GWPD 10—Estimating discharge from a pumped well by use of a circular orifice weir

VERSION: 2010.1

PURPOSE: To estimate the discharge from a pumped well from a non-vertical standard pipe by using a circular orifice weir.

Materials and Instruments

1. Steel orifice plate
2. Hand level
3. Piezometer tube, 1/8-inch or 1/4-inch diameter
4. Glass tube, 1/8-inch or 1/4-inch diameter
5. Accurate yardstick, or other suitable ridged scale
6. Graduated tape
7. Pencil or pen, blue or black ink. Strikethrough, date, and initial errors; no erasures
8. Field notebook
9. Groundwater Site Inventory (GWSI) System Groundwater Site Schedule, Form 9-1904-A

Data Accuracy and Limitations

1. The circular orifice weir method is accurate to within 2 percent.
2. The hole in the steel plate of the orifice weir must be accurately cut, be centered, be circular, and have a beveled edge. The steel plate restricts the flow through the orifice and creates a pressure head in the discharge pipe.
3. For the orifice weir to function properly, the gate valve that controls the rate of discharge must be placed at least 10 pipe diameters from the piezometer tube connection to keep pipe turbulence to a minimum.
4. The piezometer tube must be completely free of any obstruction and free of air bubbles when a reading of the pressure head is made. The head in the line is correlated with discharge by use of tables calibrated for the particular ratio between the orifice and the discharge pipe diameters (table 1).
5. The discharge pipe must be level, and the water flow from the end of the discharge pipe must fall freely.

Advantages

1. This method provides an accurate means of determining the discharge rate from turbine or centrifugal pumps.
2. No special training is needed to use this method.

Disadvantages

1. This method cannot be used to measure the pulsating flow from a piston pump.
2. Well flow must be constant.

Assumptions

1. An appropriately sized orifice plate is available and was built accurately.
2. The diameter of the orifice plate is less than eight-tenths of the inside diameter of the pipe that serves as the channel of approach.
3. The last 6 feet of the discharge line is level and contains a fitting that is screwed into a 1/8-inch or 1/4-inch tapped hole centered on the discharge line, exactly 24 inches from the orifice plate.

Instructions

1. Figure 1 shows the essential details for setting up a circular orifice weir for measuring the discharge rate of a well that is being pumped with a turbine or centrifugal pump.
2. Select an appropriately sized circular orifice weir and attach it to the end of the discharge pipe. Table 1 lists 3- to 10-inch circular orifice weirs that can be used with discharge pipes ranging from 4- to 12-inches in diameter.
3. Place a short piece of glass tubing into the upper end of the piezometer tube. Attach the lower end of the piezometer tube to the fitting on the discharge line that is located 24 inches from the orifice plate (fig. 1). Tape the piezometer tube to the scale making sure that the zero mark on the scale lines up with the center of the piezometer fitting in the discharge pipe.
4. The water level in the piezometer tube represents the pressure in the approach pipe when water is being pumped through the orifice. The water level can be observed in the glass tube.
5. To read the pressure head in the glass tube, hold the piezometer tube in an upright position perpendicular to the discharge pipe. Read the water level using the attached scale.
6. Determine the well discharge from table 1. For example, if the pressure head is 25.5 inches, the orifice plate is 5 inches in diameter and the discharge pipe is 8 inches in diameter; follow the 25.5-inch line from the left scale until it intersects with the 5-inch orifice and 8-inch pipe column. The well discharge rate obtained from table 1 is 500 gallons per minute.
7. Between water-level readings, check for air bubbles in the piezometer tube. If air bubbles are present, they can be eliminated from the piezometer tube by dropping the tube between readings so that water flows from it.
8. Record estimated discharge in the field notebook and in the discharge data section of the GWSI Groundwater Site Schedule (fig. 2, Form 9-1904-A).

Data Recording

Data are recorded in a field notebook. Discharge data should also be recorded in the discharge data section of the GWSI Groundwater Site Schedule (Form 9-1904-A).

References

Driscoll, F.G., 1986, Groundwater and wells (2d ed.): St. Paul, Minnesota, Johnson Filtration Systems, Inc., 1089 p.

Hoopes, B.C., ed., 2004, User's manual for the National Water Information System of the U.S. Geological Survey, Ground-Water Site-Inventory System (version 4.4): U.S. Geological Survey Open-File Report 2005–1251, 274 p.

Layne & Bowler, Inc., 1958, Measurement of water flow through pipe orifice with free discharge: Memphis, TN, Layne & Bowler, Inc., Bulletin 501, p. 22–25.

U.S. Geological Survey, Office of Water Data Coordination, 1977, National handbook of recommended methods for water-data acquisition: Office of Water Data Coordination, Geological Survey, U.S. Department of the Interior, chap. 2, p. 2-17.

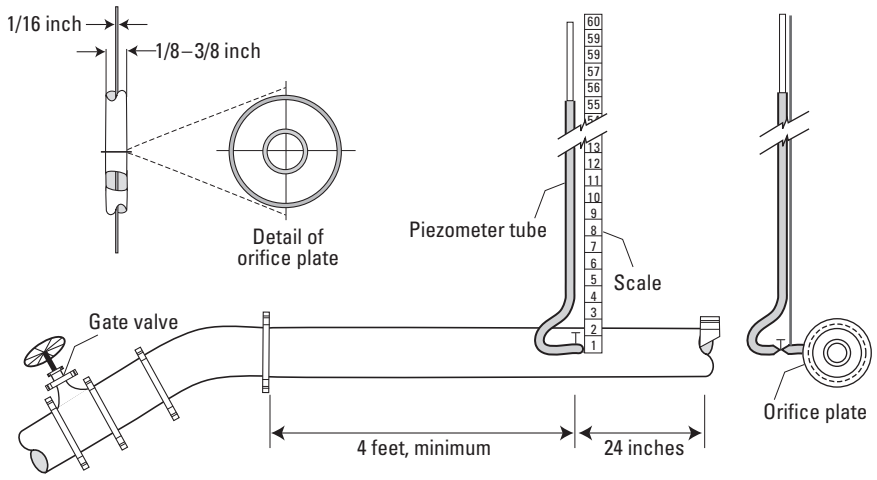

Figure 1. Essential details of the circular orifice weir commonly used for measuring well discharge when pumping by means of a turbine pump. Discharge pipe must be level (Driscoll, 1986).

Table 1. Orifice table for measurement of water through pipe orifices with free discharge. Values are in gallons per minute to the nearest whole number. (Compiled by the Engineering Department of Layne and Bowier, Inc., from original calibrations by Purdue University)

[—; no data]

Head, in inches	3-inch orifice		4-inch orifice		5-inch orifice		6-inch orifice		7-inch orifice	8-inch orifice	9-inch orifice	10-inch orifice
	4-inch pipe	6-inch pipe	6-inch pipe	8-inch pipe	6-inch pipe	8-inch pipe	8-inch pipe	10-inch pipe	10-inch pipe	10-inch pipe	12-inch pipe	12-inch pipe
5	100	76	145	140	280	220	380	320	—	—	825	1,100
5.5	104	79	153	145	293	230	394	333	—	—	860	1,150
6	108	82	160	150	305	240	408	345	—	—	895	1,200
6.5	111	85	167	155	316	250	421	358	—	—	930	1,250
7	115	88	172	160	328	260	433	370	—	—	965	1,300
7.5	119	91	179	165	339	270	446	383	—	—	1,000	1,350
8	122	94	185	170	350	280	458	395	600	935	1,032	1,400
8.5	125	96	190	175	361	289	471	408	617	963	1,065	1,440
9	128	99	195	180	372	298	483	420	633	992	1,093	1,480
9.5	130	102	200	185	383	307	495	433	650	1,016	1,120	1,520
10	133	104	205	190	393	316	508	445	666	1,040	1,148	1,560
10.5	137	107	210	195	402	324	521	458	682	1,060	1,172	1,600
11	140	109	215	200	412	330	533	470	698	1,080	1,200	1,635
11.5	143	111	220	204	421	338	545	480	713	1,100	1,225	1,670
12	146	114	225	208	430	346	556	490	728	1,120	1,250	1,705
12.5	149	116	230	212	439	354	567	500	743	1,139	1,277	1,740
13	151	118	234	216	448	362	578	510	757	1,158	1,303	1,775
13.5	154	121	239	219	457	369	589	520	771	1,176	1,328	1,810
14	157	123	243	224	465	376	599	530	785	1,194	1,352	1,845
14.5	159	126	247	227	473	383	609	540	799	1,212	1,376	1,875
15	162	128	250	231	480	390	618	550	812	1,230	1,400	1,905
15.5	164	130	254	234	488	396	627	559	825	1,248	1,421	1,940
16	167	132	257	238	495	402	636	568	838	1,266	1,441	1,970
16.5	170	134	261	241	503	408	645	577	851	1,284	1,460	2,000
17	172	136	264	245	510	414	654	586	863	1,302	1,480	2,030
17.5	175	138	268	249	517	420	663	595	875	1,319	1,500	2,060
18	178	140	271	252	524	426	672	604	887	1,336	1,520	2,089
18.5	180	142	275	256	530	432	681	612	899	1,353	1,540	2,118
19	183	144	278	259	536	438	690	620	910	1,370	1,560	2,146
19.5	185	146	282	263	542	444	699	628	922	1,387	1,580	2,175
20	187	148	285	266	548	449	708	636	933	1,404	1,600	2,204
20.5	190	150	289	270	554	455	717	643	945	1,421	1,620	2,232
21	192	152	292	273	560	460	726	650	956	1,438	1,640	2,260
21.5	195	154	295	275	566	465	735	657	968	1,455	1,659	2,288
22	197	156	299	279	572	470	744	664	979	1,471	1,677	2,316
22.5	199	158	302	282	578	475	752	671	990	1,486	1,695	2,343
23	201	160	305	285	584	479	760	678	1,001	1,500	1,714	2,360
23.5	203	162	307	288	590	484	768	685	1,012	1,515	1,732	2,382
24	205	164	310	291	596	488	776	692	1,022	1,529	1,750	2,409
24.5	207	165	314	294	602	492	784	699	1,033	1,543	1,767	2,435
25	210	167	317	297	608	496	791	706	1,043	1,557	1,783	2,461
25.5	212	169	320	300	614	500	798	713	1,059	1,571	1,799	2,487
26	214	171	323	303	620	504	805	720	1,064	1,585	1,815	2,513
26.5	216	173	326	305	626	508	812	727	1,074	1,599	1,830	2,539
27	219	174	329	308	632	512	818	734	1,084	1,613	1,845	2,565

Table 1. Orifice table for measurement of water through pipe orifices with free discharge. Values are in gallons per minute to the nearest whole number. (Compiled by the Engineering Department of Layne and Bowier, Inc., from original calibrations by Purdue University)—Continued

[—; no data]

Head, in inches	3-inch orifice		4-inch orifice		5-inch orifice		6-inch orifice		7-inch orifice	8-inch orifice	9-inch orifice	10-inch orifice
	4-inch pipe	6-inch pipe	6-inch pipe	8-inch pipe	6-inch pipe	8-inch pipe	8-inch pipe	10-inch pipe	10-inch pipe	10-inch pipe	12-inch pipe	12-inch pipe
27.5	221	176	332	311	638	516	825	741	1,094	1,627	1,860	2,590
28	222	177	335	314	644	520	831	747	1,104	1,641	1,875	2,610
28.5	224	179	337	317	650	524	838	754	1,114	1,655	1,890	2,630
29	226	180	340	320	656	528	844	760	1,124	1,669	1,905	2,650
29.5	228	182	343	323	662	532	851	767	1,134	1,683	1,920	2,670
30	230	183	346	325	668	536	857	773	1,143	1,697	1,935	2,690
30.5	232	185	348	328	674	540	863	780	1,153	1,711	1,950	2,713
31	235	186	351	330	680	544	869	786	1,162	1,725	1,965	2,736
31.5	236	188	354	333	686	548	876	793	1,172	1,739	1,980	2,759
32	239	189	357	335	692	552	882	799	1,181	1,753	2,005	2,782
32.5	240	191	360	338	697	556	889	806	1,191	1,767	2,020	2,805
33	242	192	363	340	703	560	895	812	1,200	1,791	2,040	2,828
33.5	244	194	366	342	709	564	901	818	1,209	1,795	2,050	2,850
34	246	195	369	345	715	568	907	824	1,218	1,809	2,060	2,873
34.5	248	196	372	247	720	572	913	830	1,227	1,823	2,075	2,896
35	250	197	375	349	726	576	919	836	1,235	1,837	2,090	2,919
35.5	252	198	377	351	732	580	925	842	1,243	1,851	2,100	2,941
36	254	200	380	354	737	584	931	847	1,251	1,865	2,112	2,964
36.5	256	201	383	356	743	588	937	852	1,259	1,879	2,124	2,980
37	257	203	385	358	748	592	943	857	1,266	1,893	2,136	3,002
37.5	259	204	388	360	754	596	949	862	1,274	—	2,148	3,024
38	260	205	390	363	759	600	955	867	1,281	—	2,160	3,046
38.5	262	206	393	365	765	604	961	872	1,289	—	2,173	3,068
39	263	208	396	367	770	608	967	877	1,295	—	2,185	3,088
39.5	265	209	398	369	776	612	974	882	1,304	—	2,197	3,110
40	266	210	401	371	781	616	979	887	1,311	—	2,210	3,130
40.5	267	211	403	373	786	620	985	891	1,319	—	2,225	3,146
41	269	212	406	375	790	624	990	896	1,326	—	2,233	3,160
41.5	271	213	408	378	795	628	996	901	1,334	—	2,245	3,179
42	272	214	411	380	800	631	1001	906	1,341	—	2,257	3,199
42.5	274	216	413	382	805	635	1007	910	1,349	—	2,273	3,219
43	275	217	415	384	810	638	1012	915	1,356	—	2,285	3,230
43.5	277	218	418	386	815	642	1018	920	1,364	—	2,397	3,250
44	278	219	420	388	820	645	1023	925	1,371	—	2,309	3,263
44.5	280	220	422	390	824	649	1029	929	1,379	—	2,326	3,280
45	281	222	425	392	828	652	1034	934	1,387	—	2,338	3,298
45.5	283	223	427	394	832	656	1040	939	1,394	—	2,350	3,316
46	284	224	429	396	837	659	1045	944	1,401	—	2,363	3,334
46.5	285	225	432	399	842	663	1051	948	1,409	—	2,375	3,351
47	287	227	434	401	847	666	1056	953	1,416	—	2,387	3,368
47.5	289	228	437	403	851	669	1062	958	1,424	—	2,399	3,389
48	290	229	440	405	855	672	1067	963	1,431	—	2,411	3,405
48.5	292	230	442	407	859	676	1073	967	1,439	—	2,423	3,426
49	293	231	444	409	863	679	1078	972	1,446	—	2,434	3,443
49.5	294	232	446	411	868	683	1084	977	1,454	—	2,444	3,460

Table 1. Orifice table for measurement of water through pipe orifices with free discharge. Values are in gallons per minute to the nearest whole number. (Compiled by the Engineering Department of Layne and Bowier, Inc., from original calibrations by Purdue University)—Continued

[—; no data]

Head, in inches	3-inch orifice		4-inch orifice		5-inch orifice		6-inch orifice		7-inch orifice	8-inch orifice	9-inch orifice	10-inch orifice
	4-inch pipe	6-inch pipe	6-inch pipe	8-inch pipe	6-inch pipe	8-inch pipe	8-inch pipe	10-inch pipe	10-inch pipe	10-inch pipe	12-inch pipe	12-inch pipe
50	296	234	448	413	872	686	1089	982	1,461	—	2,454	3,477
50.5	298	235	450	415	876	690	1095	986	1,469	—	2,464	3,494
51	300	236	453	417	880	693	1100	991	1,476	—	2,474	3,511
51.5	301	237	455	419	884	697	1105	996	1,484	—	2,486	3,527
52	302	238	457	421	888	700	1110	1000	1,491	—	2,498	3,544
52.5	303	239	459	423	892	704	1115	1005	1,499	—	2,510	3,560
53	304	240	461	425	896	707	1,120	1,009	1,506	—	2,522	3,575
53.5	305	241	463	427	900	711	1,125	1,014	1,513	—	2,534	3,591
54	307	243	465	429	904	714	1,130	1,018	1,520	—	2,545	3,602
54.5	309	244	467	431	908	718	1,135	1,023	1,527	—	2,555	3,618
55	310	246	469	433	912	721	1,140	1,027	1,534	—	2,565	3,634
55.5	311	247	471	435	915	725	1,145	1,032	1,541	—	2,575	3,650
56	313	248	472	437	919	727	1,150	1,036	1,548	—	2,586	3,667
56.5	314	249	474	439	923	730	1,155	1,040	1,554	—	2,597	3,684
57	315	250	476	441	927	733	1,160	1,044	1,560	—	2,608	3,702
57.5	316	251	478	443	930	736	1,165	1,046	1,567	—	2,619	3,719
58	317	252	480	445	934	739	1,170	1,052	1,574	—	2,630	3,736
58.5	319	253	482	447	938	742	1,175	1,056	1,580	—	2,641	3,752
59	320	254	485	449	942	745	1,180	1,060	1,586	—	2,653	3,768
59.5	321	256	487	451	945	748	1,185	1,064	1,592	—	2,665	3,784
60	323	257	489	453	948	751	1,190	1,068	1,598	—	2,676	3,800
60.5	324	258	491	455	951	754	1,195	1,072	—	—	—	—
61	325	259	492	457	955	757	1,200	1,076	—	—	—	—
61.5	326	261	494	459	958	760	1,205	1,080	—	—	—	—
62	328	262	496	461	961	763	1,209	1,084	—	—	—	—
62.5	329	263	498	463	964	766	1,214	1,088	—	—	—	—
63	330	264	500	465	968	769	1,218	1,092	—	—	—	—
63.5	331	265	502	467	971	772	1,223	1,096	—	—	—	—
64	333	266	504	469	974	775	1,227	1,099	—	—	—	—
64.5	334	267	507	471	977	778	1,232	1,103	—	—	—	—
65	335	268	509	472	981	781	1,236	1,106	—	—	—	—
65.5	336	269	511	474	984	784	1,241	1,110	—	—	—	—
66	338	271	513	475	988	787	1,245	1,113	—	—	—	—
66.5	339	272	515	477	991	790	1,250	1,117	—	—	—	—
67	340	273	517	479	995	793	1,254	1,120	—	—	—	—
67.5	341	274	518	481	998	796	1,259	1,124	—	—	—	—
68	343	275	520	483	1,002	799	1,263	1,127	—	—	—	—
68.5	344	276	521	485	1,005	802	1,268	1,131	—	—	—	—
69	346	277	523	487	1,009	805	1,272	1,134	—	—	—	—
69.5	347	278	524	489	1,012	808	1,276	1,137	—	—	—	—
70	349	280	525	491	1,016	811	1,280	1,140	—	—	—	—

FORM NO. 9-1904-A
Revised Sept 2009, NWIS 4.9

File Code _____
Date _____

Coded by _____
Checked by _____
Entered by _____

U.S DEPT. OF THE INTERIOR
GEOLOGICAL SURVEY

GROUNDWATER SITE SCHEDULE
General Site Data

AGENCY CODE (C4) U S G S | SITE ID (C1) | PROJECT (C5)

STATION NAME (C12/900)

1 SITE TYPE (C802) - Primary Secondary | DISTRICT (C6) | COUNTRY (C41) | STATE (C7) | County code

COUNTY or TOWN (C8)

LATITUDE (C9) . | LONGITUDE (C10) . | LAT/LONG ACCURACY (C11) H 1 5 S R F T M U
(Hndrth sec. | tenth sec. | half sec. | sec. | 3 sec. | 5 sec. | 10 sec. | min. | Unknown)

LAT/LONG METHOD (C35) C D G L M N R S U
(land net | DGPS | GPS | LORAN | map | interpolated digital map | reported | survey | unknown)

LAT/LONG DATUM (C36) NAD27 NAD83
(North American Datum of 1927 | North American Datum of 1983)

ALTITUDE (C16) .

ALTITUDE ACCURACY (C18)

ALTITUDE METHOD (C17) A D G I J L M N R U
(altimeter | DGPS | GPS | IfSAR | LiDAR | Level | map | DEM | reported | unknown)

ALTITUDE DATUM (C22) NGVD29 NAVD88
(National Geodetic Vertical Datum of 1929 | North American Vertical Datum of 1988)

LAND NET (C13) ¼ ¼ ¼ S section T township range merid

TOPOGRAPHIC SETTING (C19) A B C D E F G H K L M O P S T U V W
(alluvial fan | playa | stream channel | depression | dunes | flat | flood-plain | hill-top | sink-hole | lake or swamp | mangrove swamp | off-shore | pedi-ment | hill-side | ter-race | undu-lating | valley flat | upland draw)

HYDROLOGIC UNIT CODE (C20) | DRAINAGE BASIN CODE (C801) | STANDARD TIME ZONE (C813) | DAYLIGHT SAVINGS TIME FLAG (C814) **Y** OR **N**

MAP NAME (C14) | MAP SCALE (C15)

AGENCY USE (C803) A D I L M O R
(active no/na | discontinued | inactive site | active written | active oral | inventory site | remediated)

2 NATIONAL WATER-USE (C39)

DATA TYPE (C804)
Place an 'A' (active), an 'I' (inactive), or an 'O' (inventory) in the appropriate box
(WL cont | WL int | QW cont | QW int | PR cont | PR int | EV cont | EV int | wind vel. | tide cont | tide int | sed. con | sed. ps | peak flow | low flow | state water use)

INSTRUMENTS (C805)
(Place a "Y" in the appropriate box):
(digital recorder | graphic recorder | telemetry land line | telemetry radio | telemetry satellite | AHDAS | crest-stage gage | tide gage | deflection meter | bubble gage | stilling well | CR type recorder | weighing rain gage | tipping bucket rain gage | acoustic velocity meter | electromagnetic flowmeter | pressure transducer)

DATE INVENTORIED (C711) __ (month) – __ (day) – ____ (year)

RECORD READY FOR WEB (C32) Y C P L
(ready to display | conditional | proprietary | local use only)

REMARKS (C806)

FOOTNOTES

1 SITE TYPE (C802)

GL	Glacier	OC	Ocean	GW	Well
WE	Wetland	OC-CO	Coastal	GW-CR	Collector or Ranney type well
AT	Atmosphere	LK	Lake, Reservoir, Impoundment	GW-EX	Extensometer well
ES	Estuary			GW-HZ	Hyporheic -zone well
LA	Land	SP	Spring	GW-IW	Interconnected wells
LA-EX	Excavation	ST	Stream	GW-TH	Test hole not completed as a well
LA-OU	Outcrop	ST-CA	Canal	GW-MW	Multiple wells
LA-SNK	Sinkhole	ST-DCH	Ditch		
LA-SH	Soil hole	ST-TS	Tidal strea m		
LA-SR	Shore	FA-WIW	Waste-Injection well		

SB	Subsurface
SB-CV	Cave
SB-GWD	Groundwater drain
SB-TSM	Tunnel, shaft, or mine
SB-UZ	Unsaturated zone

2 WS DO CO IN IR MI LV PH ST RM TE AQ
(water supply | domestic | commercial | industrial | irrigation | mining | livestock | power hydroelectric | waste water treatment | remediation | thermoelectric power | aquaculture)

C22 Other (see manual for codes)
C36 Other (see manual for codes)
C39 is mandatory for all sites having data in SWUDS.

Figure 2. Groundwater Site Schedule, Form 9-1904-A.

GENERAL SITE DATA

DATA RELIABILITY (C3): C L M U
(C = field checked; L = poor location; M = minimal data; U = unchecked)

DATE OF FIRST CONSTRUCTION (C21): ___ – ___ – ___ (month – day – year)

USE OF SITE (C23): A C D E G H M O P R S T U V W X Z
(A = anode; C = standby emer. supply; D = drain; E = geothermal; G = seismic; H = heat reservoir; M = mine; O = observation; P = oil or gas; R = recharge; S = repressurize; T = test; U = unused; V = withdrawal/return; W = withdrawal; X = waste; Z = destroyed)

SECONDARY USE OF SITE (C301) (See use of site): ___

TERTIARY USE OF SITE (C302) (See use of site): ___

USE OF WATER (C24): A B C D E F H I J K M N P Q R S T U Y Z
(A = air cond.; B = bottling; C = commercial; D = de-water; E = power; F = fire; H = domestic; I = irrigation; J = industrial (cooling); K = mining; M = medicinal; N = industrial; P = public supply; Q = aquaculture; R = recreations; S = stock; T = institutional; U = unused; Y = desalination; Z = other)

SECONDARY USE OF WATER (C25) (see use of water): ___

TERTIARY USE OF WATER (C26) (see use of water): ___

AQUIFER TYPE (C713): U N C M X
(U = unconfined single; N = unconfined multiple; C = confined single; M = confined multiple; X = mixed)

PRIMARY AQUIFER (C714): ___

NATIONAL AQUIFER (C715): ___

HOLE DEPTH (C27): ___.___

WELL DEPTH (C28): ___.___

SOURCE OF DEPTH DATA (C29): A D G L M O R S Z
(A = other gov't; D = driller; G = geologist; L = logs; M = memory; O = owner; R = other reported; S = reporting agency; Z = other)

WATER-LEVEL DATA

DATE WATER-LEVEL MEASURED (C235): ___ – ___ – ___ (month – day – year)

TIME (C709): ___

WATER-LEVEL TYPE CODE (C243): L M S
(L = land surface; M = meas. pt.; S = vertical datum)

WATER LEVEL (C237/241/242): ___.___

MP SEQUENCE NO. (C248) (Mandatory if WL type=M): ___

WATER-LEVEL DATUM (C245) (Mandatory if WL type=S): NGVD29 NAVD88 ___
(NGVD29 = National Geodetic Vertical Datum 0f 1929; NAVD88 = North American Vertical Datum 0f 1988; ___ = Other (See manual for codes))

SITE STATUS FOR WATER LEVEL (C238): A B C D E F G H I J M N O P R S T V W X Z
(A = atmos. pressure; B = tide stage; C = ice; D = dry; E = recently flowing; F = flowing; G = nearby flowing; H = nearby recently flowing; I = injector site; J = injector site monitor; M = plugged; N = measurement discontinued; O = obstruction; P = pumping; R = recently pumped; S = nearby pumping; T = nearby recently pumped; V = foreign substance; W = well destroyed; X = affected by surface water; Z = other)

METHOD OF WATER-LEVEL MEASUREMENT(C239): A B C D E F G H L M N O P R S T V Z
(A = airline; B = analog; C = calibrated airline; D = differential GPS; E = estimated; F = transducer; G = pressure gage; H = calibrated press. gage; L = geophysical logs; M = manometer; N = non-rec. gage; O = observed; P = acoustic pulse; R = reported; S = steel tape; T = electric tape; V = calibrated elec. tape; Z = other)

WATER-LEVEL ACCURACY (C276): 0 1 2 9
(0 = foot; 1 = tenth; 2 = hundredth; 9 = not to nearest foot)

SOURCE OF WATER-LEVEL DATA (C244): A D G L M O R S Z
(A = other gov't; D = driller's log; G = geologist; L = geophysical logs; M = memory; O = owner; R = other reported; S = reporting agency; Z = other)

PERSON MAKING MEASUREMENT (C246) (WATER LEVEL PARTY): ___

MEASURING AGENCY (C247) (SOURCE): ___

EQUIP ID (C249) (20 char): ___

REMARKS (C267) (256 char): ___

RECORD READY FOR WEB (C858): Y C P L
(Y = ready to display; C = conditional; P = proprietary; L = local use only)

CONSTRUCTION DATA

RECORD TYPE (C754): C O N S

RECORD SEQUENCE NO. (C723): ___

DATE OF COMPLETED CONSTRUCTION (C60): ___ – ___ – ___ (month – day – year)

NAME OF CONTRACTOR (C63): ___

SOURCE OF DATA (C64): A D G L M O R S Z
(A = other gov't; D = driller; G = geologist; L = logs; M = memory; O = owner; R = other reported; S = reporting agency; Z = other)

METHOD OF CONSTRUCTION (C65): A B C D H J P R S T V W Z
(A = air-rotary; B = bored or augered; C = cable tool; D = dug; H = hydraulic rotary; J = jetted; P = air percussion; R = reverse rotary; S = sonic; T = trenching; V = driven; W = drive wash; Z = other)

TYPE OF FINISH (C66): C F G H O P S T W X Z
(C = porous concrete; F = gravel w/perf.; G = gravel screen; H = horiz. gallery; O = open end; P = perf or slotted; S = screen; T = sand point; W = walled; X = open hole; Z = other)

TYPE OF SEAL (C67): B C G N Z
(B = bentonite; C = clay; G = cement grout; N = none; Z = other)

BOTTOM OF SEAL (C68): ___

METHOD OF DEVELOPMENT (C69): A B C J N P S Z
(A = air-lift pump; B = bailed; C = compressed air; J = jetted; N = none; P = pumped; S = surged; Z = other)

HOURS OF DEVELOPMENT (C70): ___

SPECIAL TREATMENT (C71): C D E F H M Z
(C = chemicals; D = dry ice; E = explosives; F = deflocculent; H = hydrofracturing; M = mechanical; Z = other)

CONSTRUCTION HOLE DATA (3 sets shown)

RECORD TYPE (C756) HOLE   RECORD SEQUENCE NO. (C724)   SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF INTERVAL (C73) .   DEPTH TO BOTTOM OF INTERVAL (C74) .   DIAMETER OF INTERVAL (C75) .

RECORD SEQUENCE NO. (C724)

DEPTH TO TOP OF INTERVAL (C73) .   DEPTH TO BOTTOM OF INTERVAL (C74) .   DIAMETER OF INTERVAL (C75) .

RECORD SEQUENCE NO. (C724)

DEPTH TO TOP OF INTERVAL (C73) .   DEPTH TO BOTTOM OF INTERVAL (C74) .   DIAMETER OF INTERVAL (C75) .

CONSTRUCTION CASING DATA (4 sets shown)

RECORD TYPE (C758) CSNG   RECORD SEQUENCE NO. (C725)   SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF CASING (C77) .   DEPTH TO BOTTOM OF CASING (C78) .   DIAMETER OF CASING (C79) .

4 CASING MATERIAL (C80)   CASING THICKNESS (C81) .

RECORD SEQUENCE NO. (C725)   SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF CASING (C77) .   DEPTH TO BOTTOM OF CASING (C78) .   DIAMETER OF CASING (C79) .

4 CASING MATERIAL (C80)   CASING THICKNESS (C81) .

RECORD SEQUENCE NO. (C725)   SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF CASING (C77) .   DEPTH TO BOTTOM OF CASING (C78) .   DIAMETER OF CASING (C79) .

4 CASING MATERIAL (C80)   CASING THICKNESS (C81) .

RECORD SEQUENCE NO. (C725)   SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF CASING (C77) .   DEPTH TO BOTTOM OF CASING (C78) .   DIAMETER OF CASING (C79) .

4 CASING MATERIAL (C80)   CASING THICKNESS (C81) .

FOOTNOTE:

4 CASING MATERIAL CODES

A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	S	T	U	V	W	X	Y	Z	4	6
abs	brick	concrete	copper	PTFE	Fiber-glass	galv. iron	Fiber-glass plastic	wrought iron	Fiber-glass epoxy	PVC thread-ed	glass	other metal	PVC glued	PVC or plastic	FEP	rock or stone	steel	tile	coated steel	stain-less steel	wood	steel carbon	steel galva-nized	other mat.	stain-less 304	stain-less 316

CONSTRUCTION OPENINGS DATA (3 sets shown)

RECORD TYPE (C760) O P E N

RECORD SEQUENCE NO. (C726)

SEQUENCE NO. OF PARENT RECORD (C59)

DEPTH TO TOP OF INTERVAL (C83) .

DEPTH TO BOTTOM OF INTERVAL (C84) .

DIAMETER OF INTERVAL (C87) .

[5] MATERIAL TYPE (C86)

[6] TYPE OF OPENING (C85)

LENGTH OF OPENING (C89) .

WIDTH OF OPENING (C88) .

RECORD SEQUENCE NO. (C726)

DEPTH TO TOP OF INTERVAL (C83) .

DEPTH TO BOTTOM OF INTERVAL (C84) .

DIAMETER OF INTERVAL (C87) .

[5] MATERIAL TYPE (C86)

[6] TYPE OF OPENING (C85)

LENGTH OF OPENING (C89) .

WIDTH OF OPENING (C88) .

RECORD SEQUENCE NO. (C726)

DEPTH TO TOP OF INTERVAL (C83) .

DEPTH TO BOTTOM OF INTERVAL (C84) .

DIAMETER OF INTERVAL (C87) .

[5] MATERIAL TYPE (C86)

[6] TYPE OF OPENING (C85)

LENGTH OF OPENING (C89) .

WIDTH OF OPENING (C88) .

FOOTNOTES:

[5] TYPE OF MATERIAL CODES FOR OPEN SECTIONS

A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Q	R	S	T	V	W	X	Y	Z	4	6
ABS	brass or bronze	concrete	ceramic	PTFE	fiber-glass	galv. iron	fiber-glass plastic	wrought iron	fiber-glass epoxy	PVC thread-ed	glass	other metal	PVC glued	PVC	FEP	stain-less steel	steel	tile	brick	mem-brane	steel carbon	steel galva-nized	other	stain-less 304	stain-less 316

[6] TYPE OF OPENINGS CODES

F	L	M	P	R	S	T	W	X	Z
fractured rock	louvered or shutter-type	mesh screen	perforated, porous or slotted	wire-wound screen	screen (unk.)	sand point screen	walled or shored	open hole	other

CONSTRUCTION MEASURING POINT DATA

RECORD TYPE (C766) M P N T

RECORD SEQUENCE NO. (C728)

BEGINNING DATE (C321) – – (month – day – year)

ENDING DATE (C322) – –

M.P. HEIGHT (C323) .

ALTITUDE OF MEASURING POINT (C325)

ALTITUDE METHOD (C326)

ALTITUDE ACCURACY (C327)

ALTITUDE DATUM (C328)

M.P. REMARKS (C324)

RECORD READY FOR WEB (C857)

Y	C	P	L
ready to display	condi-tional	proprie-tary	local use only

CONSTRUCTION LIFT DATA

RECORD TYPE (C752): L I F T
RECORD SEQUENCE NO. (C254):
TYPE OF LIFT (C43): A air; B bucket; C centri-fugal; J jet; P piston; R rotary; S submer-sible; T turbine; U un-known; X no lift; Z other

DATE RECORDED (C38): month – day – year
PUMP INTAKE DEPTH (C44):
TYPE OF POWER (C45): D diesel; E electric; G gaso-line; H hand; L LP gas; N natural gas; S solar; W windmill; Z other

HORSE-POWER RATING (C46): .
MANUFACTURER (C48):
SERIAL NO. (C49):

POWER COMPANY (C50):
POWER COMPANY ACCOUNT NUMBER (C51):

POWER METER NUMBER (C52):
PUMP RATING (C53) (million gallons/units of fuel): .
ADDITIONAL LIFT (C255):

PERSON OR COMPANY MAINTAINING PUMP (C54):
RATED PUMP CAPACITY (gpm) (C268):
STANDBY POWER (C56) (see TYPE OF POWER):

HORSEPOWER OF STANDBY POWER SOURCE (C57): .

MISCELLANEOUS OWNER DATA

RECORD TYPE (C768): O W N R
RECORD SEQUENCE NO. (C718):
DATE OF OWNERSHIP (C159): – –

WU OWNER TYPE (C350): CP Corporation; GV Govern-ment; IN Individual; MI Military; OT Other; TG Tribal; WS Water Supplier
END DATE OF OWNERSHIP (C374): – –

OWNER'S NAME (C161):
EXAMPLES: JONES, RALPH A.
JONES CONSTRUCTION COMPANY

OWNER'S PHONE NUMBER (C351):
ACCESS TO OWNER'S NAME (C352): 0 Public Access; 1 Coop-erator; 2 USGS Only; 3 District Only; 4 Proprietary

OWNER'S ADDRESS (LINE 1) (C353):
OWNER'S ADDRESS (LINE 2) (C354):
OWNER'S CITY NAME (C355):

STATE (C356):
OWNER'S ZIP CODE (C357): –
OWNER'S COUNTRY NAME (C358):

ACCESS TO OWNER'S PHONE/ADDRESS (C359): 0 Public Access; 1 Coop-erator; 2 USGS Only; 3 District Only; 4 Proprietary

MISCELLANEOUS VISIT DATA

RECORD TYPE (C774): V I S T
RECORD SEQUENCE NO. (C737):
DATE OF VISIT (C187): month – day – year

NAME OF PERSON (C188):

MISCELLANEOUS OTHER ID DATA (2 sets shown)

RECORD TYPE (C770) O T I D

RECORD SEQUENCE NO. (C736)

OTHER ID (C190)

ASSIGNER (C191)

RECORD SEQUENCE NO. (C736)

OTHER ID (C190)

ASSIGNER (C191)

MISCELLANEOUS OTHER DATA

RECORD TYPE (C772) O T D T

RECORD SEQUENCE NO. (C312)

OTHER DATA TYPE (C181)

OTHER DATA LOCATION (C182) C D R Z
(C Cooperator's Office, D District Office, R Reporting Agency, Z other)

DATA FORMAT (C261) F M P Z
(F files, M machine readable, P published, Z other)

MISCELLANEOUS LOGS DATA (3 sets shown)

RECORD TYPE (C778) L O G S

RECORD SEQUENCE NO. (C739)

TYPE OF LOG (C199)

BEGINNING DEPTH (C200) .

ENDING DEPTH (C201) .

SOURCE OF DATA (C202) A D G L M O R S Z
(A other gov't, D driller, G geologist, L logs, M memory, O owner, R other reported, S reporting agency, Z other)

DATA FORMAT (C225) F M P Z
(F files, M machine readable, P published, Z other)

OTHER DATA LOCATION (C226)

RECORD TYPE (C778) L O G S

RECORD SEQUENCE NO. (C739)

TYPE OF LOG (C199)

BEGINNING DEPTH (C200) .

ENDING DEPTH (C201) .

SOURCE OF DATA (C202) A D G L M O R S Z
(A other gov't, D driller, G geologist, L logs, M memory, O owner, R other reported, S reporting agency, Z other)

DATA FORMAT (C225) F M P Z
(F files, M machine readable, P published, Z other)

OTHER DATA LOCATION (C226)

RECORD TYPE (C778) L O G S

RECORD SEQUENCE NO. (C739)

TYPE OF LOG (C199)

BEGINNING DEPTH (C200) .

ENDING DEPTH (C201) .

SOURCE OF DATA (C202) A D G L M O R S Z
(A other gov't, D driller, G geologist, L logs, M memory, O owner, R other reported, S reporting agency, Z other)

DATA FORMAT (C225) F M P Z
(F files, M machine readable, P published, Z other)

OTHER DATA LOCATION (C226)

ACOUSTIC LOG:
AS Sonic
AV Acoustic velocity
AW Acoustic waveform
AT Acoustic televiewer

CALIPER LOG:
CP Caliper
CS Caliper, single arm
CT Caliper, three arm
CM Caliper, multi arm
CA Caliper, acoustic

DRILLING LOG:
DT Drilling time
DR Drillers
DG Geologists
DC Core

ELECTRIC LOG:
EE Electric
ER Single-point resistance
EP Spontaneous potential
EL Long-normal resistivity
ES Short-normal resistivity
EF Focused resistivity
ET Lateral resistivity
EN Microresistivity
EC Microresistivity, forused
EO Microresistivity, lateral
ED Dipmeter

ELECTROMAGNETIC LOG:
MM Magnetic log
MS Magnetic susceptibiity log
MI Electromagnetic induction log
MD Electromagnetic dual induction log
MR Radar reflection image log
MV Radar direct-wave velocity log
MA Radar direct-wave amplitude log

FLUID LOG:
FC Fluid conductivity
FR Fluid resistivity
FT Fluid temperature
FF Fluid differential temperature
FV Fluid velocity
FS Spinner flowmeter
FH Heat-pulse flowmeter
FE Electromagnetic flowmeter
FD Doppler flowmeter
FA Radioactive tracer
FY Dye tracer
FB Brine tracer

NUCLEAR LOG:
NG Gamma
NS Spectral gamma
NA Gamma-gamma
NN Neutron
NT Neutron activitation
NM Neuclear magnetic resonance

OPTICAL LOG:
OV Video
OF Fisheye video
OS Sidewall video
OT Optical televiewer

COMBINATION LOG:
ZF Gamma, fluid resistivity, temperature
ZI Gamma, electromagnetic induction
ZR Long/short normal resistivity
ZT Fluid resistivity, temperature
ZM Electromagnetic flowmeter, fluid resistivity, temperature
ZN Long/short normal resistivity, spontaneous potential
ZP Single-point resistance, spontaneous potential
ZE Gamma, long/short normal resistivity, spontaneous potential, single-point resistance, fluid resitivity, temperature

WELL CONSTRUCTION LOG:
WC Casing collar
WD Borehold deviation

OTHER LOG:
OR Other

MISCELLANEOUS NETWORK DATA (3 types shown)

RECORD TYPE (C780) N E T W | RECORD SEQUENCE NO. (C730) | TYPE OF NETWORK (C706) Q W (water quality) | BEGINNING YEAR (C115) | ENDING YEAR (C116)

TYPE OF ANALYSIS (C120)

A	B	C	D	E	F	G	H	I	J	K	L	M	N	P	Z
physical properties	common ions	trace elements	pesticides	nutrients	sanitary analysis	codes D&B	codes B&E	codes B&C	codes B&F	codes D&E	codes C,D&E	all or most	codes B&C& radioactive	codes B,C&A	other

SOURCE AGENCY (C117) | [7] FREQUENCY OF COLLECTION (C118) | ANALYZING AGENCY (C307) | [8] PRIMARY NETWORK SITE (C257) | [8] SECONDARY NETWORK SITE (C708)

RECORD TYPE (C780) N E T W | RECORD SEQUENCE NO. (C730) | TYPE OF NETWORK (C706) W L (water level) | BEGINNING YEAR (C115) | ENDING YEAR (C116)

SOURCE AGENCY (C117) | [7] FREQUENCY OF COLLECTION (C118) | [8] PRIMARY NETWORK SITE (C257) | [8] SECONDARY NETWORK SITE (C708)

RECORD TYPE (C780) N E T W | RECORD SEQUENCE NO. (C730) | TYPE OF NETWORK (C706) W D (pumpage or withdrawals) | BEGINNING YEAR (C115) | ENDING YEAR (C116)

SOURCE AGENCY (C117) | [7] FREQUENCY OF COLLECTION (C118) | METHOD OF COLLECTION (C133)

C	E	M	U	Z
calculated	estimated	metered	unknown	other

[8] PRIMARY NETWORK SITE (C257) | [8] SECONDARY NETWORK SITE (C708)

FOOTNOTES:

[7] FREQUENCY OF COLLECTION CODES

A	B	C	D	F	I	M	O	Q	S	W	Z	2	3	4	5	X
annually	bi monthly	continuously	daily	semi-monthly	intermittent	monthly	one-time only	quarterly	semi-annually	weekly	other	bi-annually	every 3 years	every 4 years	every 5 years	every 10 years

[8] NETWORK SITE CODES

1	2	3	4
national,	district,	project,	co-operator,

MISCELLANEOUS REMARKS DATA (4 types shown)

RECORD TYPE (C788) R M K S | RECORD SEQUENCE NO. (C311) | DATE OF REMARK (C184) month – day – year

REMARKS (C185)

Subsequent entries may be used to continue the remark. Miscellaneous remarks field is limited to 256 characters.

RECORD TYPE (C788) R M K S | RECORD SEQUENCE NO. (C311) | DATE OF REMARK (C184) month – day – year

REMARKS (C185)

Subsequent entries may be used to continue the remark. Miscellaneous remarks field is limited to 256 characters.

DISCHARGE DATA

RECORD SEQUENCE NO. (C147)

DATE DISCHARGE MEASURED (C148) ___ – ___ – ____ (month – day – year)

TYPE OF DISCHARGE (C703): P F (pumped, flow)

DISCHARGE (gpm) (C150) _____ . __

ACCURACY OF DISCHARGE MEASUREMENT (C310): E G F P (excellent (LT 2%), good (2%-5%), fair (5%-8%), poor (GT 8%))

SOURCE OF DATA (C151): A D G L M O R S Z (other gov't, driller, geologist, logs, memory, owner, other reported, reporting agency, other)

METHOD OF DISCHARGE MEASUREMENT (C152): A B C D E F M O P R T U V W X Z (acoustic meter, bailer, current meter, Doppler meter, estimated, flume, totaling meter, orifice, pitot-tube, reported, trajectory, venturi meter, volumetric meas, weir, unknown, other)

PRODUCTION WATER LEVEL (C153) _____ . __

STATIC WATER LEVEL (C154) _____ . __

SOURCE OF DATA (C155): A D G L M O R S Z (other gov't, driller, geologist, logs, memory, owner, other reported, reporting agency, other)

METHOD OF WATER-LEVEL MEASUREMENT (C156): A B C D E F G H L M N O P R S T V Z (airline, recorder, calibrated airline, differential GP, estimated, transducer, pressure gage, calibrated press. gage, geophysical logs, manometer, non-rec. gage, observed, acoustic pulse, reported, steel tape, electric tape, calibrated elec. tape, other)

PUMPING PERIOD (C157) _____ . __

SPECIFIC CAPACITY (C272) _____ . __

DRAWDOWN (C309) _____ . __

GEOHYDROLOGIC DATA

RECORD TYPE (C748): G E O H

RECORD SEQUENCE NO. (C721) ___

DEPTH TO TOP OF UNIT (C91) _____ . __

DEPTH TO BOTTOM OF UNIT (C92) _____ . __

UNIT IDENTIFIER (C93) _____

LITHOLOGY (C96) ____

CONTRIBUTING UNIT (C304): P Q S N U (principal aquifer, aggregate of lithologic units, secondary aquifer, no contribution, unknown)

LITHOLOGIC MODIFIER (C97) _____

_____

_____

GEOHYDROLOGIC AQUIFER DATA

RECORD TYPE (C750): A Q F R

RECORD SEQUENCE NO. (C742) ___

SEQUENCE NO. OF PARENT RECORD (C256) ___

DATE (C95) ___ – ___ – ____ (month – day – year)

STATIC WATER LEVEL (C126) _____ . __

CONTRIBUTION (C132) ____

SITE LOCATION SKETCH AND DIRECTIONS

Township _____ Range _____

Section # _____