Prepared in cooperation with the
Matanuska-Susitna Borough and
the Alaska Department of Environmental Conservation

Preliminary Water-Table Map and Water-Quality Data for Part of the Matanuska-Susitna Valley, Alaska, 2005

Open-File Report 2006-1209

U.S. Department of the Interior
U.S. Geological Survey

Cover Photograph. Part of the Matanuska-Susitna Valley, June 17, 2006. View to the southwest, with the Matanuska River in the forground and Cook Inlet along the skyline. Photograph taken by Linda-Lee Harris, U.S. Geological Survey.

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By Edward H. Moran and Gary L. Solin

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

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Contents

Abstract 1
Introduction 1
Methods 2
Limitations of the Water-Table Map 4
Ground-Water Flow 5
Water Quality 7
Needs for Future Studies 9
References Cited 13
Appendixes 14

Plate

Preliminary water-table map and water-quality data for part of the Matanuska-Susitna Valley, Alaska, 2005

Figures

1. Annual precipitation measured in inches at the Matanuska Experimental Farm, Palmer, Alaska, 1954-93 5
2. Continuously measured water-level altitudes, Well Map-IDs 694 and 709, 1954-93 6
3. Stable isotopes oxygen-18 and hydrogen-2 from lakes and ground-water samples relative to Vienna Standard Mean Ocean Water (VSMOW) in ground- and surface-water samples, 2005, and Susitna River samples, 1985-87, Matanuska-Susitna Valley, Alaska 7
4. Chemical composition of water samples collected from lakes and wells, Matanuska-Susitna Valley, Alaska, 2005 8
5A. Water-column-profile data for Big Lake and Cottonwood Lake, Matanuska-Susitna Valley, Alaska, August and September 2005 10
5B. Water-column-profile data for Lucile Lake and Lucile Lake Spring Area, Matanuska-Susitna Valley, Alaska, August and September 2005 11
5C. Water-column-profile data for Memory Lake and Seymour (Herning) Lake, Matanuska-Susitna Valley, Alaska, August and September 2005 12

Tables

1. Water-quality data collected at surface water sites, August 2004 and September 2005, Matanuska-Susitna Valley, Alaska 3
2. Water-quality data collected from wells, 1989-2005, Matanuska-Susitna Valley, Alaska 3

Appendixes

1. Wells used for contouring the water table altitude 15
2. Water-quality data for surface-water sites sampled in 2005, Matanuska-Susitna Valley, Alaska 24
3. Water-quality data for surface-water sites sampled in 2005, Matanuska-Susitna Valley, Alaska 30
4. Water-quality data collected from wells sampled in 2005, Matanuska-Susitna Valley, Alaska 38

CONVERSION FACTORS, DATUMS, ABBREVIATIONS, and ACRONYMS

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
meter(m)	3.281	foot (ft)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
liter (L)	33.82	ounce, fluid (fl. oz)
liter (L)	2.113	pint (pt)
liter (L)	1.057	quart (qt)
liter (L)	0.2642	gallon (gal)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25 °C).

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Vertical coordinate information is referenced to the North American Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

DEM	Digital Elevation Model
DO	Dissolved Oxygen
Map Id	Map Identifier
Mat-Su	Matanuska-Susitna
SC	Specific Conductance
TIN	Triangulated Irregular Network
USGS	U.S. Geological Survey
VSMOW	Vienna Standard Mean Ocean Water

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Preliminary Water-Table Map and Water-Quality Data for Part of the Matanuska-Susitna Valley, Alaska, 2005

By Edward H. Moran and Gary L. Solin

Abstract

The Matanuska-Susitna Valley is in the northeastern part of the Cook Inlet Basin, Alaska, an area experiencing rapid population growth and development proximal to many lakes. Here water commonly flows between lakes and ground water, indicating interrelation between water quantity and quality. Thus concerns exist that poorer quality ground water may degrade local lake ecosystems. This concern has led to water-quality sampling in cooperation with the Alaska Department of Environmental Conservation and the Matanuska-Susitna Borough. A map showing the estimated altitude of the water table illustrates potential ground-water flow directions and areas where ground- and surface-water exchanges and interactions might occur. Water quality measured in selected wells and lakes indicates some differences between ground water and surface water.

The temporal and spatial scarcity of ground-water-level and water-quality data limits the analysis of flow direction and water quality. Regionally, the water-table map indicates that ground water in the eastern and southern parts of the study area flows southerly. In the north-central area, ground water flows predominately westerly then southerly. Although ground and surface water in most areas of the Matanuska-Susitna Valley are interconnected, they are chemically different. Analyses of the few water-quality samples collected in the area indicate that dissolved nitrite plus nitrate and orthophosphorus concentrations are higher in ground water than in surface water.

Introduction

Matanuska-Susitna Valley in the northeastern part of the Cook Inlet Basin is part of the Matanuska-Susitna (Mat-Su) Borough, Alaska. The borough covers more than 24,000 mi² with a population density of about 2.5 people per mi². More than 15 percent of the borough's population lives in the cities of Palmer and Wasilla (Alaska Department of Labor and Workforce Development, 2004). Population growth rate in the borough increased from 1.6 percent per year in 1990 to 2.7 percent per year in 2003 (Alaska Department of Labor and Workforce Development, 2004), and this increasing trend is expected to continue with more development occurring near lakes. Concerns that current and future development near lakes and streams could result in poor ground- and lake-water quality and ecosystem degradation led the U.S. Geological Survey (USGS), in cooperation with the Alaska Department of Environmental Conservation and the Mat-Su Borough, to measure ground- and lake-water quality during 2005.

The study area covers about 600 mi² east and south of the Little Susitna River to the Matanuska River and the coast of Cook Inlet. In the study area, about 400 mi of streams (U.S. Geological Survey, 1999) flow over aeolian, glacial, alluvial, and lacustrine deposits (Trainer, 1960; Pewe and Reger, 1993) that constitute the water-table aquifer. More than 800 lakes cover about 30 mi² and range from 0.001 to 4.70 mi² (U.S. Geological Survey, 1999). Most of the lakes are fed or drained by streams. In

most areas, stream reaches and lakes exchange water with the water-table aquifer, and the quality of surface water and ground water are related. In some areas, however, stream and lakebeds lie above a low permeability, and, usually, dry layer of fine-grained sediments resulting in locally perched surface-water bodies above the regional water table (Trainer, 1960). At these locations, little or no exchange occurs between surface and ground water.

Methods

Ground-water-level and water-quality data used to generate the features shown on plate 1 were obtained from the USGS National Water Information System (NWIS) (http://nwis.waterdata.usgs.gov/nwis/) (U.S. Geological Survey, 2005). Water-table altitudes were estimated from a Geographic Information System point dataset created from water levels measured at 792 wells (appendix 1) and stream-segment, lake-perimeter, and coastline data obtained from the USGS National Hydrographic Dataset (U.S. Geological Survey, 1999). The dataset was used to generate 20-ft contours that represent the water-table-surface altitude using an inverse distance weighting interpolation method with a 40 nearest-neighbor-point search weighted at 2. USGS 15-minute digital elevation model (DEM) data were converted to a triangulated irregular network (TIN) surface, and the TIN was used to generate 50-ft topographic contours referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Stream segments, lake perimeters, and coastline were converted to 115-ft equal-distance points. The altitude of each point was extracted from the TIN, but some stream-segment- and lake-perimeter-point altitudes were in error. Some stream-segment point altitudes conflicted with stream gradients, and these errors, likely resulted from low-resolution DEM, were manually corrected based on channel slope. Published lake altitudes (U.S. Geological Survey, 1994) were used, but if altitudes were not provided on a topographic map, altitudes for lake-perimeter points were extracted from the TIN, then averaged.

About 2,700 drillers' logs indicated that 792 wells (appendix 1 and plate 1) penetrated only sediments in the water-table aquifer or had water levels representing the water-table surface. Well-water altitudes were estimated by subtracting the depth-of-water below land surface as reported in the drillers' log or measured by the USGS from the land-surface altitudes extracted from the TIN. All well-water levels used in the dataset were measured from 1935 to 1999. About 60 percent were measured from 1982 to 1985.

From 1981 to 2005, the USGS measured dissolved nitrite plus nitrate, orthophosphorus, and other water-quality characteristics at 7 lakes and 27 wells in the area using USGS sampling protocols (http://water.usgs.gov/owq/FieldManual/). All samples were analyzed at the USGS National Water-Quality Laboratory using standard USGS analytical methods (Fishman and Friedman, 1989; Patton and Truitt, 1992; Fishman, 1993).Updates to USGS sampling and analytical methods reflect advanced analysis techniques. For example, advanced analytical techniques can provide lower detection limits for many constituents.

In 2005, Big Lake, Seymour (Herning) Lake, two sites on Lucile Lake, Memory Lake, and Cottonwood Lake were resampled for nitrite plus nitrate, orthophosphorus (table 1) and other characteristics (appendix 2) using a Van Dorn type sampler made of non-contaminating materials. Water samples collected when lakes were thermally stratified were a composite from two points in the upper part of the lake (see appendix 2, parameter codes P72016 and P72015) and a discrete sample from near the lake bottom. Water samples were collected from one discrete point when lakes were not thermally stratified. Additionally, dissolved oxygen (DO), pH, specific conductance (SC), and temperature were measured at these locations at about 0.2- to 3.28-ft (0.05 to 1 meter) depth intervals (appendix 3) using a Yellow Springs Instrument® multi-parameter meter. In 2005, these lakes also were sampled for oxygen-18/oxygen-16 and hydrogen-2/hydrogen-1 (Deuterium/Protium) isotopic ratios (appendix 2) using USGS protocols (http://isotopes.usgs.gov/Instructions.htm) and analyzed at the USGS Reston Stable Isotope Laboratory. Isotopic results are reported relative to Vienna Standard Mean Ocean Water (VSMOW) and were normalized to Standard Light Antarctic Precipitation (Tyler Coplen, U.S. Geological Survey, written commun., 2005).

Of the 27 wells sampled, 15 were sampled for nutrients (table 2), oxygen and hydrogen isotopes, and other characteristics during 2005 (appendix 4). Wells sampled in 2005 were selected to help identify the relation between lake- and ground-water quality. The 2005 well-water samples were collected following USGS protocols (http://water.usgs.gov/owq/FieldManual/). At least three casing volumes of water were removed prior to sample collection. Field parameters of DO, pH, SC, temperature, and turbidity were measured using a Yellow Springs Instrument® multi-parameter meter and monitored until stable. Then samples were collected and processed. Field parameters

Table 1. Water-quality data collected at surface water sites, August 2004 and September 2005, Matanuska-Susitna Valley, Alaska

[<, less than detection limit; E, USGS National Water-Quality Laboratory estimated concentration; Bold indicates sample collected in 2005]

Map ID	USGS Station ID	Site Location	Sample Date	(00671) Phosphorus, dissolved ortho (milligrams per liter as P)	(00631) Nitrite plus Nitrate, dissolved (milligrams per liter as N)
37	613433149554700	Horseshoe Lake north of Big Lake	8/3/2004	< 0.006	< 0.016
48	**613215149522600**	**Big Lake**	**9/8/2005**	**0.023**	**< 0.016**
183	**613623149400100**	**Seymour (Herning) Lake**	**9/13/2005**	**< 0.006**	**0.016**
296	**613441149273800**	**Lucile Lake Station 2**	**9/8/2005**	**< 0.006**	**0.021**
314	**613451149265700**	**Lucile Lake Spring Area**	**9/15/2005**	**< 0.006**	**1.95**
384	**613736149250000**	**Memory Lake**	**9/15/2005**	**< 0.006**	**E0.012**
578	**613551149192900**	**Cottonwood Lake**	**9/13/2005**	**< 0.006**	**0.034**

Table 2. Water-quality data collected from wells, 1989-2005, Matanuska-Susitna Valley, Alaska

[<, less than detection limit; E, USGS National Water-Quality Laboratory estimated concentration; Not Used, water altitude not used for water-table contouring owing to data not available at time of contouring or well penetrating the confined aquifer; M, multiple water-level measurements available; S, one water-level measurement available and usually taken at the time of drilling; Bold indicates sample collected in 2005]

Map ID	USGS Station ID	Water Measurement Date	Water Altitude (feet)	Sample Date	Water Altitude (feet) at time of sampling	(00671) Phosphorus, dissolved ortho (milligrams per liter as P)	(00631) Nitrite plus Nitrate, dissolved (milligrams per liter as N)	Comments
14	612421150044601		Not Used	8/3/1999		<0.01	1.92	
20	613053150021801		Not Used	7/28/1999		0.1	<0.05	
26	**613053149565301**	**7/1/1975**	**134.65 M**	**9/16/2005**	**135.73**	**<0.006**	**0.02**	**Near Big Lake**
62	**613223149511901**		**Not Used**	**9/9/2005**	**148.10**	**0.063**	**E0.008**	**Near Big Lake**
67	**613238149504201**		**Not Used**	**9/12/2005**	**148.06**	**0.063**	**0.019**	**Near Big Lake**
88	612606149483901		Not Used	8/4/1999		<0.01	0.12	
93	613227149483501		Not Used	9/13/1999		0.09	<0.05	
133	613550149453701		Not Used	8/6/1999		0.01	<0.05	
172	612939149413201		Not Used	8/4/1999		<0.01	0.81	
186	**613716149394101**		**Not Used**	**8/12/2005**	**305.59**	**0.007**	**0.071**	**Near Seymour (Herning) Lake**
188	**613723149393201**		**Not Used**	**9/13/2005**	**310.73**	**<0.006**	**0.1**	**Near Seymour (Herning) Lake**
189	**613717149393101**		**Not Used**	**9/13/2005**	**304.56**	**<0.006**	**0.121**	**Near Seymour (Herning) Lake**
220	613257149345401	8/23/1999	225.56 M	9/15/1999		0.02	0.37	
254	**613441149293301**	**4/4/1984**	**323 S**	**9/14/2005**	**333.73**	**0.017**	**0.313**	**Near Lucile Lake**
299	**613450149273701**	**6/16/1977**	**323 S**	**9/13/2005**	**332.35**	**0.029**	**<0.032**	**Near Lucile Lake**
318	**613442149265201**		**Not Used**	**9/9/2005**	**320.87**	**E0.004**	**1.94**	**Near Lucile Lake**
350	**613743149255101**	**6/29/1984**	**459 S**	**9/12/2005**	**452.08**	**0.028**	**<0.016**	**Near Memory Lake**
355	613553149253601		Not Used	8/16/1999		<0.01	0.15	
363	**613724149252301**	**4/22/1983**	**445 S**	**9/12/2005**	**458.70**	**E0.003**	**4.42**	**Near Memory Lake**
365	**613728149252801**		**Not Used**	**9/9/2005**	**423.72**	**0.006**	**<0.016**	**Near Memory Lake**
387	613530149244101	8/30/1999	345.64 M	8/30/1999		<0.01	0.91	
549	**613548149201001**	**6/7/1982**	**339 S**	**9/14/2005**	**337.09**	**<0.006**	**<0.016**	**Near Cottonwood Lake**
597	**613605149190001**		**Not Used**	**8/8/2005**	**339.60**	**<0.006**	**5.29**	**Near Cottonwood Lake**
598	**613533149184801**	**5/16/1984**	**311 S**	**9/14/2005**	**353.58**	**E0.004**	**1.09**	**Near Cottonwood Lake**
692	613406149152102		Not Used	8/24/1990		<0.01	<0.1	
693	613406149152103		Not Used	9/6/1989		0.03	<0.1	
767	613847149131801		Not Used	10/20/1999		0.01	<0.05	

and water levels also were monitored after sampling was completed. Wells sampled in 2005 also were sampled for oxygen-18/oxygen-16 and Deuterium/Protium isotopic ratios (appendix 2) using USGS protocols (http://isotopes.usgs.gov/Instructions.htm) and analyzed at the USGS Reston Stable Isotope Laboratory. Well-water isotopic results are reported relative to VSMOW and were normalized to Standard Light Antarctic Precipitation (Tyler Coplen, U.S. Geological Survey, written commun., 2005).

Limitations of the Water-Table Map

Water-table altitude contours shown on plate 1 reasonably indicate regional ground-water-flow patterns and areas where ground and surface water interact. However, identifying and determining ground-water flow patterns at a site-specific or local scale is limited owing to the quality and scale of the data used to generate the contours. Generally, water-table-altitude contour maps are created manually, but water-table-altitude contours were computer generated for this study with no manual editing for purposes of reproducibility.

Water-table contours were generated using 12,000 stream-segment- and lake-perimeter-point altitudes and 792 well-water altitudes. The mean error between the water-surface altitudes used for interpretation and the interpreted altitudes was 0.01 ft indicating an approximately unbiased interpretation [mean error equal to zero (Isaaks and Srivastava, 1989)]. Maximum and minimum errors were 47.7 and -32.4 ft, respectively, with a standard deviation of 1.0 ft. The largest errors occurred at stream-segment and lake-perimeter points and could result from surface-water bodies perched above the water table in these areas; a condition not accounted for in the interpretation. The errors between the measured and interpreted ground-water levels averaged -0.3 ft with a maximum and minimum of 17.1 and -27.9 ft, respectively, and a standard deviation of 2.6 ft.

The majority of point-altitude errors are associated with the TIN extracted land-surface elevations owing to the DEM resolution. Many lake altitudes extracted from the TIN differed by as much as 40 ft from published altitudes. For example, the average altitude for the 51 lake-perimeter points for Seymour (Herning) Lake was 300 ft, but the published altitude for the lake was 289 ft.

Well locations generally were plotted and assigned latitudes and longitudes by the USGS based on information on the drillers' logs; however, the actual locations are not precisely known. Locally, the topographic relief varies considerably, which indicates that TIN-extracted altitudes for some wells likely are incorrect.

About 90 percent of the water levels used to interpret the water table were from drillers' logs, and these levels generally were measured to the nearest foot immediately after drilling the well. Errors in these water-level measurements include uncertainties regarding the measurement point used by the driller to measure the depth-of-water. In contrast, multiple water-level measurements were made by the USGS for some wells where depth-of-water were reported to the nearest 0.01 ft (table 2 and appendix 1).

Water levels from drillers' logs usually are reported relative to land surface or from the top of the well casing. The top of the well casing generally is assumed to be 2 ft above land surface, but may vary by at least 0.5 ft, and landscaping around the well after drilling often changes the land-surface altitude.

Well-water levels measured immediately after drilling usually do not represent the actual potentiometric surface. Water levels in newly drilled wells may take hours or days to stabilize, depending on well-development techniques, before the water level is representative of the water-table surface. Differences between water levels used to interpret the water table and water levels measured in 2005 possibly indicate this type of measurement error (table 2 and appendix 1). Water levels in well Map-ID 598 were more than 42 ft higher in 2005 than in 1984, but water levels in well Map-ID 549, near the same lake, were almost 2 ft lower in 2005 than in 1982. The earlier water-level measurements are those reported on the drillers' log and are suspected to be poor measurements.

Because water-level information is limited for certain areas, it was necessary to use water levels measured from 1935 to 1999. Use of measurements spanning such a long period introduced errors owing to natural fluctuations in the water table. During this period, however, the annual variation in precipitation that recharges the water table likely results in only minor fluctuations of the water table. Between 1935 and 1993, annual precipitation measured at the Matanuska Experimental Farm in Palmer ranged from 8.5 to 21.1 in. (National Oceanic and Atmospheric Administration, 2002).

The water table fluctuates from year to year, but Trainer (1960) suggested that larger fluctuations occur seasonally rather than annually or interannually. Although annual precipitation measured from 1954 to 1993 in Palmer varied by 9.5 in. (0.79 ft), ranging from 11.4 (0.95 ft) to 20.9 in. (1.75 ft) (National Oceanic and Atmospheric Administration, 2002) (fig. 1), water levels measured almost annually from 1954–93 in well Map-ID

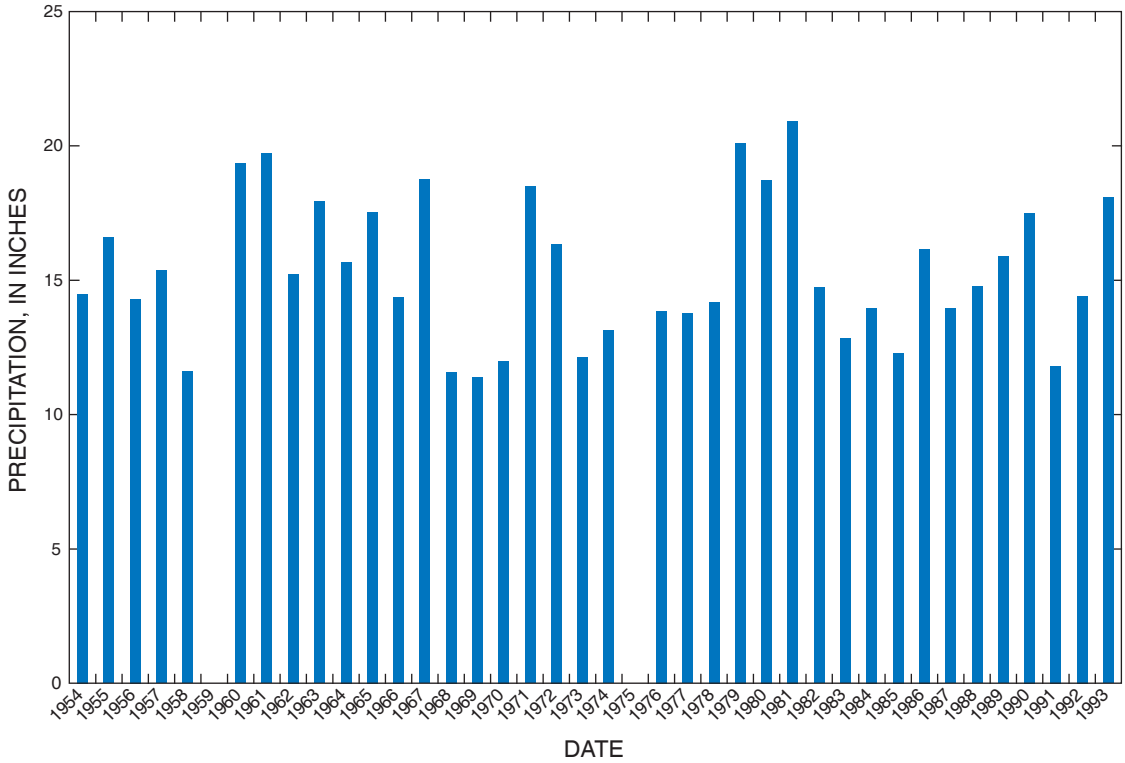

Figure 1. Annual precipitation measured in inches at the Matanuska Experimental Farm, Palmer, Alaska, 1954-93 (NOAA, 2002).

694 varied by more than 26 ft. (fig. 2A). However, water levels in well Map-ID 709, measured almost annually from 1954–74, varied by 4.2 ft (fig. 2B).

Ground-Water Flow

The surface of the water table is a subdued expression of the area's topography. Regionally, ground water flows southerly from the Talkeetna Mountain foothills, in the northern and northeastern parts of the area, to the Cook Inlet coast. In the east, ground water flows predominately southerly, except near the bluff area of the Matanuska River where ground water flows easterly toward the river. In the north-central area, ground water flows westerly, following the Little Susitna River and then flows southerly to the coast.

The shape of the water-table surface reflects areas where ground and surface water interact. Where the water table and streams intersect, the water-table altitude contours indicate the movement direction of interacting ground and surface water. A concave-up contour with the cusp pointed downstream indicates that stream water is lost to the aquifer; whereas, a concave-down contour, with the cusp pointed upstream, indicates areas where ground water discharges to the stream. The shape of the water table near the upper Lucile Creek area indicates that ground water discharges to this part of the stream.

Oxygen-18/oxygen-16 isotopic and Deuterium/Protium isotopes (shown on fig 3 as delta oxygen-18 and delta hydrogen-2, respectively) measured in 2005 indicate a possible relation between ground water and lakes (appendixes 2 and 4). Trend-line slopes for the 16 lake-water-isotope and 29 ground-water-isotope samples collected in 2005 were 4.8 and 4.7, respectively, each with a coefficient of determination (R^2) of about 0.99. Comparable slopes in trend lines indicate similar exposure to evaporation processes. Trend lines with slopes less than 5 indicate oxygen-18 and hydrogen-2 enrichment, typical for water evaporation from open surface-water bodies (Clark and Fritz, 1997). Based on these data, shallow ground water surrounding lakes sampled during 2005 has a direct hydraulic connection to the nearby lakes.

To illustrate the potential difference between isotope ratios in local precipitation and water sampled in 2005, figure 3 shows delta oxygen-18 and delta hydrogen-2 results from 8 samples collected from the Susitna River (USGS streamflow-gaging station 15294350) (about 20 mi due west of Big Lake) from 1985 to 1987. The Susitna River isotope-sample trend-line slope was 8.3 (with an

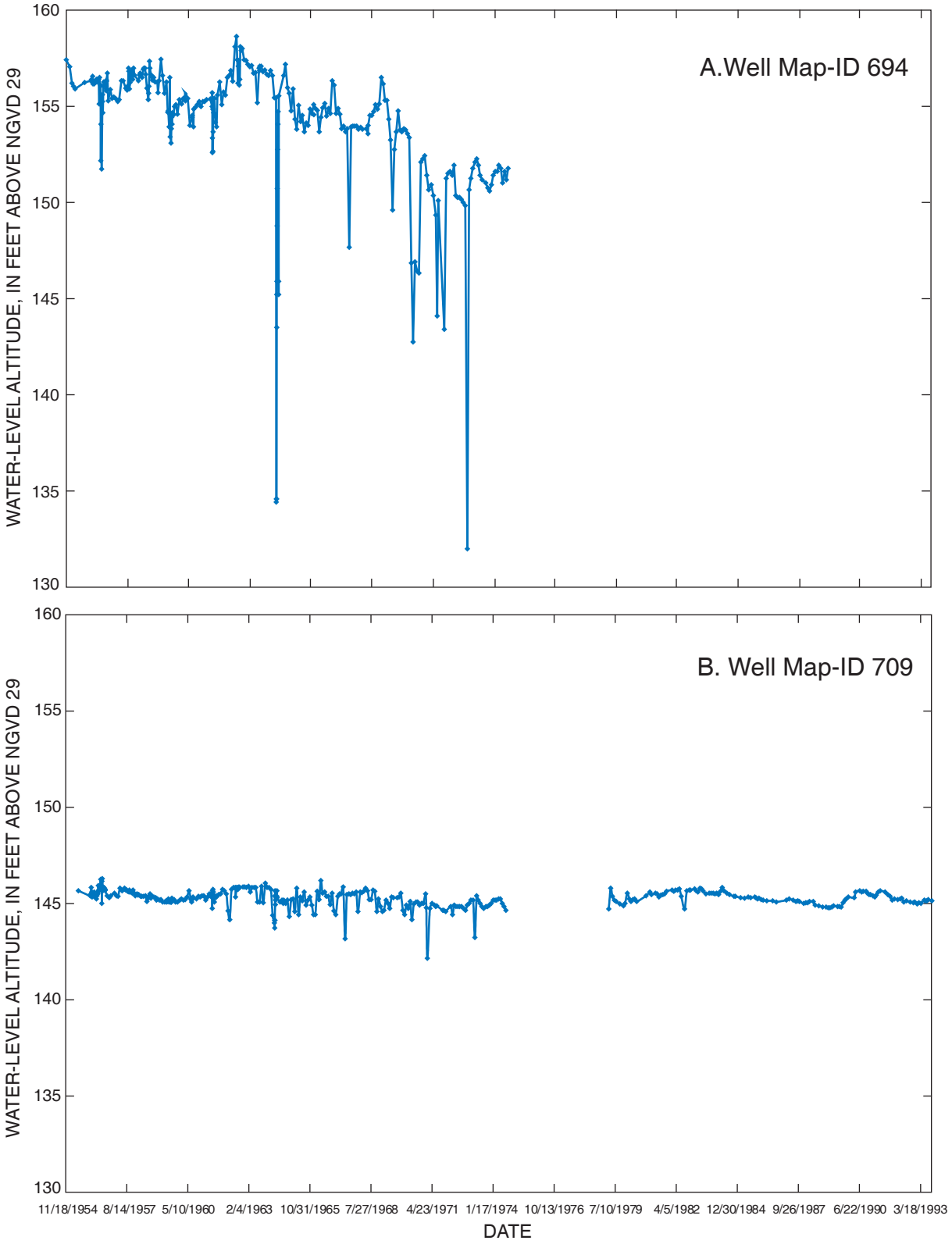

Figure 2. Continuously measured water-level altitudes, Well Map-IDs 694 and 709, 1954-93.

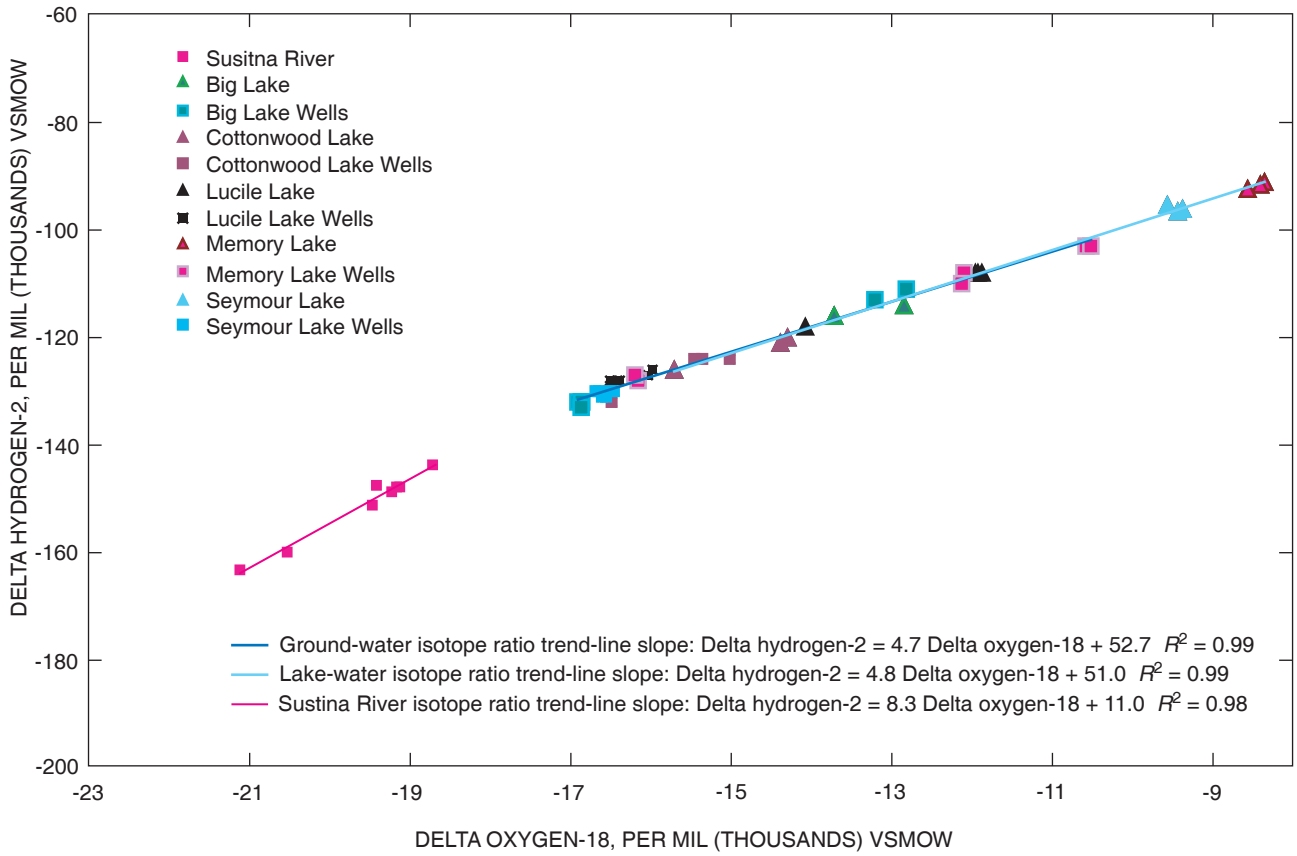

Figure 3. Stable isotopes oxygen-18 and hydrogen-2 from lakes and ground-water samples relative to Vienna Standard Mean Ocean Water (VSMOW) in ground- and surface-water samples ,2005, and Susitna River samples, 1985-87, Matanuska-Susitna Valley, Alaska (appendixes 2 and 4).

R^2 value of 0.98), a value similar to the global-meteoric-water-line (Clark and Fritz, 1997). The difference among trend lines for the Susitna River samples and the 2005 samples and the large variance of the 2005-sample isotope concentrations indicates waters likely are from different sources.

Water Quality

Similarities and differences in water quality between surface- and ground-water systems can be assessed by classifying waters based on their major-ion concentrations. Concentrations plotted on a trilinear diagram (Piper, 1944) indicated that water from the lakes and wells sampled in 2005 are calcium-bicarbonate type waters (fig. 4). Additionally, figure 4 indicates that Big and Cottonwood Lakes consist of essentially the same types of waters. Water from wells sampled near Seymour Lake was similar to Seymour Lake water. When compared with other water samples collected in 2005, one well near Cottonwood Lake and Memory Lake, and two wells near Lake Lucile have higher chloride, fluoride, nitrite plus nitrate, sulfate, and magnesium components (fig. 4).

The nutrients, nitrogen and phosphorus, are water-quality constituents that influence biological growth, and often, surface- and ground-water quality is assessed on the concentrations of these constituents. Nitrite and nitrate are oxidized forms of inorganic nitrogen that together make up most dissolved nitrogen in well-aerated surface water; although nitrite is essentially nonexistent. The orthophosphorus ion is the most important form of phosphorus because it is directly available for metabolic use by aquatic plants. Together, the bioavailability of nitrogen and phosphorus typically controls eutrophication of surface-water bodies.

Locations of lakes and wells sampled by the USGS for dissolved nitrite plus nitrate and orthophosphorus, and respective concentrations measured during the most recent water-quality data collection activities from 1989 to 2005, are listed in tables 1 and 2. Data-collection sites also are shown on plate 1. Plate 1 shows bars that represent dissolved nitrite plus nitrate and orthophosphorus concentrations from well and lake samples collected by the USGS

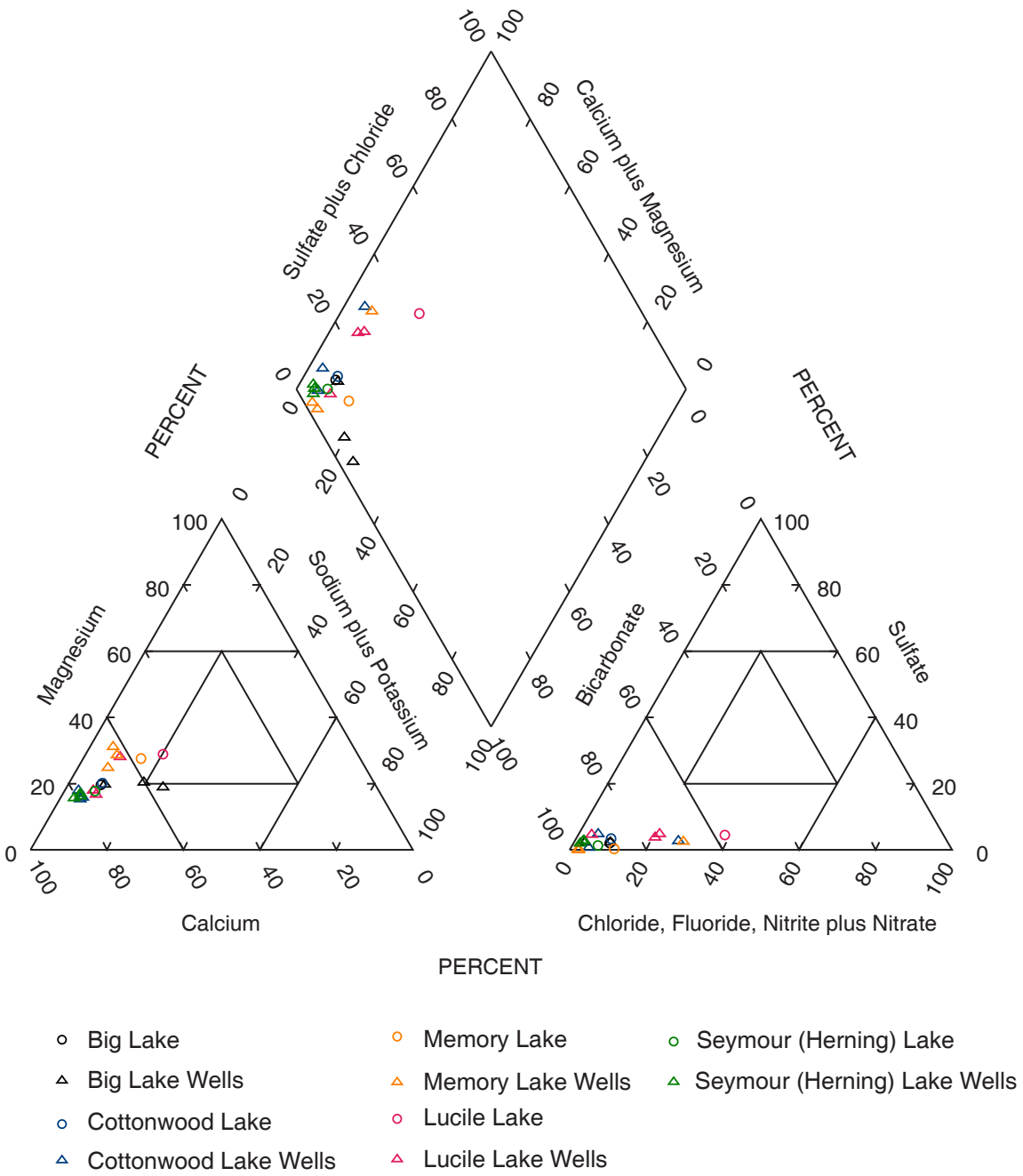

Figure 4. Chemical composition of water samples collected from lakes and wells, Matanuska-Susitna Valley, Alaska, 2005.

from 1989 to 2005 (tables 1 and 2 and appendixes 2 and 4).

Analyses of the seven USGS surface-water-quality sites showed dissolved orthophosphorus concentrations less than a detection limit of 0.006 mg/L, except for Big Lake (0.023 mg/L). For all surface-water sites, the highest dissolved nitrite-plus-nitrate concentration was 1.95 mg/L at the Lucile Lake Spring Area site in 2005. This sample was collected directly over an upwelling spring in the eastern part of Lucile Lake. All other lake samples analyzed for dissolved nitrite plus nitrate ranged from 0.034 at Cottonwood Lake to less than the detection limit of 0.016 mg/L (table 1).

Analysis for dissolved orthophosphorus for the 27 USGS ground-water-sampling sites showed concentrations ranging from 0.1 mg/L to less than a detection limit of 0.006 mg/L at well Map-IDs 26, 188, 189, 549, and 597 and 0.01 mg/L at well Map-IDs 14, 88, 172, 355, 387,

and 692 (table 2). The highest dissolved orthophosphorus concentrations in the 2005 water samples from wells were 0.063 mg/L at well Map-IDs 62 and 67 near Big Lake.

The highest dissolved nitrite-plus-nitrate concentration of 5.29 mg/L was measured in a sample collected in 2005 at well Map-ID 597, just north of the northeastern part of Cottonwood Lake. Dissolved nitrite-plus-nitrate concentrations of 4.42 and 1.94 mg/L were measured in a single water sample from wells collected near Memory Lake (well Map-ID 363) and near Lucile Lake (well Map-ID 318), respectively. In 1999, a dissolved nitrite-plus-nitrate concentration of 1.92 mg/L was measured in well Map-ID 14, in the southwestern part of the study area. All other ground-water dissolved nitrite-plus-nitrate concentrations ranged from 1.09 mg/L to less than detection limits of 0.1, 0.05, and 0.016 mg/L (table 2).

Water-column-temperature measurements taken at various depths in Big Lake, Seymour (Herning) Lake, Memory Lake, Cottonwood Lake, and two sites at Lucile Lake (fig. 5A-C) indicated the degree of thermal stratification in the water column at the time of sampling. For example, the water column in Big Lake on August 2, 2005, the deepest lake sampled in 2005, seems well stratified owing to the thermocline less than a 17-ft depth (fig. 5A). (A change greater than 1°C per 3.3 ft indicates well-stratified water columns [Wetzel, 2001]).

In August and September 2005, Seymour and Memory Lakes (fig. 5C) were well mixed and unstratified. On August 11, 2005, the profile of Cottonwood Lake indicated a well-established thermocline at a 23- to 26-ft depth (fig. 5A). However, evidence indicates recent warming of near surface water as shown by a sharp temperature increase from 10.5 to 6.5 ft. At the approximate deepest location of Lucile Lake, the water column seems unstratified (fig. 5B). In the eastern part of Lucile Lake, however, ground-water upwelling through springs on the lakebed created stratified conditions at relatively shallow depths (fig. 5B).

Needs for Future Studies

Water-table contours illustrate the regional ground-water-flow patterns and indicate potential areas of ground- and surface-water interaction. The accuracy of water-table contours, however, could be improved with additional data. Surveying wells, lakes, and stream segments to a relative datum would eliminate most altitude errors incorporated in this study. Measuring all water levels used for interpolation contemporaneously or in a single season would remove many errors caused by temporal fluctuations of the water table.

Water-quality data indicated similarities and differences between ground water and surface water. Collecting ground- and surface-water-quality samples following the same protocols used in 2005 would improve the definition of ground- and surface-water interactions.

Integrating the physical properties of the aquifer with the data used in this study into a ground-water/surface-water-flow model such as MODFLOW (Harbaugh and others, 2000) would considerably improve the definition of the regional ground-water-flow system and allow for possible site specific or local scale assessment. A ground-water/surface-water-flow model would provide a tool to better assess current water resources conditions and aid in evaluating possible future consequences associated with the conjunctive use of surface and ground water.

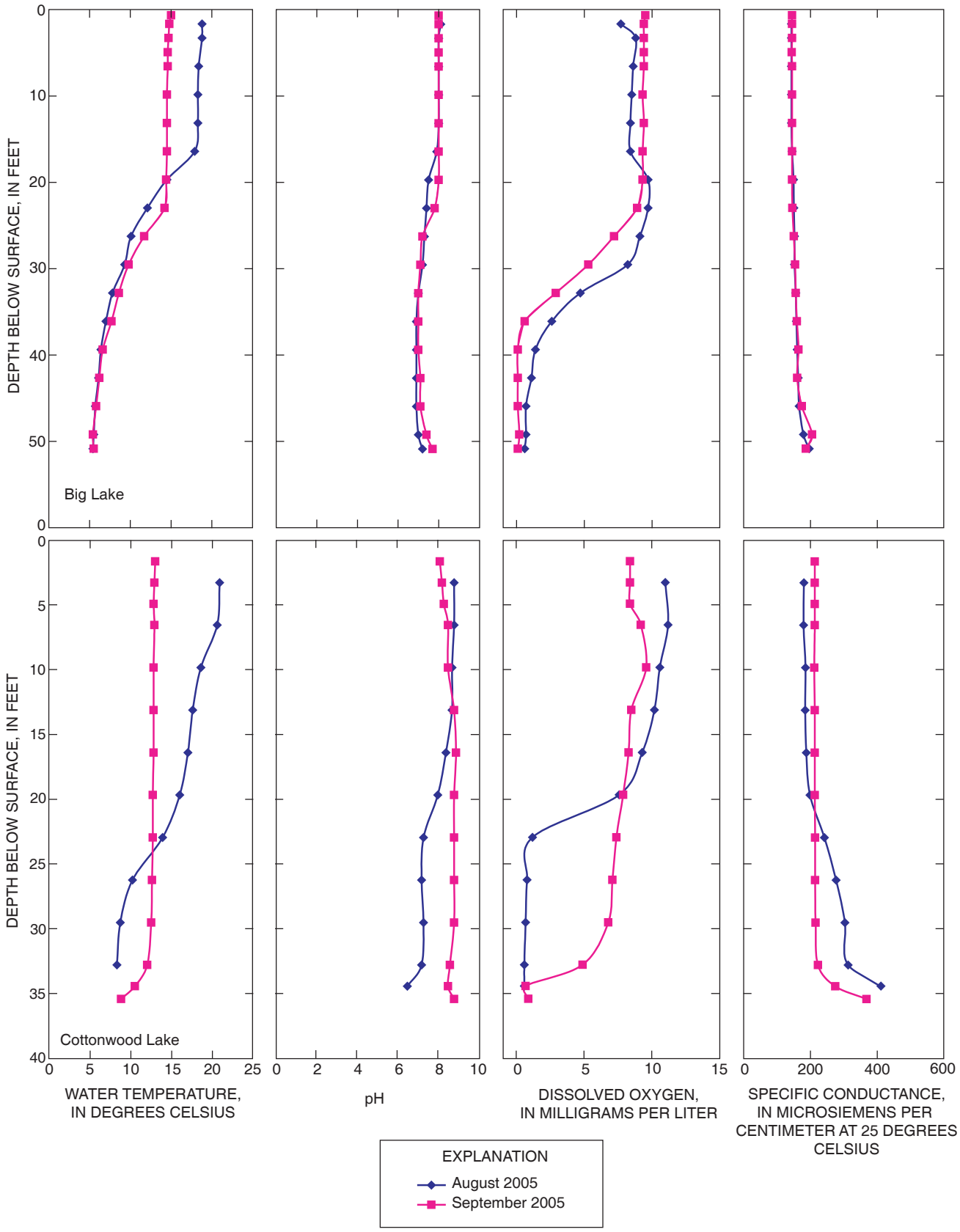

Figure 5A. Water-column-profile data for Big Lake and Cottonwood Lake, Matanuska-Susitna Valley, Alaska, August and September 2005 (see appendix 3 for data).

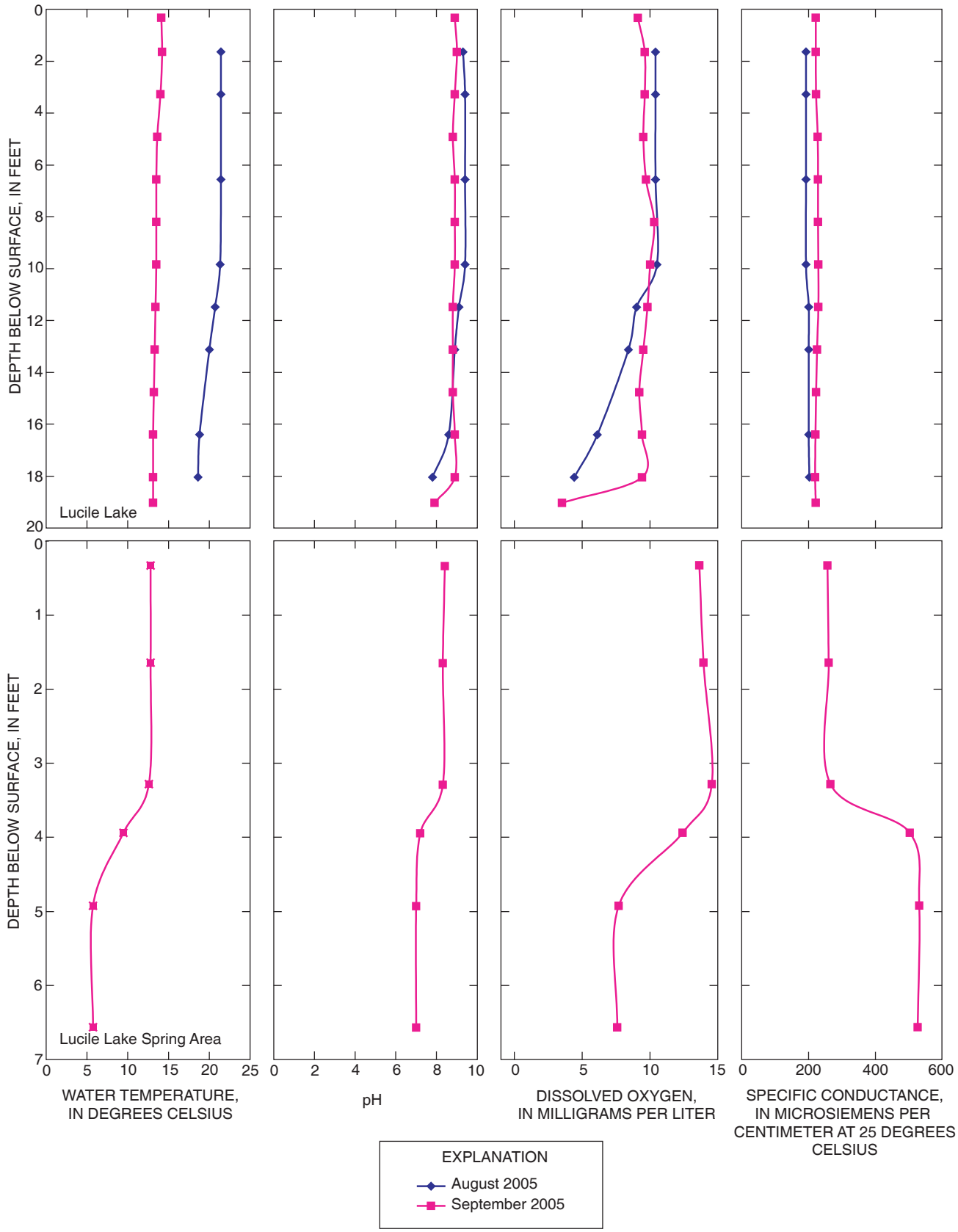

Figure 5B. Water-column-profile data for Lucile Lake and Lucile Lake Spring Area, Matanuska-Susitna Valley, Alaska, August and September 2005 (see appendix 3 for data).

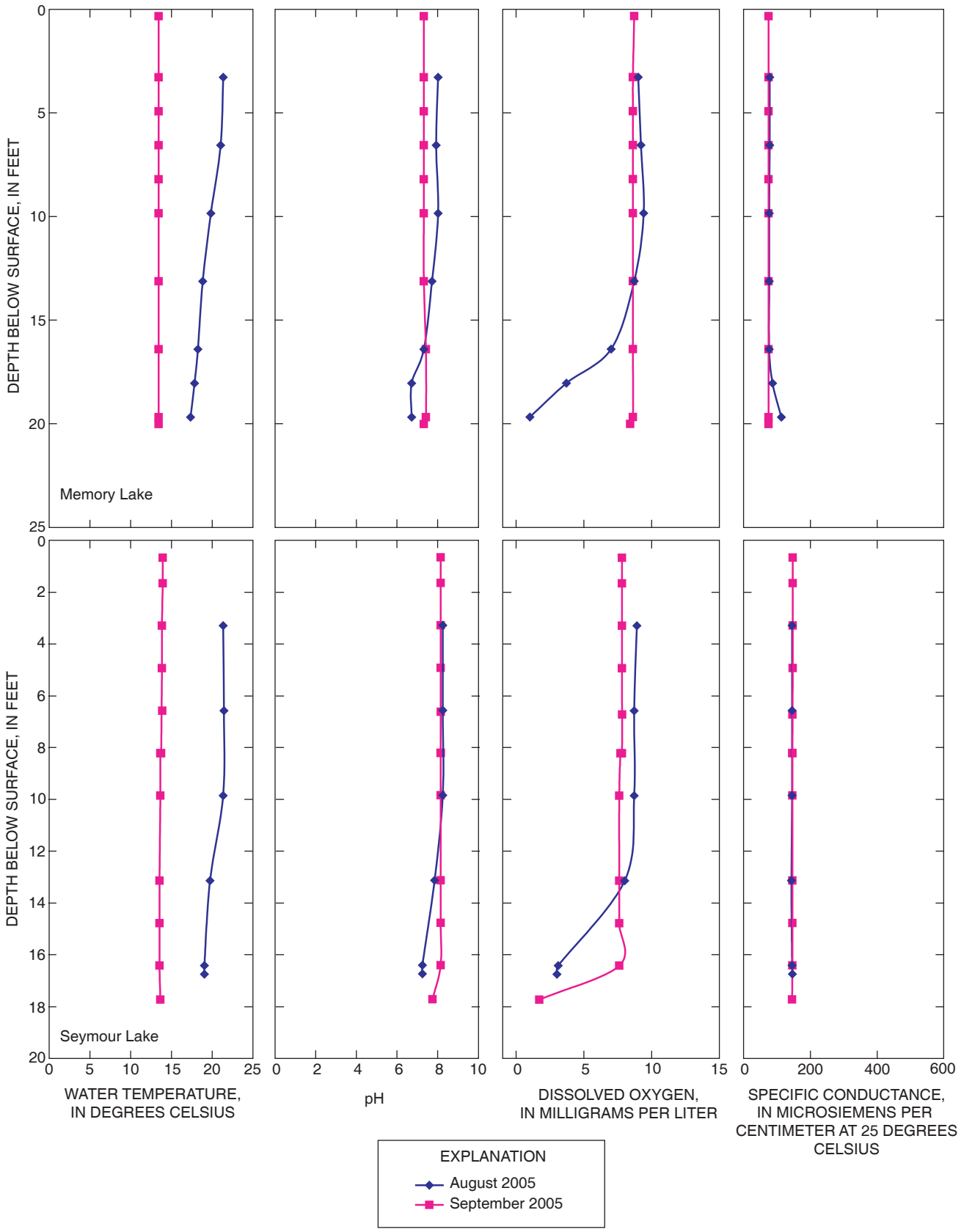

Figure 5C. Water-column-profile data for Memory Lake and Seymour (Herning) Lake, Matanuska-Susitna Valley, Alaska, August and September 2005 (see appendix 3 for data).

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Appendixes

Appendix 1. Wells used for contouring the water table altitude.

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
6	612458150050601	102	S	12/11/1984
7	612422150050101	118	S	12/11/1984
8	612419150045401	116.60	M	7/23/1985
9	612455150045501	104	S	7/23/1985
10	612429150044801	127	S	7/1/1983
11	612501150044601	106	S	5/26/1984
15	612458150044001	109	S	5/26/1984
16	612512150045901	122	S	6/10/1983
21	613043150015401	133	S	8/28/1984
22	613134149592701	124	S	11/10/1976
23	613421149571901	170	S	3/1/1976
24	613201149565401	124	S	5/1/1973
25	613117149563801	132	S	3/24/1971
26	613053149565301	134.65	M	10/15/1975
27	613224149563401	131	S	9/19/1978
29	613415149563401	152	S	6/28/1976
30	613415149563301	157	S	7/23/1978
31	613355149561901	154	S	3/26/1983
32	613218149560001	140	S	5/25/1976
33	613425149561101	154	S	2/3/1979
34	613427149561101	156	S	6/19/1978
35	613402149560401	146	S	6/10/1986
36	613438149560001	156	S	6/19/1978
38	613451149552801	168	S	1/17/1974
39	613151149530001	168	S	6/30/1976
40	613200149530001	135	S	6/29/1976
41	613240149525901	146	S	3/21/1973
42	613243149525601	143	S	3/29/1983
43	613238149525301	143	S	3/26/1973
44	613239149524201	153	S	12/12/1973
45	613239149524202	152	S	3/29/1973
46	613231149523901	142	S	1/14/1975
47	613202149522501	130	S	1/2/1974
49	613232149522101	145	S	1/11/1974
50	613205149521701	143	S	2/12/1979
51	613227149521601	128	S	2/22/1971
52	613202149521301	150	S	1/4/1974
53	613507149521601	192	S	6/12/1988
54	613156149514401	144	S	1/1/1971
55	613241149513901	142	S	5/25/1973
56	613240149513701	145	S	5/31/1973
57	613239149513601	135	S	2/11/1971
58	613236149513403	143	S	9/10/1976
59	613229149512801	133	S	6/8/1988
60	613154149512101	163	S	6/10/1975
61	613229149512201	151	S	6/10/1988
63	613226149510401	140	S	1/1/1971
64	613429149505501	182	S	12/2/1981
65	613150149503601	138	S	6/8/1979
66	613442149504901	167	S	10/30/1976
68	613424149504301	186	S	5/1/1981
69	613441149504101	167	S	7/23/1985
70	613431149504001	159	S	9/12/1975
71	613427149503801	167	S	6/4/1979
72	613122149501301	153	S	10/3/1981
73	613428149502701	174	S	6/11/1975
74	613444149502701	174	S	6/27/1973
75	613449149502401	157	S	10/25/1988
76	613505149502201	175	S	1/1/1974
77	613440149500901	177	S	4/9/1989
78	613222149495001	150	S	10/25/1979
79	613119149493101	145	S	6/22/1972
80	613214149493001	132	S	5/24/1985
81	613227149492801	161	S	11/3/1984
82	613419149493601	164	S	8/16/1985
83	613349149493002	162	S	11/18/1976
84	613349149493001	157	S	10/16/1976
85	613349149493005	163	S	2/16/1978
86	613349149493004	164	S	2/16/1978
87	613349149493007	164	S	3/8/1978
89	613307149490201	162	S	7/21/1975
90	613320149490301	151	S	6/16/1976
91	613307149485901	161	S	6/14/1976
92	613515149490101	165	S	5/26/1970
94	613242149483301	139	S	6/2/1973
95	613346149483601	181	S	7/7/1979
96	613227149482201	192	S	6/11/1983
97	613349149482801	175	S	7/14/1980
98	613441149483001	180	S	8/28/1982
99	613332149482201	189	S	8/6/1980
100	612630149473601	39	S	9/17/1971
101	613341149480201	180	S	1/1/1977
102	613349149475801	192	S	4/25/1983
103	612544149470501	91	S	10/1/1962
104	613330149474401	198	S	9/19/1976
105	613330149474101	194	S	6/18/1978
106	613334149474101	188	S	9/16/1982
107	613235149473401	228.71	M	10/15/1987
108	613330149473401	177	S	7/26/1979
109	613243149472901	157.48	M	7/1/1987
110	613235149472802	184.58	M	7/19/1989
111	613353149472901	135	S	10/1/1977

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
112	613337149470901	164	S	7/13/1976
113	613328149470701	136	S	6/5/1985
114	613637149471401	213	S	6/10/1989
115	613642149464801	215	S	7/18/1985
116	613315149462501	175	S	8/9/1978
117	613642149463801	202	S	6/24/1976
118	613637149463802	223	S	11/9/1983
119	612641149454301	65	S	8/14/1962
120	612640149454201	59	S	8/14/1962
121	613434149461301	174	S	7/19/1982
122	613628149462001	239	S	5/8/1986
123	613513149461201	207	S	3/19/1984
124	613636149461401	237	S	12/27/1985
125	613632149460501	239	S	10/9/1984
126	613344149454801	180	S	1/1/1965
127	613435149454901	172	S	7/9/1977
128	613727149455501	248	S	8/30/1984
129	613434149453901	167	S	5/7/1984
130	612704149445901	58	S	8/26/1950
131	613752149455401	230	S	10/12/1977
132	613755149455301	254.56	M	8/30/1985
134	613435149461901	176	S	7/15/1985
135	613735149454401	243	S	7/24/1985
136	613716149453301	189	S	5/22/1980
137	613805149453501	315	S	3/4/1983
138	613753149453002	262	S	8/21/1985
139	613730149452001	243	S	5/7/1984
140	613735149452001	253	S	2/26/1986
141	612843149442901	183	S	12/5/1985
142	613615149450601	200	S	9/10/1984
143	613734149451301	250	S	6/16/1988
144	613626149450602	205	S	8/9/1982
145	612817149442201	179	S	11/6/1982
146	613405149445001	163	S	11/9/1984
147	613713149450601	208	S	3/3/1983
148	613347149444401	172	S	9/1/1977
149	613739149450401	249	S	5/16/1984
150	613406149444401	165	S	11/9/1984
151	613506149444401	227	S	7/25/1985
152	613359149443801	187	S	10/20/1985
153	613412149443001	163	S	7/14/1972
154	612744149435301	67	S	7/27/1982
155	613712149443001	284	S	3/16/1985
156	613401149441101	206	S	11/9/1983
157	613653149442401	221	S	4/29/1985
158	612746149433301	76	S	4/27/1981
159	612727149432701	6	S	6/11/1971
160	613346149435701	196	S	6/12/1983
161	613519149435801	222.70	M	8/23/1985
162	613654149434201	236	S	4/9/1989
163	612834149425501	204	S	8/14/1962
164	612835149425401	206	S	8/14/1962
165	613433149432201	183	S	10/21/1983
166	613433149431801	205.45	M	11/30/1976
167	613701149431502	207	S	8/16/1983
168	613454149422901	220	S	7/16/1985
169	612914149415101	200	S	7/8/1982
170	612941149414001	216	S	11/14/1978
171	612942149414001	221	S	12/11/1978
173	613608149414101	275	S	5/12/1984
174	613624149413301	278	S	7/18/1983
175	613435149404901	220	S	7/13/1983
176	612936149401001	232	S	8/21/1962
177	612937149400901	234	S	8/21/1962
178	613625149404401	297	S	6/18/1984
179	613550149401201	279	S	1/1/1962
180	613103149394501	236	S	8/31/1983
181	613446149400001	242	S	7/21/1976
182	613427149395201	230	S	7/8/1985
184	613439149394601	205	S	7/1/1971
185	613624149394001	281	S	4/17/1982
187	613716149393601	273	S	3/8/1985
190	612955149385101	123	S	11/9/1982
191	613431149391101	225	S	11/20/1976
192	613656149391602	295	S	8/9/1958
193	612955149382801	101	S	12/20/1982
194	613617149383801	293	S	7/1/1972
195	613519149382801	277	S	5/25/1983
196	612943149375901	87	S	5/20/1985
197	613628149382501	319	S	1/1/1975
198	613638149381001	280	S	1/1/1977
199	613641149380901	316	S	1/1/1977
200	613426149385501	319	S	12/7/1976
201	613515149374901	277	S	7/14/1983
202	613611149374201	317	S	1/1/1977
203	613544149372801	279	S	6/1/1978
204	613802149372401	333	S	7/9/1977
205	613803149372001	376	S	7/25/1986
206	613545149365801	309	S	1/1/1965
207	613138149363501	219	S	9/5/1983
208	613618149364501	321	S	7/3/1984
209	613615149362001	326	S	4/11/1984

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
210	613627149360501	325	S	11/2/1983
211	613357149355201	272	S	5/23/1983
212	613439149355501	277	S	8/29/1985
213	613143149354901	212	S	12/4/1974
214	613156149353701	198	S	3/11/1975
215	613159149352101	213	S	3/1/1975
216	613218149352101	225	S	3/17/1984
217	613234149351401	224	S	3/20/1982
218	613836149353301	295	S	6/28/1975
219	613817149352601	350	S	10/31/1985
220	613257149345401	225.56	M	5/26/1999
221	613822149350501	331	S	6/20/1985
222	613243149342701	226	S	3/3/1984
223	613818149344401	299	S	6/16/1982
224	613827149343201	333	S	7/6/1981
225	613510149340701	312	S	8/1/1955
226	613212149334501	202	S	8/22/1962
227	613827149341401	323	S	5/15/1983
228	613834149341301	289	S	9/8/1982
229	613437149335301	323	S	8/18/1982
230	613833149341101	346	S	7/22/1981
231	613653149335201	380	S	10/28/1979
232	613146149332501	133	S	6/6/1984
233	613507149331102	327	S	2/1/1977
234	613515149330501	330	S	6/5/1986
235	613257149325001	252	S	3/21/1983
236	613142149322501	135	S	5/23/1984
237	613834149325801	297	S	4/13/1982
238	613303149322401	296	S	8/7/1982
239	613236149321901	222	S	8/11/1951
240	613309149321701	240	S	8/15/1985
241	613242149320201	236	S	1/1/1965
242	613314149315801	248	S	7/7/1986
243	613822149321601	349	S	7/13/1984
244	613314149314901	266	S	5/2/1983
245	613818149321201	347	S	7/7/1988
246	613822149320901	349	S	7/13/1984
247	613207149313501	174	S	1/28/1982
248	613314149312901	259	S	7/23/1984
249	613751149313901	350	S	8/27/1984
250	613155149310101	123	S	6/15/1983
251	613327149295901	271	S	11/22/1983
252	613506149295401	365	S	7/29/1985
253	613425149294301	308	S	10/17/1979
254	613441149293301	323	S	4/26/1984
255	613441149293201	324	S	4/4/1984
256	613929149295501	496	S	9/10/1974
257	613441149292801	317	S	12/4/1989
258	613450149292501	330	S	10/12/1982
259	613519149292101	348	S	5/1/1985
260	613440149291301	325	S	10/8/1982
261	613827149292901	396	S	2/14/1976
262	613820149292201	398	S	12/23/1984
263	613446149290401	317	S	7/1/1956
264	613553149290801	415	S	8/28/1975
265	613618149291001	429	S	5/27/1985
266	613513149290001	412	S	11/11/1983
267	613441149284601	317	S	7/28/1972
268	613441149283902	315	S	1/1/1969
269	613653149284201	394	S	5/31/1984
270	613700149283601	401	S	4/15/1985
271	613441149282001	306	S	7/24/1981
272	613617149282501	440	S	11/22/1985
273	613602149282001	413	S	3/3/1978
274	613654149282201	395	S	5/7/1984
275	613509149281301	328	S	7/22/1983
276	613511149281101	286	S	4/28/1984
277	613655149281601	400	S	5/31/1984
278	613647149281401	398	S	11/29/1982
279	613648149281401	394	S	6/1/1983
280	613703149281401	441	S	7/10/1983
281	613653149281301	395	S	8/23/1985
282	613611149280901	442	S	11/20/1982
283	613706149281301	399	S	5/15/1984
284	613708149281201	405	S	9/30/1983
285	613643149280701	395	S	12/15/1982
286	613650149280701	397	S	5/1/1983
287	613646149280601	405	S	9/21/1982
288	613336149274701	265	S	8/24/1962
289	613646149275901	400	S	12/8/1982
290	613709149280001	396	S	10/29/1983
291	613641149275401	403	S	12/18/1982
292	613617149275201	412	S	4/11/1985
293	613640149275301	399	S	12/15/1982
294	613650149275201	405	S	12/9/1982
295	613444149273901	293	S	4/4/1984
297	613651149274801	410	S	8/12/1982
298	613644149274701	405	S	8/7/1982
299	613450149273701	323	S	8/21/1977
300	613532149273101	384	S	5/30/1978
301	613427149272401	315	S	3/31/1973
302	613649149273301	404	S	8/5/1982

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
303	613648149272501	410	S	8/5/1982
304	613459149271301	320	S	9/27/1973
305	613552149271701	393	S	8/13/1983
306	613612149271801	404	S	8/13/1984
307	613619149271601	370	S	7/31/1978
308	613552149271001	403	S	5/23/1978
309	613708149271601	424	S	3/30/1985
310	613735149271801	438	S	7/11/1985
311	613352149265701	294	S	1/1/1949
312	613708149271201	421	S	4/1/1985
313	613504149270401	322	S	1/1/1977
315	613714149270501	419	S	4/7/1985
316	613643149265901	376	S	6/9/1986
317	613444149264801	317	S	11/14/1983
319	613456149264501	313	S	1/1/1967
320	613444149264401	320	S	7/20/1983
321	613641149265301	404	S	3/24/1983
322	613451149265501	315	S	11/21/1974
323	613454149264001	320	S	7/1/1952
324	613448149263901	318	S	12/1/1976
325	613649149264401	428	S	6/3/1983
326	613453149262801	312	S	4/1/1949
327	613451149262604	310	S	4/18/1975
328	613707149263401	418	S	4/12/1985
329	613707149263101	440	S	4/18/1985
330	613449149262002	310	S	7/1/1953
331	613617149262501	399	S	6/9/1983
332	613648149262401	451	S	8/12/1982
333	613448149261001	316	S	5/7/1983
334	613621149261701	405	S	9/29/1977
335	613634149261001	401	S	4/15/1984
336	613657149261101	388	S	6/10/1985
337	613650149261001	395	S	2/22/1985
338	613443149260001	315	S	8/1/1983
339	613632149260801	395	S	8/22/1985
340	613628149260601	416	S	6/2/1984
341	613628149260401	404	S	10/15/1983
342	613715149260401	447	S	4/17/1985
343	613731149260401	448	S	10/3/1983
344	613812149260501	442	S	11/5/1984
345	613459149254801	331	S	12/11/1977
346	613732149255701	445	S	1/14/1985
347	613740149255501	445	S	2/14/1985
348	613733149255201	447	S	6/2/1984
349	613735149255101	461	S	4/19/1984
350	613743149255101	460	S	2/9/1984
351	613628149254501	400	S	8/21/1984
352	613735149255001	457	S	4/18/1984
353	613645149254201	471	S	4/5/1983
354	613342149252701	180	S	5/16/1983
356	613732149254401	437	S	3/20/1984
357	613742149254401	440	S	2/17/1984
358	613740149254101	443	S	5/19/1984
359	613718149252601	436	S	5/28/1986
360	613641149252201	472	S	7/4/1983
361	613658149252201	420	S	3/26/1985
362	613415149250901	282	S	9/5/1978
363	613724149252301	446	S	7/8/1983
364	613656149252001	415	S	2/27/1985
366	613724149251901	442	S	4/22/1983
367	613701149251601	420	S	3/25/1985
368	613655149251501	429	S	10/17/1984
369	613417149250001	296	S	7/17/1984
370	613459149250201	315	S	7/31/1976
371	613657149251101	423	S	8/15/1984
372	613700149251101	435	S	7/18/1985
373	613703149251101	435	S	8/17/1984
374	613657149250902	435	S	2/13/1985
375	613321149245101	207	S	10/1/1955
376	613506149245401	324	S	7/15/1973
377	613658149250301	435	S	4/30/1985
378	613722149250401	453	S	5/3/1984
379	613512149245301	331	S	8/5/1967
380	613722149250201	448	S	2/20/1985
381	613726149250202	440	S	6/23/1982
382	613726149250201	446	S	5/20/1982
383	613448149244901	313	S	5/1/1977
385	613720149245601	438	S	5/2/1985
386	613329149243301	209	S	6/25/1976
387	613530149244101	345.64	M	1/1/1999
388	613721149244901	458	S	6/27/1983
389	613726149244901	443	S	6/16/1982
390	613711149244601	435	S	10/3/1984
391	613729149244701	437	S	5/23/1984
392	613721149244601	445	S	4/17/1984
393	613529149243701	350	S	5/31/1977
394	613717149244201	422	S	4/5/1985
395	613327149242401	204	S	8/1/1955
396	613711149244101	440	S	12/27/1983
397	613725149244201	464	S	10/25/1981
398	613729149244201	470	S	3/17/1982
399	613714149243701	425	S	2/12/1984

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
400	613526149242701	352	S	9/14/1976
401	613529149242701	340	S	4/10/1976
402	613719149243401	456	S	10/19/1983
403	613721149243401	480	S	8/2/1984
404	613738149243501	476	S	6/3/1982
405	613738149243502	463	S	7/8/1982
406	613714149243301	420	S	5/3/1984
407	613627149242901	366	S	8/9/1984
408	613742149243401	463	S	8/10/1983
409	613628149242701	369	S	8/16/1984
410	613629149242601	384	S	8/1/1985
411	613715149242901	444	S	5/2/1984
412	613712149242701	440	S	6/19/1984
413	613714149242601	432	S	5/2/1984
414	613630149242201	372	S	8/14/1984
415	613659149242301	435	S	9/7/1984
416	613721149242301	456	S	11/21/1983
417	613630149241801	390	S	7/18/1982
418	613718149242102	448	S	12/23/1984
419	613659149241901	440	S	4/3/1985
420	613719149241901	470	S	10/3/1984
421	613644149241601	406	S	7/24/1982
422	613527149240901	353	S	10/6/1984
423	613528149240901	355	S	10/5/1984
424	613720149241702	469	S	10/8/1984
425	613541149240901	364	S	10/15/1983
426	613332149235901	212	S	5/4/1981
427	613542149240901	365	S	11/8/1983
428	613549149240701	361	S	5/24/1983
429	613551149240701	364	S	10/8/1983
430	613546149240602	376	S	5/19/1984
431	613546149240601	376	S	5/21/1984
432	613536149240501	380	S	5/31/1977
433	613545149240401	374	S	5/26/1977
434	613523149240201	341	S	4/1/1982
435	613653149240801	417	S	5/1/1984
436	613219149235701	427	S	5/27/1977
437	613654149240801	415	S	4/2/1984
438	613536149240101	364	S	10/1/1983
439	613545149240001	394	S	6/27/1978
440	613713149240501	435	S	9/24/1983
441	613544149235801	361	S	11/7/1984
442	613513149235501	320	S	6/27/1984
443	613554149235801	357	S	12/5/1983
444	613659149240301	445	S	6/17/1985
445	613539149235601	365	S	3/24/1984
446	613544149235601	360	S	11/8/1984
447	613553149235501	360	S	4/26/1984
448	613544149235201	362	S	8/12/1984
449	613631149235501	393	S	8/4/1982
450	613555149235201	368	S	12/3/1984
451	613710149235501	417	S	6/28/1982
452	613543149234801	363	S	9/28/1984
453	613649149235301	443	S	6/23/1982
454	613546149234801	417	S	9/14/1976
455	613542149234701	389	S	3/26/1980
456	613730149235501	454	S	3/26/1985
457	613555149234701	363	S	10/23/1983
458	613555149234703	365	S	10/20/1983
459	613546149234601	373	S	10/11/1985
460	613727149235301	461	S	10/19/1983
461	613541149234401	364	S	9/23/1984
462	613550149234401	362	S	5/30/1985
463	613535149234201	366	S	6/6/1977
464	613644149234701	406	S	10/19/1982
465	613538149234101	357	S	5/28/1986
466	613533149234001	387	S	1/22/1981
467	613706149234701	420	S	4/21/1983
468	613555149234101	399	S	7/19/1984
469	613551149234001	363	S	10/18/1983
470	613555149234001	368	S	10/19/1983
471	613452149233401	282	S	6/13/1984
472	613548149233801	364	S	2/24/1984
473	613549149233701	366	S	2/17/1984
474	613655149234001	443	S	9/12/1984
475	613542149233401	365	S	5/4/1983
476	613549149233401	375	S	7/18/1984
477	613541149233301	374	S	7/26/1984
478	613549149233301	365	S	3/13/1984
479	613508149232901	316	S	7/18/1977
480	613553149233101	367	S	8/5/1985
481	613542149232801	359	S	5/13/1981
482	613731149233201	458	S	7/20/1985
483	613550149232401	366	S	5/15/1984
484	613551149232401	367	S	5/17/1984
485	613647149232701	404	S	4/30/1982
486	613347149231201	226	S	10/10/1983
487	613709149232701	438	S	4/10/1985
488	613550149232001	365	S	7/17/1985
489	613727149232701	456	S	4/3/1984
490	613703149232501	445	S	10/22/1984
491	613540149231701	365	S	8/26/1983

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
492	613632149232001	449	S	7/24/1979
493	613725149232401	446	S	11/23/1984
494	613647149232101	403	S	4/27/1982
495	613714149232201	442	S	4/30/1985
496	613710149232101	447	S	6/2/1982
497	613737149232001	458	S	4/24/1985
498	613732149231901	487	S	10/9/1985
499	613724149231801	448	S	11/9/1984
500	613730149231801	460	S	10/24/1984
501	613723149231701	445	S	11/9/1984
502	613704149230901	438	S	7/3/1985
503	613700149230401	444	S	12/2/1985
504	613704149225901	438	S	8/5/1985
505	613434149224501	267	S	8/8/1983
506	613704149225501	434	S	5/2/1985
507	613553149224701	364	S	4/27/1984
508	613555149224701	365	S	2/18/1985
509	613551149224601	362	S	4/27/1984
510	613727149225201	452	S	7/25/1985
511	613437149223801	254	S	7/21/1981
512	613539149223901	364	S	12/5/1984
513	613559149223401	362	S	2/25/1985
514	613431149221801	313	S	6/8/1982
515	613410149221201	261	S	7/7/1983
516	613431149221101	292	S	6/15/1982
517	613410149220402	262	S	7/9/1983
518	613542149220801	304	S	7/13/1984
519	613409149215701	216	S	2/27/1984
520	613734149220101	452	S	1/1/1977
521	613616149214001	432	S	4/9/1976
522	613554149212501	351	S	5/17/1984
523	613552149211401	322	S	7/6/1983
524	613417149210501	235	S	7/18/1949
525	613334149210101	199	S	7/1/1949
526	613436149205001	336	S	4/26/1984
527	613538149205401	318	S	7/5/1983
528	613322149203201	57	S	1/1/1977
529	613316149202701	54	S	6/27/1975
530	613604149203101	326	S	6/8/1983
531	613618149203201	358	S	3/13/1984
532	613615149203101	350	S	9/29/1984
533	613617149203101	362	S	3/13/1984
534	613621149203001	377	S	3/28/1985
535	613725149203101	430	S	7/15/1985
536	613541149202101	300	S	8/20/1982
537	613742149203001	434	S	8/16/1983
538	613743149203001	439	S	9/19/1984
539	613603149202201	315	S	1/28/1976
540	613434149201401	268	S	8/27/1985
541	613741149202701	427	S	2/9/1985
542	613743149202601	435	S	5/10/1984
543	613622149201801	363	S	5/9/1984
544	613814149202501	519	S	11/8/1983
545	613620149201601	349	S	12/5/1983
546	613742149202001	436	S	10/29/1984
547	613734149201901	427	S	9/18/1984
548	613726149201801	440	S	8/28/1984
549	613548149201001	340	S	6/3/1982
550	613623149201201	367	S	3/12/1984
551	613625149201201	368	S	12/5/1983
552	613736149201701	424	S	12/12/1984
553	613622149201101	370	S	3/12/1984
554	613742149201701	437	S	10/20/1984
555	613706149201001	400	S	5/23/1972
556	613814149201501	529	S	5/20/1983
557	613734149201001	413	S	5/14/1984
558	613615149200401	333	S	4/2/1984
559	613618149200301	345	S	4/2/1983
560	613727149200801	420	S	10/11/1986
561	613812149200902	535	S	5/20/1983
562	613812149200901	535	S	5/12/1983
563	613407149194901	248	S	8/10/1984
564	613603149195701	335	S	6/4/1974
565	613742149200401	434	S	3/26/1984
566	613735149200201	383	S	11/23/1984
567	613736149200201	425	S	8/31/1984
568	613729149195801	426	S	4/14/1982
569	613624149195001	343	S	7/7/1978
570	613447149194101	300	S	12/17/1985
571	613735149195001	412	S	10/17/1983
572	613738149194501	433	S	4/10/1984
573	613642149193701	365	S	8/29/1983
574	613617149193501	357	S	7/2/1983
575	613644149193701	363	S	8/31/1983
576	613608149193301	329	S	4/3/1984
577	613513149192201	319	S	6/4/1980
579	613516149191501	360	S	6/1/1979
580	613515149191301	290	S	10/28/1983
581	613716149192201	429	S	5/31/1983
582	613710149191901	380	S	6/4/1984
583	613745149191801	445	S	11/7/1984
584	613510149190401	307	S	11/23/1983

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
585	613408149185901	136	S	4/28/1979
586	613650149191101	360	S	9/19/1983
587	613748149191501	449	S	6/14/1984
588	613641149190801	357	S	4/27/1976
589	613641149190802	336	S	10/22/1983
590	613624149190501	337	S	5/4/1984
591	613655149190701	364	S	8/13/1983
592	613622149190201	369	S	10/22/1984
593	613637149190301	362	S	5/3/1984
594	613657149190201	363	S	6/8/1984
595	613506149185301	297	S	5/17/1982
596	613637149185603	357	S	5/4/1984
598	613533149184801	312	S	7/8/1984
599	613444149184201	273	S	7/2/1983
600	613849149185901	544	S	8/10/1984
601	613642149184801	358	S	4/11/1976
602	613646149184701	371	S	4/9/1983
603	613919149185601	615	S	4/15/1983
604	613645149184401	334	S	10/27/1983
605	613417149183201	145	S	8/27/1975
606	613643149184201	344	S	10/19/1981
607	613536149183601	333	S	10/13/1984
608	613536149183501	355	S	8/6/1979
609	613716149184201	367	S	2/11/1986
610	613640149183901	355	S	1/13/1985
611	613608149183201	323	S	7/31/1975
612	613515149182701	305	S	7/11/1978
613	613643149183001	360	S	3/13/1984
614	613623149182601	329	S	12/8/1983
615	613630149182601	354	S	9/23/1983
616	613401149181301	134	S	6/25/1988
617	613637149182301	343	S	5/17/1976
618	613637149182302	347	S	4/1/1982
619	613505149181501	296	S	8/1/1974
620	613332149180801	155	S	3/29/1982
621	613440149181201	191	S	8/2/1978
622	613432149180301	146	S	3/4/1985
623	613523149180601	313	S	6/11/1984
624	613529149180601	335	S	3/22/1978
625	613701149181101	358	S	6/19/1981
626	613509149180101	290	S	9/19/1977
627	613650149180601	397	S	8/6/1983
628	613340149174601	148.26	M	10/28/1953
629	613654149175901	371	S	11/30/1984
630	613507149174901	261	S	10/10/1975
631	613423149174201	173	S	9/16/1976
632	613441149174101	195	S	8/19/1982
633	613450149173401	146	S	11/1/1982
634	613639149173301	345	S	7/6/1983
635	613431149172201	184	S	10/1/1935
636	613335149171701	140	S	10/1/1945
637	613648149172401	353	S	7/8/1983
638	613555149172001	331	S	6/13/1984
639	613533149171701	281	S	5/11/1984
640	613740149171701	395	S	10/5/1984
641	613912149171901	548	S	8/29/1975
642	613636149170501	333	S	8/23/1983
643	613636149170001	335	S	7/28/1981
644	613441149165001	195	S	2/7/1975
645	613530149165301	244	S	11/18/1986
646	613911149170601	557	S	9/5/1975
647	613532149164301	248	S	5/19/1987
648	613636149164601	294	S	9/16/1986
649	613546149164301	331	S	8/29/1983
650	613434149163301	255	S	10/24/1981
651	613545149163301	317	S	3/7/1984
652	613528149163101	265	S	4/28/1986
653	613437149162701	202	S	8/4/1984
654	613911149164601	513	S	8/29/1975
655	613831149163701	500	S	7/31/1984
656	613606149161901	340	S	4/23/1981
657	613733149162401	400	S	9/13/1980
658	613601149161701	333	S	11/12/1984
659	613609149161401	364	S	5/14/1975
660	613637149161501	353	S	3/20/1987
661	613643149161301	346	S	7/11/1983
662	613347149155901	122.28	M	7/18/1950
663	613324149155701	26	S	6/3/1986
664	613829149161801	509	S	7/21/1987
665	613726149161301	388	S	5/8/1982
666	613615149160401	338	S	8/5/1980
667	613729149160501	375	S	5/8/1982
668	613407149154601	151	S	9/14/1950
669	613720149155901	365	S	1/30/1984
670	613752149160101	386	S	4/11/1971
671	613618149155402	336	S	8/10/1977
672	613707149155401	365	S	7/28/1983
673	613549149154801	292	S	11/10/1983
674	613338149153801	80	S	3/9/1983
675	613619149154901	327	S	10/1/1976
676	613712149155101	362	S	3/15/1985
677	613705149155001	383	S	5/8/1981

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
678	613324149153101	6	S	5/28/1983
679	613544149154101	296	S	11/6/1984
680	613714149154501	407	S	7/25/1978
681	613735149154401	405	S	7/11/1980
682	613554149153401	285	S	12/1/1984
683	613555149153401	285	S	12/1/1984
684	613736149154101	393	S	7/15/1980
685	613548149153301	288	S	5/23/1984
686	613654149153701	338	S	11/28/1980
687	613621149153201	341	S	10/4/1983
688	613326149151901	33	S	8/24/1983
689	613550149152901	294	S	11/8/1984
690	613742149153701	406	S	3/29/1983
691	613622149153101	339	S	9/25/1985
694	613406149152101	151.18	M	7/17/1974
695	613713149153401	357	S	5/31/1985
696	613553149152801	276	S	11/29/1984
697	613745149153601	403	S	5/5/1986
698	613549149152601	250	S	11/7/1984
699	613635149152901	337	S	11/7/1983
700	613326149151401	41	S	5/28/1983
701	613732149153002	365	S	4/28/1983
702	613548149152201	265	S	6/17/1984
703	613557149152201	278	S	8/16/1985
704	613631149152401	330	S	4/26/1984
705	613554149152101	269	S	4/4/1984
706	613324149151001	25	S	3/19/1983
707	613554149151901	285	S	5/29/1984
708	613548149151801	259	S	11/30/1984
709	613403149151001	145.31	M	8/5/1985
710	613545149151601	253	S	5/2/1985
711	613548149151601	253	S	10/29/1985
712	613624149151701	302	S	9/8/1982
713	613639149151801	351	S	9/25/1985
714	613423149150801	176	S	7/11/1955
715	613629149151701	335	S	9/9/1985
716	613548149151401	252	S	1/21/1985
718	613641149151601	320	S	3/10/1984
719	613729149151901	398	S	7/1/1984
720	613423149150501	191	S	3/28/1984
721	613355149150101	99	S	7/1/1947
722	613705149151201	397	S	8/4/1979
724	613425149145701	205	S	6/13/1983
725	613532149145701	255	S	8/19/1983
727	613656149145601	343.18	M	7/15/1949
728	613551149145001	291	S	8/18/1982
729	613341149144001	76.31	M	7/29/1964
730	613433149144201	199	S	10/23/1980
731	613536149144101	260	S	6/19/1978
732	613605149144301	280	S	10/15/1976
733	613525149143601	254	S	11/2/1982
734	613522149143401	245	S	3/11/1983
735	613602149143401	290	S	9/17/1973
736	613521149143101	250	S	10/18/1982
737	613524149143001	251	S	12/21/1982
738	613532149143001	258	S	6/18/1983
739	613526149142901	254	S	12/22/1982
740	613527149142901	260	S	10/20/1982
741	613516149142601	250	S	8/3/1982
742	613522149142601	235	S	10/1/1982
743	613527149142301	270	S	8/2/1982
744	613530149142301	270	S	3/28/1983
745	613531149142301	272	S	10/19/1982
746	613533149142301	275	S	1/17/1983
747	613528149142201	258	S	9/11/1984
748	613319149141101	-13	S	7/27/1970
749	613528149141501	265	S	8/2/1982
750	613531149141501	275	S	11/21/1982
751	613524149141401	262	S	10/19/1982
752	613525149141401	245	S	10/21/1982
753	613533149141401	278	S	10/20/1982
754	613441149141001	221	S	7/10/1981
755	613618149140901	318	S	6/29/1985
756	613708149140902	310	S	3/26/1936
760	613305149133101	30	S	5/9/1973
761	613311149132701	47	S	8/11/1986
763	613537149133001	282	S	5/11/1984
766	613556149131301	314	S	4/3/1984
768	613541149130701	275	S	9/19/1984
769	613710179130901	376	S	10/31/1985
770	613658149125801	359	S	8/22/1984
771	613713149125901	388	S	1/20/1985
772	613659149125501	351	S	6/25/1984
776	613700149123801	342	S	8/24/1983
779	613717149122601	365	S	7/3/1985
780	613542149121601	281	S	10/4/1984
781	613708149122101	380	S	3/26/1985
782	613837149122701	493	S	8/8/1983
784	613540149121001	264	S	8/10/1983
785	613837149122101	475	S	8/5/1985
788	613554149120501	279	S	4/9/1984
789	613920149121901	537	S	10/10/1985

Appendix 1.—Continued

[S, one water-level measurement available and usually the water-level measurement taken at the time of drilling; values reported to precision of measurement; M, multiple water-level measurements available]

Map ID	USGS Station ID	Water-level altitude (feet)		Date
790	613704149120602	374	S	8/12/1982
791	613551149115901	260	S	7/20/1983
792	613707149120001	375	S	7/15/1982
793	613703149115901	383	S	8/6/1982
794	613710149115901	370	S	4/6/1983
795	613710149115701	369	S	8/1/1985
796	613706149115601	374	S	6/14/1983
797	613713149115602	374	S	12/27/1983
798	613707149115201	378	S	1/15/1983
799	613555149114601	279	S	10/18/1983
800	613551149114501	261	S	2/4/1984
801	613748149114501	419	S	6/13/1985
802	613307149112501	22	S	7/5/1984
803	613553149113601	254	S	5/27/1982
804	613324149112501	70	S	5/3/1985
805	613326149112501	28	S	4/5/1980
806	613603149113401	305	S	9/1/1954
807	613750149113901	405	S	6/14/1985
808	613747149113701	387	S	8/19/1985
809	613834149113601	503	S	3/12/1985
810	613635149112501	335	S	6/12/1981
811	613552149112101	269	S	4/28/1983
812	613309149110701	115	S	4/19/1978
813	613339149110701	127	S	7/13/1985
814	613545149111301	301	S	6/11/1983
815	613558149111201	275	S	8/8/1983
816	613913149112501	531	S	9/10/1983
817	613337149110001	50	S	12/9/1978
818	613625149111101	345	S	3/21/1976
819	613330149105501	35	S	10/24/1974
820	613555149110201	260	S	5/14/1985
821	613556149110001	267	S	6/15/1985
822	613312149104601	24	S	2/4/1972
823	613909149111101	532	S	11/10/1982
824	613303149104501	31	S	6/14/1979
825	613755149110301	425	S	8/2/1983
826	613551149105401	240	S	7/19/1983
827	613910149110701	537	S	9/3/1985
828	613558149104901	246	S	9/3/1983
829	613757149105501	444	S	5/26/1986
830	613546149104101	193	S	10/19/1984
831	613543149104001	209	S	11/13/1982
832	613757149104401	408	S	7/30/1986
833	613759149104101	425	S	8/15/1985
834	613753149103901	445	S	9/30/1977
835	613719149102501	372	S	8/1/1979
836	613725149101202	402	S	3/1/1953
837	613819149100701	452	S	5/11/1984
838	613822149100701	470	S	7/29/1976
839	613715149100102	381	S	6/13/1967
840	613827149100501	478	S	1/26/1983
841	613818149100201	460	S	10/30/1984
843	613820149095301	464	S	8/1/1951
846	613746149093901	420	S	9/18/1978
847	613742149093201	424	S	5/26/1983
848	613830149093301	482	S	1/1/1949

Appendix 2. Water-quality data for surface-water sites sampled in 2005, Matanuska-Susitna Valley, Alaska

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	USGS Station ID	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time	P81903 Depth to bottom from water surface, at sampling location, feet
48	613215149522600	BIG LK S OF LONG IS NR WASILLA AK	61.537	-149.876	08/02/2005	1320	50.9
48	613215149522600	BIG LK S OF LONG IS NR WASILLA AK	61.537	-149.876	08/02/2005	1310	50.9
48	613215149522600	BIG LK S OF LONG IS NR WASILLA AK	61.537	-149.876	09/08/2005	1400	50.9
48	613215149522600	BIG LK S OF LONG IS NR WASILLA AK	61.537	-149.876	09/08/2005	1420	50.9
578	613551149192900	COTTONWOOD LK N COLONIAL PARK LAUNCH NR WASILLA AK	61.598	-149.325	08/11/2005	1340	34.8
578	613551149192900	COTTONWOOD LK N COLONIAL PARK LAUNCH NR WASILLA AK	61.598	-149.325	08/11/2005	1350	34.8
578	613551149192900	COTTONWOOD LK N COLONIAL PARK LAUNCH NR WASILLA AK	61.598	-149.325	09/13/2005	1300	36.1
296	613441149273800	LUCILE LK (STA 2) AT WASILLA AK	61.578	-149.463	08/15/2005	1355	18.4
296	613441149273800	LUCILE LK (STA 2) AT WASILLA AK	61.578	-149.463	08/15/2005	1410	18.4
296	613441149273800	LUCILE LK (STA 2) AT WASILLA AK	61.578	-149.463	09/08/2005	1930	19.0
314	613451149265700	LUCILE LK SPRING AREA NE CORNER AT WASILLA AK	61.580	-149.451	09/15/2005	1820	6.6
384	613736149250000	MEMORY LKNR WASILLA AK	61.626	-149.419	08/11/2005	1750	19.7
384	613736149250000	MEMORY LKNR WASILLA AK	61.626	-149.419	08/11/2005	1740	19.7
384	613736149250000	MEMORY LKNR WASILLA AK	61.626	-149.419	09/15/2005	1610	20.7
183	613623149400100	SEYMOUR LK NR HOUSTON AK	61.606	-149.669	08/15/2005	1130	16.7
183	613623149400100	SEYMOUR LK NR HOUSTON AK	61.606	-149.669	08/15/2005	1140	16.7
183	613623149400100	SEYMOUR LK NR HOUSTON AK	61.606	-149.669	09/13/2005	1520	18.0

Appendix 2.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P72016 Depth to bottom of sampling interval, feet	P72015 Depth to top of sampling interval, feet	P00003 Sampling depth, feet	P49701 Transparency, water, unfiltered, Secchi disc, feet	P00025 Barometric pressure, millimeters of mercury	P00400 pH, water, unfiltered, field, standard units	P00403 pH, water, unfiltered, laboratory, standard units	P90095 Specific conductance, water, unfiltered, laboratory, microsiemens per centimeter at 25 degrees Celsius
48	16.4	3.3		17.5	761	8.0	8.0	139
48			49.2	17.5	761			
48	19.7	3.3		20.2	768	8.1		
48			45.9	20.2	768	7.2		
578	6.6	3.3		16.0	764	8.6	8.3	182
578			29.5	16.0	764	7.6		
578			16.4	12.0	758			
296	9.8	3.3		15.0	755	9.0	8.8	199
296			14.8	15.0	755	8.4		
296			9.8	15.5	768			
314			4.9		749	7.5		
384			16.4	19.0	759			
384	9.8	3.3		19.0	759	7.9	7.4	78
384			9.8	15.4		7.5		
183	9.8	3.3		7.0	755	8.1	8.1	138
183			13.1	7.0	755	8.0		
183			9.8	17.0	757	8.1		

Appendix 2.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00915 Calcium, water, filtered, milligrams per liter	P00925 Magnesium, water, filtered, milligrams per liter	P00935 Potassium, water, filtered, milligrams per liter	P00930 Sodium, water, filtered, milligrams per liter	P39036 Alkalinity, water, filtered, fixed endpoint (pH 4.5) titration, field, milligrams per liter as calcium carbonate	P29801 Alkalinity, water, filtered, fixed endpoint (pH 4.5) titration, laboratory, milligrams per liter as calcium carbonate	P39086 Alkalinity, water, filtered, incremental titration, field, milligrams per liter as calcium carbonate	P00453 Bicarbonate, water, filtered, incremental titration, field, milligrams per liter
48	143	18.0	21.2	3.50	0.74	2.75		65	63	76
48	167	18.0								
48	144	11.5								
48	174	11.5								
578	184	20.5	28.0	4.78	0.94	3.68		82	84	
578	272	20.5								
578	209	17.5								
296	212	18.0	19.4	6.68	1.02	8.61		58	54	
296	213	18.0								
296	229	11.1					71		69	78
314	392	12.5								
384		22.5								
384	76	22.5	8.48	2.48	0.92	2.16		34	32	38
384	73	10.5								
183		20.2	22.3	3.22	0.91	2.46		70	64	78
183		20.2								
183	146	18.3								

Appendix 2.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00452 Carbonate, water, filtered, incremental titration, field, milligrams per liter	P00940 Chloride, water, filtered, milligrams per liter	R00950	P00950 Fluoride, water, filtered, milligrams per liter	P00955 Silica, water, filtered, milligrams per liter	R00945	P00945 Sulfate, water, filtered, milligrams per liter	P70300 Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter	R00608	P00608 Ammonia, water, filtered, milligrams per liter as nitrogen	R00631
48		4.74	<	0.1	6.48		1.3	87	<	0.010	<
48										0.160	<
48									<	0.010	<
48										0.300	<
578		6.50	<	0.1	5.58		3.1	117	<	0.010	<
578										1.680	<
578										0.068	
296		26.70	<	0.1	2.63		4.1	112		0.031	<
296										0.051	<
296	14									0.067	
314										0.029	
384									E	0.006	<
384		2.86	<	0.1	0.34	E	0.1	56	E	0.006	<
384										0.095	E
183		3.55	<	0.1	2.77		0.9	73	E	0.005	<
183									<	0.010	<
183										0.054	

Appendix 2.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00631 Nitrite plus nitrate, water, filtered, milligrams per liter as nitrogen	R00613	P00613 Nitrite, water, filtered, milligrams per liter as nitrogen	P62854 Total nitrogen (nitrate + nitrite + ammonia + organic-N), water, filtered, analytically determined, milligrams per liter	P62855 Total nitrogen (nitrate + nitrite + ammonia + organic-N), water, unfiltered, analytically determined, milligrams per liter		P00671 Orthophosphate, water, filtered, milligrams per liter as phosphorus	R00666	P00666 Phosphorus, water, filtered, milligrams per liter	P00665 Phosphorus, water, unfiltered, milligrams per liter
48	0.016	<	0.002	0.32	0.20	<	0.006	E	0.002	0.007
48	0.016	E	0.001	0.56	0.34	E	0.005		0.017	0.043
48	0.016	<	0.002	0.36	0.20	<	0.006	E	0.004	0.008
48	0.016	E	0.001	0.63	0.51		0.023		0.052	0.081
578	0.016	E	0.001	0.40	0.29	<	0.006		0.005	0.009
578	0.016		0.002	2.28	2.35	<	0.006		0.006	0.044
578	0.034		0.002	0.71	0.42	<	0.006	<	0.004	0.013
296	0.016	E	0.001	0.62	0.52	<	0.006		0.007	0.010
296	0.016	E	0.001	0.82	0.60	<	0.006		0.009	0.013
296	0.021		0.002	0.58	0.64	<	0.006		0.009	0.030
314	1.95		0.004	2.39	2.58		0.006	E	0.004	0.069
384	0.016	E	0.001	0.70	0.32	<	0.006		0.006	0.004
384	0.016	E	0.001	0.73	0.32	<	0.006		0.005	0.004
384	0.012	E	0.001	0.83	0.66	<	0.006	E	0.002	0.010
183	0.016	E	0.001	0.52	0.41	<	0.006	E	0.003	0.007
183	0.016	<	0.002	0.53	0.41	<	0.006	E	0.003	0.014
183	0.016	E	0.001	0.60	0.40	<	0.006	E	0.004	0.007

Appendix 2.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00681 Organic carbon, water, filtered, milligrams per liter	P01046 Iron, water, filtered, micrograms per liter	R01056	P01056 Manganese, water, filtered, micrograms per liter	P82082 Deuterium/Protium ratio, water, unfiltered, per mil	P82085 Oxygen-18/Oxygen-16 ratio, water, unfiltered, per mil
48	3.6	9	E	0.4	-114	-12.85
48	4.0				-116	-13.72
48	3.9					
48	4.2				-116	-13.72
578	3.6	6		0.8	-120	-14.30
578	3.1				-126	-15.71
578	3.8				-121	-14.39
296	5.2	10		2.3	-108	-11.88
296	5.1				-108	-11.93
296	4.1				-108	-11.96
314	3.8				-118	-14.08
384	7.0				-91.6	-8.41
384	7.3	19		0.6	-91.1	-8.36
384	9.2				-92.4	-8.57
183	4.8	13		0.9	-96.1	-9.38
183	4.4				-96.6	-9.44
183	3.7				-95.4	-9.57

Appendix 3. Water-quality data for surface-water sites sampled in 2005, Matanuska-Susitna Valley, Alaska

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	Station ID	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time	P81903 Depth to bottom from water surface, at sampling location, feet	P00098 Sampling depth below surface, feet
48	613215149522600	BIG LAKE SOUTH OF LONG ISLAND NEAR WASILLA ALASKA	61.537	-149.876	08/02/2005	1200	50.9	1.6
					08/02/2005	1202	50.9	3.3
					08/02/2005	1204	50.9	6.6
					08/02/2005	1206	50.9	9.8
					08/02/2005	1208	50.9	13.1
					08/02/2005	1210	50.9	16.4
					08/02/2005	1212	50.9	19.7
					08/02/2005	1214	50.9	23.0
					08/02/2005	1216	50.9	26.2
					08/02/2005	1218	50.9	29.5
					08/02/2005	1220	50.9	32.8
					08/02/2005	1222	50.9	36.1
					08/02/2005	1224	50.9	39.4
					08/02/2005	1226	50.9	42.7
					08/02/2005	1228	50.9	45.9
					08/02/2005	1230	50.9	49.2
					08/02/2005	1232	50.9	50.9
48	613215149522600	BIG LAKE SOUTH OF LONG ISLAND NEAR WASILLA ALASKA	61.537	-149.876	09/08/2005	1250	50.9	0.7
					09/08/2005	1252	50.9	1.6
					09/08/2005	1254	50.9	3.3
					09/08/2005	1256	50.9	4.9
					09/08/2005	1258	50.9	6.6
					09/08/2005	1300	50.9	9.8
					09/08/2005	1302	50.9	13.1
					09/08/2005	1304	50.9	16.4
					09/08/2005	1306	50.9	19.7
					09/08/2005	1308	50.9	23.0
					09/08/2005	1310	50.9	26.2
					09/08/2005	1312	50.9	29.5
					09/08/2005	1314	50.9	32.8
					09/08/2005	1316	50.9	36.1
					09/08/2005	1318	50.9	39.4
					09/08/2005	1320	50.9	42.7
					09/08/2005	1322	50.9	45.9
					09/08/2005	1324	50.9	49.2
					09/08/2005	1326	50.9	50.9

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00025 Barometric pressure, millimeters of mercury	P00300 Dissolved oxygen, water, unfiltered, milligrams per liter	P00400 pH, water, unfiltered, field, standard units	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00010 Temperature, water, degrees Celsius	P32234 Chlorophyll, total, phytoplankton, spectrophotometric method, uncorrected, micrograms per liter
48	761	7.7	8.1	143	18.0	18.8	
	761	8.8	8.0	143	18.0	18.8	
	761	8.6	8.0	143	18.0	18.4	
	761	8.5	8.0	143	18.0	18.3	
	761	8.4	8.0	143	18.0	18.3	
	761	8.4	7.9	145	18.0	17.9	
	761	9.7	7.5	149	18.0	14.5	
	761	9.7	7.4	150	18.0	12.1	
	761	9.1	7.3	152	18.0	10.1	
	761	8.2	7.2	152	18.0	9.3	
	761	4.7	7.0	156	18.0	7.8	
	761	2.6	6.9	158	18.0	7.0	
	761	1.4	6.9	160	18.0	6.4	
	761	1.1	6.9	163	18.0	6.1	
	761	0.7	6.9	166	18.0	5.7	
	761	0.7	7.0	179	18.0	5.5	
	761	0.6	7.2		18.0	5.4	
48	768	9.5	8.0	145	11.5	15.0	0.9
	768	9.4	8.0	145	11.5	14.8	1.0
	768	9.4	8.0	145	11.5	14.7	1.6
	768	9.4	8.0	144	11.5	14.6	1.5
	768	9.4	8.0	145	11.5	14.6	1.5
	768	9.3	8.0	145	11.5	14.5	1.6
	768	9.4	8.0	145	11.5	14.5	2.2
	768	9.3	8.0	145	11.5	14.5	1.5
	768	9.3	8.0	145	11.5	14.4	1.8
	768	8.9	7.8	146	11.5	14.2	1.8
	768	7.2	7.2	154	11.5	11.7	1.4
	768	5.3	7.1	154	11.5	9.8	1.4
	768	2.9	7.0	156	11.5	8.6	1.8
	768	0.6	7.0	159	11.5	7.7	1.6
	768	0.1	7.0	164	11.5	6.6	2.6
	768	0.1	7.1	160	11.5	6.2	5.4
	768	0.1	7.1	174	11.5	5.8	7.8
	768	0.2	7.4	205	11.5	5.4	
	768	0.1	7.7		11.5	5.5	

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	Station ID	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time	P82903 Depth to bottom from water surface, at sampling location, feet	P00098 Sampling depth below surface, feet
578	613551149192900	COTTON-WOOD LAKE NEAR NORTH COLONIAL PARK LAUNCH NEAR WASILLA ALASKA	61.598	-149.325	08/11/2005	1254	34.8	3.3
					08/11/2005	1256	34.8	6.6
					08/11/2005	1258	34.8	9.8
					08/11/2005	1300	34.8	13.1
					08/11/2005	1302	34.8	16.4
					08/11/2005	1304	34.8	19.7
					08/11/2005	1306	34.8	23.0
					08/11/2005	1308	34.8	26.2
					08/11/2005	1310	34.8	29.5
					08/11/2005	1312	34.8	32.8
					08/11/2005	1314	34.8	34.4
578	613551149192900	COTTON-WOOD LAKE NEAR NORTH COLONIAL PARK LAUNCH NEAR WASILLA ALASK	61.598	-149.325	09/13/2005	1220	36.1	1.6
					09/13/2005	1222	36.1	3.3
					09/13/2005	1224	36.1	4.9
					09/13/2005	1226	36.1	6.6
					09/13/2005	1228	36.1	9.8
					09/13/2005	1230	36.1	13.1
					09/13/2005	1232	36.1	16.4
					09/13/2005	1234	36.1	19.7
					09/13/2005	1236	36.1	23.0
					09/13/2005	1238	36.1	26.2
					09/13/2005	1240	36.1	29.5
					09/13/2005	1242	36.1	32.8
					09/13/2005	1244	36.1	34.4
					09/13/2005	1246	36.1	35.4
296	613441149273800	LUCILE LAKE (STATION 2) AT WASILLA ALASKA	61.578	-149.463	08/15/2005	1328	18.4	0.2
					08/15/2005	1330	18.4	3.3
					08/15/2005	1332	18.4	6.6
					08/15/2005	1334	18.4	9.8
					08/15/2005	1336	18.4	11.5
					08/15/2005	1338	18.4	13.1
					08/15/2005	1340	18.4	16.4
					08/15/2005	1342	18.4	18.0

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00025 Barometric pressure, millimeters of mercury	P00300 Dissolved oxygen, water, unfiltered, milligrams per liter	P00400 pH, water, unfiltered, field, standard units	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00010 Temperature, water, degrees Celsius	P32234 Chlorophyll, total, phytoplankton, spectrophotometric method, uncorrected, micrograms per liter
578	764	11.0	8.8	184	20.5	20.9	
	764	11.2	8.8	183	20.5	20.6	
	764	10.6	8.7	188	20.5	18.6	
	764	10.2	8.7	187	20.5	17.6	
	764	9.3	8.4	190	20.5	17.0	
	764	7.6	8.0	199	20.5	16.0	
	764	1.2	7.3	235	20.5	13.9	
	764	0.8	7.2	264	20.5	10.2	
	764	0.7	7.3	286	20.5	8.7	
	764	0.6	7.2	294	20.5	8.3	
	764	0.6	6.5	403	20.5	8.0	
578	757	8.4	8.1	211	17.5	13.0	3.6
	757	8.4	8.2	211	17.5	12.9	3.9
	757	8.4	8.3	211	17.5	12.8	4.6
	757	9.2	8.5	211	17.5	12.9	4.6
	757	9.6	8.5	210	17.5	12.8	4.6
	757	8.5	8.8	211	17.5	12.8	4.2
	757	8.3	8.9	211	17.5	12.8	3.8
	757	7.9	8.8	211	17.5	12.7	3.5
	757	7.4	8.8	212	17.5	12.7	3.3
	757	7.1	8.8	212	17.5	12.6	3.7
	757	6.8	8.8	213	17.5	12.5	3.0
	757	4.9	8.6	219	17.5	12.0	4.2
	757	0.7	8.5	262	17.5	10.5	9.3
	757	0.9	8.8	340	17.5	8.8	
296	755	11.4	9.3	192	18.0	21.4	
	755	11.4	9.4	192	18.0	21.4	
	755	11.4	9.4	192	18.0	21.4	
	755	11.5	9.4	192	18.0	21.3	
	755	10.0	9.1	200	18.0	20.7	
	755	9.4	8.9	200	18.0	20.0	
	755	7.1	8.6	200	18.0	18.8	
	755	5.4	7.8	202	18.0	18.6	

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	Station ID	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time	P82903 Depth to bottom from water surface, at sampling location, feet	P00098 Sampling depth below surface, feet
296	613441149273800	LUCILE LAKE (STATION 2) AT WASILLA ALASKA	61.578	-149.463	09/08/2005	1900	19.0	0.3
					09/08/2005	1902	19.0	1.6
					09/08/2005	1904	19.0	3.3
					09/08/2005	1906	19.0	4.9
					09/08/2005	1908	19.0	6.6
					09/08/2005	1910	19.0	8.2
					09/08/2005	1912	19.0	9.8
					09/08/2005	1914	19.0	11.5
					09/08/2005	1916	19.0	13.1
					09/08/2005	1918	19.0	14.8
					09/08/2005	1920	19.0	16.4
					09/08/2005	1922	19.0	18.0
					09/08/2005	1924	19.0	19.0
314	613451149265700	LUCILE LAKE SPRING AREA NORTHEAST CORNER AT WASILLA ALASKA	61.580	-149.451	09/15/2005	1752	6.6	0.3
					09/15/2005	1754	6.6	1.6
					09/15/2005	1756	6.6	3.3
					09/15/2005	1758	6.6	3.9
					09/15/2005	1800	6.6	4.9
					09/15/2005	1802	6.6	6.6
384	613736149250000	MEMORY LAKE NEAR WASILLA ALASKA	61.626	-149.419	08/11/2005	1712	19.7	3.3
					08/11/2005	1714	19.7	6.6
					08/11/2005	1716	19.7	9.8
					08/11/2005	1718	19.7	13.1
					08/11/2005	1720	19.7	16.4
					08/11/2005	1722	19.7	18.0
					08/11/2005	1724	19.7	19.7

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00025 Barometric pressure, millimeters of mercury	P00300 Dissolved oxygen, water, unfiltered, milligrams per liter	P00400 pH, water, unfiltered, field, standard units	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00010 Temperature, water, degrees Celsius	P32234 Chlorophyll, total, phytoplankton, spectrophotometric method, uncorrected, micrograms per liter
296	768	10.1	8.9	221	11.1	14.1	2.0
	768	10.6	9.0	221	11.1	14.2	1.5
	768	10.6	8.9	222	11.1	14.0	1.5
	768	10.5	8.8	227	11.1	13.6	1.9
	768	10.7	8.9	228	11.1	13.5	1.6
	768	11.3	8.9	228	11.1	13.5	2.2
	768	11.0	8.9	229	11.1	13.5	2.3
	768	10.8	8.8	229	11.1	13.4	2.1
	768	10.5	8.8	225	11.1	13.3	1.9
	768	10.2	8.8	222	11.1	13.2	2.2
	768	10.4	8.9	220	11.1	13.1	1.9
	768	10.4	8.9	219	11.1	13.1	4.0
	768	4.5	7.9	221	11.1	13.1	
314	749	13.6	8.4	258	12.5	12.8	
	749	13.9	8.3	262	12.5	12.8	
	749	14.5	8.3	267	12.5	12.6	
	749	12.4	7.2	503	12.5	9.5	
	749	7.8	7.0	531	12.5	5.8	
	749	7.7	7.0	526	12.5	5.8	
384	759	9.0	8.0	77	22.5	21.3	
	759	9.2	7.9	77	22.5	21.0	
	759	9.4	8.0	76	22.5	19.8	
	759	8.7	7.7	76	22.5	18.8	
	759	7.0	7.3	76	22.5	18.2	
	759	3.7	6.7	86	22.5	17.8	
	759	1.0	6.7	112	22.5	17.3	

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	Station ID	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time	P82903 Depth to bottom from water surface, at sampling location, feet	P00098 Sampling depth below surface, feet
384	613736149250000	MEMORY LAKE NEAR WASILLA ALASKA	61.626	-149.419	09/15/2005	1530	20.7	0.3
					09/15/2005	1532	20.7	3.3
					09/15/2005	1534	20.7	4.9
					09/15/2005	1536	20.7	6.6
					09/15/2005	1538	20.7	8.2
					09/15/2005	1540	20.7	9.8
					09/15/2005	1542	20.7	13.1
					09/15/2005	1544	20.7	16.4
					09/15/2005	1546	20.7	19.7
					09/15/2005	1548	20.7	20.0
183	613623149400100	SEYMOUR LAKE NEAR HOUSTON ALASKA	61.606	-149.669	08/15/2005	1048	16.7	3.3
					08/15/2005	1050	16.7	6.6
					08/15/2005	1052	16.7	9.8
					08/15/2005	1054	16.7	13.1
					08/15/2005	1056	16.7	16.4
					08/15/2005	1058	16.7	16.7
183	613623149400100	SEYMOUR LAKE NEAR HOUSTON ALASKA	61.606	-149.669	09/13/2005	1450	18.0	0.7
					09/13/2005	1452	18.0	1.6
					09/13/2005	1454	18.0	3.3
					09/13/2005	1456	18.0	4.9
					09/13/2005	1458	18.0	6.6
					09/13/2005	1500	18.0	8.2
					09/13/2005	1502	18.0	9.8
					09/13/2005	1504	18.0	13.1
					09/13/2005	1506	18.0	14.8
					09/13/2005	1508	18.0	16.4
					09/13/2005	1510	18.0	17.7

Appendix 3.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00025 Barometric pressure, millimeters of mercury	P00300 Dissolved oxygen, water, unfiltered, milligrams per liter	P00400 pH, water, unfiltered, field, standard units	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00010 Temperature, water, degrees Celsius	P32234 Chlorophyll, total, phytoplankton, spectrophotometric method, uncorrected, micrograms per liter
384	748	8.7	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.3	74	10.5	13.4	
	748	8.6	7.4	74	10.5	13.4	
	748	8.6	7.4	74	10.5	13.4	
	748	8.4	7.3	74	10.5	13.4	
183	755	8.9	8.2	145	20.2	21.4	
	755	8.7	8.2	145	20.2	21.5	
	755	8.7	8.2	145	20.2	21.4	
	755	8.0	7.8	143	20.2	19.8	
	755	3.1	7.2	145	20.2	19.1	
	755	3.0	7.2	146	20.2	19.1	
183	757	7.8	8.1	147	18.3	14.0	1.1
	757	7.8	8.1	147	18.3	14.0	1.3
	757	7.8	8.1	147	18.3	13.9	1.9
	757	7.8	8.1	147	18.3	13.9	1.4
	757	7.8	8.1	146	18.3	13.8	1.4
	757	7.7	8.1	146	18.3	13.7	1.7
	757	7.6	8.1	146	18.3	13.7	1.4
	757	7.6	8.1	146	18.3	13.6	1.9
	757	7.6	8.1	146	18.3	13.6	2.0
	757	7.6	8.1	146	18.3	13.6	1.8
	757	1.7	7.7	145	18.3	13.7	

Appendix 4. Water-quality data collected from wells sampled in 2005, Matanuska-Susitna Valley, Alaska.

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	Station ID	Location	Station Name	Latitude NAD 83 Decimal Degrees	Longitude NAD 83 Decimal Degrees	Sample Date	Sample Time
26	613053149565301	Near Big Lake	SB01700435DCDC1 002	61.514	-149.944	08/03/2005	1210
26	613053149565301	Near Big Lake	SB01700435DCDC1 002	61.514	-149.944	09/16/2005	1300
62	613223149511901	Near Big Lake	SB01700329ABBD1 020	61.540	-149.855	08/01/2005	1410
62	613223149511901	Near Big Lake	SB01700329ABBD1 020	61.540	-149.855	09/09/2005	1040
67	613238149504201	Near Big Lake	SB01700320DDAD1 007	61.544	-149.844	08/09/2005	1120
67	613238149504201	Near Big Lake	SB01700320DDAD1 007	61.544	-149.844	09/12/2005	1510
254	613441149293301	Near Lucile Lake	SB01700108DBBC1 020	61.577	-149.495	08/10/2005	1310
254	613441149293301	Near Lucile Lake	SB01700108DBBC1 020	61.577	-149.495	09/14/2005	1620
318	613442149265201	Near Lucile Lake	SB01700110BCCD3 046	61.579	-149.448	08/15/2005	1800
318	613442149265201	Near Lucile Lake	SB01700110BCCD3 046	61.579	-149.448	09/09/2005	1630
299	613450149273701	Near Lucile Lake	SB01700109ACCD2 016	61.579	-149.463	08/10/2005	1625
299	613450149273701	Near Lucile Lake	SB01700109ACCD2 016	61.579	-149.463	09/13/2005	1700
598	613533149184801	Near Cottonwood Lake	SA01700105CAAA1 031	61.592	-149.315	08/08/2005	1640
598	613533149184801	Near Cottonwood Lake	SA01700105CAAA1 031	61.592	-149.315	09/14/2005	1100
549	613548149201001	Near Cottonwood Lake	SA01700106ACAA1 007	61.596	-149.338	08/09/2005	1520
549	613548149201001	Near Cottonwood Lake	SA01700106ACAA1 007	61.596	-149.338	09/14/2005	1350
597	613605149190001	Near Cottonwood Lake	SA01800132CDAC2 001	61.602	-149.317	08/08/2005	1220
186	613716149394101	Near Seymour Lake	SB01800229DAAA3 001	61.631	-149.664	08/12/2005	1440
186	613716149394101	Near Seymour Lake	SB01800229DAAA3 001	61.631	-149.664	09/13/2005	1340
189	613717149393101	Near Seymour Lake	SB01800228CBBB1 001	61.621	-149.661	08/12/2005	1700
189	613717149393101	Near Seymour Lake	SB01800228CBBB1 001	61.621	-149.661	09/13/2005	1140
188	613723149393201	Near Seymour Lake	SB01800228BCCB1 004	61.622	-149.661	08/12/2005	1130
188	613723149393201	Near Seymour Lake	SB01800228BCCB1 004	61.622	-149.661	09/13/2005	940
363	613724149252301	Near Memory Lake	SB01800127ADCA1 008	61.623	-149.425	08/05/2005	1310
363	613724149252301	Near Memory Lake	SB01800127ADCA1 008	61.623	-149.425	09/12/2005	1210
365	613728149252801	Near Memory Lake	SB01800127ADBA1 034	61.624	-149.425	08/03/2005	1600
365	613728149252801	Near Memory Lake	SB01800127ADBA1 034	61.624	-149.425	09/09/2005	1340
350	613743149255101	Near Memory Lake	SB01800127ABBD2 021	61.627	-149.433	08/05/2005	1600
350	613743149255101	Near Memory Lake	SB01800127ABBD2 021	61.627	-149.433	09/12/2005	1010

Appendix 4.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P72008 Depth of well, feet below land surface datum	P72019 Depth to water level, feet below land surface	P72000 Altitude of land surface, feet (NAVD88)	P61055 Water level, depth below measuring point, feet	P00059 Flow rate, instantaneous, gallons per minute	P72004 Pump or flow period prior to sampling, minutes	P00090 Oxidation reduction potential, millivolts	P00025 Barometric pressure, millimeters of mercury	P00300 Dissolved oxygen, water, unfiltered, milligrams per liter	P00400 pH, water, unfiltered, field, standard units
26	24.0	12.53	153.36	13.13	7.2	96		752	2.1	7.0
26	24.0	11.91	153.36	12.51	8.2		3.0	750	0.9	6.9
62	108.0	1.16	149.64	2.74	20.0	165	-87.0	759	1.0	8.4
62	108.0	0.92	149.64	2.50	20.0	49	-92.0	762	1.6	8.3
67	78.7	4.92	153.41	7.58	6.9	69	-168.0	769	0.4	8.5
67	78.7	3.68	153.41	6.34	7.2	60	-157.0	757	0.1	8.4
254	40.0	2.97	326.72	4.97		185	-21.0	765	2.3	7.6
254	40.0	1.47	326.72	3.47	8.9	58	-48.0	757	1.2	7.8
318	42.0	16.17	338.73	17.96	6.2	164	-23.0		2.5	7.6
318	42.0	15.48	338.73	17.27	10.3	51	-46.0	750	2.3	7.6
299	42.0	17.63	342.34	18.83	8.2	84	-133.0		0.3	8.4
299	42.0	16.70	342.34	17.90	8.7	46	-137.0	756	0.2	8.3
598	80.0	41.40	360.49	42.73	9.0	67	-26.0	765	0.9	7.8
598	80.0	41.01	360.49	42.34	9.6	37	-48.0	756	0.2	7.9
549	40.0	10.06	338.49	11.06	6.2	80	-71.0	762	0.3	7.4
549	40.0	9.73	338.49	10.73	14.3	77	-82.0		0.3	7.6
597	51.0	6.30	335.73	10.47	2.9	159	55.0	765	8.1	7.4
186	80.0	60.03	378.77	62.39	5.9	83	-48.0		1.7	7.3
186	39.0	28.77	345.95	31.13	10.6	44	-68.0	755	1.0	7.3
189	39.0	28.61	345.95	30.97	11.2	47	24.0		1.0	7.1
189	99.0	76.53	408.85	78.88	10.0	32	-55.0	756	0.7	7.1
188	99.0	76.61	408.85	78.97	10.0	60	-55.0	762	1.1	7.2
188	60.0	26.33	493.83	28.87	13.3	31	-78.0	754	0.6	7.2
363	60.0	25.75	493.83	28.29	13.6	174		752	2.3	6.9
363	100.0	42.10	508.57	45.02	11.2	36	0.2		1.5	6.9
365	100.0	42.16	508.57	45.08	11.6	80	-100.0		0.8	7.2
365	80.0	35.61	505.99	37.86	9.5	43	-129.0	752	0.3	7.1
350	80.0	35.45	505.99	37.69	9.9	62	0.0	752	0.6	6.9
350						58	-60.0	748	0.3	6.9

Appendix 4.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P00403 pH, water, unfiltered, laboratory, standard units	P90095 Specific conductance, water, unfiltered, laboratory, microsiemens per centimeter at 25 degrees Celsius	P00095 Specific conductance, water, unfiltered, microsiemens per centimeter at 25 degrees Celsius	P00020 Temperature, air, degrees Celsius	P00010 Temperature, water, degrees Celsius	P00915 Calcium, water, filtered, milligrams per liter	P00925 Magnesium, water, filtered, milligrams per liter	P00935 Potassium, water, filtered, milligrams per liter	P00930 Sodium, water, filtered, milligrams per liter
26	6.5	139	141	15.5	9.1	19.9	3.39	0.57	2.84
26			147	10.6	9.6				
62	8.3	209	210	18.0	6.6	25.9	5.34	1.55	12.70
62			215	10.0	6.0				
67	8.3	217	219	15.6	4.5	28.0	5.77	1.54	9.65
67			222	11.6	4.4				
254	7.7	315	319		5.9	50.3	6.86	1.23	6.39
254			283	16.0	6.3				
318	7.7	503	506	20.0	5.8	80.6	11.80	1.56	8.70
318			503	11.5	5.6				
299	8.1	227	229		5.9	31.7	8.68	0.94	5.13
299			231	14.6	5.9				
598	7.9	379	377	21.5	4.6	64.8	8.97	0.99	3.16
598			377	10.1	4.5				
549	7.7	301	297		9.6	50.8	6.21	1.12	3.84
549			307	15.5	9.4				
597	7.6	529	543	19.5	4.1	90.7	10.60	1.61	6.45
186	7.6	299	301	26.1	4.8	54.3	6.77	1.14	3.52
186			303	14.8	4.6				
189	7.5	298	301	27.1	4.8	52.9	7.00	1.10	3.10
189			304	12.7	4.6				
188	7.4	374	378	29.0	4.9	67.6	8.01	1.23	3.04
188			375	9.8	4.5				
363	7.0	529	538	16.0	5.5	77.1	17.30	1.55	9.84
363			547	12.5	5.1				
365	6.9	243	269	18.0	8.2	31.4	8.68	1.17	4.28
365			277	11.5	7.5				
350	7.1	219	222	20.0	5.5	29.7	8.97	0.81	3.00
350			225	10.6	5.4				

Appendix 4.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	P29801 Alkalinity, water, filtered, fixed endpoint (pH 4.5) titration, laboratory, milligrams per liter as calcium carbonate	P39086 Alkalinity, water, filtered, incremental titration, field, milligrams per liter as calcium carbonate	P00453 Bicarbonate, water, filtered, incremental titration, field, milligrams per liter	P00940 Chloride, water, filtered, milligrams per liter	R00950	P00950 Fluoride, water, filtered, milligrams per liter	P00955 Silica, water, filtered, milligrams per liter	R00945	P00945 Sulfate, water, filtered, milligrams per liter	P70300 Residue on evaporation, dried at 180 degrees Celsius, water, filtered, milligrams per liter
26	64	64	78	4.54	E	0.1	7.81		1.6	83
26										
62	110	101	123	0.59		0.1	11.90		2.7	123
62										
67	112	114	139	2.16	E	0.1	11.20		2.7	127
67										
254	121	117	142	21.50	E	0.1	12.20		7.4	189
254										
318	132	192	234	31.30	<	0.1	13.30		9.2	276
318										
299	113	110	134	2.62	E	0.1	12.90		5.3	126
299										
598	175	179	218	3.98	E	0.1	12.10		9.0	219
598										
549	153	137	167	4.41	<	0.1	10.90		0.9	166
549										
597	174	191	233	38.20	<	0.1	14.10		6.8	340
186	155	152	185	1.53	E	0.1	14.80		3.0	174
186										
189	153	148	181	1.81	E	0.1	13.20		3.9	164
189										
188	160	189	230	2.59	E	0.1	11.50		5.5	213
188										
363	133	191	233	44.60	<	0.1	17.60		6.8	307
363										
365	129	129	156	1.95	<	0.1	27.30	<	0.2	157
365										
350	118	114	140	1.40	E	0.1	26.30	<	0.2	146
350										

Appendix 4.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	R00608	P00608 Ammonia, water, filtered, milligrams per liter as nitrogen	R00631	P00631 Nitrite plus nitrate, water, filtered, milligrams per liter as nitrogen	R00613	P00613 Nitrite, water, filtered, milligrams per liter as nitrogen	R62854	P62854 Total nitrogen (nitrate + nitrite + ammonia + organic-N), water, filtered, analytically determined, milligrams per liter	R62855	P62855 Total nitrogen (nitrate + nitrite + ammonia + organic-N), water, unfiltered, analytically determined, milligrams per liter
26	<	0.010		0.043	<	0.002		0.06		0.07
26	<	0.010		0.020	<	0.002	E	0.04		0.09
62		0.123		0.021		0.002		0.17		0.16
62		0.140	E	0.008	E	0.001		0.17		0.15
67		0.148	<	0.016	<	0.002		0.17		0.16
67		0.160		0.019	<	0.002		0.17		0.17
254	<	0.010		0.623		0.002		0.64		0.66
254	<	0.010		0.313	E	0.001		0.33		0.35
318	<	0.010		1.950	<	0.002		1.95		1.93
318	<	0.010		1.940	<	0.002		2.08		2.06
299		0.021	<	0.016	<	0.002	<	0.06	E	0.05
299		0.022	<	0.032	<	0.004	<	0.06	<	0.06
598	E	0.005		1.080		0.118		1.11		1.13
598	<	0.010		1.090		0.119		1.28		1.15
549		0.021	<	0.016	<	0.002		0.07		0.06
549		0.018	<	0.016	<	0.002		0.07		0.11
597	<	0.010		5.290	<	0.002		5.26		5.26
186		0.052		0.071	<	0.002		0.15	<	0.06
186										0.15
189	<	0.010		0.127	<	0.002		0.15		0.08
189	<	0.010		0.121	<	0.002		0.14		0.12
188	E	0.006		0.120	<	0.002		0.14		0.08
188	E	0.006		0.100	E	0.001		0.13		0.12
363		0.021		4.180	<	0.002		4.04		4.02
363		0.022		4.420	<	0.002		4.31		4.39
365		1.810	<	0.016	<	0.002		1.89		1.86
365		1.800	<	0.016		0.008		2.02		1.87
350		0.024	<	0.016	<	0.002		0.10		0.10
350		0.025	<	0.016	<	0.002		0.11		0.10

Appendix 4.—Continued

[Column names starting with "R" are comment columns that pertain to reported water-quality parameter "P" code concentrations in adjacent columns. Comments include: parameter concentration in sample was less than (<) the detection-limit value as indicated in the "P" column; "E" is parameter concentration listed in the adjacent "P" code column was estimated by the USGS National Water-Quality Laboratory]

Map ID	R00671	P00671 Ortho-phosphate, water, filtered, milligrams per liter as phospho-rus	R00666	P00666 Phos-phorus, water, filtered, mil-ligrams per liter	R00665	P00665 Phospho-rus, water, unfiltered, milligrams per liter	P00681 Organic carbon, water, filtered, mil-ligrams per liter	P01046 Iron, water, filtered, micro-grams per liter	P01056 Man-ganese, water, filtered, micro-grams per liter	P82082 Deute-rium/Pro-tium ratio, water, unfiltered, per mil	P82085 Oxygen-18/Oxy-gen-16 ratio, water, unfiltered, per mil
26	E	0.003	E	0.002	E	0.003	0.8	51	3.0	-113	-13.21
26	<	0.006	E	0.003	E	0.003	1.0			-111	-12.82
62		0.061		0.075		0.080	0.9	26	46.0	-132	-16.91
62		0.063		0.074		0.099				-132	-16.87
67		0.059		0.071		0.074		83	44.2	-132	-16.86
67		0.063		0.074		0.074	0.7			-133	-16.87
254		0.020		0.025		0.026	0.9	120	6.3	-128	-16.51
254		0.017		0.026		0.029	0.7			-129	-16.51
318	<	0.006		0.004		0.007	0.6	41	1.7	-126	-15.98
318	E	0.004		0.006		0.006	0.6			-127	-16.04
299		0.034		0.040		0.048	0.4	51	55.9	-128	-16.39
299		0.029		0.039		0.049	0.5			-128	-16.42
598		0.006		0.008		0.013	2.2	11	274	-132	-16.49
598	E	0.004		0.009		0.010	2.1			-130	-16.52
549	<	0.006	E	0.002	E	0.004	1.9	126	348	-124	-15.36
549	<	0.006	E	0.004		0.005	2.5			-124	-15.46
597	<	0.006	<	0.004	E	0.003	0.7	30	1.7	-124	-15.02
186		0.007		0.012	<	0.004	0.9	84	76.3	-130	-16.46
186						0.015	0.8			-130	-16.51
189	<	0.006		0.005	<	0.004		22	0.8	-131	-16.56
189	<	0.006		0.005		0.006	0.8			-131	-16.61
188	<	0.006	E	0.002	<	0.004	0.9	302	28.4	-130	-16.65
188	<	0.006	<	0.004	<	0.004	0.8			-130	-16.69
363	<	0.006		0.005		0.005	0.7	8	68.1	-128	-16.16
363	E	0.003		0.006		0.004	0.8			-127	-16.2
365	<	0.006		0.094		0.091	2.2	7960	531	-108	-12.1
365		0.006		0.008		0.092	2.3			-110	-12.13
350		0.024		0.031		0.036	2.2	138	2170	-103	-10.58
350		0.028		0.031		0.037	2.2			-103	-10.52