 | |
| 02:48 pm | 3 | 15.60 | | | | |
| 02:49 pm | 4 | 15.69 | 13.66 | | | |
| 02:50 pm | 5 | 15.74 | | | | |
| 02:51 pm | 6 | 15.80 | | 2.69 | 549 | |
| 02:52 pm | 7 | | | 2.70 | 550 | |
| 02:53 pm | 8 | 15.92 | | | | |
| 02:55 pm | 10 | 15.99 | 13.90 | | | |
| 02:57 pm | 12 | 16.04 | | 2.70 | 550 | |
| 02:59 pm | 14 | 16.10 | | | | |
| 03:01 pm | 16 | 16.13 | 14.06 | | | |
| 03:03 pm | 18 | 16.17 | | 2.69 | 549 | Adjust rate |
| 03:04 pm | 19 | | | 2.70 | 550 | |
| 03:05 pm | 20 | 16.22 | | | | |
| 03:10 pm | 25 | 16.27 | 14.18 | 2.70 | 550 | |
| 03:12 pm | 27 | 16.30 | | | | |
| 03:14 pm | 29 | 16.31 | 14.23 | | | |
| 03:15 pm | 30 | 16.32 | | | | Reduce rate |
| 03:16 pm | 1 | 15.74 | | 2.23 | 500 | Step 2 |
| 03:17 pm | 2 | 15.74 | | | | |
| 03:18 pm | 3 | 15.74 | | | | |
| 03:19 pm | 4 | 15.72 | | | | |
| 03:20 pm | 5 | 15.73 | 13.85 | | | |
| 03:21 pm | 6 | 15.73 | | 2.23 | 500 | |

## WATER-LEVEL MEASUREMENTS (Continued)
## I-70 Well No. 8A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:23 pm | 8 | 15.74 | | | | |
| 03:25 pm | 10 | 15.75 | | 2.22 | 499 | Adjust rate |
| 03:26 pm | 11 | | | 2.23 | 500 | |
| 03:27 pm | 12 | 15.76 | 13.88 | | | |
| 03:29 pm | 14 | 15.77 | | | | |
| 03:31 pm | 16 | 15.78 | | | | |
| 03:33 pm | 18 | 15.78 | | | | |
| 03:35 pm | 20 | 15.78 | 13.90 | 2.23 | 500 | |
| 03:40 pm | 25 | 15.78 | | | | |
| 03:42 pm | 27 | 15.80 | | | | |
| 03:44 pm | 29 | 15.80 | 13.91 | | | |
| 03:45 pm | 30 | 15.80 | | | | Reduce rate |
| 03:46 pm | 1 | 15.25 | | 1.80 | 450 | Step 3 |
| 03:47 pm | 2 | 15.23 | | | | |
| 03:48 pm | 3 | 15.22 | | | | |
| 03:49 pm | 4 | 15.21 | 13.57 | 1.80 | 450 | |
| 03:50 pm | 5 | 15.21 | | | | |
| 03:51 pm | 6 | 15.20 | | | | |
| 03:53 pm | 8 | 15.20 | | | | |
| 03:54 pm | 9 | | | 1.80 | 450 | Collected water sample; |
| 03:55 pm | 10 | 15.20 | | | | T=60.3°F |
| 03:57 pm | 12 | 15.20 | 13.55 | | | |
| 03:59 pm | 14 | 15.20 | | | | |
| 04:01 pm | 16 | 15.20 | | 1.80 | 450 | |
| 04:03 pm | 18 | 15.20 | | | | |
| 04:05 pm | 20 | 15.20 | | | | Collected BART samples |
| 04:06 pm | 21 | | 13.57 | | | |
| 04:10 pm | 25 | 15.20 | | | | |
| 04:12 pm | 27 | 15.20 | | | | |
| 04:14 pm | 29 | 15.21 | 13.56 | | | |
| 04:15 pm | 30 | 15.21 | | | | Reduce rate |
| 04:16 pm | 1 | 14.66 | | 1.42 | 400 | Step 4 |
| 04:17 pm | 2 | 14.64 | | | | |
| 04:18 pm | 3 | 14.62 | | | | |
| 04:19 pm | 4 | 14.61 | | 1.42 | 400 | |
| 04:20 pm | 5 | 14.61 | 13.17 | | | |
| 04:21 pm | 6 | 14.61 | | | | |
| 04:23 pm | 8 | 14.60 | | | | |
| 04:25 pm | 10 | 14.60 | | 1.42 | 400 | |
| 04:27 pm | 12 | 14.60 | 13.15 | | | |
| 04:30 pm | 15 | 14.59 | | | | |
| 04:32 pm | 17 | 14.59 | | 1.41 | 399 | Adjust rate |
| 04:33 pm | 18 | | | 1.42 | 400 | |

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 8A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 04:34 pm | 19 | 14.61 | | | | |
| 04:35 pm | 20 | | 13.15 | | | |
| 04:36 pm | 21 | 14.62 | | | | |
| 04:40 pm | 25 | 14.63 | | 1.42 | 400 | |
| 04:41 pm | 26 | | 13.17 | | | |
| 04:42 pm | 27 | 14.63 | | | | |
| 04:44 pm | 29 | 14.63 | | 1.42 | 400 | |
| 04:45 pm | 30 | 14.63 | 13.17 | | | |

**Note::** Sand and incrustation sample collected from settling tank.

## DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W9A* | *Piezometer No. I-70 P9A* |
|---|---|---|
| Date Drilled: | 4/5/89 | 4/13/89 |
| Casing | | |
| Top elevation: | 402.8 | 407.52 |
| Diameter: | 16-in.SS | 2-in. PVC |
| Length (ft): | 40.9 | na |
| Screen | | |
| Bottom elevation: | 301.9 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 40 | 3 |
| Slot size, lower: | 0.055-in. | na |
| Length, upper (ft) | 20 | - |
| Slot size, upper: | 0.020-in. | - |
| Measuring Point Elevation: | 404.05 | 407.52 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 28.84 | - |
| Height of temp. MP (ft): | 3.80 | - |
| Depth below perm. MP (ft): | 25.04 | 28.81 |
| Elevation: | 379.01 | 378.71 |
| Date of Step Test: | 5/12/94 | - |
| Water Sample | | |
| Time: | 10:47 am | - |
| Temperature: | 60.4° F | - |
| Laboratory No.: | 227662 | - |
| Distance and Direction to Piez. from PW: | | 6.0 ft East |
| Time PW Off Before Step Test: | | na |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Omnidata datalogger
na-information not available

SWS Crew: M. Anliker, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 9A
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 05/12/94 | | | | | | |
| 09:09 am | 0 | 28.84 | | | | Solinst dropline |
| 09:10 am | 0 | | 28.81 | | | Solinst dropline |
| 09:31 am | 0 | 28.84 | 28.77 | | | Data logger started |
| 09:32 am | 1 | 28.84 | 28.77 | | | Water level trend |
| 09:33 am | 2 | 28.84 | 28.76 | | | |
| 09:34 am | 3 | 28.84 | 28.76 | | | |
| 09:35 am | 4 | 28.84 | 28.76 | | | |
| 09:36 am | 5 | 28.84 | 28.76 | | | |
| 09:37 am | 6 | 28.84 | 28.76 | | | |
| 09:38 am | 7 | 28.84 | 28.76 | | | |
| 09:39 am | 8 | 28.84 | 28.76 | | | |
| 09:40 am | 0 | 28.84 | 28.75 | | | Pump On |
| 09:41 am | 1 | 34.64 | 31.96 | | | Step 1 |
| 09:42 am | 2 | 34.80 | 32.11 | 2.00 | 470 | Q max |
| 09:43 am | 3 | 34.38 | 31.89 | | | |
| 09:44 am | 4 | 34.21 | 31.82 | 1.80 | 450 | Discharge gassy |
| 09:45 am | 5 | 34.23 | 31.84 | | | |
| 09:46 am | 6 | 34.27 | 31.86 | | | |
| 09:47 am | 7 | 34.29 | 31.88 | | | |
| 09:48 am | 8 | 34.31 | 31.91 | | | |
| 09:49 am | 9 | 34.33 | 31.93 | | | |
| 09:50 am | 10 | 34.36 | 31.95 | 1.80 | 450 | |
| 09:51 am | 11 | 34.38 | 31.97 | | | |
| 09:52 am | 12 | 34.37 | 31.96 | | | |
| 09:53 am | 13 | 34.41 | 32.00 | | | |
| 09:54 am | 14 | 34.41 | 32.00 | | | |
| 09:55 am | 15 | 34.44 | 32.02 | | | |
| 09:56 am | 16 | 34.45 | 32.02 | 1.79 | | Adjust rate |
| 09:57 am | 17 | 34.47 | 32.06 | 1.80 | 450 | |
| 09:58 am | 18 | 34.47 | 32.05 | | | |
| 09:59 am | 19 | 34.50 | 32.06 | | | |
| 10:00 am | 20 | 34.49 | 32.08 | | | |
| 10:01 am | 21 | 34.51 | 32.09 | 1.80 | 450 | |
| 10:02 am | 22 | 34.53 | 32.10 | | | |
| 10:03 am | 23 | 34.52 | 32.10 | | | |
| 10:04 am | 24 | 34.54 | 32.12 | | | |
| 10:05 am | 25 | 34.55 | 32.13 | | | |
| 10:06 am | 26 | 34.55 | 32.13 | | | |
| 10:07 am | 27 | 34.56 | 32.14 | | | |
| 10:08 am | 28 | 34.57 | 32.14 | | | |
| 10:09 am | 29 | 34.58 | 32.16 | 1.79 | | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 9A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:10 am | 30 | 34.59 | 32.16 | | | Reduce rate |
| 10:11 am | 1 | 34.05 | 31.87 | 1.42 | 400 | Step 2 |
| 10:12 am | 2 | 34.03 | 31.86 | 1.42 | | |
| 10:13 am | 3 | 34.02 | 31.85 | | | |
| 10:14 am | 4 | 34.03 | 31.86 | | | |
| 10:15 am | 5 | 34.00 | 31.84 | | | |
| 10:16 am | 6 | 34.02 | 31.86 | 1.42 | 400 | |
| 10:17 am | 7 | 34.02 | 31.86 | | | |
| 10:18 am | 8 | 34.04 | 31.87 | | | |
| 10:19 am | 9 | 34.04 | 31.87 | | | |
| 10:20 am | 10 | 34.02 | 31.86 | | | |
| 10:21 am | 11 | 34.03 | 31.87 | | | |
| 10:22 am | 12 | 34.03 | 31.88 | | | |
| 10:23 am | 13 | 34.04 | 31.88 | 1.41 | | |
| 10:24 am | 14 | 34.03 | 31.88 | | | |
| 10:25 am | 15 | 34.04 | 31.86 | | | |
| 10:26 am | 16 | 34.05 | 31.89 | | | |
| 10:27 am | 17 | 34.05 | 31.89 | | | |
| 10:28 am | 18 | 34.05 | 31.89 | | | |
| 10:29 am | 19 | 34.05 | 31.89 | | | |
| 10:30 am | 20 | 34.05 | 31.89 | 1.42 | 400 | Adjusted rate |
| 10:31 am | 21 | 34.07 | 31.89 | | | |
| 10:32 am | 22 | 34.08 | 31.91 | | | |
| 10:33 am | 23 | 34.07 | 31.91 | | | |
| 10:34 am | 24 | 34.09 | 31.91 | | | |
| 10:35 am | 25 | 34.09 | 31.92 | | | |
| 10:36 am | 26 | 34.09 | 31.92 | | | |
| 10:37 am | 27 | 34.09 | 31.92 | | | |
| 10:38 am | 28 | 34.09 | 31.92 | 1.42 | 400 | |
| 10:39 am | 29 | 34.10 | 31.93 | | | |
| 10:40 am | 30 | 34.10 | 31.93 | | | Reduce rate |
| 10:41 am | 1 | 33.53 | 31.62 | 1.08 | 350 | Step 3 |
| 10:42 am | 2 | 33.50 | 31.60 | | | |
| 10:43 am | 3 | 33.50 | 31.60 | | | |
| 10:44 am | 4 | 33.49 | 31.59 | | | |
| 10:45 am | 5 | 33.49 | 31.58 | | | |
| 10:46 am | 6 | 33.49 | 31.59 | | | |
| 10:47 am | 7 | 33.47 | 31.58 | 1.08 | 350 | Water sample collected; |
| 10:48 am | 8 | 33.48 | 31.58 | | | T=60.4°F |
| 10:49 am | 9 | 33.48 | 31.58 | | | |
| 10:50 am | 10 | 33.48 | 31.58 | | | |
| 10:51 am | 11 | 33.48 | 31.58 | 1.08 | 350 | |
| 10:52 am | 12 | 33.47 | 31.59 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 9A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:53 am | 13 | 33.47 | 31.58 | | | |
| 10:54 am | 14 | 33.48 | 31.58 | | | |
| 10:55 am | 15 | 33.48 | 31.58 | | | |
| 10:56 am | 16 | 33.49 | 31.59 | | | |
| 10:57 am | 17 | 33.47 | 31.57 | 1.08 | 350 | |
| 10:58 am | 18 | 33.49 | 31.58 | | | |
| 10:59 am | 19 | 33.47 | 31.58 | | | |
| 11:00 am | 20 | 33.48 | 31.58 | | | |
| 11:01 am | 21 | 33.47 | 31.59 | | | |
| 11:02 am | 22 | 33.48 | 31.58 | | | |
| 11:03 am | 23 | 33.48 | 31.58 | | | |
| 11:04 am | 24 | 33.48 | 31.58 | | | |
| 11:05 am | 25 | 33.47 | 31.59 | | | |
| 11:06 am | 26 | 33.48 | 31.59 | | | |
| 11:07 am | 27 | 33.48 | 31.58 | | | |
| 11:08 am | 28 | 33.49 | 31.59 | 1.08 | 350 | |
| 11:09 am | 29 | 33.49 | 31.59 | | | |
| 11:10am | 30 | 33.49 | 31.59 | | | Reduce rate |
| 11:11 am | 1 | 32.94 | 31.29 | 0.79 | 300 | Step 4 |
| 11:12am | 2 | 32.93 | 31.29 | | | |
| 11:13am | 3 | 32.92 | 31.27 | 0.79 | 300 | |
| 11:14am | 4 | 32.92 | 31.28 | | | |
| 11:15 am | 5 | 32.92 | 31.27 | | | |
| 11:16am | 6 | 32.92 | 31.27 | | | |
| 11:17am | 7 | 32.91 | 31.26 | | | |
| 11:18am | 8 | 32.92 | 31.27 | 0.80 | 300 | |
| 11:19am | 9 | 32.92 | 31.27 | | | |
| 11:20 am | 10 | 32.92 | 31.27 | | | |
| 11:21 am | 11 | 32.91 | 31.27 | 0.80 | 300 | |
| 11:22 am | 12 | 32.91 | 31.26 | | | |
| 11:23 am | 13 | 32.91 | 31.27 | | | |
| 11:24 am | 14 | 32.91 | 31.26 | | | |
| 11:25 am | 15 | 32.91 | 31.26 | | | |
| 11:26 am | 16 | 32.90 | 31.26 | | | |
| 11:27 am | 17 | 32.91 | 31.26 | 0.80 | 300 | |
| 11:28 am | 18 | 32.90 | 31.26 | | | |
| 11:29 am | 19 | 32.91 | 31.26 | 0.80 | 300 | |
| 11:30 am | 20 | 32.90 | 31.26 | | | |
| 11:31 am | 21 | 32.90 | 31.26 | | | |
| 11:32 am | 22 | 32.89 | 31.25 | 0.80 | 300 | |
| 11:33 am | 23 | 32.89 | 31.25 | | | |
| 11:34 am | 24 | 32.88 | 31.25 | | | |
| 11:35 am | 25 | 32.89 | 31.25 | | | |

WATER-LEVEL MEASUREMENTS (Concluded)
I-70 Well No. 9A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11 36 am | 26 | 32.88 | 31.25 | | | |
| 11 37 am | 27 | 32.89 | 31.25 | | | |
| 11 38 am | 28 | 32.89 | 31.25 | | | |
| 11 39 am | 29 | 32.90 | 31.26 | | | |
| 11 40 am | 30 | 32.88 | 31.24 | 0.80 | 300 | End of Step Test |

**Note::** Incrustation deposits in settling tank, but no sand.

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 WW* | *Piezometer No. I-70 PW* |
|---|---|---|
| Date Drilled: | 1973 | - |
| Casing | | |
| Top elevation: | 400.8 | 409.8 |
| Diameter: | 16-in.SS | 2-in. PVC |
| Length (ft): | 37.4 | na |
| Screen | | |
| Bottom elevation: | 303.4 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 60 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 401.5 | 409.8 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 35.10 | Plugged |
| Height of temp. MP (ft): | 8.8 | - |
| Depth below perm. MP (ft): | 26.30 | - |
| Elevation: | 375.20 | - |
| Date of Step Test: | 8/1/95 | - |
| Water Sample | | |
| Time: | 2:59 pm | - |
| Temperature: | 60.3° F | - |
| Laboratory No.: | 228881 | - |
| Distance and Direction to Piez. from PW: | | 5.8 ft Southeast |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Sand tank
Hermit datalogger
na-information not available

SWS Crew: R. Olson, M. Anliker

WATER-LEVEL MEASUREMENTS
I-70 Well No. 10
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 08/01/95 | | | | | | |
| 10:43 am | 0 | 35.18 | | | | SI dropline |
| 11:00 am | 0 | 35.11 | | | | SI dropline |
| 01:54 pm | 0 | 35.10 | | | | SI dl thru 3" hole |
| 02:02 pm | 0 | 35.16 | | | | Datalogger started |
| 02:03 pm | 1 | 35.16 | | | | Water level trend |
| 02:04 pm | 2 | 35.17 | | | | |
| 02:05 pm | 3 | 35.17 | | | | Piezometer plugged |
| 02:06 pm | 4 | 35.17 | | | | |
| 02:07 pm | 5 | 35.17 | | | | |
| 02:08 pm | 6 | 35.17 | | | | |
| 02:09 pm | 7 | 35.17 | | | | |
| 02:10 pm | 8 | 35.17 | | | | |
| 02:11 pm | 9 | 35.16 | | | | |
| 02:12 pm | 10 | 35.17 | | | | |
| 02:13 pm | 11 | 35.17 | | | | |
| 02:14 pm | 12 | 35.16 | | | | |
| 02:15 pm | 0 | 35.16 | | | | Pump On |
| 02:16 pm | 1 | 43.04 | | 1.86 | 455 | Step 1; Q max |
| 02:17 pm | 2 | 42.30 | | 1.80 | 450 | Much leakage on adapter pipe attached to well head |
| 02:18 pm | 3 | 42.19 | | | | |
| 02:19 pm | 4 | 42.14 | | | | |
| 02:20 pm | 5 | 42.13 | | | | |
| 02:21 pm | 6 | 41.99 | | | | |
| 02:22 pm | 7 | 41.95 | | | | |
| 02:23 pm | 8 | 42.07 | | 1.65 | | Won't hold rate |
| 02:24 pm | 9 | 42.04 | | 1.42 | 400 | |
| 02:25 pm | 10 | 41.96 | | | | |
| 02:26 pm | 11 | 42.01 | | 1.41 | 400 | |
| 02:27 pm | 12 | 42.00 | | 1.42 | 400 | |
| 02:28 pm | 13 | 42.02 | | | | |
| 02:29 pm | 14 | 42.05 | | | | |
| 02:30 pm | 15 | 42.01 | | | | |
| 02:31 pm | 16 | 42.02 | | | | |
| 02:32 pm | 17 | 42.04 | | 1.42 | 400 | |
| 02:33 pm | 18 | 42.06 | | | | |
| 02:34 pm | 19 | 42.01 | | | | |
| 02:35 pm | 20 | 42.01 | | | | |
| 02:36 pm | 21 | 42.02 | | | | |
| 02:37 pm | 22 | 42.05 | | | | |
| 02:38 pm | 23 | 42.05 | | | | |
| 02:39 pm | 24 | 42.07 | | | | |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 10

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 02:40 pm | 25 | 42.04 | | 1.41 | 400 | |
| 02:41 pm | 26 | 42.05 | | | | |
| 02:42 pm | 27 | 42.09 | | | | |
| 02:43 pm | 28 | 42.10 | | | | |
| 02:44 pm | 29 | 42.08 | | | | |
| 02:45 pm | 30 | 42.04 | | 1.41 | 400 | Decrease rate |
| 02:46 pm | 1 | 41.64 | | 1.08 | 350 | Step 2 |
| 02:47 pm | 2 | 41.68 | | | | |
| 02:48 pm | 3 | 41.68 | | | | |
| 02:49 pm | 4 | 41.64 | | | | |
| 02:50 pm | 5 | 41.66 | | 1.07 | 350 | |
| 02:51 pm | 6 | 41.66 | | | | |
| 02:52 pm | 7 | 41.71 | | | | |
| 02:53 pm | 8 | 41.68 | | | | |
| 02:54 pm | 9 | 41.69 | | 1.07 | 350 | |
| 02:55 pm | 10 | 41.70 | | | | |
| 02:56 pm | 11 | 41.77 | | | | |
| 02:57 pm | 12 | 41.68 | | | | |
| 02:58 pm | 13 | 41.71 | | | | |
| 02:59 pm | 14 | 41.73 | | | | Water sample collected; |
| 03:00 pm | 15 | 41.72 | | | | T=60.3°F |
| 03:01 pm | 16 | 41.68 | | 1.06 | | Adjust rate |
| 03:02 pm | 17 | 41.73 | | 1.08 | 350 | |
| 03:03 pm | 18 | 41.77 | | | | |
| 03:04 pm | 19 | 41.69 | | | | |
| 03:05 pm | 20 | 41.71 | | 1.08 | 350 | BART samples |
| 03:06 pm | 21 | 41.68 | | | | |
| 03:07 pm | 22 | 41.71 | | | | |
| 03:08 pm | 23 | 41.73 | | | | |
| 03:09 pm | 24 | 41.74 | | | | |
| 03:10 pm | 25 | 41.72 | | 1.08 | 350 | |
| 03:11 pm | 26 | 41.73 | | | | |
| 03:12 pm | 27 | 41.69 | | | | |
| 03:13 pm | 28 | 41.69 | | | | |
| 03:14 pm | 29 | 41.69 | | | | |
| 03:15 pm | 30 | 41.71 | | 1.07 | 350 | Decrease rate |
| 03:16 pm | 1 | 41.30 | | 0.80 | 300 | Step 3 |
| 03:17 pm | 2 | 41.26 | | | | |
| 03:18 pm | 3 | 41.31 | | | | |
| 03:19 pm | 4 | 41.31 | | 0.78 | 300 | Adjust rate |
| 03:20 pm | 5 | 41.39 | | 0.79 | 300 | |

## WATER-LEVEL MEASUREMENTS (Concluded)
## I-70 Well No. 10

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:21 pm | 6 | 41.39 | | | | |
| 03:22 pm | 7 | 41.42 | | | | |
| 03:23 pm | 8 | 41.42 | | | | |
| 03:24 pm | 9 | 41.40 | | | | |
| 03:25 pm | 10 | 41.42 | | | | |
| 03:26 pm | 11 | 41.38 | | | | |
| 03:27 pm | 12 | 41.36 | | | | |
| 03:28 pm | 13 | 41.41 | | | | |
| 03:29 pm | 14 | 41.37 | | | | |
| 03:30 pm | 15 | 41.41 | | | | |
| 03:31 pm | 16 | 41.39 | | | | |
| 03:32 pm | 17 | 41.42 | | | | |
| 03:33 pm | 18 | 41.44 | | | | |
| 03:34 pm | 19 | 41.46 | | | | |
| 03:35 pm | 20 | 41.43 | | | | |
| 03:36 pm | 21 | 41.42 | | | | |
| 03:37 pm | 22 | 41.48 | | | | |
| 03:38 pm | 23 | 41.45 | | | | |
| 03:39 pm | 24 | 41.44 | | | | |
| 03:40 pm | 25 . | 41.42 | | | | |
| 03:41 pm | 26 | 41.45 | | | | |
| 03:42 pm | 27 | 41.45 | | | | |
| 03:43 pm | 28 | 41.41 | | | | |
| 03:44 pm | 29 | 41.43 | | | | Thunderstorm |
| 03:45 pm | 30 | 41.40 | | 0.79 | 300 | End of Step Test |

**Notes:** Substantial amount of fine sand and some gravel pack collected in settling tank. Collected about 2 cups. This was about 75-80 percent of total sample in tank.

## DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W13* | *Piezometer No. I-70 P13* |
|---|---|---|
| Date Drilled: | 7/90 | 1990 |
| Casing | | |
| Top elevation: | 397.0 | 407.2 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 33.8 | na |
| Screen | | |
| Bottom elevation: | 303.2 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 40 | 3 |
| Slot size, lower: | 0.055-in. | na |
| Length, upper (ft): | 20 | - |
| Slot size, upper: | 0.020-in. | - |
| Measuring Point Elevation: | 407.0 (temp) | 407.2 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 34.22 | - |
| Height of temp. MP (ft): | - | - |
| Depth below perm. MP (ft): | | 34.14 |
| Elevation: | 372.8 | 373.1 |
| Date of Step Test: | 4/25/95 | - |
| Water Sample | | |
| Time: | 1:42 pm | - |
| Temperature: | 59.9° F | - |
| Laboratory No.: | 228641 | - |
| Distance and Direction to Piez. from PW: | | 6.7 ft West |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | I70 W3A,6,8A,10,11A,14 |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
Water level data collected w/Omnidata (SN1099) and 30 psi and 6 psi (No. 4) transducers
No sand in tank following step test
na-information not available

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 13
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 04/25/95 | | | | | | |
| 11:51 am | | | 34.14 | | | SI dropline |
| 11:54 am | 0 | 34.22 | | | | SI dropline |
| 12:30 pm | 0 | | | | | Data logger started |
| 12:31 pm | 1 | 34.24 | 34.15 | | | Water level trend |
| 12:32 pm | 2 | 34.23 | 34.14 | | | |
| 12:33 pm | 3 | 34.23 | 34.14 | | | |
| 12:34 pm | 4 | 34.23 | 34.15 | | | |
| 12:35 pm | 5 | 34.22 | 34.15 | | | |
| 12:36 pm | 6 | 34.22 | 34.12 | | | |
| 12:37 pm | 7 | 34.23 | 34.12 | | | |
| 12:38 pm | 8 | 34.23 | 34.12 | | | |
| 12:39 pm | 9 | 34.23 | 34.13 | | | |
| 12:40 pm | 10 | 34.23 | 34.13 | | | |
| 12:41 pm | 11 | 34.23 | 34.13 | | | |
| 12:42 pm | 12 | 34.22 | 34.14 | | | |
| 12:43 pm | 13 | 34.22 | 34.13 | | | |
| 12:44 pm | 14 | 34.23 | 34.13 | | | |
| 12:45 pm | 15 | 34.22 | 34.14 | | | |
| 12:46 pm | 16 | 34.22 | 34.13 | | | |
| 12:47 pm | 17 | 34.22 | 34.13 | | | |
| 12:48 pm | 18 | 34.22 | 34.13 | | | |
| 12:49 pm | 19 | 34.22 | 34.13 | | | |
| 12:50 pm | 0 | 34.22 | 34.12 | | | Pump On |
| 12:51 pm | 1 | 40.75 | 35.32 | | | |
| 12:52 pm | 2 | 40.94 | 35.41 | | | Pumping rate too low for |
| 12:53 pm | 3 | 40.98 | 35.44 | | | step test; will conduct |
| 12:54 pm | 4 | 40.99 | 35.46 | | | drawdown test only. |
| 12:55 pm | 5 | 41.04 | 35.48 | | | |
| 12:56 pm | 6 | 41.07 | 35.50 | | | |
| 12:57 pm | 7 | 41.08 | 35.51 | 0.37 | 205 | |
| 12:58 pm | 8 | 41.10 | 35.51 | | | |
| 12:59 pm | 9 | 41.10 | 35.50 | | | |
| 01:00 pm | 10 | 41.12 | 35.52 | | | |
| 01:01 pm | 11 | 41.13 | 35.53 | | | |
| 01:02 pm | 12 | 41.13 | 35.53 | | | |
| 01:03 pm | 13 | 41.13 | 35.54 | | | |
| 01:04 pm | 14 | 41.13 | 35.54 | | | |
| 01:05 pm | 15 | 41.14 | 35.53 | | | |
| 01:06 pm | 16 | 41.14 | 35.52 | | | |
| 01:07 pm | 17 | 41.15 | 35.54 | | | |
| 01:08 pm | 18 | 41.15 | 35.55 | | | |
| 01:09 pm | 19 | 41.16 | 35.55 | | | |

## WATER-LEVEL MEASUREMENTS (Concluded)
## I-70 Well No. 13

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:10 pm | 20 | 41.15 | 35.54 | | | |
| 01:11 pm | 21 | 41.16 | 35.53 | 0.38 | 208 | |
| 01:12 pm | 22 | 41.16 | 35.53 | | | |
| 01:13 pm | 23 | 41.17 | 35.54 | | | |
| 01:14 pm | 24 | 41.17 | 35.55 | | | |
| 01:15 pm | 25 | 41.16 | 35.56 | | | |
| 01:16 pm | 26 | 41.16 | 35.56 | | | |
| 01:17 pm | 27 | 41.17 | 35.57 | | | |
| 01:18 pm | 28 | 41.17 | 35.58 | | | |
| 01:19 pm | 29 | 41.17 | 35.57 | | | |
| 01:20 pm | 30 | 41.17 | 35.57 | 0.38 | 208 | |
| 01:21 pm | 31 | 41.18 | 35.56 | | | |
| 01:22 pm | 32 | 41.18 | 35.57 | | | |
| 01:23 pm | 33 | 41.18 | 35.57 | | | |
| 01:24 pm | 34 | 41.18 | 35.58 | | | |
| 01:25 pm | 35 | 41.18 | 35.58 | | | |
| 01:26 pm | 36 | 41.18 | 35.58 | | | |
| 01:27 pm | 37 | 41.18 | 35.57 | | | |
| 01:28 pm | 38 | 41.18 | 35.56 | | | |
| 01:29 pm | 39 | 41.18 | 35.55 | | | |
| 01:30 pm | 40 | 41.18 | 35.55 | | | |
| 01:31 pm | 41 | 41.19 | 35.56 | | | |
| 01:32 pm | 42 | 41.18 | 35.57 | | | |
| 01:33 pm | 43 | 41.18 | 35.53 | | | |
| 01:34 pm | 44 | 41.19 | 35.55 | | | |
| 01:35 pm | 45 | 41.19 | 35.58 | | | |
| 01:36 pm | 46 | 41.18 | 35.60 | | | |
| 01:37 pm | 47 | 41.19 | 35.62 | 0.38 | 208 | |
| 01:38 pm | 48 | 41.18 | 35.62 | | | |
| 01:39 pm | 49 | 41.18 | 35.60 | | | |
| 01:40 pm | 50 | 41.18 | 35.59 | | | |
| 01:41 pm | 51 | 41.19 | 35.58 | | | |
| 01:42 pm | 52 | 41.19 | 35.59 | | | Water sample collected; |
| 01:43 pm | 53 | 41.18 | 35.58 | | | T=59.9°F |
| 01:44 pm | 54 | 41.19 | 35.58 | | | |
| 01:45 pm | 55 | 41.19 | 35.58 | 0.38 | 208 | BART samples collected |
| 01:46 pm | 56 | 41.20 | 35.59 | | | |
| 01:47 pm | 57 | 41.19 | 35.61 | | | |
| 01:48 pm | 58 | 41.18 | 35.62 | | | |
| 01:49 pm | 59 | 41.18 | 35.62 | | | |
| 01:50 pm | 60 | 41.18 | 35.58 | | | End of drawdown test |

**Note::** Chunks of incrustation in settling tank following drawdown test, but no sand.

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. I-70 W14* | *Piezometer No. I-70 P14* |
|---|---|---|
| Date Drilled: | 7/90 | 1990 |
| Casing | | |
| Top elevation: | 382.5 | 390.8 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 21.5 | na |
| Screen | | |
| Bottom elevation: | 301.0 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 40 | 3 |
| Slot size, lower: | 0.055-in. | na |
| Length, upper (ft): | 20 | - |
| Slot size: | 0.020-in. | - |
| Measuring Point Elevation: | - | 390.8 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 14.87 | - |
| Height of temp. MP (ft): | - | - |
| Depth below perm. MP (ft): | - | 15.24 |
| Elevation: | - | 375.56 |
| Date of Step Test: | 6/22/94 | - |
| Water Sample | | |
| Time: | 2:45 pm | - |
| Temperature: | 58.1° F | - |
| Laboratory No.: | 227793 | - |
| Distance and Direction to Piez. from PW: | | Not recorded |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | I70 W2A,3A,5,15 |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
Omnidata datalogger
na-information not available

SWS Crew: M. Anliker, R. Olson

WATER-LEVEL MEASUREMENTS
I-70 Well No. 14
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 06/22/94 | | | | | | |
| 01:25 pm | | 14.87 | 15.24 | | | Dropline |
| 01:41 pm | 0 | 14.87 | 15.22 | | | Datalogger started |
| 01:42 pm | 1 | 14.86 | 15.22 | | | Water level trend |
| 01:43 pm | 2 | 14.86 | 15.21 | | | |
| 01:44 pm | 3 | 14.87 | 15.22 | | | |
| 01:45 pm | 4 | 14.87 | 15.21 | | | |
| 01:46 pm | 5 | 14.87 | 15.22 | | | |
| 01:47 pm | 6 | 14.87 | 15.21 | | | |
| 01:48 pm | 7 | 14.87 | 15.21 | | | |
| 01:49 pm | 8 | 14.87 | 15.21 | | | |
| 01:50 pm | 0 | 14.87 | 15.21 | | | Pump On |
| 01:51 pm | 1 | 25.59 | 16.33 | | | Step 1; discharge gassy |
| 01:52 pm | 2 | 25.73 | 16.49 | 1.40 | 396 | Max Q |
| 01:53 pm | 3 | 25.78 | 16.54 | | | |
| 01:54 pm | 4 | 25.79 | 16.57 | | | |
| 01:55 pm | 5 | 24.96 | 16.50 | 1.09 | 351 | |
| 01:56 pm | 6 | 25.00 | 16.51 | | | |
| 01:57 pm | 7 | 25.01 | 16.52 | | | |
| 01:58 pm | 8 | 25.04 | 16.53 | | | |
| 01:59 pm | 9 | 25.05 | 16.54 | | | |
| 02:00 pm | 10 | 25.07 | 16.55 | | | |
| 02:01 pm | 11 | 25.07 | 16.56 | 1.08 | 350 | |
| 02:02 pm | 12 | 25.08 | 16.57 | | | |
| 02:03 pm | 13 | 25.09 | 16.57 | | | |
| 02:04 pm | 14 | 25.10 | 16.58 | | | |
| 02:05 pm | 15 | 25.11 | 16.59 | | | |
| 02:06 pm | 16 | 25.12 | 16.59 | 1.08 | 350 | |
| 02:07 pm | 17 | 25.12 | 16.60 | | | |
| 02:08 pm | 18 | 25.12 | 16.59 | | | |
| 02:09 pm | 19 | 25.13 | 16.60 | | | |
| 02:10 pm | 20 | 25.13 | 16.61 | | | |
| 02:11 pm | 21 | 25.15 | 16.61 | | | |
| 02:12 pm | 22 | 25.15 | 16.62 | | | |
| 02:13 pm | 23 | 25.15 | 16.63 | | | |
| 02:14 pm | 24 | 25.16 | 16.62 | | | |
| 02:15 pm | 25 | 25.16 | 16.64 | 1.08 | 350 | |
| 02:16 pm | 26 | 25.17 | 16.63 | | | |
| 02:17 pm | 27 | 25.18 | 16.64 | | | |
| 02:18 pm | 28 | 25.18 | 16.64 | | | |
| 02:19 pm | 29 | 25.17 | 16.65 | | | |
| 02:20 pm | 30 | 25.17 | 16.64 | 1.08 | 350 | Reduce rate |

WATER-LEVEL MEASUREMENTS (Continued)
I-70 Well No. 14

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 02:21 pm | 1 | 23.94 | 16.52 | 0.79 | 300 | Step 2 |
| 02:22 pm | 2 | 23.86 | 16.50 | | | |
| 02:23 pm | 3 | 23.85 | 16.50 | | | |
| 02:24 pm | 4 | 23.85 | 16.50 | 0.79 | 300 | |
| 02:25 pm | 5 | 23.85 | 16.50 | | | |
| 02:26 pm | 6 | 23.85 | 16.50 | | | |
| 02:27 pm | 7 | 23.86 | 16.50 | | | |
| 02:28 pm | 8 | 23.85 | 16.50 | | | |
| 02:29 pm | 9 | 23.86 | 16.50 | | | |
| 02:30 pm | 10 | 23.86 | 16.51 | | | |
| 02:31 pm | 11 | 23.86 | 16.50 | | | |
| 02:32 pm | 12 | 23.86 | 16.51 | | | |
| 02:33 pm | 13 | 23.86 | 16.51 | | | |
| 02:34 pm | 14 | 23.86 | 16.51 | 0.79 | 300 | |
| 02:35 pm | 15 | 23.86 | 16.51 | | | |
| 02:36 pm | 16 | 23.83 | 16.51 | | | |
| 02:37 pm | 17 | 23.83 | 16.51 | | | |
| 02:38 pm | 18 | 23.84 | 16.51 | | | |
| 02:39 pm | 19 | 23.83 | 16.52 | | | |
| 02:40 pm | 20 | 23.84 | 16.51 | | | |
| 02:41 pm | 21 | 23.84 | 16.51 | | | |
| 02:42 pm | 22 | 23.83 | 16.50 | | | |
| 02:43 pm | 23 | 23.84 | 16.51 | 0.79 | 300 | |
| 02:44 pm | 24 | 23.84 | 16.52 | | | |
| 02:45 pm | 25 | 23.84 | 16.51 | | | Water sample collected; |
| 02:46 pm | 26 | 23.85 | 16.52 | | | T=58.1°F |
| 02:47 pm | 27 | 23.85 | 16.52 | | | |
| 02:48 pm | 28 | 23.86 | 16.52 | | | |
| 02:49 pm | 29 | 23.86 | 16.52 | | | |
| 02:50 pm | 30 | 23.86 | 16.53 | | | Reduce rate |
| 02:51 pm | 1 | 22.56 | 16.38 | 0.55 | 250 | Step 3 |
| 02:52 pm | 2 | 22.57 | 16.37 | | | |
| 02:53 pm | 3 | 22.56 | 16.36 | | | |
| 02:54 pm | 4 | 22.55 | 16.37 | 0.54 | 248 | BART samples collected |
| 02:55 pm | 5 | 22.54 | 16.36 | | | |
| 02:56 pm | 6 | 22.54 | 16.36 | | | |
| 02:57 pm | 7 | 22.53 | 16.35 | | | |
| 02:58 pm | 8 | 22.55 | 16.36 | | | |
| 02:59 pm | 9 | 22.54 | 16.36 | | | |
| 03:00 pm | 10 | 22.54 | 16.36 | 0.54 | 248 | |
| 03:01 pm | 11 | 22.54 | 16.36 | | | |
| 03:02 pm | 12 | 22.54 | 16.35 | | | |
| 03:03 pm | 13 | 22.54 | 16.36 | | | |
| 03:04 pm | 14 | 22.54 | 16.36 | | | |

## WATER-LEVEL MEASUREMENTS (Concluded)
## I-70 Well No. 14

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:05 pm | 15 | 22.54 | 16.35 | 0.54 | 248 | |
| 03:06 pm | 16 | 22.54 | 16.36 | | | |
| 03:06 pm | 17 | 22.60 | | | | Solinst DL check |
| 03:07 pm | 17 | 22.54 | 16.36 | | | |
| 03:08 pm | 18 | 22.55 | 16.36 | | | |
| 03:09 pm | 19 | 22.54 | 16.36 | | | |
| 03:10 pm | 20 | 22.54 | 16.36 | | | |
| 03:10 pm | 21 | | 16.45 | 0.54 | 248 | Solinst DL check |
| 03:11 pm | 21 | 22.54 | 16.36 | | | |
| 03:12 pm | 22 | 22.55 | 16.35 | | | |
| 03:13 pm | 23 | 22.55 | 16.36 | 0.54 | 248 | |
| 03:14 pm | 24 | 22.55 | 16.36 | | | |
| 03:15 pm | 25 | 22.55 | 16.36 | | | |
| 03:16 pm | 26 | 22.55 | 16.36 | | | |
| 03:17 pm | 27 | 22.54 | 16.36 | | | |
| 03:18 pm | 28 | 22.54 | 16.36 | | | |
| 03:19 pm | 29 | 22.55 | 16.35 | | | |
| 03:20 pm | 30 | 22.55 | 16.36 | | | End of Step Test |

## DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. 25th St. W4* | *Piezometer No. 25th St. P4* |
|---|---|---|
| Date Drilled: | 7/22/75 | 1975 |
| Casing | | |
| Top elevation: | 391.46 | 401.5 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 27.85 | na |
| Screen | | |
| Bottom elevation: | 301.26 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 60 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 392.4 | 401.5 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 13.08 | Plugged |
| Height of temp. MP (ft): | 9.3 | - |
| Depth below perm. MP (ft): | 3.78 | - |
| Elevation: | 388.62 | - |
| Date of Step Test: | 7/24/92 | - |
| Water Sample | | |
| Time: | 12:24 pm | - |
| Temperature: | 60.0° F | - |
| Laboratory No.: | 226026 | - |
| Distance and Direction to Piez. from PW: | | 4.5 ft S |
| Time PW Off Before Step Test: | | Overnight |
| Wells in Operation at Site at Time of Step Test: | | 25th St. Wells 1,5,7,9 |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
Sand tank used - a few scale chips collected in tank but no sand
na-information not available

SWS Crew: R. Olson, E. Sanderson

WATER-LEVEL MEASUREMENTS
25th St. Well No. 4
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 07/24/92 | | | | | | |
| 09:25 am | 0.0 | 13.08 | | | | Solinst Dropline |
| 09:38 am | 0.0 | 13.09 | | | | McDAS started |
| | 1.0 | 13.09 | | | | Water Level Trend |
| 09:40 am | 2.0 | 13.09 | | | | Piezometer plugged |
| | 3.0 | 13.08 | | | | |
| | 4.0 | 13.08 | | | | |
| | 5.0 | 13.07 | | | | |
| | 6.1 | 12.99 | | | | |
| | 7.1 | 12.99 | | | | |
| | 8.1 | 12.98 | | | | |
| | 9.1 | 12.95 | | | | |
| | 10.1 | 13.09 | | | | |
| | 11.1 | 13.09 | | | | |
| 09:50 am | 12.1 | 13.09 | | | | |
| | 13.1 | 13.09 | | | | |
| | 14.1 | 13.09 | | | | |
| | 15.1 | 13.08 | | | | |
| | 16.1 | 13.08 | | | | |
| | 17.1 | 13.09 | | | | |
| | 18.1 | 13.09 | | | | |
| | 19.1 | 13.09 | | | | |
| | 20.1 | 13.09 | | | | |
| | 21.1 | 13.09 | | | | |
| | 21.9 | 13.09 | | | | |
| 10:00 am | | | | | | Pump On |
| 10:01 am | 1.0 | 15.58 | | | | Step 1 |
| | 2.0 | 15.60 | | 0.60 | 260 | Pump running backwards? |
| | 3.0 | 15.58 | | | | |
| | 4.0 | 14.96 | | | | |
| | 5.3 | 15.62 | | | | |
| 10:06 am | 6.1 | 15.60 | | | | |
| | 6.5 | 15.61 | | | | Pump Off |
| | 6.7 | 13.84 | | | | Water Level Trend |
| | 7.1 | 13.23 | | | | B. Roberts switched wires |
| | 8.1 | 13.13 | | | | at main control box |
| | 8.5 | 13.11 | | | | |
| | 9.1 | 13.10 | | | | |
| | 9.5 | 13.10 | | | | |
| | 10.1 | 13.10 | | | | |
| 10:10 am | 0.0 | 13.10 | | | | Pump On |
| | 1.0 | 20.58 | | 6.00 | 820 | Step 1; Max rate |
| | 2.0 | 20.31 | | 5.80 | 800 | Water red in color |

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| | 3.0 | 20.27 | | | | Well 5 pump off |
| | 4.0 | 20.28 | | | | |
| | 5.0 | 20.51 | | | | |
| | 6.0 | 20.99 | | | | Well 5 pump back on |
| | 8.0 | 21.07 | | | | |
| 10:20 am | 10.0 | 21.08 | | 5.80 | 800 | Water clear |
| | 12.0 | 21.10 | | | | |
| | 14.0 | 21.12 | | | | |
| | 15.0 | 21.12 | | 5.80 | 800 | |
| | 16.0 | 21.14 | | | | |
| | 18.0 | 21.15 | | | | |
| 10:30 am | 20.0 | 21.16 | | 5.81 | 800 | |
| | 22.1 | 21.17 | | | | |
| | 23.9 | 21.18 | | | | |
| | 24.9 | 21.18 | | | | |
| | 25.9 | 21.19 | | | | |
| | 26.9 | 21.19 | | 5.81 | 800 | |
| | 27.9 | 21.20 | | | | |
| | 29.0 | 21.19 | | 5.81 | 800 | |
| | 29.4 | 21.20 | | | | |
| 10:40 am | 30.0 | | | | | Reduce Rate |
| 10:41 am | 1.0 | 20.73 | | 5.08 | 750 | Step 2 |
| | 2.0 | 20.73 | | | | |
| | 3.0 | 20.73 | | | | |
| | 4.0 | 20.73 | | | | |
| | 5.0 | 20.74 | | | | |
| | 6.1 | 20.74 | | 5.09 | 750 | |
| | 8.1 | 20.75 | | | | |
| 10:50 am | 10.1 | 20.75 | | | | |
| | 12.1 | 20.75 | | 5.09 | 750 | |
| | 14.1 | 20.75 | | | | |
| | 16.1 | 20.77 | | | | |
| | 18.1 | 20.78 | | | | |
| | 19.1 | 20.77 | | 5.08 | 750 | |
| 11:00 am | 20.1 | 20.78 | | | | |
| | 22.1 | 20.79 | | | | |
| | 24.1 | 20.79 | | | | |
| | 25.1 | 20.80 | | 5.09 | 750 | |
| | 26.1 | 20.80 | | | | |
| | 27.1 | 20.80 | | | | |
| | 28.1 | 20.80 | | | | |
| | 29.1 | 20.81 | | | | |
| | 29.7 | 20.81 | | | | |
| 11:10 am | 30.0 | | | | | Reduce Rate |

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11:11 am | 1.0 | 20.33 | | 4.40 | 700 | Step 3 |
| | 2.0 | 20.34 | | 4.41 | 700 | |
| | 3.0 | 20.34 | | | | |
| | 4.0 | 20.35 | | | | |
| | 5.0 | 20.34 | | | | |
| | 6.1 | 20.35 | | | | |
| | 8.1 | 20.35 | | 4.42 | 700 | |
| 11:20 am | 10.1 | 20.35 | | | | |
| | 12.1 | 20.35 | | | | |
| | 14.1 | 20.35 | | | | |
| | 16.1 | 20.36 | | 4.41 | 700 | |
| | 18.1 | 20.36 | | | | |
| 11:30 am | 20.1 | 20.36 | | | | |
| | 22.1 | 20.37 | | 4.41 | 700 | |
| | 24.1 | 20.38 | | | | |
| | 25.1 | 20.38 | | | | |
| | 26.1 | 20.37 | | | | |
| | 27.1 | 20.38 | | | | |
| | 28.1 | 20.38 | | 4.41 | 700 | |
| | 29.1 | 20.39 | | | | |
| | 29.7 | 20.39 | | | | |
| 11:40 am | 30.0 | | | | | Reduce Rate |
| 11:41 am | 1.0 | 19.95 | | 3.81 | 650 | Step 4 |
| | 2.0 | 19.94 | | | | |
| | 3.0 | 19.94 | | | | |
| | 4.0 | 19.94 | | | | |
| | 5.0 | 19.95 | | 3.81 | 650 | |
| | 6.1 | 19.95 | | | | |
| | 8.1 | 19.94 | | | | |
| 11:50 am | 10.1 | 19.94 | | | | |
| | 12.1 | 19.94 | | 3.81 | 650 | |
| | 14.1 | 19.95 | | | | |
| | 16.1 | 19.95 | | | | |
| | 18.1 | 19.95 | | | | |
| 12:00 pm | 20.1 | 19.95 | | | | |
| | 21.1 | 19.96 | | 3.81 | 650 | |
| | 22.1 | 19.96 | | | | |
| | 24.1 | 19.97 | | | | |
| | 25.1 | 19.97 | | | | |
| | 26.1 | 19.97 | | 3.81 | 650 | |
| | 27.1 | 19.96 | | | | |
| | 28.1 | 19.97 | | | | |
| | 29.1 | 19.97 | | 3.81 | 650 | |
| | 29.7 | 19.97 | | | | |

WATER-LEVEL MEASUREMENTS (Concluded)
25th St. Well No. 4

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 12:10pm | 30.0 | | | | | Reduce Rate |
| 12:11 pm | 1.0 | 19.51 | | | | Step 5 |
| | 2.0 | 19.50 | | 3.22 | 600 | |
| | 3.0 | 19.50 | | | | |
| | 4.0 | 19.49 | | | | |
| | 5.0 | 19.50 | | | | |
| | 6.1 | 19.50 | | | | |
| | 8.1 | 19.51 | | | | BART samples collected |
| 12:20 pm | 10.1 | 19.50 | | 3.22 | 600 | |
| | 12.1 | 19.51 | | | | |
| | 14.1 | 19.51 | | 3.22 | 600 | Water sample collected, |
| | 16.1 | 19.51 | | | | T=60°F |
| | 18.1 | 19.52 | | | | |
| 12:30 pm | 20.1 | 19.53 | | | | |
| | 22.1 | 19.52 | | | | |
| | 24.1 | 19.52 | | 3.22 | 600 | |
| | 25.1 | 19.52 | | | | |
| | 26.1 | 19.53 | | | | |
| | 27.1 | 19.52 | | | | |
| | 28.1 | 19.52 | | | | |
| | 29.1 | 19.53 | | | | |
| 12:40 pm | 30.1 | 19.53 | | 3.22 | 600 | End of Test |

DEWATERING WELL DATA
Posttreatment Step Test

| | *Well No. 25th St. W8* | *Piezometer No. 25th St. P8* |
|---|---|---|
| Date Drilled: | 8/22/75 | 1975 |
| Casing | | |
| Top elevation: | 389.66 | 400.5 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 29.27 | na |
| Screen | | |
| Bottom elevation: | 300.39 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 60 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 390.8 | 400.5 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 13.16 | - |
| Height of temp. MP (ft): | 10.2 | - |
| Depth below perm. MP (ft): | 2.96 | 12.28 |
| Elevation: | 387.84 | 388.22 |
| Date of Step Test: | 11/15/93 | - |
| Water Sample | | |
| Time: | 3:09 pm | - |
| Temperature: | 58° F | - |
| Laboratory No.: | 227237 | - |
| Distance and Direction to Piez. from PW: | | 4.0 ft Northwest |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | 25th St. W2,3,4,7,9 |

Notes: SWS 8-in. dia. orifice tube w/plate No. 4
Omnidata#1333
Sand tank
na-information not available

SWS Crew: E. Sanderson, R. Olson

WATER-LEVEL MEASUREMENTS
25th St. Well No. 8
Posttreatment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11/15/93 | | | | | | |
| 12:47 pm | 0 | 13.16 | 12.28 | | | Dropline |
| 01:16pm | 1 | 13.17 | 12.28 | | | Water level trend |
| 01:17 pm | 2 | 13.17 | 12.28 | | | |
| 01:18pm | 3 | 13.16 | 12.28 | | | |
| 01:19 pm | 4 | 13.16 | 12.29 | | | |
| 01:20 pm | 5 | 13.16 | 12.29 | | | |
| 01:21pm | 6 | 13.16 | 12.30 | | | |
| 01:22 pm | 7 | 13.16 | 12.30 | | | |
| 01:23 pm | 8 | 13.16 | 12.30 | | | |
| 01:24 pm | 9 | 13.16 | 12.30 | | | |
| 01:25 pm | 10 | 13.16 | 12.31 | | | |
| 01:26 pm | 11 | 13.54 | 12.47 | | | |
| 01:27 pm | 12 | 13.16 | 12.31 | | | |
| 01:28 pm | 13 | 12.73 | 12.47 | | | |
| 01:29 pm | 0 | 13.13 | 12.27 | | | Pump On |
| 01:30 pm | 1 | 19.43 | 12.41 | 3.45 | 620 | Step l; Max Q |
| 01:31 pm | 2 | 19.34 | 12.47 | 3.23 | 600 | |
| 01:32 pm | 3 | 19.34 | 12.52 | | | |
| 01:33 pm | 4 | 19.34 | 12.57 | | | |
| 01:34 pm | 5 | 19.35 | 12.57 | | | |
| 01:35 pm | 6 | 19.35 | 12.58 | | | |
| 01:36 pm | 7 | 19.35 | 12.58 | | | |
| 01:37 pm | 8 | 19.35 | 12.59 | | | |
| 01:38 pm | 9 | 19.35 | 12.59 | | | |
| 01:39 pm | 10 | 19.36 | 12.60 | | | |
| 01:40 pm | 11 | 19.35 | 12.60 | | | |
| 01:41 pm | 12 | 19.35 | 12.61 | 3.23 | 600 | |
| 01:42 pm | 13 | 19.36 | 12.61 | | | |
| 01:43 pm | 14 | 19.36 | 12.61 | | | |
| 01:44 pm | 15 | 19.35 | 12.61 | | | |
| 01:45 pm | 16 | 19.36 | 12.62 | | | |
| 01:46 pm | 17 | 19.37 | 12.62 | 3.20 | 598 | Increase rate |
| 01:47 pm | 18 | 19.36 | 12.62 | 3.23 | 600 | |
| 01:48 pm | 19 | 19.36 | 12.63 | | | |
| 01:49 pm | 20 | 19.38 | 12.63 | | | |
| 01:50 pm | 21 | 19.39 | 12.63 | | | |
| 01:51 pm | 22 | 19.38 | 12.63 | | | |
| 01:52 pm | 23 | 19.39 | 12.64 | | | |
| 01:53 pm | 24 | 19.38 | 12.64 | | | |
| 01:54 pm | 25 | 19.39 | 12.64 | | | |
| 01:55 pm | 26 | 19.38 | 12.64 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
25th St. Well No. 8

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:56 pm | 27 | 19.39 | 12.64 | | | |
| 01:57 pm | 28 | 19.39 | 12.65 | 3.23 | 600 | |
| 01:58 pm | 29 | 19.39 | 12.65 | | | |
| 01:59 pm | 30 | 19.39 | 12.65 | | | Decrease rate |
| 02:00 pm | 1 | 18.88 | 12.65 | 2.70 | 550 | Step 2 |
| 02:01 pm | 2 | 18.87 | 12.66 | | | |
| 02:02 pm | 3 | 18.86 | 12.66 | | | |
| 02:03 pm | 4 | 18.87 | 12.66 | | | |
| 02:04 pm | 5 | 18.87 | 12.66 | | | |
| 02:05 pm | 6 | 18.87 | 12.66 | | | |
| 02:06 pm | 7 | 18.87 | 12.67 | 2.68 | 548 | Adjust rate |
| 02:07 pm | 8 | 18.89 | 12.67 | 2.71 | 551 | |
| 02:08 pm | 9 | 18.90 | 12.67 | | | |
| 02:09 pm | 10 | 18.90 | 12.67 | | | |
| 02:10 pm | 11 | 18.90 | 12.67 | | | |
| 02:11 pm | 12 | 18.90 | 12.67 | | | |
| 02:12 pm | 13 | 18.90 | 12.67 | | | |
| 02:13 pm | 14 | 18.90 | 12.68 | | | |
| 02:14 pm | 15 | 18.91 | 12.68 | 2.71 | 551 | |
| 02:15 pm | 16 | 18.90 | 12.68 | | | |
| 02:16 pm | 17 | 18.91 | 12.68 | | | |
| 02:17 pm | 18 | 18.91 | 12.68 | | | |
| 02:18 pm | 19 | 18.91 | 12.69 | | | |
| 02:19 pm | 20 | 18.91 | 12.69 | | | |
| 02:20 pm | 21 | 18.91 | 12.69 | | | |
| 02:21 pm | 22 | 18.91 | 12.69 | | | |
| 02:22 pm | 23 | 18.92 | 12.69 | 2.71 | 551 | |
| 02:23 pm | 24 | 18.92 | 12.70 | | | |
| 02:24 pm | 25 | 18.91 | 12.70 | | | |
| 02:25 pm | 26 | 18.92 | 12.70 | | | |
| 02:26 pm | 27 | 18.92 | 12.70 | | | |
| 02:27 pm | 28 | 18.91 | 12.70 | | | |
| 02:28 pm | 29 | 18.92 | 12.70 | | | |
| 02:29 pm | 30 | 18.92 | 12.71 | 2.71 | 551 | Decrease rate |
| 02:30 pm | 1 | 18.40 | 12.71 | 2.23 | 500 | Step 3 |
| 02:31 pm | 2 | 18.39 | 12.71 | | | |
| 02:32 pm | 3 | 18.39 | 12.71 | | | |
| 02:33 pm | 4 | 18.39 | 12.71 | | | |
| 02:34 pm | 5 | 18.39 | 12.71 | | | |
| 02:35 pm | 6 | 18.39 | 12.71 | | | |
| 02:36 pm | 7 | 18.38 | 12.72 | | | |
| 02:37 pm | 8 | 18.39 | 12.72 | 2.22 | 499 | |
| 02:38 pm | 9 | 18.39 | 12.72 | | | |

## WATER-LEVEL MEASUREMENTS (Continued)
## 25th St. Well No. 8

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 02:39 pm | 10 | 18.40 | 12.72 | | | |
| 02:40 pm | 11 | 18.40 | 12.72 | | | |
| 02:41 pm | 12 | 18.40 | 12.73 | | | |
| 02:42 pm | 13 | 18.40 | 12.73 | | | |
| 02:43 pm | 14 | 18.40 | 12.73 | | | |
| 02:44 pm | 15 | 18.40 | 12.73 | | | |
| 02:45 pm | 16 | 18.40 | 12.73 | 2.22 | 499 | |
| 02:46 pm | 17 | 18.40 | 12.73 | | | |
| 02:47 pm | 18 | 18.40 | 12.74 | | | |
| 02:48 pm | 19 | 18.40 | 12.74 | | | |
| 02:49 pm | 20 | 18.40 | 12.74 | | | |
| 02:50 pm | 21 | 18.41 | 12.74 | | | |
| 02:51 pm | 22 | 18.41 | 12.74 | | | |
| 02:52 pm | 23 | 18.41 | 12.74 | | | |
| 02:53 pm | 24 | 18.41 | 12.74 | | | |
| 02:54 pm | 25 | 18.41 | 12.75 | 2.22 | 499 | |
| 02:55 pm | 26 | 18.41 | 12.75 | | | |
| 02:56 pm | 27 | 18.42 | 12.75 | | | |
| 02:57 pm | 28 | 18.41 | 12.75 | | | |
| 02:58 pm | 29 | 18.41 | 12.75 | | | |
| 02:59 pm | 30 | 18.41 | 12.75 | 2.22 | 499 | Decrease rate |
| 03:00 pm | 1 | 17.90 | 12.75 | 1.81 | 451 | Step 4 |
| 03:01 pm | 2 | 17.91 | 12.76 | | | |
| 03:02 pm | 3 | 17.91 | 12.76 | | | |
| 03:03 pm | 4 | 17.92 | 12.76 | 1.81 | 451 | |
| 03:04 pm | 5 | 17.91 | 12.76 | | | |
| 03:05 pm | 6 | 17.92 | 12.76 | | | |
| 03:06 pm | 7 | 17.91 | 12.76 | | | |
| 03:07 pm | 8 | 17.92 | 12.77 | | | |
| 03:08 pm | 9 | 17.92 | 12.77 | 1.80 | 450 | Collected water sample, |
| 03:09 pm | 10 | 17.91 | 12.77 | | | T=58°F |
| 03:10 pm | 11 | 17.92 | 12.77 | | | |
| 03:11 pm | 12 | 17.91 | 12.77 | | | |
| 03:12 pm | 13 | 17.91 | 12.77 | | | |
| 03:13 pm | 14 | 17.91 | 12.77 | | | |
| 03:14 pm | 15 | 17.92 | 12.77 | | | |
| 03:15 pm | 16 | 17.91 | 12.77 | 1.80 | 450 | |
| 03:16 pm | 17 | 17.91 | 12.77 | | | |
| 03:17 pm | 18 | 17.92 | 12.78 | | | |
| 03:18 pm | 19 | 17.92 | 12.78 | | | |
| 03:19 pm | 20 | 17.92 | 12.78 | | | |
| 03:20 pm | 21 | 17.92 | 12.78 | | | |
| 03:21 pm | 22 | 17.92 | 12.78 | | | |

WATER-LEVEL MEASUREMENTS (Concluded)
25th St. Well No. 8

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:22 pm | 23 | 17.92 | 12.78 | 1.80 | 450 | |
| 03:23 pm | 24 | 17.93 | 12.78 | | | |
| 03:24 pm | 25 | 17.92 | 12.78 | | | |
| 03:25 pm | 26 | 17.92 | 12.79 | | | |
| 03:26 pm | 27 | 17.92 | 12.79 | | | |
| 03:27 pm | 28 | 17.92 | 12.79 | | | |
| 03:28 pm | 29 | 17.92 | 12.79 | | | |
| 03:29 pm | 30 | 17.92 | 12.79 | 1.80 | 450 | Decrease rate |
| 03:30 pm | 1 | 17.41 | 12.79 | 1.41 | 399 | Step 5 |
| 03:31 pm | 2 | 17.40 | 12.79 | 1.42 | 400 | |
| 03:32 pm | 3 | 17.40 | 12.80 | | | |
| 03:33 pm | 4 | 17.40 | 12.80 | | | |
| 03:34 pm | 5 | 17.40 | 12.80 | | | BART samples collected |
| 03:35 pm | 6 | 17.41 | 12.80 | | | |
| 03:36 pm | 7 | 17.41 | 12.80 | | | |
| 03:37 pm | 8 | 17.41 | 12.80 | | | |
| 03:38 pm | 9 | 17.41 | 12.80 | | | |
| 03:39 pm | 10 | 17.41 | 12.80 | | | |
| 03:40 pm | 11 | 17.41 | 12.80 | 1.42 | 400 | |
| 03:41 pm | 12 | 17.41 | 12.81 | | | |
| 03:42 pm | 13 | 17.42 | 12.81 | | | |
| 03:43 pm | 14 | 17.41 | 12.81 | | | |
| 03:44 pm | 15 | 17.40 | 12.81 | | | |
| 03:45 pm | 16 | 17.42 | 12.81 | | | |
| 03:46 pm | 17 | 17.42 | 12.81 | | | |
| 03:47 pm | 18 | 17.41 | 12.81 | | | |
| 03:48 pm | 19 | 17.42 | 12.81 | 1.42 | 400 | |
| 03:49 pm | 20 | 17.42 | 12.81 | | | |
| 03:50 pm | 21 | 17.42 | 12.81 | | | |
| 03:51 pm | 22 | 17.42 | 12.82 | | | |
| 03:52 pm | 23 | 17.42 | 12.82 | | | |
| 03:53 pm | 24 | 17.42 | 12.82 | | | |
| 03:54 pm | 25 | 17.43 | 12.82 | | | |
| 03:55 pm | 26 | 17.42 | 12.82 | | | |
| 03:56 pm | 27 | 17.43 | 12.82 | 1.42 | 400 | |
| 03:57 pm | 28 | 17.42 | 12.82 | | | |
| 03:58 pm | 29 | 17.42 | 12.82 | | | |
| 03:59 pm | 30 | 17.42 | 12.83 | 1.42 | 400 | End of Step Test |

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. Venice W1* | *Piezometer No. Venice P1* |
|---|---|---|
| Date Drilled: | 1979 | 1979 |
| Casing | | |
| Top elevation: | 405.3 | 411.21 |
| Diameter: | 16-in.SS | 2-in. PVC |
| Length (ft): | 32.3 | na |
| Screen | | |
| Bottom elevation: | 322.1 | na |
| Diameter: | 16-in.SS | 2-in. PVC |
| Length (ft): | 50.9 | 3 |
| Slot size: | 0.080-in. | na |
| Measuring Point Elevation: | 405.55 | 411.21 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 23.08 | - |
| Height of temp. MP (ft): | 5.9 | - |
| Depth below perm. MP (ft): | 17.18 | Plugged |
| Elevation: | 388.37 | - |
| Date of Step Test: | 3/29/94 | - |
| Water Sample | | |
| Time: | 2:39 pm | - |
| Temperature: | 57.7° F | - |
| Laboratory No.: | 227474 | - |
| Distance and Direction to Piez. from PW: | | 4.9 ft Northeast |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Venice W2,4,5,6A,7 |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
Omnidata
na-information not available

SWS Crew: M. Anliker, R. Olson

WATER-LEVEL MEASUREMENTS
Venice Well No. 1
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03/29/94 | | | | | | |
| 12:03 pm | | 23.08 | | | | Dropline |
| 12:26 pm | 0 | 23.08 | | | | Logging started |
| 12:27 pm | 1 | 23.07 | | | | Water level trend |
| 12:28 pm | 2 | 23.08 | | | | Piezometer plugged |
| 12:29 pm | 3 | 23.07 | | | | |
| 12:30 pm | 0 | 23.07 | | | | Pump On |
| 12:31 pm | 1 | 41.59 | | 4.20 | 680 | Step 1; Q max |
| 12:32 pm | 2 | 41.60 | | 3.80 | 650 | |
| 12:33 pm | 3 | 41.60 | | | | |
| 12:34 pm | 4 | 41.59 | | | | |
| 12:35 pm | 5 | 41.59 | | 3.70 | | Won't maintain 650 gpm; |
| 12:36 pm | 6 | 41.58 | | | | reduce to 600 gpm |
| 12:37 pm | 7 | 41.53 | | 3.23 | 600 | |
| 12:38 pm | 8 | 40.37 | | | | |
| 12:39 pm | 9 | 40.21 | | | | |
| 12:40 pm | 10 | 40.20 | | 3.22 | | |
| 12:41 pm | 11 | 40.21 | | | | |
| 12:42 pm | 12 | 40.28 | | | | |
| 12:43 pm | 13 | 40.30 | | 3.22 | | |
| 12:44 pm | 14 | 40.31 | | | | |
| 12:45 pm | 15 | 40.32 | | | | |
| 12:46 pm | 16 | 40.33 | | | | |
| 12:47 pm | 17 | 40.34 | | | | |
| 12:48 pm | 18 | 40.34 | | | | |
| 12:49 pm | 19 | 40.35 | | | | |
| 12:50 pm | 20 | 40.35 | | | | |
| 12:51 pm | 21 | 40.35 | | | | |
| 12:52 pm | 22 | 40.37 | | 3.21 | | Adjust rate |
| 12:53 pm | 23 | 40.44 | | 3.23 | 600 | |
| 12:54 pm | 24 | 40.45 | | | | |
| 12:55 pm | 25 | 40.47 | | | | |
| 12:56 pm | 26 | 40.46 | | | | |
| 12:57 pm | 27 | 40.47 | | | | |
| 12:58 pm | 28 | 40.47 | | | | |
| 12:59 pm | 29 | 40.47 | | | | |
| 01:00 pm | 30 | 40.48 | | 3.23 | 600 | Decrease rate |
| 01:01 pm | 1 | 38.92 | | 2.70 | 550 | Step 2 |
| 01:02 pm | 2 | 38.86 | | | | |
| 01:03 pm | 3 | 38.85 | | | | |
| 01:04 pm | 4 | 38.85 | | | | |
| 01:05 pm | 5 | 38.85 | | | | |
| 01:06 pm | 6 | 38.86 | | 2.70 | 550 | |

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 1

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:07 pm | 7 | 38.87 | | | | |
| 01:08 pm | 8 | 38.87 | | | | |
| 01:09 pm | 9 | 38.88 | | | | |
| 01:10pm | 10 | 38.89 | | | | |
| 01:11 pm | 11 | 38.89 | | | | |
| 01:12pm | 12 | 38.89 | | 2.70 | 550 | |
| 01:13pm | 13 | 38.90 | | | | |
| 01:14 pm | 14 | 38.89 | | | | |
| 01:15 pm | 15 | 38.90 | | | | |
| 01:16 pm | 16 | 38.90 | | 2.68 | | |
| 01:17 pm | 17 | 38.96 | | 2.70 | 550 | |
| 01:18 pm | 18 | 38.97 | | | | |
| 01:19 pm | 19 | 38.97 | | | | |
| 01:20 pm | 20 | 38.98 | | | | |
| 01:21 pm | 21 | 38.98 | | | | |
| 01:22 pm | 22 | 38.99 | | 2.70 | 550 | |
| 01:23 pm | 23 | 39.00 | | | | |
| 01:24 pm | 24 | 39.00 | | | | |
| 01:25 pm | 25 | 39.00 | | | | |
| 01:26 pm | 26 | 39.00 | | 2.70 | 550 | |
| 01:27 pm | 27 | 39.01 | | | | |
| 01:28 pm | 28 | 39.02 | | | | |
| 01:29 pm | 29 | 39.02 | | 2.70 | 550 | |
| 01:30 pm | 30 | 39.03 | | | | Decrease rate |
| 01:31 pm | 1 | 37.51 | | 2.23 | 500 | Step 3 |
| 01:32 pm | 2 | 37.44 | | | | |
| 01:33 pm | 3 | 37.43 | | | | |
| 01:34 pm | 4 | 37.41 | | 2.23 | 500 | |
| 01:35 pm | 5 | 37.40 | | | | |
| 01:36 pm | 6 | 37.39 | | | | |
| 01:37 pm | 7 | 37.39 | | | | |
| 01:38 pm | 8 | 37.39 | | | | |
| 01:39 pm | 9 | 37.39 | | 2.23 | 500 | |
| 01:40 pm | 10 | 37.39 | | | | |
| 01:41 pm | 11 | 37.40 | | | | |
| 01:42 pm | 12 | 37.40 | | | | |
| 01:43 pm | 13 | 37.39 | | | | |
| 01:44 pm | 14 | 37.39 | | 2.23 | 500 | |
| 01:45 pm | 15 | 37.38 | | | | |
| 01:46 pm | 16 | 37.38 | | | | |
| 01:47 pm | 17 | 37.39 | | | | |
| 01:48 pm | 18 | 37.41 | | 2.23 | 500 | Adjusted rate |
| 01:49 pm | 19 | 37.42 | | | | |
| 01:50 pm | 20 | 37.42 | | | | |

## WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 1

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:51 pm | 21 | 37.41 | | 2.23 | 500 | |
| 01:52 pm | 22 | 37.41 | | | | |
| 01:53 pm | 23 | 37.40 | | | | |
| 01:54 pm | 24 | 37.41 | | | | |
| 01:55 pm | 25 | 37.41 | | 2.22 | | Adjust rate |
| 01:56 pm | 26 | 37.48 | | 2.23 | 500 | |
| 01:57 pm | 27 | 37.49 | | | | |
| 01:58 pm | 28 | 37.49 | | | | |
| 01:59 pm | 29 | 37.49 | | 2.23 | 500 | |
| 02:00 pm | 30 | 37.50 | | | | Decrease rate |
| 02:01 pm | 1 | 35.98 | | 1.80 | 450 | Step 4 |
| 02:02 pm | 2 | 35.92 | | | | |
| 02:03 pm | 3 | 35.89 | | 1.80 | 450 | |
| 02:04 pm | 4 | 35.88 | | | | |
| 02:05 pm | 5 | 35.88 | | | | |
| 02:06 pm | 6 | 35.88 | | | | |
| 02:07 pm | 7 | 35.88 | | | | |
| 02:08 pm | 8 | 35.87 | | | | |
| 02:09 pm | 9 | 35.87 | | | | |
| 02:10 pm | 10 | 35.87 | | | | |
| 02:11 pm | 11 | 35.87 | | 1.80 | 450 | |
| 02:12 pm | 12 | 35.87 | | | | |
| 02:13 pm | 13 | 35.86 | | | | |
| 02:14 pm | 14 | 35.87 | | | | |
| 02:15 pm | 15 | 35.88 | | | | |
| 02:16 pm | 16 | 35.88 | | | | |
| 02:17 pm | 17 | 35.88 | | 1.80 | 450 | |
| 02:18 pm | 18 | 35.88 | | | | |
| 02:19 pm | 19 | 35.88 | | | | |
| 02:20 pm | 20 | 35.88 | | | | |
| 02:21 pm | 21 | 35.88 | | | | |
| 02:22 pm | 22 | 35.89 | | 1.80 | 450 | |
| 02:23 pm | 23 | 35.89 | | | | |
| 02:24 pm | 24 | 35.88 | | | | |
| 02:25 pm | 25 | 35.88 | | | | |
| 02:26 pm | 26 | 35.89 | | 1.80 | 450 | |
| 02:27 pm | 27 | 35.89 | | | | |
| 02:28 pm | 28 | 35.88 | | | | Collected water sample; |
| 02:29 pm | 29 | 35.88 | | 1.80 | 450 | T=57.7°F |
| 02:30 pm | 30 | 35.89 | | | | Decrease rate |
| 02:31 pm | 1 | 34.46 | | 1.42 | 400 | Step 5 |
| 02:32 pm | 2 | 34.40 | | | | |
| 02:33 pm | 3 | 34.44 | | | | |
| 02:34 pm | 4 | 34.43 | | 1.42 | 400 | |

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 1

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 02:35 pm | 5 | 34.55 | | | | |
| 02:36 pm | 6 | 34.55 | | | | |
| 02:37 pm | 7 | 34.55 | | | | |
| 02:38 pm | 8 | 34.54 | | | | |
| 02:39 pm | 9 | 34.54 | | | | |
| 02:40 pm | 10 | 34.55 | | | | |
| 02:41 pm | 11 | 34.55 | | 1.42 | 400 | |
| 02:42 pm | 12 | 34.36 | | | | |
| 02:43 pm | 13 | 34.27 | | 1.46 | | Adjust rate |
| 02:44 pm | 14 | 34.31 | | | | |
| 02:45 pm | 15 | 34.33 | | 1.41 | | Adjust rate |
| 02:46 pm | 16 | 34.32 | | | | |
| 02:47 pm | 17 | 34.33 | | | | |
| 02:48 pm | 18 | 34.33 | | | | |
| 02:49 pm | 19 | 34.32 | | 1.42 | 400 | |
| 02:50 pm | 20 | 34.32 | | | | |
| 02:51 pm | 21 | 34.33 | | | | |
| 02:52 pm | 22 | 34.32 | | | | |
| 02:53 pm | 23 | 34.33 | | 1.42 | 400 | |
| 02:54 pm | 24 | 34.33 | | | | |
| 02:55 pm | 25 | 34.34 | | | | |
| 02:56 pm | 26 | 34.33 | | 1.42 | 400 | |
| 02:57 pm | 27 | 34.33 | | | | |
| 02:58 pm | 28 | 34.32 | | | | |
| 02:59 pm | 29 | 34.33 | | 1.42 | 400 | |
| 03:00 pm | 30 | 34.33 | | | | End of Step Test |

**Note::** Sand in tank; sample collected.

DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. Venice W6A* | *Piezometer No. Venice P6A* |
|---|---|---|
| Date Drilled: | 7/90 | 1990 |
| Casing | | |
| Top elevation: | 400.8 | 408.6 |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 32.8 | na |
| Screen | | |
| Bottom elevation: | 318.0 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 10 | 3 |
| Slot size, lower: | 0.090-in. | na |
| Length, upper (ft): | 40 | - |
| Slot size, upper: | 0.030-in. | - |
| Measuring Point Elevation: | 400.8 | 408.6 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 16.01 | - |
| Height of temp. MP (ft): | 7.6 | - |
| Depth below perm. MP (ft): | 8.41 | 16.28 |
| Elevation: | 392.39 | 392.32 |
| Date of Step Test: | 6/23/94 | - |
| Water Sample | | |
| Time: | 11:46 am | - |
| Temperature: | 59.2° F | - |
| Laboratory No.: | 227792 | - |
| Distance and Direction to Piez. from PW: | | 6.7 ft Northeast |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
Omnidata, transmitter Nos. 16 & 7
Sand tank (no sand collected)
na-information not available

SWS Crew: M. Anliker, R. Olson

# WATER-LEVEL MEASUREMENTS
## Venice Well No. 6A
## Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 06/23/94 | | | | | | |
| 09:17 am | | 16.01 | | | | |
| 09:18 am | | | 16.28 | | | |
| 09:31 am | 0 | 16.01 | 16.28 | | | Logging started |
| 09:32 am | I | 16.01 | 16.19 | | | Water level trend |
| 09:33 am | 2 | 16.01 | 16.11 | | | |
| 09:34 am | 3 | 16.01 | 16.09 | | | |
| 09:35 am | 4 | 16.00 | 16.09 | | | |
| 09:36 am | 5 | 16.01 | 16.09 | | | |
| 09:37 am | 6 | 16.01 | 16.09 | | | |
| 09:38 am | 7 | 16.01 | 16.09 | | | |
| 09:39 am | 8 | 16.01 | 16.09 | | | |
| 09:40 am | 0 | 16.01 | 16.09 | | | Pump On |
| 09:41 am | 1 | 28.70 | 20.13 | 6.20 | 825 | Step 1 |
| 09:42 am | 2 | 28.45 | 20.25 | 5.78 | 798 | |
| 09:43 am | 3 | 28.52 | 20.35 | | | |
| 09:44 am | 4 | 28.57 | 20.44 | | | |
| 09:45 am | 5 | 28.61 | 20.50 | | | |
| 09:46 am | 6 | 28.65 | 20.56 | 5.78 | 798 | |
| 09:47 am | 7 | 28.70 | 20.61 | | | |
| 09:48 am | 8 | 28.73 | 20.64 | | | |
| 09:49 am | 9 | 28.74 | 20.68 | | | |
| 09:50 am | 10 | 28.77 | 20.71 | | | |
| 09:51 am | 11 | 28.78 | 20.73 | | | |
| 09:52 am | 12 | 28.80 | 20.76 | | | |
| 09:53 am | 13 | 28.82 | 20.78 | | | |
| 09:54 am | 14 | 28.84 | 20.80 | | | |
| 09:55 am | 15 | 28.85 | 20.82 | | | |
| 09:56 am | 16 | 28.87 | 20.83 | | | |
| 09:57 am | 17 | 28.88 | 20.85 | 5.75 | 795 | Adjust rate |
| 09:58 am | 18 | 28.90 | 20.87 | 5.78 | 798 | |
| 09:59 am | 19 | 28.89 | 20.88 | | | |
| 10:00 am | 20 | 28.89 | 20.89 | | | |
| 10:01 am | 21 | 28.90 | 20.90 | | | |
| 10:02 am | 22 | 28.93 | 20.92 | 5.78 | 798 | |
| 10:03 am | 23 | 28.93 | 20.93 | | | |
| 10:04 am | 24 | 28.93 | 20.94 | | | |
| 10:05 am | 25 | 28.95 | 20.95 | | | |
| 10:06 am | 26 | 28.95 | 20.96 | 5.78 | 798 | |
| 10:07 am | 27 | 28.95 | 20.97 | | | |
| 10:08 am | 28 | 28.97 | 20.98 | | | |
| 10:09 am | 29 | 28.97 | 20.99 | | | |
| 10:10am | 30 | 28.98 | 21.00 | 5.77 | 798 | Decrease rate |

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 6A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:11 am | 1 | 28.26 | 20.78 | 5.08 | 750 | Step 2 |
| 10:12 am | 2 | 28.26 | 20.77 | | | |
| 10:13 am | 3 | 28.25 | 20.77 | | | |
| 10:14 am | 4 | 28.25 | 20.78 | | | |
| 10:15 am | 5 | 28.25 | 20.78 | 5.08 | 750 | |
| 10:16 am | 6 | 28.26 | 20.78 | | | |
| 10:17 am | 7 | 28.26 | 20.79 | | | |
| 10:18 am | 8 | 28.28 | 20.79 | | | |
| 10:19 am | 9 | 28.29 | 20.80 | | | |
| 10:20 am | 10 | 28.29 | 20.80 | | | |
| 10:21 am | 11 | 28.30 | 20.81 | | | |
| 10:22 am | 12 | 28.29 | 20.81 | 5.08 | 750 | |
| 10:23 am | 13 | 28.30 | 20.82 | | | |
| 10:24 am | 14 | 28.30 | 20.82 | 5.08 | 750 | |
| 10:25 am | 15 | 28.30 | 20.82 | | | |
| 10:26 am | 16 | 28.30 | 20.82 | | | |
| 10:27 am | 17 | 28.30 | 20.83 | | | |
| 10:28 am | 18 | 28.31 | 20.83 | | | |
| 10:29 am | 19 | 28.32 | 20.84 | | | |
| 10:30 am | 20 | 28.33 | 20.84 | 5.08 | 750 | |
| 10:31 am | 21 | 28.32 | 20.85 | | | |
| 10:32 am | 22 | 28.33 | 20.86 | | | |
| 10:33 am | 23 | 28.34 | 20.85 | | | |
| 10:34 am | 24 | 28.35 | 20.86 | 5.07 | 750 | |
| 10:35 am | 25 | 28.34 | 20.87 | | | |
| 10:36 am | 26 | 28.35 | 20.87 | | | |
| 10:37 am | 27 | 28.35 | 20.88 | | | |
| 10:38 am | 28 | 28.36 | 20.88 | 5.07 | 750 | |
| 10:39 am | 29 | 28.37 | 20.88 | | | |
| 10:40 am | 30 | 28.38 | 20.89 | 5.07 | 750 | Decrease rate |
| 10:41 am | 1 | 27.66 | 20.66 | 4.41 | 700 | Step 3 |
| 10:42 am | 2 | 27.63 | 20.64 | | | |
| 10:43 am | 3 | 27.62 | 20.64 | | | |
| 10:44 am | 4 | 27.62 | 20.64 | | | |
| 10:45 am | 5 | 27.62 | 20.64 | | | |
| 10:46 am | 6 | 27.61 | 20.64 | 4.41 | 700 | |
| 10:47 am | 7 | 27.62 | 20.64 | | | |
| 10:48 am | 8 | 27.62 | 20.64 | | | |
| 10:49 am | 9 | 27.62 | 20.64 | | | |
| 10:50 am | 10 | 27.62 | 20.63 | | | |
| 10:51 am | 11 | 27.62 | 20.64 | 4.41 | 700 | |
| 10:52 am | 12 | 27.63 | 20.64 | | | |
| 10:53 am | 13 | 27.63 | 20.64 | | | |
| 10:54 am | 14 | 27.63 | 20.64 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 6A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 10:55 am | 15 | 27.64 | 20.64 | | | |
| 10:56 am | 16 | 27.63 | 20.64 | 4.41 | 700 | |
| 10:57 am | 17 | 27.64 | 20.65 | | | |
| 10:58 am | 18 | 27.64 | 20.65 | | | |
| 10:59 am | 19 | 27.63 | 20.65 | | | |
| 11:00 am | 20 | 27.63 | 20.65 | | | |
| 11:01 am | 21 | 27.64 | 20.65 | | | |
| 11:02 am | 22 | 27.65 | 20.65 | 4.41 | 700 | |
| 11:03 am | 23 | 27.64 | 20.65 | | | |
| 11:04 am | 24 | 27.64 | 20.65 | | | |
| 11:05 am | 25 | 27.65 | 20.66 | | | |
| 11:06 am | 26 | 27.65 | 20.66 | | | |
| 11:07 am | 27 | 27.66 | 20.66 | 4.41 | 700 | |
| 11:08 am | 28 | 27.66 | 20.66 | | | |
| 11:09 am | 29 | 27.66 | 20.66 | | | |
| 11:10 am | 30 | 27.66 | 20.66 | 4.41 | 700 | Decrease rate |
| 11:11 am | 1 | 26.91 | 20.43 | 3.80 | 650 | Step 4 |
| 11:12 am | 2 | 26.93 | 20.42 | | | |
| 11:13am | 3 | 26.94 | 20.42 | | | |
| 11:14 am | 4 | 26.92 | 20.42 | | | |
| 11:15 am | 5 | 26.92 | 20.41 | | | |
| 11:16 am | 6 | 26.92 | 20.41 | | | |
| 11:17 am | 7 | 26.93 | 20.41 | 3.80 | 650 | |
| 11:18 am | 8 | 26.92 | 20.41 | | | |
| 11:19am | 9 | 26.93 | 20.41 | | | |
| 11:20 am | 10 | 26.93 | 20.41 | | | |
| 11:21 am | 11 | 26.91 | 20.41 | 3.80 | 650 | Adjusted rate down |
| 11:22 am | 12 | 26.91 | 20.41 | | | |
| 11:23 am | 13 | 26.91 | 20.41 | | | |
| 11:24 am | 14 | 26.91 | 20.40 | | | |
| 11:25 am | 15 | 26.90 | 20.40 | | | |
| 11:26 am | 16 | 26.91 | 20.40 | | | |
| 11:27 am | 17 | 26.90 | 20.40 | | | |
| 11:28 am | 18 | 26.89 | 20.40 | 3.80 | 650 | |
| 11:29 am | 19 | 26.90 | 20.40 | | | |
| 11:30 am | 20 | 26.88 | 20.39 | 3.80 | 650 | |
| 11:31 am | 21 | 26.91 | 20.40 | | | |
| 11:32 am | 22 | 26.90 | 20.40 | | | |
| 11:33 am | 23 | 26.90 | 20.40 | 3.79 | | Adjust rate |
| 11:34 am | 24 | 26.92 | 20.41 | 3.80 | 650 | |
| 11:35 am | 25 | 26.92 | 20.40 | | | |
| 11:36 am | 26 | 26.92 | 20.40 | | | |
| 11:37 am | 27 | 26.93 | 20.41 | | | |
| 11:38 am | 28 | 26.92 | 20.41 | | | |

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 6A

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 11:39 am | 29 | 26.94 | 20.41 | | | |
| 11:40 am | 30 | 26.93 | 20.41 | 3.80 | 650 | Decrease rate |
| 11:41 am | 1 | 26.21 | 20.18 | 3.23 | 600 | Step 5 |
| 11:42 am | 2 | 26.19 | 20.17 | | | |
| 11:43 am | 3 | 26.18 | 20.16 | | | |
| 11:44 am | 4 | 26.19 | 20.15 | | | |
| 11:45 am | 5 | 26.17 | 20.15 | | | |
| 11:46 am | 6 | 26.17 | 20.15 | | | Collected water sample; |
| 11:47 am | 7 | 26.18 | 20.15 | | | T=59.2°F |
| 11:48 am | 8 | 26.17 | 20.14 | 3.23 | 600 | Adjusted rate down |
| 11:49 am | 9 | 26.17 | 20.14 | | | |
| 11:50 am | 10 | 26.16 | 20.14 | | | |
| 11:51 am | 11 | 26.17 | 20.14 | | | |
| 11:52 am | 12 | 26.17 | 20.13 | 3.23 | 600 | BART samples collected |
| 11:53 am | 13 | 26.17 | 20.13 | | | |
| 11:54 am | 14 | 26.17 | 20.14 | | | |
| 11:55 am | 15 | 26.17 | 20.13 | | | |
| 11:56 am | 16 | 26.17 | 20.13 | | | |
| 11:57 am | 17 | 26.17 | 20.14 | | | |
| 11:58 am | 18 | 26.17 | 20.14 | | | |
| 11:59 am | 19 | 26.18 | 20.14 | | | |
| 12:00 pm | 20 | 26.17 | 20.14 | 3.23 | 600 | |
| 12:01 pm | 21 | 26.17 | 20.13 | | | |
| 12:02 pm | 22 | 26.17 | 20.13 | | | |
| 12:03 pm | 23 | 26.16 | 20.13 | 3.23 | 600 | |
| 12:04 pm | 24 | 26.18 | 20.13 | | | |
| 12:05 pm | 25 | 26.18 | 20.13 | | | |
| 12:06 pm | 26 | 26.18 | 20.13 | | | |
| 12:07 pm | 27 | 26.18 | 20.13 | | | |
| 12:08 pm | 28 | 26.17 | 20.14 | | | |
| 12:09 pm | 29 | 26.17 | 20.13 | | | |
| 12:10pm | 30 | 26.18 | 20.13 | 3.23 | 600 | End of Step Test |

**Note::** Very little sand (< teaspoon) in settling tank following the step test; no sample collected.

## DEWATERING WELL DATA
Condition Assessment Step Test

| | *Well No. Venice W7* | *Piezometer No. Venice P7* |
|---|---|---|
| Date Drilled: | 7/90 | 1990 |
| Casing | | |
| Top elevation: | 399.3(?) | 409.1(?) |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length (ft): | 33.7 | na |
| Screen | | |
| Bottom elevation: | 321.0 | na |
| Diameter: | 16-in. SS | 2-in. PVC |
| Length, lower (ft): | 10 | 3 |
| Slot size, lower: | 0.090-in. | na |
| Length, upper (ft): | 35 | - |
| Slot size, upper: | 0.030-in. | - |
| Measuring Point Elevation: | - | 409.1 |
| Nonpumping Water Level | | |
| Depth below temp. MP (ft): | 18.03 | - |
| Height of temp. MP (ft): | 8.16 | - |
| Depth below perm. MP (ft): | 9.87 | 17.88 |
| Elevation: | - | - |
| Date of Step Test: | 5/4/94 | - |
| Water Sample | | |
| Time: | 3:17 pm | - |
| Temperature: | 58° F | - |
| Laboratory No.: | 227594 | - |
| Distance and Direction to Piez. from PW: | | 11.25 ft South |
| Time PW Off Before Step Test: | | Not recorded |
| Wells in Operation at Site at Time of Step Test: | | Not recorded |

**Notes:** SWS 8-in. dia. orifice tube w/plate No. 4
McDAS
na-information not available

SWS Crew: M. Anliker, R. Olson

WATER-LEVEL MEASUREMENTS
Venice Well No. 7
Condition Assessment Step Test

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 05/04/94 | | | | | | |
| 12:49 pm | 0.0 | 18.03 | | | | Solinst dropline |
| 12:50 pm | 0.0 | | 17.88 | | | Solinst dropline |
| 01:05 pm | 0.0 | 18.03 | 17.88 | | | |
| 01:06 pm | 1.0 | 18.05 | 18.01 | | | Data logging started |
| 01:07 pm | 2.0 | 18.05 | 18.07 | | | Water level trend |
| 01:08 pm | 3.0 | 18.05 | 18.10 | | | |
| 01:09 pm | 4.0 | 18.04 | 18.12 | | | |
| 01:10 pm | 5.0 | 18.05 | 18.16 | | | |
| 01:11 pm | 6.0 | 18.06 | 18.21 | | | |
| 01:12 pm | 7.0 | 18.05 | 18.23 | | | |
| 01:13pm | 8.0 | 18.04 | 18.25 | | | |
| 01:14pm | 9.0 | 18.03 | 18.27 | | | |
| 01:15 pm | 9.8 | 18.04 | 18.29 | | | |
| 01:16pm | 11.1 | 18.04 | 18.29 | | | |
| 01:17 pm | 12.1 | 18.05 | 18.30 | | | |
| 01:18pm | 13.1 | 18.06 | 18.32 | | | |
| 01:19pm | 14.1 | 18.05 | 18.32 | | | |
| 01:20 pm | 0.0 | | | | | Pump On |
| 01:21 pm | 1.0 | 40.12 | 21.47 | 6.50 | 845 | Step l; Max Q |
| 01:22 pm | 2.0 | 39.82 | 21.75 | 5.78 | 798 | |
| 01:23 pm | 3.0 | 39.93 | 21.88 | | | |
| 01:24 pm | 4.0 | 40.13 | 22.02 | 5.76 | | Adjust rate up |
| 01:25 pm | 5.0 | 40.28 | 22.14 | 5.78 | 798 | |
| 01:26 pm | 6.0 | 40.37 | 22.20 | | | |
| 01:27 pm | 7.0 | 40.42 | 22.24 | 5.78 | 798 . | |
| 01:28 pm | 8.0 | 40.49 | 22.30 | | | |
| 01:29 pm | 9.0 | 40.52 | 22.33 | | | |
| 01:30 pm | 10.0 | 40.54 | 22.36 | | | |
| 01:31pm | 11.0 | 40.58 | 22.39 | 5.77 | | |
| 01:31 pm | 12.0 | 40.53 | 22.38 | | | |
| 01:33 pm | 13.0 | 40.58 | 22.41 | | | |
| 01:34 pm | 14.0 | 40.63 | 22.45 | | | |
| 01:35 pm | 15.0 | 40.66 | 22.48 | 5.76 | | Adjust rate up |
| 01:36 pm | 16.0 | 40.72 | 22.52 | 5.78 | 798 | |
| 01:37 pm | 17.0 | 40.75 | 22.55 | | | |
| 01:38 pm | 18.1 | 40.79 | 22.54 | | | |
| 01:39 pm | 19.0 | 40.76 | 22.54 | | | |
| 01:40 pm | 20.0 | 40.74 | 22.57 | | | |
| 01:40 pm | 21.0 | 40.64 | 22.53 | 5.78 | 798 | |
| 01:42 pm | 22.1 | 40.65 | 22.54 | | | |
| 01:43 pm | 23.0 | 40.67 | 22.59 | | | |
| 01:44 pm | 24.0 | 40.68 | 22.61 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 7

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 01:45 pm | 25.1 | 40.69 | 22.61 | | | |
| 01:45 pm | 26.0 | 40.69 | 22.61 | | | |
| 01:46 pm | 27.0 | 40.71 | 22.62 | | | |
| 01:47 pm | 28.0 | 40.71 | 22.63 | 5.78 | 798 | |
| 01:48 pm | 29.0 | 40.73 | 22.67 | | | |
| 01:49 pm | 29.7 | 40.74 | 22.67 | 5.78 | 798 | |
| 01:50 pm | 30.0 | | | | | Decrease rate |
| 01:51 pm | 1.0 | 39.35 | 22.50 | 5.09 | 750 | Step 2 |
| 01:52 pm | 2.0 | 39.42 | 22.52 | | | |
| 01:53 pm | 3.0 | 39.43 | 22.53 | | | |
| 01:54 pm | 4.0 | 39.47 | 22.55 | 5.09 | 750 | |
| 01:55 pm | 5.0 | 39.49 | 22.56 | | | |
| 01:56 pm | 6.0 | 39.47 | 22.55 | | | |
| 01:57 pm | 7.0 | 39.47 | 22.56 | | | |
| 01:58 pm | 8.0 | 39.44 | 22.53 | | | |
| 01:59 pm | 9.0 | 39.49 | 22.61 | | | |
| 02:00 pm | 10.0 | 39.74 | 22.72 | 5.09 | 750 | |
| 02:01 pm | 11.1 | 39.74 | 22.71 | | | |
| 02:02 pm | 12.0 | 39.75 | 22.70 | | | |
| 02:02 pm | 13.0 | 39.76 | 22.72 | | | |
| 02:04 pm | 14.0 | 39.76 | 22.72 | | | |
| 02:05 pm | 15.1 | 39.76 | 22.73 | | | |
| 02:05 pm | 16.0 | 39.77 | 22.76 | | | |
| 02:06 pm | 17.0 | 39.78 | 22.76 | | | |
| 02:07 pm | 18.0 | 39.79 | 22.75 | 5.09 | 750 | |
| 02:08 pm | 19.0 | 39.80 | 22.75 | | | |
| 02:09 pm | 20.0 | 39.79 | 22.76 | | | |
| 02:10 pm | 21.0 | 39.80 | 22.78 | | | |
| 02:11 pm | 22.0 | 39.80 | 22.78 | | | |
| 02:12 pm | 23.0 | 39.80 | 22.77 | | | |
| 02:13 pm | 24.0 | 39.81 | 22.76 | | | |
| 02:14 pm | 25.0 | 39.82 | 22.76 | | | |
| 02:16 pm | 26.0 | 39.81 | 22.78 | 5.08 | 750 | |
| 02:17 pm | 27.0 | 39.82 | 22.80 | | | |
| 02:18 pm | 28.1 | 39.81 | 22.79 | | | |
| 02:18 pm | 29.0 | 39.85 | 22.81 | | | |
| 02:19 pm | 29.8 | 39.85 | 22.82 | 5.08 | 750 | |
| 02:20 pm | 30.0 | | | | | Decrease rate |
| 02:21 pm | 1.0 | 38.52 | 22.65 | 4.41 | 700 | Step 3 |
| 02:22 pm | 2.0 | 38.47 | 22.65 | | | |
| 02:23 pm | 3.0 | 38.47 | 22.65 | | | |
| 02:24 pm | 4.0 | 38.46 | 22.64 | | | |
| 02:25 pm | 5.0 | 38.46 | 22.63 | | | |
| 02:26 pm | 6.0 | 38.47 | 22.60 | | | |

WATER-LEVEL MEASUREMENTS (Continued)
Venice Well No. 7

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 02:27 pm | 7.0 | 38.48 | 22.57 | | | |
| 02:28 pm | 8.0 | 38.47 | 22.57 | | | |
| 02:29 pm | 9.0 | 38.48 | 22.57 | 4.41 | 700 | |
| 02:30 pm | 10.0 | 38.48 | 22.58 | | | |
| 02:31 pm | 11.1 | 38.49 | 22.59 | | | |
| 02:32 pm | 12.0 | 38.49 | 22.60 | | | |
| 02:32 pm | 13.0 | 38.49 | 22.60 | | | |
| 02:34 pm | 14.1 | 38.49 | 22.61 | | | |
| 02:35 pm | 15.1 | 38.49 | 22.60 | | | |
| 02:35 pm | 16.0 | 38.50 | 22.61 | 4.41 | 700 | |
| 02:36 pm | 17.0 | 38.49 | 22.62 | | | |
| 02:37 pm | 18.0 | 38.50 | 22.62 | | | |
| 02:38 pm | 19.0 | 38.51 | 22.63 | | | |
| 02:39 pm | 20.0 | 38.50 | 22.63 | | | |
| 02:40 pm | 21.0 | 38.51 | 22.64 | | | |
| 02:41 pm | 22.0 | 38.51 | 22.64 | 4.41 | 700 | |
| 02:42 pm | 23.0 | 38.50 | 22.65 | | | |
| 02:43 pm | 24.0 | 38.49 | 22.66 | | | |
| 02:44 pm | 25.0 | 38.51 | 22.67 | | | |
| 02:46 pm | 26.0 | 38.52 | 22.68 | | | |
| 02:47 pm | 27.0 | 38.52 | 22.68 | | | |
| 02:48 pm | 28.1 | 38.53 | 22.68 | 4.41 | 700 | |
| 02:48 pm | 29.0 | 38.53 | 22.68 | | | |
| 02:49 pm | 29.8 | 38.53 | 22.69 | | | |
| 02:50 pm | 30.0 | | | | | Decrease rate |
| 02:51 pm | 1.0 | 37.25 | 22.54 | | | Step 4 |
| 02:52 pm | 2.0 | 37.18 | 22.52 | 3.80 | 650 | |
| 02:53 pm | 3.0 | 37.19 | 22.52 | | | |
| 02:54 pm | 4.0 | 37.17 | 22.52 | 3.80 | 650 | |
| 02:55 pm | 5.0 | 37.18 | 22.52 | | | |
| 02:56 pm | 6.0 | 37.18 | 22.53 | | | |
| 02:57 pm | 7.0 | 37.19 | 22.54 | | | |
| 02:58 pm | 8.0 | 37.18 | 22.53 | | | |
| 02:59 pm | 9.0 | 37.18 | 22.52 | | | |
| 03:00 pm | 10.0 | 37.18 | 22.52 | | | |
| 03:01 pm | 11.0 | 37.19 | 22.50 | 3.80 | 650 | |
| 03:02 pm | 12.0 | 37.19 | 22.48 | | | |
| 03:03 pm | 13.0 | 37.19 | 22.46 | | | |
| 03:04 pm | 14.0 | 37.19 | 22.47 | | | |
| 03:05 pm | 15.0 | 37.19 | 22.47 | | | |
| 03:06 pm | 16.0 | 37.20 | 22.46 | 3.80 | 650 | |
| 03:07 pm | 17.0 | 37.20 | 22.46 | | | |
| 03:08 pm | 18.0 | 37.20 | 22.44 | | | |
| 03:09 pm | 19.0 | 37.20 | 22.42 | 3.80 | 650 | |

WATER-LEVEL MEASUREMENTS (Concluded)
Venice Well No. 7

| *Hour* | *Time (min)* | *Adjusted depth to water in well (ft)* | *Adjusted depth to water in piezometer (ft)* | *Orifice tube piez. (ft)* | *Pumping rate (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|
| 03:10 pm | 20.0 | 37.20 | 22.43 | | | |
| 03:11pm | 21.0 | 37.20 | 22.42 | | | |
| 03:12 pm | 22.0 | 37.21 | 22.42 | | | |
| 03:13 pm | 23.0 | 37.19 | 22.42 | | | |
| 03:14 pm | 24.0 | 37.19 | 22.43 | | | |
| 03:15 pm | 25.1 | 37.20 | 22.43 | | | |
| 03:16 pm | 26.0 | 37.20 | 22.43 | 3.80 | 650 | |
| 03:17 pm | 27.0 | 37.21 | 22.44 | | | Water samples collected; |
| 03:18 pm | 28.0 | 37.21 | 22.45 | | | T=57.9°F |
| 03:18 pm | 29.0 | 37.22 | 22.46 | | | |
| 03:19 pm | 29.8 | 37.22 | 22.47 | | | |
| 03:20 pm | 30.0 | | | | | Decrease rate |
| 03:21 pm | 1.0 | 35.93 | 22.30 | 3.23 | 600 | Step 5 |
| 03:22 pm | 2.0 | 35.82 | 22.26 | | | |
| 03:24 pm | 4.0 | | | | | Piping adaptor broke; |
| 03:25 pm | 5.0 | 19.79 | 19.97 | | | Terminate Step Test |
| 03:26 pm | 6.0 | 19.48 | 19.77 | | | |
| 03:27 pm | 7.3 | 19.33 | 19.64 | | | |
| 03:27 pm | 8.0 | 19.28 | 19.59 | | | |
| 03:28 pm | 9.0 | 19.23 | 19.54 | | | |
| 03:29 pm | 9.5 | 19.20 | 19.51 | | | |

**Note::** No sand in settling tank.

## Appendix B. Chemical Quality of Ground Water from IDOT Dewatering Wells, FY 93 (Phase 10)

Appendix B. Chemical Quality of Ground Water at IDOT Dewatering Sites
FY 93 (Phase 10)

| Site | I-70 | I-70 | I-70 | I-70 |
|---|---|---|---|---|
| Well No. | 4 | 6 | 7A | 8A |
| Section Location<br>T2N, R9W,<br>St. Clair Co. | 7.7b | 7.7b | 7.7b | 7.7b |
| Date Collected | 05/11/95 | 05/12/95 | 05/05/94 | 12/17/92 |
| Laboratory No. | 228699 | 228701 | 227595 | 226432 |
| Iron (Fe), mg/L | 13.18 | 11.91 | 11.66 | 14.26 |
| Manganese (Mn), mg/L | 0.83 | 0.45 | 0.85 | 0.84 |
| Calcium (Ca), mg/L | 153 | 153 | 197 | 228 |
| Magnesium (Mg), mg/L | 38.1 | 41.2 | 41.4 | 49.8 |
| Sodium (Na), mg/L | 26.2 | 54.6 | 59.5 | 47.0 |
| Silica ($SiO_2$), mg/L | 34.8 | 30.4 | 31.7 | 36.4 |
| Fluoride (F), mg/L | 0.3 | 0.5 | 0.2 | 0.7 |
| Nitrate ($NO_3$), mg/L | <0.02 | <0.02 | 0.02 | <0.1 |
| Chloride (CI), mg/L | 73.6 | 64.9 | 93.5 | 67.0 |
| Sulfate ($SO_4$), mg/L | 153 | 192 | 279 | 302 |
| Aluminum (Al), mg/L | 0.03 | 0.04 | <0.017 | 0.03 |
| Arsenic (As), mg/L | <0.11 | <0.11 | <0.11 | <0.11 |
| Barium (Ba), mg/L | 0.07 | 0.09 | 0.12 | 0.11 |
| Beryllium (Be), mg/L | <0.003 | <0.003 | - | - |
| Boron (B), mg/L | 0.20 | 0.34 | 0.62 | 0.84 |
| Cadmium (Cd), mg/L | <0.017 | <0.017 | <0.017 | <0.017 |
| Chromium (Cr), mg/L | <0.007 | <0.007 | <0.01 | <0.007 |
| Copper (Cu), mg/L | <0.007 | <0.007 | <0.01 | <0.006 |
| Lead (Pb), mg/L | <0.066 | <0.066 | <0.066 | <0.063 |
| Nickel (Ni), mg/L | <0.031 | <0.031 | <0.031 | <0.031 |
| Potassium (K), mg/L | 3.4 | 6.0 | 9.0 | 10.4 |
| Selenium (Se), mg/L | <0.18 | <0.18 | <0.18 | <0.18 |
| Silver (Ag), mg/L | <0.014 | <0.014 | <0.014 | <0.014 |
| Zinc (Zn), mg/L | <0.02 | <0.02 | <0.02 | <0.02 |
| Alkalinity (as $CaCO_3$), mg/L | 349 | 386 | 413 | 441 |
| Hardness (as $CaCO_3$), mg/L | 538 | 551 | 662 | 774 |
| Total dissolved minerals, mg/L | 743 | 832 | 1005 | 1044 |
| Turbidity (lab), NTU | 101 | 105 | 121 | 158 |
| Color, PCU | 8 | 10 | 14 | <5 |
| Odor | Musty | None | None | None |
| pH (lab) | 7.3 | 7.3 | 7.1 | 7.3 |
| Temperature, °F | 57.7 | 58.1 | 60 | 60 |

**Notes::**
< = below detection limit (i.e., <1.0 = less than 1.0 mg/l)
mg/L = milligrams per liter
= concentration not determined/information not available

Appendix B. (Continued)

| Site | I-70 | I-70 | I-70 | I-70 |
|---|---|---|---|---|
| Well No. | 8A | 9A | 10 | 13 |
| Section Location<br>T2N, R9W,<br>St. Clair Co. | 7.7b | 7.7b | 7.7b | 7.7b |
| Date Collected | 03/16/94 | 05/12/94 | 08/01/95 | 04/25/95 |
| Laboratory No. | 227449 | 227662 | 228881 | 228641 |
| Iron (Fe), mg/L | 11.54 | 16.6 | 15.04 | 14.29 |
| Manganese (Mn), mg/L | 0.73 | 0.68 | 0.58 | 0.75 |
| Calcium (Ca), mg/L | 194 | 239 | 213 | 213 |
| Magnesium (Mg), mg/L | 40.4 | 54.9 | 52.3 | 50.4 |
| Sodium (Na), mg/L | 48.1 | 51.8 | 114 | 123 |
| Silica ($SiO_2$), mg/L | 35.3 | 35.7 | 37.3 | 38.0 |
| Fluoride (F), mg/L | 0.3 | 0.3 | 0.2 | 0.3 |
| Nitrate ($NO_3$), mg/L | 0.04 | <0.02 | <0.02 | 0.08 |
| Chloride (Cl), mg/L | 73.8 | 66.5 | 71.0 | 73.2 |
| Sulfate ($SO_4$), mg/L | 267 | 422 | 442 | 412 |
| Aluminum (Al), mg/L | 0.03 | 0.02 | 0.09 | 0.048 |
| Arsenic (As), mg/L | <0.11 | <0.11 | <0.11 | <0.11 |
| Barium (Ba), mg/L | 0.10 | 0.09 | 0.09 | 0.13 |
| Beryllium (Be), mg/L | - | - | <0.003 | <0.003 |
| Boron (B), mg/L | 0.79 | 0.98 | 0.65 | 0.83 |
| Cadmium (Cd), mg/L | <0.017 | <0.017 | <0.017 | <0.017 |
| Chromium (Cr), mg/L | 0.009 | 0.008 | <0.007 | <0.007 |
| Copper (Cu), mg/L | <0.01 | <0.01 | <0.007 | <0.007 |
| Lead (Pb), mg/L | <0.063 | <0.066 | <0.066 | <0.066 |
| Nickel (Ni), mg/L | <0.031 | 0.060 | <0.031 | <0.031 |
| Potassium (K), mg/L | 8.0 | 8.5 | 6.5 | 6.1 |
| Selenium (Se), mg/L | <0.18 | <0.18 | <0.18 | <0.18 |
| Silver (Ag), mg/L | <0.014 | <0.014 | <0.014 | <0.014 |
| Zinc (Zn), mg/L | <0.02 | <0.02 | <0.02 | <0.02 |
| Alkalinity (as $CaCO_3$), mg/L | 374 | 462 | 454 | 491 |
| Hardness (as $CaCO_3$), mg/L | 650 | 822 | 746 | 739 |
| Total dissolved minerals, mg/L | 897 | 1218 | 1280 | 1257 |
| Turbidity (lab), NTU | 84 | 197 | 166 | 88.6 |
| Color, PCU | 10 | 6 | 6 | 7 |
| Odor | None | None | Musty | Musty |
| pH (lab) | 7.9 | 7.7 | 7.6 | 7.5 |
| Temperature, °F | 60.3 | 60.4 | 60.3 | 59.9 |

**Notes::**

< = below detection limit (i.e., <1.0 = less than 1.0 mg/l)

mg/L = milligrams per liter

\- = concentration not determined/information not available

Appendix B. (Continued)

| Site | I-70 | 25th St. | 25th St. |
|---|---|---|---|
| Well No. | 14 | 4 | 8 |
| Section Location | | | |
| T2N, R9W, | | | |
| St. Clair Co. | 7.7b | 17.6d | 17.6d |
| Date Collected | 06/22/94 | 07/24/92 | 11/15/93 |
| Laboratory No. | 227793 | *226026 | 227237 |
| Iron (Fe), mg/L | 2.97 | 17.69 | 12.19 |
| Manganese (Mn), mg/L | 1.37 | 0.64 | 0.70 |
| Calcium (Ca), mg/L | 206 | 234 | 152 |
| Magnesium (Mg), mg/L | 47.2 | 61.4 | 44.8 |
| Sodium (Na), mg/L | 59.8 | 261 | 22.7 |
| Silica ($SiO_2$), mg/L | - | 35.1 | 39.4 |
| Fluoride (F), mg/L | 0.3 | 1.1 | 0.4 |
| Nitrate ($NO_3$), mg/L | 0.46 | <0.1 | 0.03 |
| Chloride (Cl), mg/L | 83.9 | 44.0 | 41.9 |
| Sulfate ($SO_4$), mg/L | 285 | 902 | 155 |
| Aluminum (Al), mg/L | <0.017 | 0.029 | 0.04 |
| Arsenic (As), mg/L | <0.11 | <0.11 | <0.11 |
| Barium (Ba), mg/L | 0.07 | 0.117 | 0.09 |
| Beryllium (Be), mg/L | - | - | - |
| Boron (B), mg/L | 0.62 | 0.22 | 0.08 |
| Cadmium (Cd), mg/L | <0.017 | <0.017 | <0.017 |
| Chromium (Cr), mg/L | <0.007 | <0.007 | 0.02 |
| Copper (Cu), mg/L | <0.01 | <0.006 | <0.01 |
| Lead (Pb), mg/L | <0.066 | <0.066 | <0.063 |
| Nickel (Ni), mg/L | <0.031 | <0.031 | <0.031 |
| Potassium (K), mg/L | 6.08 | 9.4 | 6.0 |
| Selenium (Se), mg/L | <0.18 | <0.18 | <0.18 |
| Silver (Ag), mg/L | <0.014 | <0.014 | <0.014 |
| Zinc (Zn), mg/L | <0.02 | <0.02 | <0.02 |
| Alkalinity (as $CaCO_3$), mg/L | 422 | 475 | 360 |
| Hardness (as $CaCO_3$), mg/L | 708 | 836 | 564 |
| Total dissolved minerals, mg/L | 1031 | 1880 | 682 |
| Turbidity (lab), NTU | 28.9 | 120 | 11 |
| Color, PCU | <5 | <1 | <5 |
| Odor | None | None | None |
| pH (lab) | 7.8 | 7.7 | 7.5 |
| Temperature, °F | 58.1 | 60 | 58.0 |

**Notes:**

< = below detection limit (i.e., <1.0 = less than 1.0 mg/l)

mg/L = milligrams per liter

\- = concentration not determined/information not available

* Mercury = <0.05 mg/L

Appendix B. (Concluded)

| Site | Venice | Venice | Venice |
|---|---|---|---|
| Well No. | 1 | 6A | 7 |
| Section Location T3N, R10W, Madison Co. | 35.4g | 35.3g | 35.4g |
| Date Collected | 03/29/94 | 06/23/94 | 05/04/94 |
| Laboratory No. | 227474 | 227792 | 227594 |
| Iron (Fe), mg/L | 18.40 | 18.94 | 16.61 |
| Manganese (Mn), mg/L | 0.65 | 0.55 | 0.64 |
| Calcium (Ca), mg/L | 207 | 201 | 188 |
| Magnesium (Mg), mg/L | 47.0 | 48.6 | 42.9 |
| Sodium (Na), mg/L | 32.6 | 53.2 | 28.9 |
| Silica ($SiO_2$), mg/L | 36.5 | - | 34.7 |
| Fluoride (F), mg/L | 0.2 | 0.2 | 0.3 |
| Nitrate ($NO_3$), mg/L | <0.02 | <0.02 | <0.02 |
| Chloride (Cl), mg/L | 36.4 | 77.1 | 35.8 |
| Sulfate ($SO_4$), mg/L | 330 | 243 | 262 |
| Aluminum (Al), mg/L | 0.1 | 0.018 | 0.02 |
| Arsenic (As), mg/L | <0.11 | <0.11 | <0.11 |
| Barium (Ba), mg/L | 0.14 | 0.16 | 0.12 |
| Beryllium (Be), mg/L | - | - | - |
| Boron (B), mg/L | 1.43 | 0.86 | 0.64 |
| Cadmium (Cd), mg/L | <0.017 | <0.017 | <0.017 |
| Chromium (Cr), mg/L | 0.013 | <0.007 | 0.008 |
| Copper (Cu), mg/L | <0.01 | <0.01 | <0.01 |
| Lead (Pb), mg/L | <0.066 | <0.066 | <0.066 |
| Nickel (Ni), mg/L | <0.031 | <0.031 | <0.031 |
| Potassium (K), mg/L | 7.8 | 5.70 | 7.07 |
| Selenium (Se), mg/L | <0.18 | <0.18 | <0.18 |
| Silver (Ag), mg/L | <0.014 | <0.014 | <0.014 |
| Zinc (Zn), mg/L | <0.02 | <0.02 | <0.02 |
| Alkalinity (as $CaCO_3$), mg/L | 417 | 440 | 426 |
| Hardness (as $CaCO_3$), mg/L | 710 | 701 | 645 |
| Total dissolved minerals, mg/L | 955 | 991 | 892 |
| Turbidity (lab), NTU | 202 | 239 | 202 |
| Color, PCU | <5 | 8 | 5 |
| Odor | None | None | None |
| pH (lab) | 7.5 | 7.2 | 7.2 |
| Temperature, °F | 57.7 | 59.2 | 58 |

**Notes::**
< = below detection limit (i.e., <1.0 = less than 1.0 mg/l)
mg/L = milligrams per liter
- = concentration not determined/information not available

## Appendix C. Results of Step Tests on Dewatering Wells, FY 84 - FY 93 (Phases 1-10)

## Appendix C. Results of Step Tests on Dewatering Wells
### FY 84 - FY 93 (Phases 1-10)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *$\Delta h$*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **I-70** | | | | | | | | |
| No. 1 | 8/15/84 | ** | 18.1 e | ** | 33.1 e | 12.8 e | 328 | Pretreat |
| No. 1 | 8/14/85 | ** | 8.89 e | ** | 67.5 e | 3.3 e | 390 | Posttreat |
| No. 1 | 5/17/89 | 3.31 e | 14.68 e | 22.5 | 40.9 e | 8.5 e | 250 | |
| No. 1A | 4/26/95 | 0.92 | 14.98 e | 6.1 | 40.8 | 8.7 e | 445 | Initial test-New well |
| No. 2 | 7/19/83 | ** | 11.9 e | ** | 50.4 e | 7.9 e | 500 | Pretreat |
| No. 2 | 8/15/85 | ** | 8.32 e | ** | 72.1 e | P | 410 | Posttreat |
| No. 2 | 6/20/88 | ** | 11.98 e | ** | 50.1 e | P | 365 | Pretreat |
| No. 2 | 2/1/89 | 0.19e | 8.31 e | 2.3 | *12.2 c* | P | 270 | Posttreat; Piezometer partially plugged |
| No. 2A | 11/16/93 | 1.78 e | 20.82 e | 8.5 | 29.7 | 14.0 e | 438 | Initial test-New well |
| No. 3 | 6/28/83 | ** | 8.53 | ** | 70.9 | 5.65 | | |
| No. 3 | 6/24/86 | 1.11 | 7.47 | 14.9 | 80.3 | 3.64 | 610 | Pretreat |
| No. 3 | 1/14/87 | 0.82 | 6.09 | 13.5 | 98.5 | 2.40 | 620 | Posttreat |
| No. 3 | 12/11/89 | 0.46 | 13.4 e | 3.4 | 44.9 | 7.3 e | 530 | Pretreat |
| No. 3 | 4/17/90 | 4.8 e | 8.7 e | 54.5 | 84.0 | 2.9 e | 440 | Posttreat |
| No. 3A | 10/29/93 | 1.34 e | 15.25 e | 8.8 | 40.0 | 7.7 e | 540 | Initial test-New well |
| No. 4 | 8/16/84 | 0.07 | 9.33 | 0.8 | 64.3 | P | | Pretreat |
| No. 4 | 1/8/87 | ** | 5.89 | ** | 101.9 | P | 660 | Posttreat |
| No. 4 | 5/11/95 | ** | 6.70 | ** | 89.7 | P | 685 | |
| No. 5 | 7/10/84 | 0.89 | 6.53 | 13.6 | 91.9 | 2.11 | 740 | |
| No. 5 | 1/13/87 | ** | 7.98 | ** | 75.2 | 4.76 | 665 | Posttreat |
| No. 5 | 2/2/89 | 0.71 | 6.23 | 11.4 | 96.3 | P | 650+ | Posttreat |
| No. 5 | 10/14/93 | 1.19 e | 13.67 e | 8.7 | 44.8 | P | 500 | |

Appendix C. (Continued)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *Δh*@ 600 gpm (ft)* | *Observed *£max (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **I-70** (Cont'd) | | | | | | | | |
| No. 6 | 7/19/85 | 0.23 | 5.39 | 4.3 | 111.3 | P | 625 | |
| No. 6 | 8/1/90 | -- | -- | -- | 16.1 | | 145 | |
| No. 6 | 10/29/91 | 0.19 | 4.93 | 3.8 | 121.7 | -- | 750 | Posttreat; Piez. buried |
| No. 6 | 5/12/95 | ** | 6.72 | ** | 89.3 | 2.5 | 610 | |
| No. 7 | 6/30/83 | 1.88 | 18.55 | 10.1 | 32.3 | 15.0 | | Replaced 11/86 |
| No. 7A | 7/23/87 | ** | 8.39 | ** | 71.5 | 2.13 | 770 | |
| No. 7A | 6/15/89 | 2.25 | 11.43 | 19.7 | 52.5 | 8.97 e | 520 | |
| No. 7A | 6/27/90 | 6.8 e | 26.7 e | 25.3 | 24.6 | 13.2 e | 425 | Pretreat |
| No. 7A | 8/6/91 | 0.32 | 8.58 | 3.7 | 69.9 | 1.4 | 625 | Posttreat |
| No. 7A | 5/5/94 | 0.54 e | 11.1 e | 4.8 e | 54.5 | 2.9 e | 465 | |
| No. 8 | 8/1/84 | 2.68 | 13.54 | 19.8 | 44.3 | 9.94 | 625 | Pretreat |
| No. 8 | 12/5/85 | 0.07 | 6.83 | 1.0 | 87.8 | 2.21 | 750 | Posttreat |
| No. 8 | 6/22/88 | ** | 12.62 | ** | 47.5 e | 8.22 | 600 | |
| No. 8A | 10/4/89 | ** | 6.10 | ** | 98.4 | 1.38 | 778 | |
| No. 8A | 10/1/91 | 0.29 | 11.61 | 2.5 | 51.7 | 6.4 | 620 | |
| No. 8A | 12/17/92 | 0.17 e | 9.8 e | 1.2 e | 61.1 | 5.3 e | 590 | Pretreat |
| No. 8A | 3/16/94 | 0.27 e | 7.9 e | 3.4 e | 76.0 | 2.5 e | 588 | Posttreat |
| No. 9 | 6/28/84 | ** | 9.46 | ** | 63.4 | 5.94 | 630 | |
| No. 9A | 10/3/89 | ** | 6.04 e | ** | 99.4 e | 1.72 e | 523 | |
| No. 9A | 6/26/90 | 0.4 e | 6.2 e | 6.3 | 97.1 | 2.1 e | 575 | |
| No. 9A | 4/26/91 | ** | 5.95 e | -- | 100.8 | 2.7 e | 535 | |
| No. 9A | 7/23/92 | 0.24 e | 7.8 e | 3.1 | 78.7 | 2.9 e | 525 | |
| No. 9A | 5/12/94 | 0.13 e | 7.7 e | 1.6e | 78.3 | 3.1 e | 470 | |

Appendix C. (Continued)

| Well | Date of test | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *$\Delta h$*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **I-70** (Cont'd) | | | | | | | | |
| No. 10 | 7/31/84 | 5.97 e | 16.93 e | 35.3 | 35.4 e | P | 480 | Pretreat |
| No. 10 | 9/4/85 | 0.66 | 6.61 e | 10.0 | 90.8 | P | 490 | Posttreat |
| No. 10 | 8/13/87 | 1.07 | 18.98 e | 5.6 | 31.6 e | 10.4 e | 390 | Pretreat |
| No. 10 | 1/30/89 | 1.74 e | 11.51 e | 15.1 | 52.1 e | 4.34 e | 370 | Posttreat |
| No. 10 | 2/7/91 | -- | 19.3 e | — | 31.1 | P | 270 | Pretreat; Drawdown test only |
| No. 10 | 8/8/91 | 0.95 | 9.4 e | 10.0 | 65.2 | P | 450 | Posttreat |
| No. 10 | 8/1/95 | ** | 6.2 e | ** | 57.9 | P | 455 | |
| No. 11 | 8/2/84 | 1.58 e | 15.55 e | 10.2 | 38.6 e | 13.35 e | 555 | Pretreat |
| No. 11 | 9/5/85 | ** | 5.63 | ** | 106.6 | P | | Posttreat |
| No. 11 | 8/12/87 | ** | 11.56 e | ** | 51.9e | P | 550 | Pretreat |
| No. 11 | 1/31/89 | 0.03 | 6.62 e | 0.5 | 90.6 e | P | 570 | Posttreat; Piezometer partially plugged |
| No. 11A | 10/28/93 | 0.40 e | 16.09 e | 2.5 | 37.6 | 12.5 e | 474 | Initial test-New well |
| No. 12A | 6/16/83 | 0.20 | 3.82 | 5.2 | 157.1 | P | | |
| No. 12A | 7/30/86 | ** | 13.3 e | ** | 45.1 | P | 450 | Pretreat |
| No. 12A | 11/16/87 | 1.45 | 2.36 | 61.4 | 254.2 | P | 750 | Posttreat |
| No. 12A | 5/15/91 | 1.09 | 4.7 e | 23.2 | 132.6 | 2.0 e | 520 | |
| No. 13 | 4/25/91 | 0.47 | 7.57 e | 6.2 | 79.9 | 2.9 e | 560 | New well, initial test |
| No. 13 | 4/25/95 | ** | 20.1 e | ** | 29.9 | 4.4 e | 208 | Drawdown test |
| No. 14 | 12/20/90 | 0.13 | 5.93 | 2.2 | 100.5 | 3.0 | 750 | New well, initial test |
| No. 14 | 6/22/94 | ** | 16.0 e | ** | 34.0 | 14.6 e | 396 | |
| No. 15 | 10/15/93 | 2.95 e | 14.88 e | 19.8 | 41.5 | 9.1 e | 545 | Initial test-New well |

Appendix C. (Continued)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *$\Delta h$*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **1-64** | | | | | | | | |
| No. 1 | 7/21/87 | ** | 4.13 | ** | 145.3 | 0.85 | 660 | |
| No. 1 | 9/24/91 | 0.12 | 4.33 | 2.8 | 138.6 | P | 630 | |
| No. 2 | 7/25/85 | 0.09 | 5.32 e | 1.7 | 112.8 | 5.22 | 550 | |
| No. 3 | 6/26/84 | 0.52 | 10.73 e | 4.8 | 55.9 e | P | 525 | Pretreat |
| No. 3 | 6/21/88 | 0.68 e | 5.68 e | 12.0 e | 105.6 e | P | 555 | Posttreat |
| No. 4 | 7/15/85 | 0.66 | 4.40 | 15.0 | 136.4 | P | | |
| No. 9 | 10/5/83 | 0.37 | 6.22 | 5.9 | 96.5 | 2.3 | | |
| No. 10 | 7/11/84 | ** | 7.46 | ** | 80.4 | 2.73 | 605 | |
| No. 11 | 8/14/84 | ** | 7.22 e | ** | 83.1 e | 3.2 e | 520 | |
| No. 11 | 6/16/89 | 0.52 | 7.45 e | 7.0 | 80.5 e | P | 505 | |
| No. 12 | 7/18/85 | 0.17 | 6.22 e | 2.8 | 96.5 | 1.62 e | 590 | |
| No. 13 | 7/12/84 | ** | 6.44 | ** | 93.2 | 2.65 | 600 | |
| No. 14 | 8/3/90 | 0.31 | 4.71 e | 6.5 | 128.2 | P | 585 | Initial test |
| No. 15 | 6/29/83 | 0.73 | 9.94 | 7.3 | 60.4 | 4.6 | | Pretreat |
| No. 15 | 8/13/85 | 0.71 | 7.24 | 9.8 | 82.9 | 2.97 | 615 | Posttreat |
| No. 15 | 7/22/87 | 0.84 e | 6.94 e | 12.1 e | 86.5 e | 2.52 | 570 | |
| **25th St.** | | | | | | | | |
| No. 1 | 8/11/89 | 1.0 e | 3.6 e | 27.2 | 184.7 | P | 375 | |
| No. 1 | 9/4/91 | | | | 31.6 | P | 235 | Drawdown test only |
| No. 2 | 7/20/83 | 0.54 | 5.69 | 9.5 | 105.4 | 1.1 | | |
| No. 2 | 8/9/89 | ** | 10.3 e | ** | 58.3 e | -- | 550 | Pretreat; Ah elevation data not available |
| No. 2 | 4/18/90 | 0.45 | 4.87 | 9.3 | 120.4 | 0.6 | 795 | Posttreat |

Appendix C. (Continued)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *Δh*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **25th St.** (Cont'd) | | | | | | | | |
| No. 3 | 9/6/85 | 0.03 | 4.89 | 0.6 | 122.7 | 1.75 | | |
| No. 3 | 9/7/89 | 0.80 e | 14.9 e | 5.4 | 40.9 | 4.5 e | 560 | Pretreat |
| No. 3 | 12/19/90 | 0.28 | 10.29 | 2.7 | 58.1 | 3.0 | 650 | Pretreat |
| No.3 | 5/14/91 | 0.17 | 5.59 | 3.0 | 106.5 | 0.9 | 780 | Posttreat |
| No. 4 | 8/2/90 | 1.86 | 10.87 | 17.1 | 55.2 | -- | 635 | Initial test |
| No. 4 | 11/19/91 | 0.62 | 4.75 | 13.1 | 119.9 | P | 840 | Posttreat |
| No. 4 | 7/24/92 | ** | 6.24 | ** | 98.8 | P | 820 | |
| No. 5 | 5/16/89 | 0.47 e | 23.28 e | 0.02 | 25.8 e | 15.2 e | 352 | Pretreat |
| No. 5 | 4/19/90 | ** | 4.92 | ** | 122.0 | 1.0 | 790 | Posttreat |
| No. 6 | 6/27/84 | 0.14 | 9.44 | 1.5 | 63.6 | P | 775 | Pretreat |
| No. 6 | 1/7/87 | 0.23 | 4.38 | 5.3 | 137.0 | P | 775 | Posttreat |
| No. 6 | 2/8/91 | ** | 4.96 | ** | 122.5 | 1.9 | 810 | |
| No. 7 | 3/21/91 | 1.56 | 5.15 | 30.3 | 110.8 | P | 735 | Initial test |
| No. 8 | 6/15/83 | 0.11 | 4.70 | 2.3 | 127.7 | 1.5 | | |
| No. 8 | 4/24/91 | -- | 13.2 e | -- | 45.5 | 9.5 e | 255 | Drawdown test only |
| No. 8 | 11/15/93 | ** | 6.23 | ** | 96.3 | 4.81 | 620 | Posttreat |
| No. 9 | 6/25/86 | ** | 5.55 e | ** | 110.4 | 2.04 e | 520 | |
| No. 9 | 9/18/91 | 0.66 e | 5.10e | 12.9 | 117.6 | 1.8 e | 580 | |
| No. 10 | 7/26/85 | ** | 9.56 | ** | 62.8 | 3.59 | | Pretreat |
| No. 10 | 11/18/87 | 0.43 | 6.24 | 6.9 | 96.2 | 2.06 | 800 | Posttreat |
| **Venice** | | | | | | | | |
| No. 1 | 11/30/83 | 2.29 | 18.33 e | 12.5 | 32.7 | 10.9 e | 500 | Pretreat |
| No. 1 | 12/4/85 | 0.39 | 7.89 | 4.9 | 74.5 | 2.33 | 870 | Posttreat |

Appendix C. (Continued)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *$\Delta h$*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **Venice** (Cont'd) | | | | | | | | |
| No. 1 | 9/6/89 | 0.81 | 6.94 | 11.7 | 85.1 | 1.9 | 740 | |
| No. 1 | 3/29/94 | 2.9 | 17.4 | 16.6 | 34.5 | P | 680 | |
| No. 2 | 11/17/83 | 0.05 | 4.70 | 1.0 | 127.7 | 1.2 | | |
| No. 2 | 9/5/89 | 12.49 | 44.70 e | 27.9 | 13.4 e | 33.3 e | 200 | Pretreat; Water level below intake |
| No. 2 | 5/8/90 | ** | 6.34 | ** | 94.7 | 2.4 | 730 | Posttreat |
| No. 2 | 10/2/91 | 1.30 | 6.14 | 21.1 | 92.8 | 2.3 | 780 | |
| No. 3 | 11/28/83 | ** | 9.20 | ** | 65.2 | 4.2 | | Pretreat |
| No. 3 | 1/6/87 | 0.35 | 7.60 | 4.6 | 78.3 | P | 775 | Posttreat |
| No. 3 | 12/5/90 | #* | 9.54 | ** | 62.9 | 6.1 | 700 | |
| No. 3 | 12/16/91 | ** | 6.26 e | ** | 97.2 | 2.3 | 840 | Posttreat |
| No. 4 | 12/1/83 | 0.39 | 5.15 | 7.6 | 116.5 | 2.3 | | |
| No. 4 | 12/6/90 | -- | 30.0 e | -- | 20.0 | 26.0 e | 262 | Pretreat; Drawdown test only |
| No. 4 | 9/17/91 | 0.66 | 5.86 | 11.3 | 102.4 | 2.7 | 795 | Posttreat |
| No. 5 | 11/15/83 | 0.16 | 4.98 | 3.2 | 120.5 | 1.9 | | |
| No. 5 | 12/7/89 | 4.3 e | 13.7 e | 31.4 | 43.8 | 9.6 e | 500 | Pretreat |
| No. 5 | 5/2/90 | ** | 5.38 | ** | 109.7 | 1.6 | 740 | Posttreat |
| No. 5 | 3/24/92 | 0.73 | 5.28 | 13.8 | 110.5 | P | 760 | |
| No. 6 | 11/29/83 | 0.16 | 7.82 | 2.0 | 76.7 | 6.1 | | Pretreat |
| No. 6 | 11/17/87 | 3.18 | 4.13 | 77.0 | 145.3 | 2.61 | 800 | Posttreat |
| No. 6A | 3/20/91 | 1.89 | 6.84 e | 27.6 | 78.6 | 3.7 | 900 | New well, initial test |
| No. 6A | 6/23/94 | ** | 9.9 | ** | 61.5 | 6.1 | 825 | |

Appendix C. (Concluded)

| *Well* | *Date of test* | *Well loss @ 600 gpm (ft)* | *Drawdown @ 600 gpm (ft)* | *Well loss portion (%)* | *Observed specific capacity (gpm/ft)* | *$\Delta h$*@ 600 gpm (ft)* | *Observed $Q_{max}$ (gpm)* | *Remarks* |
|---|---|---|---|---|---|---|---|---|
| **Venice** (Cont'd) | | | | | | | | |
| No. 7 | 2/27/91 | ** | 7.48 | ** | 80.2 | 4.1 | 895 | New well, initial test |
| No. 7 | 5/4/94 | ** | 17.5 | ** | 35.2 | 13.9 e | 845 | |

**Notes:**
* -Head difference between pumped well and adjacent piezometer.
**-Coefficient immeasurable. Turbulent well loss negligible over the pumping rates tested.
e-Estimate based on interpolated values adjusted to 600 gpm
P-Piezometer plugged or partially plugged

# Appendix D. Well Rehabilitation Field Notes, FY 93 (Phase 10)

## WELL REHABILITATION FIELD NOTES

WELL SITE: I-70 Well 8A                                                            OBSERVER: Al Brown

CONTRACTOR: Brotcke Engineering Company

MEASURING POINT: Not recorded (NR)

MEASURING EQUIP.: Contractors 6x5 orifice tube, electric dropline

1. SPECIFIC CAPACITY TEST                                                            DATE: 3/5/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 10:15 am | 10.3 | | | | NPWL |
| 10:30 | 27.0 | | 68.5 | 1030 | |
| 11:35 | 27.8 | 17.5 | 67.5 | 1023 | PWL |

Note: All specific capacity tests-static water level (SWL) measured after minimum 30 min. period of well inactivity. Minimum period of pumpage for drawdown measurements is 60 min.

60 min. specific capacity: 58.5 gpm/ft

2. 400 LBS POLYPHOSPHATE APPLICATION                                                            DATE: 3/5/93

A. INITIAL CHLORINATION

Quantity: 2,500 gal                                        Strength: 500 mg/l chlorine

Time - initial: NR                                        Injection rate: NR
- complete:

B. POLYPHOSPHATE INJECTION, 400 lbs total

| | | Batch 1 | Batch 2 |
|---|---|---|---|
| Phosphate: | | 200 lbs | 200 lbs |
| Quantity | $H_2O$: | 1800 gal | 1800 gal |
| Time - initial: | | NR | NR |
| - complete: | | NR | NR |
| Injection rate: | | 1600 gpm | 1600 gpm |

C. DISPLACEMENT, 16,000 gallons chlorinated water (500 mg/1)

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| 1 hour | | |

D. PUMPED TO WASTE

Time - initial:
- complete: 6 hours

Q: Quantity:

3. SPECIFIC CAPACITY TEST DATE: 3/8/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 8:10 am | 10.35 | | | | NPWL |
| 8:30 | 23.5 | | 72 | | |
| 8:45 | 23.6 | | 64.0 | 996 | |
| 9:10 | 24.0 | 13.6 | 64.0 | 996 | PWL |

60 min. specific capacity: 73.2 gpm/ft

4. ACIDIZATION - INHIBITED MURIATIC ACID DATE: 3/8/93

A. ACID INIECTION

Acid strength: 20° baume Quantity: 1000 gal

Time - initial: 9:20 am Q: 40 gpm
- complete: 9:45 am

B. DISPLACEMENT, 4,000-5,000 gallons nonchlorinated water

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| NR | NR | NR |

Comments: 2 hour wait

C. PUMPED TO WASTE

Time - initial: 2:00 pm (3/8/93)
- complete: 8:00 am (3/9/93)

Q: NR Quantity: NR

WELL REHABILITATION -I-70 Well 8A (Continued)

5. SPECIFIC CAPACITY TEST DATE: 3/9/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 8:00 am | 23.4 | | 59.0 | 960 | PWL |
| 8:30 | 12.1 | 11.3 | | | NPWL |

60 min. specific capacity: 85.0 gpm/ft

6. 600 LBS POLYPHOSPHATE APPLICATION DATE: 3/9/93

A. INITIAL CHLORINATION

Quantity: 2,500 gal Strength: 500 mg/l

Time - initial: NR Injection rate: NR
- complete:

B. POLYPHOSPHATE INJECTION, 600 lbs total

| | Batch 1 | Batch 2 | Batch 3 |
|---|---|---|---|
| Phosphate: | 200 lbs | 200 lbs | 200 lbs |
| Quantity $H_2O$: | 1,800 gal | 1,800 gal | 1,800 gal |
| Time - initial: | NR | NR | NR |
| -complete: | NR | NR | NR |
| Injection rate: | 1,400 | 1,700 | 1,700 |

Comments:

C. DISPLACEMENT, 30,000 gallons chlorinated water (500 mg/1)

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| NR | NR | NR |

Comments: 1 hour wait

D. PUMPED TO WASTE (6 hours)

Time - initial: 2:00 pm (3/9/93)
- complete: 10:00 am (3/10/93

Q: 1,050 gpm Quantity: -1,260,000 gal

7. SPECIFIC CAPACITY TEST DATE: 3/10/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 10:30 am | 13.0 | | | | NPWL |
| 11:30 | 23.5 | 10.5 | 62 | 988 | PWL |

60 min. specific capacity: 94.1 gpm/ft

# WELL REHABILITATION FIELD NOTES

WELL SITE: 25th St. Well 8 — OBSERVER: Al Brown

CONTRACTOR: Brotcke Engineering Company

MEASURING POINT: Not recorded (NR)

MEASURING EQUIP.: Contractor's 6x5 orifice tube, electric dropline

## 1. SPECIFIC CAPACITY TEST — DATE: 2/15/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 1:30 pm | 15.2 | | | | NPWL |
| 2:30 | 21.5 | 6.3 | 18.0 | 528 | PWL |

Note: All specific capacity tests—static water level (SWL) measured after minimum 30 min. period of well inactivity. Minimum period of pumpage for drawdown measurements is 60 min.

60 min. specific capacity: 83.8 gpm/ft

## 2. 400 LBS POLYPHOSPHATE APPLICATION — DATE: 2/17/93

### A. INITIAL CHLORINATION

Quantity: 2,500 gal — Strength: 500 mg/l

Time - initial: NR — Injection rate: NR

- complete: NR

### B. POLYPHOSPHATE INJECTION, 400 lbs total

| | | Batch 1 | Batch 2 |
|---|---|---|---|
| Phosphate: | | 200 lbs | 200 lbs |
| Quantity | $H_2O$: | 1,800 gal | 1,800 gal |
| Time - initial: | | NR | NR |
| - complete: | | NR | NR |
| Injection rate: | | NR | NR |

### C. DISPLACEMENT, 16,000 gallons chlorinated water (500 mg/1)

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| NR | NR | NR |

D. PUMPED TO WASTE

Time - initial: 2:45 pm
- complete: (Electricity off during night)

Q: NR Quantity:

3. SPECIFIC CAPACITY TEST DATE: 2/23/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 10:20 am | 14.2 | | 68.5 | 1030 | NPWL |
| 11:25 | 24.2 | 10.0 | | | PWL |

60 min. specific capacity: 103.0 gpm/ft

4. ACIDIZATION - INHIBITED MURIATIC ACID DATE: 2/23/93

A. ACID INJECTION

Acid strength: 20° baume Quantity: 1,000 gal

Time - initial: 11:30 am Q: 33 gpm
- complete: 12:00 pm

B. DISPLACEMENT, 4,000 gallons nonchlorinated water

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| 1:00 pm/1:04 pm | 4,000 | 2,000 |

C. PUMPED TO WASTE

Time - initial: 3:00 pm (2/23/93)
- complete: 8:05 am (2/24/93)

Q: Quantity:

5. SPECIFIC CAPACITY TEST DATE: 2/24/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 8:35 am | 14.8 | | 68 | 1,026 | NPWL |
| 9:35 | 24.2 | 9.4 | 68 | 1,026 | PWL |

60 min. specific capacity: 109.1 gpm/ft

6. 600 LBS POLYPHOSPHATE APPLICATION DATE: 2/24/93

A. INITIAL CHLORINATION

Quantity: 2,500 Strength: 500 mg/l

Time - initial: Injection rate: 3,750 gpm
- complete: (40 sec)

B. POLYPHOSPHATE INJECTION, 600 lbs total

| | | Batch 1 | Batch 2 | Batch 3 |
|---|---|---|---|---|
| Phosphate: | | 200 lbs | 200 lbs | 200 lbs |
| Quantity | $H_2O$: | 1,800 gal | 1,800 gal | 1,800 gal |
| Time - initial: | | | | |
| - complete: | | 1 min. 5 sec. | 73 sec. | 73 sec. |
| Injection rate: | | 1,660 gpm | 1,480 gpm | 1,480 gpm |

C. DISPLACEMENT, 30,000 gallons chlorinated water (500 mg/1)

| Time - initial/complete | Quantity (gal) | Q (gpm) |
|---|---|---|
| NR | | |

D. PUMPED TO WASTE

Time - initial: 2:30 pm (2/24/93)
- complete: 11:00 am (3/1/93)

Q: NR Quantity: NR

7. SPECIFIC CAPACITY TEST DATE: 3/1/93

| Time | Depth (ft) | Drawdown (ft) | Piez. tube (in.) | Pumping rate (gpm) | Remarks |
|---|---|---|---|---|---|
| 11:00 am | 13.4 | | | | NPWL |
| 12:00 pm | 22.2 | 8.8 | 68 | 1,023 | PWL |

60 min. specific capacity: 116.3 gpm/ft

# Appendix E. Sieve Data for Material Pumped from Dewatering Wells, FY 93 (Phase 10)

Appendix E. Sieve Data for Material Pumped from Dewatering Wells (Cumulative Percent Retained)

| **Site** | **I-70** | **I-70** | **I-70** | **Venice** |
|---|---|---|---|---|
| **Well** | **8A** | **8A** | **10** | **1** |
| Date collected | 12/17/92 | 03/16/94 | 08/01/95 | 03/29/94 |
| Sample no. | PS 10072 | PS 10696 | PS 10697 | PS 10698 |
| Sample wt. (gm) | 45.83 | 45.36 | 313.25 | 836.30 |
| Split sample wt. (gm) | | | 99.89 | 125.92 |
| U.S. Sieve No./ Sieve opening (mm) | | | | |
| 10 (2.000) | 0.59 | 0.29 | 3.74 | 0.10 |
| 18(1.000) | 3.05 | 22.16 | 14.79 | 0.44 |
| 25 (0.710) | | 54.87 | 17.11 | 0.60 |
| 35 (0.500) | 12.63 | 87.79 | 18.95 | 0.77 |
| 60 (0.250) | 37.25 | 96.47 | 25.27 | 2.17 |
| 120 (0.125) | 96.29 | 99.23 | 46.18 | 67.80 |
| 230 (0.063) | 100.00 | 99.85 | 99.89 | 99.79 |
| Pan | 100.02 | - | - | - |

# Appendix F. Chemical Quality Data,
# FY 84 - FY 93 (Phases 1-10)

# Appendix F.  Chemical Quality Data,  FY 84-FY 93 (Phases 1-10)

| Well | Date | Lab No. | Iron Fe (mg/L) | Manganese Mn (mg/L) | Calcium Ca (mg/L) | Magnesium Mg (mg/L) | Sodium Na (mg/L) | Silica SiO2 (mg/L) | Nitrate NO3-N (mg/L) | Chloride Cl (mg/L) | Sulfate SO4 (mg/L) | Alkalinity CaCO3 (mg/L) | Hardness CaCO3 (mg/L) | TDS (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I-70 Site | | | | | | | | | | | | | | |
| 1 | 08/15/84 | 220249 | 1020 | | 201 | 45.0 | 124.0 | 29.8 | 3.7 | 136 | 320 | 480 | 687 | 1203 |
| 1 | 08/14/85 | 221273 | 10.98 | | 218 | 48.0 | 112.0 | 2.3 | 2.9 | 140 | 360 | 488 | 741 | 1279 |
| 1 | 05/17/89 | 223086 | 6.02 | 1.40 | 177 | 37.6 | 118.0 | 28.6 | 1.6 | 85 | 347 | 479 | 596 | 1046 |
| 1A | 04/26/95 | 228642 | 11.33 | 1.49 | 232 | 48.7 | 182 | 33.3 | 0.20 | 192 | 369 | 510 | 779 | 1446 |
| 2 | 07/19/83 | 218825 | 11.90 | | 180 | 40.0 | 127.0 | 31.4 | | 131 | 290 | 464 | 614 | 1105 |
| 2 | 08/15/85 | 221272 | 5.55 | | 182 | 42.4 | 124.0 | 20 | | 140 | 360 | 464 | 628 | 1159 |
| 2 | 06/20/88 | 222598 | 1120 | 120 | 177 | 40.0 | 110.0 | 30.9 | 0.4 | 138 | 246 | 465 | 606 | 1088 |
| 2 | 02/01/89 | 222892 | 10.60 | 0.61 | 160 | 45.0 | 68.9 | 28.9 | 02 | 128 | 261 | 395 | 584 | 967 |
| 2A | 11/16/93 | 227238 | 14.00 | 1.35 | 228 | 49.6 | 176 | 36.9 | 0.03 | 200 | 299 | 482 | 773 | 1308 |
| 3 | 06/28/83 | 218685 | 14.40 | | 224 | 522 | 112.0 | 32.8 | | 198 | 307 | 440 | 774 | 1238 |
| 3 | 06/24/86 | 221686 | 14.80 | 0.86 | 162 | 40.0 | 180.0 | 31.6 | | 230 | 300 | 444 | 569 | 1250 |
| 3 | 01/14/87 | 221954 | 8.70 | 0.81 | 211 | 40.8 | 99.0 | 31.6 | | 154 | 266 | 416 | 694 | 1074 |
| 3 | 12/11/89 | 223290 | 7.57 | 0.76 | 162 | 38.8 | 332 | 32 | | 69 | 222 | 385 | 564 | 826 |
| 3 | 04/17/90 | 223481 | 6.11 | 0.71 | 156 | 352 | 452 | | | 87 | 188 | 369 | 534 | 834 |
| 3A | 10/29/93 | 227203 | 12.83 | 0.83 | 175 | 41.0 | 385 | 35.0 | <0.02 | 53.1 | 175 | 374 | 605 | 877 |
| 4 | 08/17/84 | 220250 | 920 | | 197 | 462 | 62.8 | 29.7 | 0.7 | 125 | 247 | 408 | 632 | 982 |
| 4 | 01/08/87 | 221949 | 6.90 | 0.95 | 219 | 40.0 | 33.6 | 29.6 | 0.9 | 79 | 221 | 369 | 711 | 854 |
| 4 | 05/11/95 | 228699 | 13.18 | 0.83 | 153 | 38.1 | 262 | 34.8 | <0.02 | 73.6 | 153 | 349 | 538 | 743 |
| 5 | 07/10/84 | 220112 | 11.60 | | 148 | 372 | 293 | 32 | | 84 | 169 | 336 | 524 | 775 |
| 5 | 01/13/87 | 221953 | 7.50 | 0.88 | 187 | 38.8 | 332 | 31.1 | 12 | 83 | 195 | 360 | 626 | 787 |
| 5 | 02/02/89 | 222891 | 7.73 | 1.07 | 175 | 382 | 124.0 | 30 | | 113 | 305 | 495 | 594 | 1099 |
| 5 | 10/14/93 | 227164 | 13.36 | 054 | 163 | 43.4 | 61.7 | 37.1 | 0.3 | 106 | 151 | 404 | 585 | 883 |
| 6 | 08/01/90 | 223646 | 10.80 | 0.44 | 152 | 40.5 | 55.5 | | 0.3 | 58 | 242 | 355 | 546 | 858 |
| 6 | 10/29/91 | 225019 | 11.52 | 0.47 | 158 | 40.7 | 55.0 | 30.7 | <0.1 | 81.0 | 218 | 363 | 562 | 839 |
| 6 | 05/12/95 | 228701 | 11.91 | 0.45 | 153 | 412 | 54.6 | 30.4 | <0.02 | 64.9 | 192 | 386 | 551 | 832 |
| 7 | 06/30/83 | 218687 | 12.10 | | 189 | 41.8 | 51.7 | 31.1 | | 77 | 285 | 367 | 643 | 936 |
| 7A | 07/23/87 | 222215 | 8.30 | 0.63 | 152 | 36.8 | 50.8 | 33.8 | | 98 | 244 | 355 | 531 | 926 |
| 7A | 06/27/90 | 223575 | 10.70 | 0.87 | 220 | 492 | 78.9 | | | 76 | 403 | 461 | 751 | 1198 |
| 7A | 08/06/91 | 224511 | 12.10 | 0.79 | 196 | 43.0 | 77.9 | 34.1 | | 98 | 304 | 429 | 666 | 1075 |
| 7A | 05/05/94 | 227595 | 11.66 | 0.85 | 197 | 41.4 | 595 | 31.7 | 0.02 | 93.5 | 279 | 413 | 662 | 1005 |
| 8 | 08/01/84 | 220187 | 13.50 | | 210 | 445 | 69.6 | 30.4 | | 89 | 332 | 438 | 707 | 1076 |
| 8 | 12/05/85 | 221485 | 1220 | | 193 | 432 | 65.8 | 29.8 | | 87 | 310 | 412 | 659 | 1011 |
| 8 | 06/22/88 | 222600 | 1530 | 0.80 | 210 | 465 | 432 | 31 | | 57 | 317 | 451 | 715 | 1089 |
| 8A | 10/04/89 | 223203 | 10.59 | 0.95 | 208 | 42.7 | 72.4 | 30.8 | | 103 | 322 | 457 | 695 | 1055 |
| 8A | 10/01/91 | 224907 | 12.70 | 1.03 | 201 | 42.9 | 104.0 | 27.0 | <0.1 | 144 | 317 | 447 | 678 | 1198 |
| 8A | 12/17/92 | 226432 | 1426 | 0.84 | 228 | 49.8 | 47.0 | 36.4 | <0.1 | 67.0 | 302 | 441 | 774 | 1044 |
| 8A | 03/16/94 | 227449 | 11.54 | 0.73 | 194 | 40.4 | 48.1 | 35.3 | 0.04 | 73.8 | 267 | 374 | 650 | 897 |
| 9 | 06/28/84 | 220091 | 1220 | | 178 | 43.4 | 815 | 322 | 0.4 | 108 | 320 | 376 | 623 | 1082 |
| 9A | 10/03/89 | 223202 | 10.90 | 0.67 | 231 | 49.6 | 41.0 | 335 | | 63 | 378 | 466 | 780 | 1099 |
| 9A | 06/26/90 | 223574 | 16.60 | 0.70 | 232 | 54.9 | 230.0 | | | 71 | 694 | 522 | 805 | 1642 |
| 9A | 04/26/91 | 224140 | 1524 | 0.59 | 224 | 50.8 | 40.8 | 372 | | 58 | 356 | 440 | 768 | 1112 |
| 9A | 07/23/92 | 226027 | 16.96 | 0.60 | 232 | 55.5 | 76.6 | 36.4 | 0.3 | 64.0 | 441 | 477 | 807 | 1238 |
| 9A | 05/12/94 | 227662 | 16.6 | 0.68 | 239 | 54.9 | 51.8 | 35.7 | <0.02 | 66.5 | 422 | 462 | 822 | 1218 |
| 10 | 07/31/84 | 220186 | 13.10 | | 202 | 512 | 47.9 | 33.3 | | 67 | 332 | 424 | 715 | 1042 |
| 10 | 09/04/85 | 221318 | 16.10 | | 234 | 58.4 | 50.4 | | | 57 | 450 | 432 | 824 | 1181 |
| 10 | 08/13/87 | 222254 | 1130 | 0.60 | 218 | 54.4 | 44.4 | 36.5 | 02 | 68 | 376 | 424 | 768 | 1132 |
| 10 | 01/30/89 | 222889 | 11.42 | 0.56 | 189 | 47.0 | 38.8 | 33.7 | | 63 | 354 | 436 | 665 | 1024 |
| 10 | 02/07/91 | 223980 | 12.65 | 0.54 | 225 | 56.6 | 60.4 | | | 73 | 455 | 424 | 794 | 1242 |
| 10 | 08/08/91 | 224512 | 1420 | 0.54 | 198 | 50.4 | 65.4 | 35.7 | | 78 | 399 | 388 | 701 | 1150 |
| 10 | 08/01/95 | 228881 | 15.04 | 0.58 | 213 | 52.3 | 114 | 37.3 | <0.02 | 71 | 442 | 454 | 746 | 1280 |
| 11 | 08/02/84 | 220188 | 13.10 | | 169 | 43.0 | 47.5 | 31.8 | | 72 | 270 | 362 | 599 | 893 |
| 11 | 09/05/85 | 221319 | 15.90 | | 204 | 53.3 | 65.4 | | | 57 | 420 | 3% | 728 | 1127 |
| 11 | 08/12/87 | 222253 | 9.00 | 0.50 | 170 | 44.8 | 55.6 | 28.6 | 02 | 102 | 271 | 349 | 608 | 930 |
| 11 | 01/31/89 | 222890 | 9.11 | 0.55 | 154 | 43.0 | 39.9 | 32.6 | | 73 | 300 | 346 | 561 | 889 |
| 11A | 10/28/93 | 227202 | 13.04 | 0.48 | 175 | 44.7 | 34.3 | 372 | <0.02 | 38.7 | 192 | 399 | 620 | 912 |
| 12A | 06/16/83 | 218640 | 13.80 | | 167 | 46.6 | 49.4 | 30.7 | | 67 | 350 | 352 | 608 | 971 |
| 12A | 07/30/86 | 221717 | 18.10 | 0.69 | 172 | 47.0 | 86.0 | 34.4 | | 185 | 250 | 360 | 622 | 1050 |

# Appendix F. (Continued)

| *Fluoride* *F* *(mg/L)* | *Aluminum* *Al* *(mg/L)* | *Arsenic* *As* *(mg/L)* | *Barium* *Ba* *(mg/L)* | *Beryllium* *Be* *(mg/L)* | *Boron* *B* *(mg/L)* | *Cadmium* *Cd* *(mg/L)* | *Chromium* *Cr* *(mg/L)* | *Copper* *Cu* *(mg/L)* | *Lead* *Pb* *(mg/L)* | *Mercury* *Hg* *(mg/L)* | *Nickel* *Ni* *(mg/L)* | *Potassium* *K* *(mg/L)* | *Selenium* *Se* *(mg/L)* | *Silver* *Ag* *(mg/L)* | *Zinc* *Zn* *(mg/L)* | *Well* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 1 |
| | | | | | | | | | | | | | | | | 1 |
| | | | | | | | | | | | | | | | | 1 |
| 0 3 | <0.017 | <0.11 | 0.11 | <0.003 | 1.07 | <0.017 | <0.007 | <0.007 | <0.066 | | <0.031 | *92* | <0.18 | <0.014 | <0.02 | 1A |
| | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 2 |
| 0.4 | 0.02 | <0.11 | 0.12 | | 1.03 | <0.017 | 0.02 | <0.01 | <0.063 | | <0.031 | 12.6 | <0.18 | <0.014 | <0.02 | 2A |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| 0 3 | 0.02 | <0.11 | 0.08 | | 0.1 | <0.017 | <0.007 | <0.01 | <0.063 | | <0.031 | 9.8 | <0.18 | <0.014 | <0.02 | 3A |
| | | | | | | | | | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | 4 |
| 0.3 | 0.03 | <0.11 | 0.07 | <0.003 | 0.20 | <0.017 | <0.007 | <0.007 | <0.066 | | <0.031 | 3.4 | <0.18 | <0.014 | <0.02 | 4 |
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 5 |
| 0.3 | <0.017 | <0.11 | 0.10 | | 0.10 | <0.017 | 0.01 | <0.01 | <0.063 | | <0.031 | 5.9 | <0.18 | <0.014 | <0.02 | 5 |
| | | | | | | | | | | | | | | | | 6 |
| 0.3 | | | | | | | | | | | | 7.8 | | | | 6 |
| 0.5 | 0.04 | <0.11 | 0.09 | <0.003 | 034 | <0.017 | <0.007 | <0.007 | <0.066 | | <0.031 | 6.0 | <0.18 | <0.014 | <0.02 | 6 |
| | | | | | | | | | | | | | | | | 7 |
| | | | | | | | | | | | | | | | | 7A |
| | | | | | | | | | | | | | | | | 7A |
| | | | | | | | | | | | | | | | | 7A |
| *02* | <0.017 | <0.11 | 0.12 | | 0.62 | <0.017 | <0.01 | <0.01 | <0.066 | | <0.031 | 9.0 | <0.18 | <0.014 | <0.02 | 7A |
| | | | | | | | | | | | | | | | | 8 |
| | | | | | | | | | | | | | | | | 8 |
| | | | | | | | | | | | | | | | | 8 |
| | | | | | | | | | | | | | | | | 8A |
| 0.5 | | | | | | | | | | | | | | | | 8A |
| 0.7 | 0.03 | <0.11 | 0.11 | | 0.84 | <0.017 | <0.007 | <0.006 | <0.063 | | <0.031 | 10.4 | <0.18 | <0.014 | <0.02 | 8A |
| 0.3 | 0.03 | <0.11 | 0.10 | | 0.79 | <0.017 | 0.009 | <0.01 | <0.063 | | <0.031 | 8.0 | <0.18 | <0.014 | <0.02 | 8A |
| | | | | | | | | | | | | | | | | 9 |
| | | | | | | | | | | | | | | | | 9A |
| | | | | | | | | | | | | | | | | 9A |
| | | | | | | | | | | | | | | | | 9A |
| 0.7 | 0.027 | <0.11 | 0.09 | | 0.76 | <0.017 | <0.007 | <0.006 | <0.066 | <0.05 | <0.031 | 10.1 | <0.18 | <0.014 | <0.02 | 9A |
| 0.3 | 0.02 | <o.n | 0.09 | | 0.98 | <0.017 | 0.008 | <0.01 | <0.066 | | 0.060 | 8.5 | <0.18 | <0.014 | <0.02 | 9A |
| | | | | | | | | | | | | | | | | 10 |
| | | | | | | | | | | | | | | | | 10 |
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| | | | | | | | | | | | | | | | | 10 |
| *02* | 0.09 | <0.11 | 0.09 | <0.003 | 0.65 | <0.017 | <0.007 | <0.007 | <0.066 | | <0.031 | 6.5 | <0.18 | <0.014 | <0.02 | 10 |
| | | | | | | | | | | | | | | | | 11 |
| | | | | | | | | | | | | | | | | 11 |
| | | | | | | | | | | | | | | | | 11 |
| | | | | | | | | | | | | | | | | 11 |
| 0.4 | 0.02 | <0.11 | 0.10 | | 0.17 | <0.017 | <0.007 | <0.01 | <0.063 | | <0.031 | 102 | <0.18 | <0.014 | <0.02 | 11A |
| | | | | | | | | | | | | | | | | 12A |
| | | | | | | | | | | | | | | | | 12A |

| *Well* | *Date* | *Lab No.* | *Iron* *Fe* *(mg/L)* | *Manganese* *Mn* *(mg/L)* | *Calcium* *Ca* *(mg/L)* | *Magnesium* *Mg* *(mg/L)* | *Sodium* *Na* *(mg/L)* | *Silica* *SiO2* *(mg/L)* | *Nitrate* *NO3-N* *(mg/L)* | *Chloride* *Cl* *(mg/L)* | *Sulfate* *SO4* *(mg/L)* | *Alkalinity* *CaCO3* *(mg/L)* | *Hardness* *CaCO3* *(mg/L)* | *TDS* *(mg/L)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12A | 11/15/87 | 222342 | 830 | 0.50 | 158 | 43.6 | 623 | 27.3 | | 113 | 722 | 316 | 574 | 816 |
| 12A | 05/15/91 | 224201 | 11.84 | 0.48 | 131 | 43.8 | 92.4 | 33.4 | 02 | 158 | 224 | 341 | 507 | 987 |
| 13 | 04/25/91 | 224138 | 9.72 | 0.46 | 147 | 37.0 | 332 | 36.8 | 0.1 | 39 | 184 | 322 | 519 | 736 |
| 13 | 04/25/95 | 228641 | 1429 | 0.75 | 213 | 50.4 | 123.0 | 38.0 | 0.08 | 732 | 412 | 491 | 739 | 1257 |
| 14 | 12/20/90 | 223933 | 8.36 | 0.97 | 166 | 38.7 | 42.9 | 26.9 | 0.6 | 77 | 220 | 368 | 573 | 835 |
| 14 | 06/22/4 | 227793 | 2.97 | 1.37 | 206 | 472 | 59.8 | | 0.46 | 83.9 | 285 | 422 | 708 | 1031 |
| 15 | 10/15/93 | 227163 | 18.84 | 0.75 | 229 | 63.8 | 111 | 34.4 | 02 | 140 | 265 | 593 | 834 | 1234 |
| | | Average | 11.78 | 0.76 | 191 | 45.3 | 75.0 | 32.3 | 0.47 | 97 | 303 | 417 | 662 | 1046 |
| | | Minimum | 2.97 | 0.44 | 131 | 352 | 262 | 20.0 | <0.02 | 39 | 151 | 316 | 507 | 736 |
| | | Maximum | 18.84 | 1.49 | 239 | 63.8 | 230.0 | 38.0 | 3.7 | 230 | 694 | 593 | 834 | 1642 |
| | | No. of samples | 64 | 48 | 64 | 64 | 64 | 56 | 33 | 64 | 64 | 64 | 64 | 64 |

## I-64 Site

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 07/21/87 | 222213 | 1230 | 0.47 | 221 | 57.6 | 40.4 | 31.9 | | 61 | 411 | 456 | 788 | 1183 |
| 1 | 09/24/91 | 224847 | 16.00 | 0.53 | 235 | 573 | 229 | 35.1 | <0.1 | 73.0 | 685.0 | 504 | 822 | 1708 |
| 2 | 07/25/85 | 221219 | 16.60 | | 228 | 56.8 | 33.1 | 35.6 | | 50 | 410 | 428 | 802 | 1098 |
| 3 | 06/26/84 | 220089 | 20.00 | | 227 | 61.8 | 87.1 | 33 | | 55 | 625 | 428 | 821 | 1448 |
| 3 | 06/21/88 | 222599 | 18.40 | 0.60 | 258 | 62.0 | 64.8 | 33.4 | 0.4 | 64 | 516 | 461 | 899 | 1439 |
| 6 | 07/21/83 | 218827 | 17.60 | | 225 | 60.3 | 85.4 | 33.8 | | 45 | 580 | 424 | 809 | 1323 |
| 9 | 10/05/83 | 219087 | 12.90 | | 202 | 53.8 | 29.8 | 32.9 | 0.3 | 41 | 350 | 412 | 725 | 974 |
| 10 | 07/11/84 | 220113 | 18.70 | | 277 | 74.1 | 222.0 | 32.8 | | 390 | 636 | 424 | 998 | 1997 |
| 11 | 08/14/84 | 220248 | 15.90 | | 220 | 54.1 | 45.6 | 352 | 0.3 | 61 | 358 | 448 | 771 | 1111 |
| 11 | 06/16/89 | 223066 | 15.00 | 0.56 | 215 | 443 | 44.3 | 33.4 | | 60 | 376 | 501 | 761 | 1198 |
| 13 | 07/12/84 | 220114 | 15.80 | | 204 | 53.3 | 29.8 | 34.7 | 2.3 | 50 | 361 | 412 | 729 | 1080 |
| 14 | 08/03/90 | 223648 | 12.35 | 0.52 | 213 | 473 | 269.0 | | 0.3 | 61 | 713 | 512 | 727 | 1762 |
| 15 | 06/29/83 | 218686 | 20.00 | | 260 | 60.8 | 752 | 35.4 | | 57 | 585 | 416 | 899 | 1388 |
| 15 | 08/13/85 | 221271 | 17.90 | | 254 | 62.4 | 119.0 | 30.5 | | 59 | 710 | 420 | 890 | 1580 |
| 15 | 07/22/87 | 222214 | 14.00 | 0.60 | 243 | 64.0 | 166.0 | 33.6 | | 62 | 787 | 456 | 870 | 1750 |
| | | Average | 1623 | 035 | 232 | 58.0 | 102.7 | 33.7 | 0.6 | 79 | 540 | 447 | 821 | 1403 |
| | | Minimum | 1230 | 0.47 | 202 | 44.3 | 29.8 | 303 | <0.1 | 41 | 350 | 412 | 725 | 974 |
| | | Maximum | 20.00 | 0.60 | 277 | 74.1 | 269.0 | 35.6 | 2.3 | 390 | 787 | 512 | 998 | 1997 |
| | | No. of samples | 15 | 6 | 15 | 15 | 15 | 14 | 6 | 15 | 15 | 15 | 15 | 15 |

## 25th Street Site

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 02/11/89 | 223141 | 8.50 | 0.66 | 166 | 46.8 | 120.0 | | 02 | 34 | 548 | 415 | 607 | 1226 |
| 1 | 09/04/91 | 224802 | 15.10 | 035 | 200 | 55.7 | 262.0 | 34.0 | <0.1 | 28.9 | 850 | 419 | 728 | 1777 |
| 2 | 08/09/89 | 223142 | 8.10 | 0.52 | 205 | 59.9 | 251.0 | | 02 | 37 | 928 | 451 | 758 | 1816 |
| 2 | 04/18/90 | 223480 | 5.40 | 0.39 | 240 | 68.8 | 226.0 | | | 35 | 972 | 451 | 882 | 1891 |
| 3 | 09/06/85 | 221320 | 17.90 | | 222 | 61.9 | 143.0 | | | 38 | 680 | 404 | 808 | 1484 |
| 3 | 09/07/89 | 223167 | 14.90 | 0.62 | 246 | 66.9 | 254.0 | 32.1 | | 47 | 939 | 474 | 889 | 1925 |
| 3 | 05/14/91 | 224200 | 22.90 | 0.72 | 179 | 73.1 | 314.0 | 35.7 | | 49 | 1171 | 477 | 747 | 2335 |
| 3 | 12/19/90 | 223932 | 18.30 | 0.69 | 239 | 652 | 220.0 | 312 | | 33 | 911 | 449 | 864 | 1911 |
| 4 | 08/02/90 | 223647 | 14.90 | 0.62 | 250 | 66.8 | 276.0 | | 0.1 | 39 | 944 | 457 | 898 | 2032 |
| 4 | 11/19/91 | 225122 | 9.04 | 0.56 | 175 | 47.3 | 75.0 | 36.4 | <0.1 | 34 | 353 | 397 | 631 | 993 |
| 4 | 07/24/92 | 226026 | 17.69 | 0.64 | 234 | 61.4 | 261 | 35.1 | <0.1 | 44 | 902 | 475 | 836 | 1880 |

# Appendix F. (Continued)

| *Fluoride* *F* *(mg/L)* | *Aluminum* *Al* *(mg/L)* | *Arsenic* *As* *(mg/L)* | *Barium* *Ba* *(mg/L)* | *Beryllium* *Be* *(mg/L)* | *Boron* *B* *(mg/L)* | *Cadmium* *Cd* *(mg/L)* | *Chromium* *Cr* *(mg/L)* | *Copper* *Cu* *(mg/L)* | *Lead* *Pb* *(mg/L)* | *Mercury* *Hg* *(mg/L)* | *Nickel* *Ni* *(mg/L)* | *Potassium* *K* *(mg/L)* | *Selenium* *Se* *(mg/L)* | *Silver* *Ag* *(mg/L)* | *Zinc* *Zn* *(mg/L)* | *Well* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 12A |
| | | | | | | | | | | | | | | | | 12A |
| | | | | | | | | | | | | | | | | 13 |
| 0.3 | 0.048 | <0.11 | 0.13 | <0.003 | 0.83 | <0.017 | <0.007 | <0.007 | <0.066 | | <0.031 | 6.1 | <0.18 | <0.014 | <0.02 | 13 |
| | | | | | | | | | | | | | | | | 14 |
| 0.3 | <0.017 | <0.11 | 0.07 | | 0.62 | <0.017 | <0.007 | <0.01 | <0.066 | | <0.031 | 6.08 | <0.18 | <0.014 | <0.02 | 14 |
| 0 3 | <0.017 | <0.11 | 0.14 | | 0.51 | <0.017 | 0.01 | <0.01 | <0.063 | | <0.031 | 8.5 | <0.18 | <0.014 | <0.02 | 15 |
| 0.4 | 0.03 | <0.11 | 0.10 | <0.003 | 0.60 | <0.017 | | | | | | 8.1 | <0.18 | <0.014 | <0.02 | |
| *02* | <0.017 | | 0.07 | | 0.10 | | <0.007 | <0.006 | <0.063 | | <0.031 | 3.4 | | | | |
| 0.7 | 0.09 | | 0.14 | | 1.07 | | 0.02 | <0.01 | <0.066 | | 0.060 | 12.6 | | | | |
| 18 | 16 | 16 | 16 | 5 | 16 | 16 | 16 | 16 | 16 | 1 | 16 | 17 | 16 | 16 | 16 | |
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| 1.0 | | | | | | | | | | | | | | | | 1 |
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| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
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| 0.8 | | | | | | | | | | | | | | | | 1 |
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| | | | | | | | | | | | | | | | | 4 |
| 0.4 | | | | | | | | | | | | | | | | 4 |
| 1.1 | 0.029 | <0.U | 0.12 | | 0.22 | <0.017 | <0.007 | <0.006 | <0.066 | <0.05 | <0.031 | 9.4 | <0.18 | <0.014 | <0.02 | 4 |

# Appendix F. Chemical Quality Data, FY 84-FY 93 (Phases 1-10)

| *Well* | *Date* | *Lab No.* | *Iron* *Fe* *(mg/L)* | *Manganese* *Mn* *(mg/L)* | *Calcium* *Ca* *(mg/L)* | *Magnesium* *Mg* *(mg/L)* | *Sodium* *Na* *(mg/L)* | *Silica* *SiO2* *(mg/L)* | *Nitrate* *NO3-N* *(mg/L)* | *Chloride* *Cl* *(mg/L)* | *Sulfate* *SO4* *(mg/L)* | *Alkalinity* *CaCO3* *(mg/L)* | *Hardness* *CaCO3* *(mg/L)* | *TDS* *(mg/L)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5 | 05/16/89 | 223085 | 8.90 | 037 | 137 | 38.9 | 15.7 | 32.1 | | 24 | 181 | 369 | 502 | 688 |
| 5 | 04/19/90 | 223479 | 4.90 | 0.49 | 129 | 35.4 | 16.5 | | | 23 | 160 | 360 | 467 | 661 |
| 6 | 06/27/84 | 220090 | 10.50 | | 132 | 38.0 | 142 | 34 | | 24 | 176 | 334 | 486 | 663 |
| 6 | 01/07/87 | 221948 | 8.40 | 0.36 | 152 | 38.0 | 152 | 33.3 | | 26 | 167 | 334 | 536 | 644 |
| 6 | 02/08/91 | 223981 | 9.30 | 039 | 139 | 392 | 15.1 | | | 32 | 201 | 331 | 508 | 683 |
| 7 | 03/21/91 | 224038 | 12.20 | 0.45 | 145 | 43.1 | 22.3 | 33.4 | | 48 | 191 | 331 | 539 | 738 |
| 8 | 06/15/83 | 218639 | 9.10 | | 124 | 38.7 | 16.6 | 33.4 | | 21 | 185 | 356 | 469 | 659 |
| 8 | 04/24/91 | 224139 | 11.90 | 0.78 | 134 | 39.1 | 17.4 | 38.1 | 02 | 31 | 122 | 351 | 495 | 612 |
| 8 | 11/15/93 | 227237 | 12.19 | 0.70 | 152 | 44.8 | 22.7 | 39.4 | 0.03 | 41.9 | 155 | 360 | 564 | 682 |
| 9 | 06/25/86 | 221687 | 18.90 | 0.82 | 123 | 42.0 | 17.5 | 32.5 | | 21 | 190 | 352 | 480 | 688 |
| 9 | 09/18/91 | 224803 | 1220 | 0.54 | 156 | 45.8 | 58.6 | 34.0 | <0.1 | 28.9 | 325 | 369 | 578 | 911 |
| 10 | 07/26/85 | 221220 | 16.50 | | 193 | 53.6 | 179.0 | 33.9 | | 30 | 660 | 412 | 702 | 1408 |
| 10 | 11/18/87 | 222344 | 4.50 | 0.50 | 176 | 52.5 | 153.0 | 32.7 | 02 | 39 | 571 | 406 | 655 | 1332 |
| | | Average | 12.18 | 0.58 | 177 | 51.0 | 123.6 | 342 | 0.1 | 34 | 520 | 397 | 651 | 1235 |
| | | Minumum | 4.50 | 0.36 | 123 | 35.4 | 142 | 312 | <0.1 | 21 | 122 | 331 | 467 | 612 |
| | | Maximum | 22.90 | 0.82 | 250 | 73.1 | 314.0 | 39.4 | 02 | 49 | 1171 | 477 | 898 | 2335 |
| | | No. of samples | 24 | 20 | 24 | 24 | 24 | 17 | 10 | 24 | 24 | 24 | 24 | 24 |

## Venice Site

| *Well* | *Date* | *Lab No.* | *Iron* *Fe* *(mg/L)* | *Manganese* *Mn* *(mg/L)* | *Calcium* *Ca* *(mg/L)* | *Magnesium* *Mg* *(mg/L)* | *Sodium* *Na* *(mg/L)* | *Silica* *SiO2* *(mg/L)* | *Nitrate* *NO3-N* *(mg/L)* | *Chloride* *Cl* *(mg/L)* | *Sulfate* *SO4* *(mg/L)* | *Alkalinity* *CaCO3* *(mg/L)* | *Hardness* *CaCO3* *(mg/L)* | *TDS* *(mg/L)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/30/83 | 219239 | 25.70 | | 256 | 612 | 38.3 | 26.7 | | 66 | 465 | 444 | 890 | 1241 |
| 1 | 12/04/85 | 221486 | 17.80 | | 226 | 60.8 | 36.8 | 33 | | 59 | 460 | 420 | 814 | 1169 |
| 1 | 09/06/89 | 223166 | 1736 | 0.55 | 220 | 53.6 | 352 | 31.4 | | 43 | 372 | 475 | 769 | 1114 |
| 1 | 03/29/94 | 227474 | 18.40 | 0.65 | 207 | 47.0 | 32.6 | 36.5 | <0.02 | 36.4 | 330 | 417 | 710 | 955 |
| 2 | 11/17/83 | 219213 | 21.60 | | 261 | 542 | 30.1 | 31.8 | 0.8 | 42 | 440 | 476 | 874 | 1195 |
| 2 | 09/05/89 | 223165 | 23.80 | 0.60 | 199 | 50.9 | 39.6 | 32.6 | | 50 | 328 | 470 | 706 | 1002 |
| 2 | 05/08/90 | 223505 | 15.10 | 0.66 | 193 | 44.9 | 35.8 | | | 44 | 297 | 462 | 666 | 970 |
| 2 | 10/02/91 | 224908 | 1720 | 0.65 | 193 | 422 | 34.9 | 30.8 | <0.1 | 53.1 | 273 | 445 | 655 | 984 |
| 3 | 11/28/83 | 219237 | 20.10 | | 216 | 51.7 | 65.1 | 26.6 | 03 | 79 | 325 | 472 | 752 | 1097 |
| 3 | 01/06/87 | 221947 | 1530 | 036 | 253 | 52.0 | 392 | 343 | | 55 | 343 | 469 | 845 | 1060 |
| 3 | 12/05/90 | 223911 | 17.10 | 0.55 | 194 | 46.7 | 49.5 | 37.9 | | 57 | 218 | 461 | 676 | 972 |
| 3 | 12/16/91 | 225267 | 828 | 0.39 | 182 | 46.9 | 34.0 | 39.6 | <0.1 | 73.6 | 249 | 399 | 647 | 890 |
| 4 | 12/01/83 | 219241 | 20.70 | | 208 | 52.8 | 50.0 | 253 | 0.6 | 86 | 330 | 424 | 735 | 1054 |
| 4 | 12/06/90 | 223912 | 10.93 | 0.52 | 1% | 47.9 | 40.9 | 34.6 | | 62 | 284 | 417 | 686 | 950 |
| 4 | 09/17/91 | 224804 | 15.00 | 0.45 | 180 | 452 | 44.5 | 32.3 | | 85 | 311 | 400 | 635 | 999 |
| 5 | 11/15/83 | 219212 | 2030 | | 224 | 55.8 | 38.5 | 31.8 | | 65 | 380 | 428 | 788 | 1104 |
| 5 | 12/07/89 | 223289 | 11.00 | 0.52 | 185 | 50.6 | 44.7 | 31.6 | | 68 | 313 | 425 | 670 | 990 |
| 5 | 05/02/90 | 223504 | 15.10 | 0.58 | 187 | 50.9 | 502 | | | 74 | 314 | 443 | 676 | 1011 |
| 5 | 03/24/92 | 225674 | 17.60 | 0.56 | 198 | 50.9 | 47.7 | 34.9 | 0.1 | 124 | 490 | 418 | 703 | 982 |
| 6 | 11/29/83 | 219238 | 22.70 | | 226 | 56.0 | 38.1 | 24.4 | | 62 | 410 | 402 | 794 | 1138 |
| 6 | 11/17/87 | 222343 | 9.60 | 0.40 | 1% | 55.4 | 413 | 33.8 | | 55 | 419 | 387 | 717 | 1087 |
| 6A | 03/20/91 | 224037 | 15.40 | 0.48 | 184 | 482 | 45.6 | 332 | | 62 | 284 | 400 | 657 | 958 |
| 6A | 06/23/94 | 227792 | 18.94 | 0.55 | 201 | 48.6 | 532 | | <0.02 | 77.1 | 243 | 440 | 701 | 991 |
| 7 | 02/27/91 | 224009 | 18.08 | 0.72 | 223 | 46.7 | 38.4 | 34.4 | | 25 | 300 | 432 | 748 | 1000 |
| 7 | 05/04/94 | 227594 | 16.61 | 0.64 | 188 | 42.9 | 28.9 | 34.7 | <0.02 | 35.8 | 262 | 426 | 645 | 892 |
| | | Average | 17.188 | 0.56 | 208 | 50.6 | 41.3 | 32.4 | 02 | 61.6 | 338 | 434 | 726 | 1032 |
| | | Minimum | 828 | 0.39 | 180 | 422 | 28.9 | 24.4 | <0.02 | 25 | 218 | 387 | 635 | 890 |
| | | Maximum | 25.7 | 0.72 | 261 | 612 | 65.1 | 39.6 | 0.8 | 124 | 490 | 476 | 890 | 1241 |
| | | No. of samples | 25 | 18 | 25 | 25 | 25 | 22 | 9 | 25 | 25 | 25 | 25 | 25 |

# Appendix F. (Continued)

| *Fluoride F (mg/L)* | *Aluminum Al (mg/L)* | *Arsenic As (mg/L)* | *Barium Ba (mg/L)* | *Beryllium Be (mg/L)* | *Boron B (mg/L)* | *Cadmium Cd (mg/L)* | *Chromium Cr (mg/L)* | *Copper Cu (mg/L)* | *Lead Pb (mg/L)* | *Mercury Hg (mg/L)* | *Nickel Ni (mg/L)* | *Potassium K (mg/L)* | *Selenium Se (mg/L)* | *Silver Ag (mg/L)* | *Zinc Zn (mg/L)* | *Well* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 6 |
| | | | | | | | | | | | | | | | | 6 |
| | | | | | | | | | | | | | | | | 6 |
| | | | | | | | | | | | | | | | | 7 |
| | | | | | | | | | | | | | | | | 8 |
| | | | | | | | | | | | | | | | | 8 |
| 0.4 | 0.04 | <0.11 | 0.09 | | 0.08 | <0.017 | 0.02 | <0.01 | <0.063 | | <0.031 | 6.0 | <0.18 | <0.014 | <0.02 | 8 |
| | | | | | | | | | | | | | | | | 9 |
| 0 3 | | | | | | | | | | | | | | | | 9 |
| | | | | | | | | | | | | | | | | 10 |
| | | | | | | | | | | | | | | | | 10 |
| 0.6 | 0.035 | | 0.10 | | 0.15 | | | | | | | 7.7 | | | | |
| 0.3 | 0.029 | | 0.09 | | 0.08 | | | | | | | 6 | | | | |
| 1.1 | 0.04 | | 0.12 | | *022* | | | | | | | 9.4 | | | | |
| 5 | 2 | 2 | 2 | *0* | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | |
| | | | | | | | | | | | | | | | | 1 |
| | | | | | | | | | | | | | | | | 1 |
| | | | | | | | | | | | | | | | | 1 |
| *02* | 0.1 | <0.11 | 0.14 | | 1.43 | <0.017 | 0.013 | <0.01 | <0.066 | | <0.031 | 7.8 | <0.18 | <0.014 | <0.02 | 1 |
| | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 2 |
| 0.4 | | | | | | | | | | | | | | | | 2 |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 3 |
| 0.3 | | | | | | | | | | | | | | | | 3 |
| | | | | | | | | | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | 4 |
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 5 |
| 0.5 | | | | | | | | | | | | | | | | 5 |
| | | | | | | | | | | | | | | | | 6 |
| | | | | | | | | | | | | | | | | 6 |
| | | | | | | | | | | | | | | | | 6A |
| *02* | 0.018 | <0.11 | 0.16 | | 0.86 | <0.017 | <0.007 | <0.01 | <0.066 | | <0.031 | 5.70 | <0.18 | <0.014 | <0.02 | 6A |
| | | | | | | | | | | | | | | | | 7 |
| 0.3 | 0.02 | <0.11 | 0.12 | | 0.64 | <0.017 | 0.008 | <0.01 | <0.066 | | <0.031 | 7.07 | <0.18 | <0.014 | <0.02 | 7 |
| 0 3 | 0.05 | | 0.14 | | 0.98 | | | | | | | 6.86 | | | | |
| *02* | 0.018 | | 0.12 | | 0.64 | | | | | | | 5.7 | | | | |
| 0.5 | 0.1 | | 0.16 | | 1.43 | | 0.013 | | | | | 7.8 | | | | |
| 6 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 3 | 3 | 0 | 3 | 3 | 3 | 3 | 3 | |

## Appendix G. Dewatering Well Ground-Water Levels and Operation, FY 93 (Phase 10)

## Appendix G. Dewatering Well Ground-Water Levels and Operation, FY 93 (Phase 10)

### I-70 Site

| | | | *August 27, 1992* | | *October 29, 1992* | | *December 17, 1992* | | *March 1, 1993* | | *April 29, 1993* | | *July 1, 1993* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Well Piez* | *MP Elev* | *Temp MP* | *G W Elev* | *Pump Ah* | *G W Elev* | *Pump Ah* | *G W Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* |
| W 1A | * | | | Off | | Off | 40.08 | PmpOut | | Off+ | | On | | On |
| P 1A | * | | 37.42 | | 41.74 | | | | 32.55 | | 42.08 | | 49.72 | |
| W 2A | * | | | On | | On | | On | | Off+ | | On | | On |
| P 2A | * | | 41.57 | | 45.67 | | 45.16 | | 32.29 | | 41.84 | | 49.70 | |
| W 3A | * | | | Off | | On | | On | | Off+ | | On | 51.73 | On |
| P 3A | * | | 38.81 | | 41.71 | | 42.26 | | 26.53 | | 36.12 | | 44.59 | |
| W 4 | 389.1 | 396.6 | 373.8 | Off | 371.3 | Off | 370.1 | Off | 381.1 | Off+ | 378.1 | ? | 367.9 | Off |
| P 4 | | | Piezometer destroyed by new concrete footing for road sign. | | | | | | | | | | | |
| W 5 | 385.9 | 391.1 | 373.8 | Off | 372.2 | Off | 369.8 | Off | 380.8 | Off+ | 378.9 | Off | 369.2 | Off |
| P 5 | 391.1 | | | | | | | | | | | | | |
| W 6 | 386.6 | 391.7 | Temp | Off | Temp | | Temp | Off | 381.5 | Off+ | 379.8 | Off | 371.9 | Off |
| P 6 | 391.9 | | buried | | buried | | buried | | | | | | | |
| W 7A | * | | 11.15 | Off | 23.72 | On | 14.38 | Off | 7.94 | Off+ | 10.22 | Off | 29.43 | On |
| P 7A | * | | | | 22.11 | | | | | | | | 27.17 | |
| W 8A | * | | 9.47 | Off | 15.20 | Off | 12.86 | Off | 5.78 | Off+ | 8.23 | Off | 27.08 | On |
| P 8A | * | | | | | | 13.40 | | | | | | 24.98 | |
| W 9A | | 407.8 | 376.9 | Off | 372.1 | Off | 373.4 | Off | 381.0 | Off+ | 378.1 | Off | 359.2 | On |
| P 9A | 407.5 | | | | | | | | | | | | 363.9 | |
| W 10 | 401.5 | 410.2 | Buried due to | | Buried due to | | Buried due to | | Buried due to | | | ? | | ? |
| P 10 | 409.8 | | construction | | construction | | construction | | construction | | | | | |

**Notes:**

* Measuring point elevations not available; depths to water recorded

+ All wells off for the day for work at Bowman pumping station.

? Data not determined/not available

Appendix G. (Continued)

**I-70 Site (Continued)**

| *Well Piez* | *MP Elev* | *Temp MP* | *August 27, 1992* *GW Elev* | *Pump Δh* | *October 29, 1992* *GW Elev* | *Pump Δh* | *December 17, 1992* *GW Elev* | *Pump Δh* | *March 1, 1993* *GW Elev* | *Pump Δh* | *April 29, 1993* *GW Elev* | *Pump Δh* | *July 1, 1993* *GW Elev* | *Pump Δh* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W 11A | * | | | Off | | ? | | | 23.24 | Off+ | | On | | On |
| P 11A | * | | 32.26 | | 36.83 | | 36.32 | | | | 28.79 | | 38.12 | |
| W 12A | | 395.8 | 387.1 | Off | 374.2 | Off | 369.4 | On | 381.5 | Off+ | 380.7 | Off | 368.6 | On |
| P 12A | 395.8 | | | | | | 369.7 | 0.3 | | | | | 369.5 | 0.9 |
| W 13 | 397.0 | 407.0 | 374.8 | Off | 360.8 | On | 370.7 | Off | 382.2 | Off+ | 378.0 | Off | 360.6 | On |
| P 13 | 407.2 | | | | 365.6 | 4.8 | | | | | | | 365.8 | 5.2 |
| W 14 | 382.5 | 391.0 | | On | 371.9 | ? | | | 380.8 | Off+ | 378.8 | Off | 360.1 | On |
| P 14 | 390.8 | | 18.36 | | | | | | | | | | | |
| W 15 | | | | Off | | On | 23.94 | On | 10.36 | Off+ | | On | | On |
| P 15 | | | 19.54 | | 22.3 | | | | | | 15.98 | | 24.44 | |
| RW | 390.6 | | 375.9 | | 371.3 | | | | 380.8 | | 378.7 | | 366.8 | |

**Notes:**

* Measuring point elevations not available; depths to water recorded

+ All wells off for the day for work at Bowman pumping station.

? Data not determined/not available

Appendix G. (Continued)

**1-64 Site (Westbound)**

| Well Piez | MP Elev | Temp MP | August 26, 1992 GW Elev | August 26, 1992 Pump Ah | October 29, 1992 GW Elev | October 29, 1992 Pump Ah | December 17, 1992 GW Elev | December 17, 1992 Pump Ah | March 1, 1993 GW Elev | March 1, 1993 Pump Ah | April 28, 1993 GW Elev | April 28, 1993 Pump Ah | July 1, 1993 GW Elev | July 1, 1993 Pump Ah |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W 1 | 399.7 | 407.6 | 379.9 | Off | 375.8 | Off | 376.1 | Off | 382.4 | Off+ | 382.1 | Off | 373.4 | Off |
| P 1 | 406.6 | | | | | | | | | | | | | |
| W 2 | 397.1 | 402.1 | 382.4 | Off | 379.3 | Off | 378.7 | Off | 383.8 | Off+ | 384.6 | Off | 378.8 | Off |
| P 2 | 401.5 | | | | | | | | | | | | | |
| W 3 | 394.6 | 402.1 | 383.9 | Off | 381.2 | Off | 380.3 | Off | 384.9 | Off+ | 386.0 | Off | 381.3 | Off |
| P 3 | 400.0 | | | | | | | | | | | | | |
| W 4 | 394.0 | 400.2 | 384.7 | Off | 382.3 | Off | 381.3 | Off | 385.6 | Off+ | 386.8 | Off | 382.8 | Off |
| P 4 | 399.4 | | | | | | | | | | | | | |
| W 5 | 396.5 | 401.1 | 385.6 | Off | 383.5 | Off | 382.2 | Off | 386.5 | Off+ | 387.6 | Off | 384.5 | Off |
| P 5 | 400.2 | | | | | | | | | | | | | |
| W 6 | 394.3 | 400.2 | 383.4 | On | 384.6 | Off | 380.1 | On | 387.4 | Off+ | 388.3 | Off | 386.0 | Off |
| P 6 | 399.9 | | 384.4 | 1.0 | | | 381.2 | 1.1 | | | | | | |
| W 7 | 392.2 | 398.0 | 387.0 | Off | 385.0 | Off | 383.3 | Off | 388.1 | Off+ | 388.5 | Off | 386.7 | Off |
| P 7 | 397.6 | | | | | | | | | | | | | |
| W 8 | 396.7 | 405.5 | 386.2 | On | 384.8 | Off | 381.8 | On | 388.8 | Off+ | 388.4 | Off | 385.1 | On |
| P 8 | 404.9 | | Plugged | | | | Plugged | | | | | | Plugged | |
| W 9 | 391.4 | 397.4 | 387.8 | Off | 375.4 | On | 372.0 | On | 388.9 | Off+ | 375.1 | On | 373.8 | On |
| P 9 | 397.0 | | | | 382.4 | 7.0 | 381.2 | 9.2 | | | 385.6 | 10.5 | 384.4 | 10.6 |
| W 10 | 395.4 | 404.7 | 389.1 | Off | 386.4 | Off | 385.2 | Off | 389.4 | Off+ | 389.4 | Off | 387.9 | Off |
| P 10 | 404.6 | | | | | | | | | | | | | |
| RW1 | 403.0 | | 384.3 | | 381.7 | | | | 385.1 | | 386.3 | | 382.0 | |

**Notes:**
+ All wells off for the day for work at Bowman pumping station.

Appendix G. (Continued)

**1-64 Site (Eastbound)**

| Well Piez | MP Elev | Temp MP | August 26, 1992 GW Elev | August 26, 1992 Pump Ah | October 29, 1992 GW Elev | October 29, 1992 Pump Ah | December 17, 1992 GW Elev | December 17, 1992 Pump Ah | March 1, 1993 GW Elev | March 1, 1993 Pump Ah | April 28, 1993 GW Elev | April 28, 1993 Pump Ah | July 1, 1993 GW Elev | July 1, 1993 Pump Ah |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W 11 | 397.0 | 402.8 | 382.4 | Off | 379.0 | Off | 378.8 | Off | 383.7 | Off+ | 384.4 | Off | 378.1 | Off |
| P 11 | 402.5 | | | | | | | | | | | | | |
| W 12 | 395.2 | 401.6 | 383.6 | Off | 380.6 | Off | 380.1 | Off | 384.5 | Off+ | 385.6 | Off | 380.4 | Off |
| P 12 | 401.5 | | | | | | | | | | | | | |
| W 13 | 394.3 | 399.1 | 384.8 | Off | 382.2 | Off | 381.3 | Off | 385.5 | Off+ | 386.7 | Off | 382.7 | Off |
| P 13 | 399.1 | | | | | | | | | | | | | |
| W 14 | 396.0 | 400.5 | 385.5 | Off | 383.3 | Off | 382.2 | Off | 386.3 | Off+ | 387.5 | Off | 384.2 | Off |
| P 14 | 399.7 | | | | | | | | | | | | | |
| W 15 | 395.1 | 400.5 | 386.3 | Off | 384.4 | Off | 383.0 | Off | 387.2 | Off+ | 388.3 | Off | 385.8 | Off |
| P 15 | 399.7 | | | | | | | | | | | | | |
| W 16 | 393.7 | 399.8 | 386.9 | Off | 385.1 | Off | 383.4 | Off | 387.8 | Off+ | 388.7 | Off | 386.7 | Off |
| P 16 | 398.8 | | | | | | | | | | | | | |
| W 17 | 392.1 | 398.0 | 387.5 | Off | 385.2 | Off | 383.6 | Off | 388.1 | Off+ | 388.8 | Off | 387.2 | Off |
| P 17 | 397.8 | | | | Plugged | | | | | | | | | |
| W 18 | 391.3 | 396.6 | 384.0 | On | 381.1 | On | 379.7 | On | 388.0 | Off+ | 388.7 | Off | 387.3 | Off |
| P 18 | 396.4 | | 387.5 | 3.5 | 386.1 | 5.0 | 384.9 | 5.2 | | | | | | |
| W 19 | 391.8 | 397.0 | 388.1 | Off | 385.4 | Off | 384.1 | Off | 388.4 | Off+ | 388.8 | Off | 387.8 | Off |
| P 19 | 397.0 | | | | | | | | | | | | | |
| W 20 | 395.4 | 405.3 | 389.7 | Off | 387.4 | Off | 386.3 | Off | 389.7 | Off+ | 390.2 | Off | 389.7 | Off |
| P 20 | 404.7 | | | | | | | | | | | | | |
| RW2 | 398.2 | | 388.1 | | 385.2 | | | | 388.4 | | 390.1 | | 387.6 | |

**Notes:**
+ All wells off for the day for work at Bowman pumping station.

# Appendix G. (Continued)

## 25th Street Site

| | | | August 27, 1992 | | October 29, 1992 | | December 17, 1992 | | March 1, 1993 | | April 29 1993 | | July 1, 1993 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Well Piez* | *MP Elev* | *Temp MP* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* | *GW Elev* | *Pump Ah* |
| W 1 | 399.7 | 407.4 | 380.7 | On | 387.8 | Off | 386.6 | Off | 389.5 | Off | 388.1 | Off | 389.8 | Off |
| P 1 | 407.3 | | 384.8 | 4.1 | | | | | | | | | | |
| W 2 | 394.6 | 402.8 | 386.5 | Off | 380.1 | On | 380.8 | On | 384.2 | On | 381.9 | On | 388.2 | Off |
| P 2 | 401.9 | | | | 383.5 | 3.4 | 382.0 | 1.2 | 385.3 | 1.1 | 382.9 | 1.0 | | |
| W 3 | 390.4 | 400.3 | 384.6 | Off | 385.1 | Off | 377.7 | On | 380.7 | On | 377.3 | On | 378.5 | On |
| P 3 | 400.2 | | | | | | 379.3 | 1.6 | 383.2 | 2.5 | 379.8 | 2.5 | 380.6 | 2.1 |
| W 4 | 392.4 | 401.6 | 376.5 | On | 377.7 | On | 376.7 | On | 381.1 | On | 378.5 | On | 379.0 | On |
| P 4 | 401.5 | | Plugged | | Plugged | | Plugged | | Plugged | | Plugged | | Plugged | |
| W 5 | 396.2 | 404.2 | 379.0 | On | 379.7 | On | 384.3 | Off | 388.0 | Off | 385.6 | Off | 387.0 | Off |
| p 5 | 403.8 | | Plugged | | | | Plugged | | Plugged | | | | Plugged | |
| W 6 | 396.5 | 405.4 | 384.6 | Off | 385.7 | Pmp Out | 385.1 | Pmp Out | 388.5 | Pmp Out | 386.0 | Pmp Out | 387.3 | Pmp Out |
| p 6 | 404.5 | | | | | | | | | | | | | |
| W 7 | 392.6 | 402.9 | 375.7 | On | 380.1 | On | 379.3 | On | 382.7 | On | 379.1 | On | 379.0 | On |
| p 7 | 402.0 | | Plugged | | 392.0 | 11.9 | Plugged | | Plugged | | Plugged | | Plugged | |
| W 8 | 390.8 | 401.0 | 384.4 | Off | 385.4 | Off | 384.1 | Off | 387.5 | Off | 381.5 | On | 382.6 | On |
| p 8 | 400.5 | | | | | | | | | | 382.5 | 1.0 | 383.7 | 1.1 |
| W 9 | 409.4 | 414.5 | 380.9 | On | 382.4 | On | 380.8 | On | 384.1 | On | 381.2 | On | 381.7 | On |
| p 9 | 414.7 | | 384.3 | 3.4 | 385.0 | 2.6 | 383.6 | 2.8 | 387.0 | 2.9 | 384.7 | 3.5 | 386.2 | 4.5 |
| W 10 | 398.6 | 407.5 | 387.9 | Off | 388.1 | Off | 386.9 | Off | 390.0 | Off | 388.3 | Off | 390.0 | Off |
| p 10 | 406.1 | | | | | | | | | | | | | |
| RW | 401.4 | | 386.1 | | 387.3 | | | | 388.8 | | 386.1 | | 387.8 | |

# Appendix G. (Concluded)

**Venice Site**

| Well Piez | | MP Elev | Temp MP | *August 27, 1992* GW Elev | Pump Ah | *October 27, 1992* GW Elev | Pump Ah | *December 18, 1992* GW Elev | Pump Ah | *March 2, 1993* GW Elev | Pump Ah | *April 28, 1993* GW Elev | Pump Ah | *July 1, 1993* GW Elev | Pump Ah |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| W | 1 | 405.6 | 411.6 | 394.4 | Off | 394.4 | Off | 395.3 | Off | 394.4 | Off | 401.6 | Off | 386.4 | On |
| P | 1 | 411.2 | | | | | | | | | | | | Plugged | |
| W | 2 | 405.6 | 411.0 | 394.0 | Off | 394.5 | Off | 392.5 | On | 391.6 | On | 398.5 | On | 392.1 | On |
| P | 2 | 410.3 | | | | | | 393.2 | 0.7 | 392.5 | 0.9 | 399.5 | 1.0 | 398.5 | 6.4 |
| W | 3 | 402.6 | 408.6 | 392.8 | Off | 394.9 | Off | 387.8 | On | 387.5 | On | 393.3 | On | 393.0 | On |
| P | 3 | 408.4 | | | | | | 391.7 | 3.9 | Flooded | | Flooded | | 397.2 | 4.2 |
| W | 4 | 403.1 | 408.1 | 385.7 | On | 394.8 | Off | 392.8 | Off | 387.7 | On | 393.6 | On | 393.7 | On |
| P | 4 | 407.2 | | 389.3 | 3.6 | | | | | 389.1 | 1.4 | 395.4 | 1.8 | 395.7 | 2.0 |
| W | 5 | 401.1 | 407.4 | 393.4 | Off | 394.7 | Off | 394.0 | Off | 393.2 | Off | 399.6 | Off | 399.6 | Off |
| P | 5 | 407.2 | | | | | | | | | | | | | |
| W | 6A | 400.8 | 408.4 | 393.8 | Off | 394.9 | Off | 394.3 | Off | 393.5 | Off | 400.0 | Off | 399.9 | Off |
| P | 6A | 408.6 | | | | | | | | | | | | | |
| W | 7 | 399.3 | 407.5 | 390.3 | Off | 390.1 | Off | 391.0 | Off | 390.1 | Off | 397.4 | Off | 394.8 | Off |
| P | 7 | 409.1 | | | | | | | | | | | | | |
| RW | | 407.3 | | 393.3 | | 394.5 | | | | 392.7 | | 399.2 | | 399.0 | |

## Appendix H. Chemical Quality Data for Combined Well Discharge Points, FY 93 (Phase 10)

## Appendix H. Chemical Quality Data for Combined Well Discharge Points, FY 93 (Phase 10)

| *Inorganic Constituent* | | *September 21-22, 1992, Sample Set** *01* | *02* | *03* | *04* | *05* | *05/LS* | *06* | *07* | *MDL* |
|---|---|---|---|---|---|---|---|---|---|---|
| Iron(Fe) | mg/L | <0.003 | 15.7 | 12.3 | 14.8 | 12.1 | 12.0 | 11.8 | 0.007 | 0.003 |
| Manganese (Mn) | mg/L | <0.002 | 0.529 | 0.637 | 0.619 | 0.531 | 0.527 | 0.520 | <0.002 | 0.002 |
| Calcium (Ca) | mg/L | <0.027 | 197 | 202 | 195 | 167 | 166 | 164 | 0.096 | 0.027 |
| Magnesium (Mg) | mg/L | <0.026 | 47.6 | 48.6 | 46.4 | 46.7 | 46.5 | 45.8 | 0.043 | 0.026 |
| Sodium (Na) | mg/L | 0.085 | 41.0 | 171 | 163 | 117 | 117 | 116 | <0.40 | 0.40 |
| Potassium (K) | mg/L | <0.56 | 6.94 | 8.82 | 8.88 | 6.66 | 6.47 | 6.79 | <0.56 | 0.56 |
| Aluminum (Al) | mg/L | <0.013 | 0.020 | 0.014 | 0.017 | <0.013 | 0.020 | <0.013 | <0.013 | 0.013 |
| Arsenic (As) | mg/L | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | 0.06 |
| Barium (Ba) | mg/L | <0.002 | 0.127 | 0.084 | 0.085 | 0.096 | 0.096 | 0.094 | <0.002 | 0.002 |
| Boron (B) | mg/L | <0.34 | 0.84 | 0.47 | 0.45 | <0.34 | <0.34 | <0.34 | <0.34 | 0.34 |
| Cadmium (Cd) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Chromium (Cr) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | 0.005 | 0.006 | <0.003 | <0.003 | 0.003 |
| Copper (Cu) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.003 |
| Lead(Pb) | mg/L | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | 0.012 |
| Mercury (Hg) (cold vapor) | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 0.2 |
| Nickel (Ni) | mg/L | <0.008 | <0.008 | <0.008 | 0.011 | <0.008 | <0.008 | <0.008 | <0.008 | 0.008 |
| Selenium (Se) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Silicon (Si) | mg/L | 0.08 | 17.7 | 16.4 | 16.0 | 16.1 | 16.0 | 15.8 | <0.25 | 0.25 |
| Silver (Ag) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.003 |
| Zinc(Zn) | mg/L | <0.002 | 0.240 | 0.073 | 0.024 | 0.095 | 0.095 | 0.035 | 0.012 | 0.002 |
| Beryllium (Be) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| Cobalt (Co) | mg/L | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.002 |
| Lithium (Li) | mg/L | <0.004 | 0.041 | 0.038 | 0.037 | 0.029 | 0.028 | 0.029 | <0.004 | 0.004 |
| Molybdenum (Mo) | mg/L | <0.008 | <0.008 | <0.008 | 0.011 | <0.008 | <0.008 | <0.008 | <0.008 | 0.008 |
| Phosphorus (P) | mg/L | <0.09 | 0.71 | 0.60 | 0.68 | 0.43 | 0.51 | 0.59 | <0.09 | 0.09 |
| Sulphur (S) | mg/L | <0.05 | 89 | 151 | 143 | 149 | 147 | 145 | 0.06 | 0.05 |
| Antimony (Sb) | mg/L | <0.10 | 0.12 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.10 |
| Tin (Sn) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Strontium (Sr) | mg/L | <0.001 | 0.605 | 0.513 | 0.489 | 0.403 | 0.403 | 0.395 | <0.001 | 0.001 |
| Titanium (Ti) | mg/L | <0.002 | 0.003 | 0.002 | 0.003 | 0.002 | 0.003 | 0.002 | <0.002 | 0.002 |
| Thallium (Tl) | mg/L | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | 0.09 |
| Vanadium (V) | mg/L | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | 0.004 |
| Fluoride (F) | mg/L | <0.1 | 0.7 | 1.1 | 1.1 | 0.9 | 0.9 | 0.9 | <0.1 | 0.1 |
| Chloride (Cl) | mg/L | <0.3 | 63 | 158 | 159 | 32 | 31 | 31 | <0.3 | 0.3 |
| Nitrate (NO3-N) | mg/L | <0.02 | <0.02 | <0.02 | 0.02 | 0.02 | 0.02 | 0.02 | <0.02 | 0.02 |
| Phosphate (o-PO4-P) | mg/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | 0.3 |
| Sulfate (SO4) | mg/L | <0.9 | 271 | 477 | 476 | 496 | 495 | 495 | <0.9 | 0.9 |
| PH | (in lab) | 5.3 | 7.4 | 7.7 | 7.7 | 7.4 | 7.5 | 7.6 | 5.9 | |
| Alkalinity (as CaC03) | mg/L | <2 | 441 | 450 | 451 | 412 | 412 | 412 | <2 | 2 |
| Hardness (as CaC03) | mg/L | 0 | 688 | 704 | 677 | 610 | 606 | 598 | 0 | |
| Total suspended solids | mg/L | <2 | 6 | 8 | 35 | 6 | | 7 | <2 | 2 |
| Total Dissolved Minerals | mg/L | 13 | 997 | 1450 | 1433 | 1227 | 1189 | 1212 | 13 | 2 |
| Color | P.U. | 0 | 5 | 5 | 5 | 5 | 5 | 5 | 0 | 0 |

**Notes:** * Sample Sets:

| | |
|---|---|
| 01 | Trip blank |
| 02 | Venice sampling point |
| 03 | Bowman pump station inlet sampling point |
| 04 | Bowman pump station outfall to Schoenberger Creek sampling point |
| 05 | 25th Street sampling point at discharge to drainage system |
| 05/LS | Laboratory split sample from 25th Street sampling point at discharge to drainage system |
| 06 | Field duplicate sample from 25th Street sampling point at discharge to drainage system |
| 07 | Field blank |
| MDL | Method detection limit |

Appendix H. Continued

| *Volatile Organic Compound (Method 502.2)* | | *September 21-22, 1992, Sample Set** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *01* | *02* | *03* | *04* | *05* | *05/LS* | *06* | *07* |
| 1,1,1,2-tetrachloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1,1 -trichloroethane | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,1,2,2-tetrachloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1,2-trichloroelhane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1-dichloroethane | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,1-dichloroethy lene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,1-dichloropropylene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,2,3-trichlorobenzene | ug/L | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 |
| 1,2,3-trichloropropane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2,4-trichlorobenzene | ug/L | <0.3 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,4-trimethylbenzene | ug/L | <0.3 | <0.3 | 0.4 | 0.4 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,2-dibromoethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2-dibromo-3-chloropropane | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| 1,2-dichlorobenzene | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 1,2-dichloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2-dichloropropane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,3,5-trimethylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,3-dichlorobenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,4-dichlorobenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 2-chlorotoluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 4-chlorotoluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| benzene | ug/L | <0.3 | <0.3 | 0.6 | 0.5 | <0.3 | <0.3 | <0.3 | <0.3 |
| bromobenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromochloromethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromodichloromethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromoform | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromomelhane | ug/L | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 |
| carbon tetrachloride | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| chlorobenzene | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| chloroethane | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| chloroform | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 1.5 |
| chloromethane | ug/L | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 |
| cis-1,2-dichloroethylene | ug/L | <0.3 | <0.3 | 1.5 | 1.2 | <0.3 | <0.3 | <0.3 | <0.3 |
| cis-l,3-dichloropropylene | ug/L | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 |
| dibromochloromethane | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| dibromomethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| dichlorodifluoromethane | ug/L | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 |
| ethylbenzene | ug/L | <0.2 | <0.2 | 0.8 | 0.6 | <0.2 | <0.2 | <0.2 | <0.2 |
| hexachlorobutadiene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| isopropylbenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| methylene chloride | ug/L | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 |
| naphthalene | ug/L | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| n-butylbenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| n-propylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| p-isopropyltoluene | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| sec-butylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| styrene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| tetrachloroethylene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| toluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 0.5 |
| total xylenes | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| trans-1,2-dichloroethylene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| trans-1,3-dichloropropylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| trichloroethylene | ug/L | <0.2 | <0.2 | 0.3 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| trichlorofluoromethane | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| t-butylbenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| vinyl chloride | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |

## Appendix H. Continued

| *Inorganic Constituent* | | *November 9, 1992, Sample Set** | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *08* | *09* | *10* | *11* | *12* | *13* | *MDL* |
| Iron(Fe) | mg/L | 0.09J | 13.5 | 15.3 | 16.1 | 14.0 | 0.010 | 0.003 |
| Manganese (Mn) | mg/L | <0.002 | 0.659 | 0.523 | 0.669 | 0.597 | <0.002 | 0.002 |
| Calcium (Ca) | mg/L | <0.027 | 202 | 185 | 198 | 198 | 0.062 | 0.027 |
| Magnesium (Mg) | mg/L | <0.026 | 50.7 | 52.6 | 49.7 | 49.4 | <0.026 | 0.026 |
| Sodium (Na) | mg/L | <0.40 | 157 | 157 | 153 | 42.7 | <0.40 | 0.40 |
| Potassium (K) | mg/L | <0.56 | 9.01 | 7.88 | 9.02 | 7.39 | <0.56 | 0.56 |
| Aluminum (Al) | mg/L | <0.013 | 0.026 | 0.014 | 0.035 | <0.013 | <0.013 | 0.013 |
| Arsenic (As) | mg/L | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | <0.06 | 0.06 |
| Barium (Ba) | mg/L | <0.002 | 0.091 | 0.095 | 0.096 | 0.134 | <0.002 | 0.002 |
| Boron (B) | mg/L | <0.34 | 0.53 | <0.34 | 0.51 | 0.97 | <0.34 | 0.34 |
| Cadmium (Cd) | mg/L | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Chromium (Cr) | mg/L | <0.003 | 0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.003 |
| Copper (Cu) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.003 |
| Lead(Pb) | mg/L | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | <0.012 | 0.012 |
| Mercury (Hg) (cold vapor) | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 0.2 |
| Nickel (Ni) | mg/L | <0.008 | <0.008 | <0.008 | <0.008 | 0.009 | <0.008 | 0.008 |
| Selenium (Se) | mg/L | <0.05 | 0.07 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Silicon (Si) | mg/L | <0.25 | 16.6 | 17.0 | 16.6 | 17.0 | <0.25 | 0.25 |
| Silver (Ag) | mg/L | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.003 |
| Zinc (Zn) | mg/L | <0.002 | 0.187 | 0.027 | 0.013 | <0.002 | 0.006 | 0.002 |
| Beryllium (Be) | mg/L | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 |
| Cobah(Co) | mg/L | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.002 |
| Lithium (Li) | mg/L | <0.004 | 0.040 | 0.033 | 0.039 | 0.044 | <0.004 | 0.004 |
| Molybdenum (Mo) | mg/L | <0.008 | 0.009 | <0.008 | 0.011 | <0.008 | <0.008 | 0.008 |
| Phosphorus (P) | mg/L | <0.09 | 0.50 | 0.55 | 0.62 | 0.45 | <0.09 | 0.09 |
| Sulphur (S) | mg/L | <0.05 | 162 | 199 | 161 | 101 | 0.06 | 0.05 |
| Antimony (Sb) | mg/L | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | <0.10 | 0.10 |
| Tin (Sn) | mg/L | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | <0.05 | 0.05 |
| Strontium (Sr) | mg/L | <0.001 | 0.539 | 0.481 | 0.530 | 0.658 | <0.001 | 0.001 |
| Titanium (Ti) | mg/L | <0.002 | <0.002 | 0.002 | 0.002 | <0.002 | <0.002 | 0.002 |
| Thallium (Tl) | mg/L | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | <0.09 | 0.09 |
| Vanadium (V) | mg/L | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | <0.004 | 0.004 |
| Fluoride (F) | mg/L | <0.1 | 1.0 | 1.0 | 1.0 | 0.8 | <0.1 | 0.1 |
| Chloride (Cl) | mg/L | <0.3 | 119 | 33 | 119 | 61 | <0.3 | 0.3 |
| Nitrate (NO3-N) | mg/L | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | 0.02 |
| Phosphate (o-PO4-P) | mg/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | 0.3 |
| Sulfate (SO4) | mg/L | <0.9 | 466 | 577 | 467 | 285 | <0.9 | 0.9 |
| pH | (in lab) | 5.2 | 7.4 | 7.4 | 7.7 | 7.3 | 5.5 | |
| Alkalinity (as CaC03) | mg/L | <2 | 439 | 415 | 437 | 442 | <2 | 2 |
| Hardness (as CaC03) | mg/L | 0 | 713 | 679 | 697 | 698 | 0 | |
| Total suspended solids | mg/L | <1.0 | 9.4 | <1.0 | 30.2 | 5.0 | <1.0 | 2 |
| Total Dissolved Minerals | mg/L | <2 | 1345 | 1350 | 1338 | 1006 | <2 | 2 |
| Color | P.U. | <5 | 5 | 5 | 5 | 5 | <5 | 0 |

**Notes:** * Sample Sets:

| | |
|---|---|
| 08 | Trip blank |
| 09 | Bowman pump station inlet sampling point |
| 10 | 25th Street sampling point at discharge to drainage system |
| 11 | Bowman pump station outfall to Schoenberger Creek sampling point |
| 12 | Venice sampling point |
| 13 | Field blank |
| MDL | Method detection limit |

Appendix H. Concluded

| *Volatile Organic Compound (Method 502.2)* | | *November 9, 1992, Sample Set** | | | | | |
|---|---|---|---|---|---|---|---|
| | | *08* | *09* | *10* | *11* | *12* | *13* |
| 1,1,1,2-tetrachloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1,1-trichloroethane | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,1,2,2-tetrachloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1,2-trichloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,1-dichloroethane | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,1-dichloroethylene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,1-dichloropropylene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,2,3-trichlorobenzene | ug/L | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 |
| 1,2,3-trichloropropane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2,4-trichlorobenzene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| 1,2,4-trimethylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,2-dibromoethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2-dibromo-3-chloropropane | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| 1,2-dichlorobenzene | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| 1,2-dichloroethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,2-dichloropropane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 1,3,5-trimethylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| 1,3-dichlorobenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| 1,4-dichlorobenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 2-chlorotoluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| 4-chlorotoluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| benzene | ug/L | <0.3 | 0.5 | <0.3 | 0.4 | <0.3 | <0.3 |
| bromobenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromochloromethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromodichloromethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromoform | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| bromomethane | ug/L | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 | <2.8 |
| carbon tetrachloride | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| chlorobenzene | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| chloroethane | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| chloroform | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | 4.3 |
| chloromethane | ug/L | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 | <3.2 |
| cis-1,2-dichloroethylene | ug/L | <0.3 | 1.1 | <0.3 | 0.9 | <0.3 | <0.3 |
| cis-1,3-dichloropropylene | ug/L | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 | <0.8 |
| dibromochloromethane | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| dibromomethane | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| dichlorodifluoromethane | ug/L | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 | <1.6 |
| ethylbenzene | ug/L | <0.2 | 0.4 | <0.2 | 0.3 | <0.2 | <0.2 |
| hexachlorobutadiene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| isopropylbenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| methylene chloride | ug/L | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 | <1.4 |
| naphthalene | ug/L | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 | <1.0 |
| n-butylbenzene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| n-propylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| p-isopropyltoluene | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| sec-butylbenzene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| styrene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| tetrachloToethylene | ug/L | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 | <0.3 |
| toluene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| total xylenes | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |
| trans-1,2-dichloroethylene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| trans-1,3-dichloropropylene | ug/L | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| trichloroethylene | ug/L | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 | <0.2 |
| trichlorofluoromethane | ug/L | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 |
| t-butylbenzene | ug/L | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 | <0.4 |
| vinyl chloride | ug/L | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 | <0.7 |

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