84339

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF MINING, LAND & WATER
Alaska Hydrologic Survey

WATER WELL LOG Revised 08/18/2016

Drilling Started: ___/___/_____ Completed: 9 / 5 / 2002 Pump Install: ___/___/_____

City/Borough	Subdivision	Block	Lot	Property Owner Name & Address
Matanuska-Susitna Borough	PALMER MUNICIPAL AIRPORT		1	City Of Palmer ,

Well location: Latitude 61.58568300000002 **Longitude** -149.096779
Meridian S Township 017N Range 002E Section 04 , SE 1/4 of SE 1/4 of SW 1/4 of SE 1/4

BOREHOLE DATA: (from ground surface)
Suggest T.**M. Hanna's hydrogeologic classification system***
https://my.ngwa.org/NC__Product?id=a185000000BYub3AAD

	Depth From	Depth To
sandy silt	0	4
sandy gravel: brown, loose, cobbly	4	28
gravel: brown, silty, cobbly, occasional boulders	28	78
medium gravel: brown, sandy, cobbley	78	99
medium gravel: brown, sandy, cobbley. wet	99	115
water gravel: coarse, sandy	115	143
water sand: slightly gravelly	143	146
water gravel: slightly gravelly	146	150
sand: medium coarse, wet	150	151
water gravel: medium coarse sand. clear	151	165
silt: clayey, occasional pebbles, semi consolidated, holds open hole	165	173

Include description or sketch of well location (include road names, buildings, etc.):

North

Drilling method: ☒ Air rotary, ☐ Cable tool, ☐ Other _____
Well use: ☒ Public supply, ☐ Domestic, ☐ Reinjection, ☐ Hydrofracking
☐ Commercial, ☐ Observation/Monitoring, ☐ Test/Exploratory, ☐ Cooling,
☐ Irrigation/Agriculture, ☐ Grounding, ☐ Recharge/Aquifer Storage,
☐ Heating, ☐ Geothermal Exploration, ☐ Other _____
Fluids used: _____

Depth of hole: 175 ft Casing stickup: 2 ft
Casing type: A53B Steel Casing thickness: _____ inches
Casing diameter: 16 inches Casing depth: _____ ft
Liner type: _____ Depth: _____ ft Diameter: _____ inches
Note: _____

Well intake opening type: ☐ Open end, ☐ Open hole, ☒ Other screened
Screen type: see well logs. 120 - 30 -, Screen mesh size: _____
Screen start: _____ ft, Screen stop: _____ ft, Perforated ☐ Yes ☒ No
Perforation description: _____ Perf from: _____ ft, Perf to: _____ ft, Perf from: _____ ft, Perf to: _____ ft
Gravel packed ☐ Yes ☒ No Gravel start: _____ ft , Gravel stop: _____ ft
Note: _____

Static water (from top of casing): 107 ft on ___/___/_____ Artesian well ☐
Pumping level & yield: 3.8 feet after 20.5 hours at 1832 gpm
Method of testing: top drive turbine pump
Development method: surgeblock Duration: _____
Recovery rate: _____ gpm

Grout type: _____ Volume _____
Depth: From _____ ft, To _____ ft

Final pump intake depth: _____ ft Model: _____
Pump size: _____ hp Brand name: _____

Was well disinfected upon completion? ☐ Yes ☒ No
Method of disinfection: _____
Was water quality tested? ☐ Yes ☒ No
Water quality parameters tested: _____

Well driller name: Wayne Westberg
Company name: M-W Drilling, Inc.
Mailing address: PO Box 110389
City: Anchorage State: AK Zip: 99511
Phone number: (907) 345 - 4000
Driller's signature: _____
Date: _____/_____/_____

AS 41.08.020(b)(4) and AAC 11 AAC 93.140(a) require that a copy of the well log be submitted to the Department of Natural Resources within **45 days of well completion**. Well logs may be submitted using the online well log reporting system available at:

https://dnr.alaska.gov/welts/

OR email electronic well logs to

dnr.water.reports@alaska.gov

Anchorage Municipal Code 15.55.060(I) and North Pole Ordinance 13.32.030(D) require that a copy of this well log be submitted to the Development Services Department/City within **30 days of well completion**.

City Permit Number: _____
Date of Issue: ___/___/_____

Parcel Identification Number: _____-_____-_____

*Guide for Using the Hydrogeologic Classification System for Logging Water Well Boreholes by Thomas M. Hanna NGWA Press

M-W Drilling, Inc.

♦P.O. Box 110378♦ Anchorage, AK 99511♦
♦907-345-4000 ♦ 907-345-3287 Fax♦

Job No.: 02-138 Project No.: Palmer Well No. 5 Permit No. N/A

Groundwater Well As-Built & Log

♦ *Well Owner:* City of Palmer ♦ *Use of Well:* Public- Class A
♦ *Legal Description:* Northwest Corner of Springer Loop & Industrial Way
Palmer, Alaska

Construction

♦ *Hole Depth:* 175' ♦ *Casing Size:* 16" ♦ *Cased To:* 167.23 ♦ *Material:* A 53 Steel
♦ *Drill Method:* Air Rotary 24" 21'
Perf.
♦ *Well Completion-* *Open end* ____ *Screen* X *Perforated* ____ *Method:* ____
♦ *Screen/ Perforation description:* See attached drawing
♦ *Grout Notes:* 24" Surface casing installed to 21" & pulled while grouting with 2 yards of neat cement.

♦ *Well Development:* *Method:* Surgeblock *Notes:* ____
♦ *Static water level (SWL)* 107' *(above) (below) top of casing (TOC).*
♦ *Well yield test at* 1831.7 *gallons per minute (GPM)/ ~~gallons per hour (GPH)~~ for* 20.5 *hours with* 3.79' *of drawdown (DD) from static level (SWL).*
♦ *Method:* Top drive turbine pump=- 300hp; yield calculated from total gallons pumped for the Test Pump duration

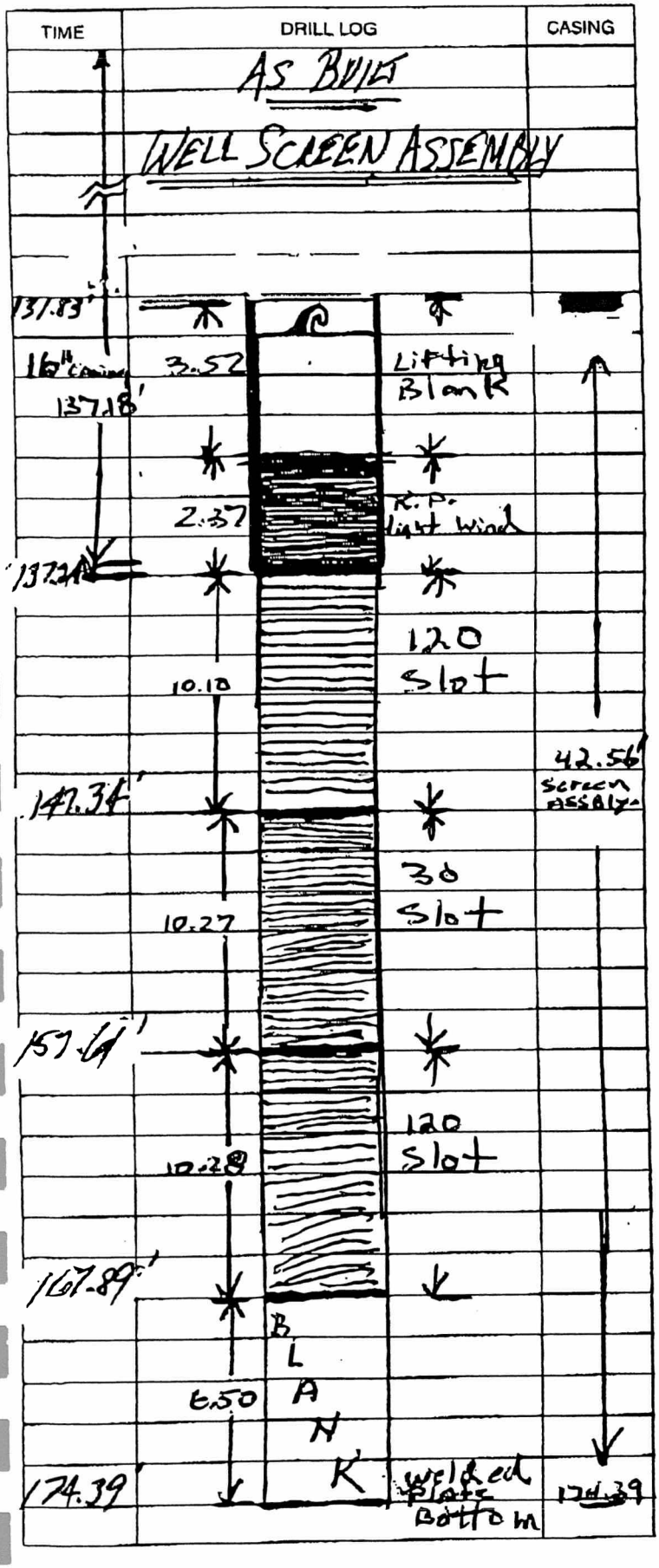
♦ *Date of completion:* N/A ♦ *Pump Install:* ____

Well Log

Depth in feet from top of casing.	Details of formations penetrated, size of material, color and hardness.
+2 TO 0	Casing stickup
0 TO 6	Sandy silt
6 TO 30	Sandy gravel: brown, loose, cobbly
30 TO 80	Gravel: brown, silty, cobbley, occasional boulders
80 TO 101	Medium gravel: brown, sandy, cobbley
101 TO 117	As above: wet
117 TO 145	Water gravel: coarse, sandy
145 TO 148	Water sand: slightly gravelly
148 TO 152	Water gravel: as above
152 TO 153	Sand: medium coarse, wet
153 TO 167	Water gravel: as above, clear
167 TO 175	Silt: clayey, occasional pebbles, semi consolidated, holds open hole
TO	
TO	
TO	
TO	

Wayne E Kuntz

NWWA Certified Contractor
Certificate No's. 814 & 973



M-W DRILLING, INC.

DATE 09-05-02

CREW

NAME City of Palmer	PROJ. NO. 02-138
ADDRESS	
CITY	PHONE
JOB LOCATION	

EQUIP.#					
END					
START					

TEST PUMP SETTING
120' - 8" column
6.87 - 12" Bowls
2.60 - Tail strainer
*129.47' Total

DEPTH	WELL LOG
0-_____	CASING STICK UP
STATIC LEVEL	107' GPM - YIELD 183

OWNER REPRESENTATIVE:

Water Phase I
Well #5

CITY OF PALMER PRODUCTION WELL #5

PUMP TEST ANALYSIS REPORT

Contract No. 3690
MWH Job No. 1850823.030101

Prepared for:

City of Palmer
231 W. Evergreen
Palmer, Alaska 99645
Attn: Rick Koch

Prepared by:

MWH
4100 Spenard Road
Anchorage, AK 99517
(907) 248-8883
(907) 248-8884 fax

January 2003

MWH

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MWH

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ACRONYMS AND ABBREVIATIONS

ADEC	Alaska Department of Environmental Conservation
bgs	below ground surface
CT&E	CT&E Environmental Services, Inc.
gpd/ft	gallons per day per foot
gpm	gallons per minute
gpm/ft	gallons per minute pumped per foot of drawdown
MCL	maximum contaminant level
Well #4	Palmer Production Well #4
Well #5	Palmer Production Well #5

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

MWH performed well pump test analysis for the City of Palmer Production Well #5 (Well #5) on behalf of the City of Palmer. The pump testing was conducted to determine the long-term production potential of the well, based on the calculated specific capacity, transmissivity, and storage coefficient.

MW-Drilling constructed Well #5 under the direction of Kris Ivarson, Hydrogeologist with MWH. The well was completed on September 5, 2002. Test pumping activities were conducted from September 18 through 20, 2002. The site is located at the corner of Springer Loop and Industrial Way in Palmer, Alaska. A site location map is provided on Figure 1.

1.2 PROJECT ORGANIZATION

The project organization is as follows:

Well Owner – City of Palmer

Drilling Company – MW-Drilling of Anchorage, Alaska

Project Engineer – Robert Gilfilian, P.E., Principal Engineer with MWH

Project Hydrogeologist On-Site – Kris Ivarson, Hydrogeologist with MWH

Project Laboratory – CT&E Environmental Services, Inc. Anchorage, Alaska (CT&E)

2.0 WELL CONSTRUCTION

2.1 PRODUCTION WELL #5 SITE SELECTION

Well #5 was placed approximately 100 feet southwest of Palmer Production Well #4 (Well #4). The site selection was made based the results of previous pump tests and analysis conducted on Well #4. Data from Well #4 can be obtained from the City of Palmer. Tests on Well #4 indicated that sufficient water was available in the aquifer to support a second, high production well in the vicinity.

2.2 PRODUCTION WELL #5 CONSTRUCTION DETAILS

Well #5 consists of a 16-inch diameter, steel-cased well, drilled to a total depth of 175 feet below ground surface (bgs). The well is cased to 167.23 feet bgs, of which approximately 42.5 feet is screen assembly. The screen assembly consists of 120-slot size screen from approximately 137 to 147 feet bgs, 30-slot size screen from 147 to 157 feet bgs, and 120-slot size screen from 157 to

167 feet bgs. A completed well log and screen assembly as-built is included in Appendix A. Sieve analysis results from selected soil samples are included in Appendix B.

2.3 WELL DEVELOPMENT

Well #5 was developed using a surge block (photo to right). Screen sections of up to 3 feet were exposed, then the surge block was used to bring the fine material into the well from the surrounding soil formation. The sand and other fine material was then removed from the well. This proceeded until a majority of the sand material had been removed.

Surge block in use.

Well development testing was conducted using a Rossum sand test. The sand test is conducted during pump testing and is a measurement of the amount of sand that can be removed from the well during use. Test results from Well #5 indicate that no sand was remaining in the well water column following development.

3.0 PUMP TEST ACTIVITIES AND ANALYSIS

3.1 PUMP TESTING PROCEDURE

Test pumping is conducted to determine specific aquifer characteristics and the capabilities of the well. For Production Well #5, a 300 horsepower, top drive turbine pump was installed in the well for test pumping. Attached to the pump was a discharge pipe and hose, a totalizer to measure the total volume of water pumped and to calculate the discharge rate, and a Rossum sand indicator to determine if the well was adequately developed. During pumping, water was discharged to a trench approximately 100 feet from the test well and then allowed to drain into the surrounding road ditches (photo to right).

Discharge of water during step-test

3.2 DATA ANALYSIS

Pump testing was performed using both step-drawdown and constant rate testing methods. A specific capacity, or step-drawdown test, was conducted first. This type of pump test provides a means of evaluating the performance of a well under increasingly higher pumping rates (Driscoll, 1986) and also provides a way of determining an appropriate pumping rate for the continuous pump test. A continuous pumping test is used to evaluate the hydraulic properties of the aquifer.

3.3 SPECIFIC CAPACITY TEST

A 4.5-hour, step-drawdown test was performed on Well #5, with water levels measured in nearby Well #4. This test is used to calculate the specific capacity of a well, or its yield per unit of drawdown. Specific capacity is typically expressed in units of gallons per minute pumped per foot of drawdown (gpm/ft), and generally decreases as pumping time increases.

The test was comprised of four pumping steps, ranging in duration from 50 to 90 minutes each. The well was pumped at rates of 1,400, 1,600, 1,800, and 1,930 gallons per minute (gpm). The water level changes were recorded in Well #4, Well #5, the Palmer Observation Well, and the nearby Lewis Well (Figure 1) using water level indicators and/or pressure transducers. Well #4 and the Palmer Observation Well are approximately 100 feet or less from Well #5. The Lewis Well is located approximately 400 feet crossgradient from Well #5. The total drawdown in Well #4 over the 4.5-hour test was 0.58 feet. Less than 1.0-foot of drawdown was measured in the surrounding wells. Specific capacity for Well #5 was derived using the Hantush-Bierschenk Method (Kruseman and de Ridder, 2000; Driscoll, 1986). The computed specific capacity for each step is presented in Table 1. Measured water levels and associated calculations used to derive specific capacity are presented in Appendix C.

Table 1 Specific Capacity Results for Palmer Well #5

Pumping Rate (gpm)	Specific Capacity (gpm/ft)
1,400	4,167
1,600	3,571
1,800	3,125
1,930	2,890

Key:
gpm – gallons per minute
gpm/ft – gallons per minute pumped per foot of drawdown

Following completion of the step test, the well was allowed to recover to within 0.5 feet of the original static water level prior to conducting the constant rate test. Measurements collected during recovery are also included in Appendix C.

3.4 CONSTANT RATE AQUIFER TEST

The constant rate aquifer test involved pumping Well #5 continuously at a rate of 1,830 gpm for approximately 20 hours, for a total of approximately 2.25 million gallons. Water levels were continuously measured in Well #5, Well #4, the Palmer Observation Well, and the Lewis Well, which is located on the adjoining property (Figure 1). Transmissivities were determined using drawdown data collected from each well and application of the Cooper and Jacob method (Driscoll, 1986). Transmissivity is an indicator of how well an aquifer will conduct water over a given vertical thickness of porous medium and is often expressed in units of gpd/ft.

In addition, storage coefficients were calculated for each of the above wells, except Well #5. The storage coefficient is dimensionless and represents the volume of water released from (or

stored in) an aquifer per unit surface area of aquifer material per unit change in hydraulic head. The results for both parameters are summarized in Table 2.

Table 2 Transmissivity and Storage Coefficient Values Derived from the Palmer Well #5 Continuous Pumping Test

Well	Transmissivity (gpd/ft)	Storage Coefficient (dimensionless)
Palmer #5	805,640	NA[1]
Palmer #4	912,045	0.17
Palmer Observation	1,150,914	0.23
Average	**956,200**	**0.20**

Key:
1 – Storage coefficient cannot be calculated for a pumping well.
gpd/ft – gallons per day per foot
NA – not applicable

Calculations from the Lewis Well resulted in a transmissivity of 3,718,338 gpd/ft and a storage coefficient of 0.38, which are considered outlying results. These results were not included in the averages for Well #5, since they are for a well approximately 400 feet from the Well #5 and nearly three times the values found in the remaining wells. The water level measurement data and calculations for transmissivity and storage coefficient are presented in Appendix C.

These results are consistent with the 1,000,000 gpd/ft (average) reported by Hart Crowser Inc. (1987) from an aquifer test performed on Well #4. Moreover, a highly-transmissive aquifer, as calculated by both Hart Crowser and MWH, with a large capacity for yielding water was indicated for Well #4. Data on transmissivities from various aquifers types in the literature (e.g., Domenico and Schwartz, 1990; Freeze and Cherry, 1979) indicate these data are consistent with a coarse, well-sorted gravel or glacial outwash.

Less than 2 feet of drawdown was observed in Well #4, located 100 feet upgradient from Well #5, when Well #5 was pumped at 1,830 gpm during the constant rate test. In addition, the total drawdown in the pumping well (Well #5) was 3.79 feet after 20.5 hours of pumping at this high rate. These results indicate that well interference will be minimal, less than 5 feet in Well #4, as a result of long-term, continuous pumping of both Well #4 and Well #5 at the recommended pumping rates.

4.0 WATER QUALITY LABORATORY ANALYSES AND RESULTS

4.1 WATER SAMPLE COLLECTION AND TESTING

Water samples were collected from Well #5 at the completion of the constant rate aquifer test. Water samples were collected in laboratory-supplied sample containers for analysis of drinking water quality parameters. Samples were placed in a cooler with blue ice and maintained at 4 ±2 degrees Celsius. The samples were delivered to CT&E in accordance with standard chain-of-custody procedures for laboratory analysis. Field procedures and methods were conducted in accordance with Alaska Department of Environmental Conservation (ADEC) Regulations 18

Alaska Administrative Code 78 and the *Underground Storage Tank Procedures Manual – Standard Sampling Procedures* (December 1, 1999).

4.2 ANALYTICAL TEST RESULTS

Laboratory analytical results for the ground water samples collected during this monitoring event are summarized in Table 3, along with the regulatory maximum contaminant levels (MCLs). The parameters listed are representative of the laboratory results. Not all compounds analyzed by the various test methods are included in Table 3. Only those compounds that were detected, or considered as critical water quality parameters, were included. A complete list of analyzed compounds is included in the laboratory report provided in Appendix D.

Table 3 Laboratory Analytical Results

Water Quality Parameter	Units	Palmer Well #5	MCL
Volatile Organic Compounds			
Benzene	mg/L	U (0.0005)	0.005
Toluene	mg/L	0.0011	1.0
Ethylbenzene	mg/L	U (0.0005)	0.7
Total xylenes	mg/L	U (0.0005)	10.0
Total trihalomethanes	mg/L	U (0.0005)	0.1
Inorganic Contaminants			
Antimony	mg/L	U (0.0001)	0.006
Arsenic	mg/L	U (0.0002)	0.05
Barium	mg/L	0.0203	2
Beryllium	mg/L	U (0.0004)	0.004
Cadmium	mg/L	U (0.0001)	0.005
Chromium	mg/L	U (0.004)	0.1
Cyanide	mg/L	U (0.0050)	0.2
Fluoride	mg/L	U (0.200)	4.0
Mercury	mg/L	U (0.0002)	0.002
Nickel	mg/L	U (0.0005)	0.1
Nitrate	mg/L	0.696	10
Nitrite	mg/L	U (0.200)	1
Selenium	mg/L	U (0.002)	0.05
Thallium	mg/L	U (0.0003)	0.002
Secondary Contaminants			
Chloride	mg/L	5.69	250
Color	PCU	5.0	15
Copper	mg/L	0.0123	1
Iron	mg/L	0.126	0.3
Langlier index	At 140°F	-0.18	NA
Langlier index	At 40°F	-1.26	NA
Manganese	mg/L	U (0.005)	0.05
Odor	T.O.N.	U (1.00)	3
pH	pH units	6.80	6.5 to 8.5
Sodium	mg/L	7.86	250
Sulfate	mg/L	69.6	250
Total Dissolved Solids	mg/L	215	500
Zinc	mg/L	0.00603	5

Table 3 (cont.) Laboratory Analytical Results

Water Quality Parameter	Units	Palmer Well #5	MCL
Other Contaminants			
Total coliform	col/100ml	0	0
Foaming agents	mg/L	U (0.10)	2.0
Pesticides	mg/L	U	Specific to each Pesticide
PCBs	mg/L	U (0.255)	0.0005
Gross Alpha/Gross Beta	pCi/L/mrem	U	15 / 4

Key:
°F – degrees Fahrenheit
AAC – Alaska Administrative Code
col/100ml – colonies per 100 milliliters
MCL – maximum contaminant level
mg/L – milligrams per liter
mrem – milli-rem
NA – not analyzed
pCi/L – pico Curie/liter
PCU – primary color units
T.O.N. – Threshold Odor Number
U – Undetected above the practical quantitation limits shown in parenthesis OR listed in Appendix D.

No contaminants were identified above the MCL from the sample collected at the completion of the constant rate pump test at Well #5. However, toluene was detected. While the contaminant concentration of toluene is well below the MCL, the presence of toluene may indicate a potential for contamination.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The pump test results indicate that Well #5 is a very efficient well, with a high transmissivity and storage coefficient. Pump test results also indicate that Well #5 is capable of sustained production at a rate of 1,800 to 2,000 gpm of water, with minimal hydraulic impact on the aquifer. This means that the aquifer can sustain a high rate of pumping without a significant drop in the yield or static water level. Based on test results, both Well #4 and Well #5 can be pumped at their recommended long-term yields of 1,200 and 1,800 gpm, respectively, at the same time and with minimal well interference (less than 5 feet drawdown).

To confirm the presence of toluene in Well #5, MWH recommends installing a test pump and purging Well #5 by removing 10 well casing volumes of water (approximately 1,000 gallons). Following pumping, a water sample would be collected from both Well #4 and Well #5. The samples would be tested for contaminants by United States Environmental Protection Agency Test Method 524.2.

6.0 REFERENCES

Domenico, P.A. and F.W. Schwartz. 1990. Physical and Chemical Hydrogeology. John Wiley and Sons, New York, New York.

Driscoll, F.G. 1986. Groundwater and Wells. 2nd Edition. Johnson Filtration Systems, Inc., St. Paul, Minnesota.

Freeze, R.A. and J.A. Cherry. 1979. Groundwater. Prentice-Hall Inc., Englewood Cliffs, New Jersey.

Hart Crowser. 1987. Palmer Production Well No. 4

Kruseman, G.P. and N.A. de Ridder. 2000. Analysis and Evaluation of Pumping Test Data. 2nd Edition. Publication 47, International Institute for Land Reclamation and Improvement, Wageningen, The Netherlands.

7.0 LIMITATIONS

MWH conducted this work in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. All sampling activities were completed in accordance with the ADEC *Underground Storage Tanks Procedures Manual – Standard Sampling Procedures* (December 1, 1999). No other warranty, expressed or implied, is made. Data and recommendations made herein were prepared for the City of Palmer. Information herein is for use at this site, in accordance with the purpose of the report described.

Data analysis was conducted by Michael Goodrich, Hydrologist, with MWH.

Data reviewed and report prepared by:

Kristine Ivarson
Hydrogeologist, MWH

1-16-03
Date