

**PORT HEIDEN WASHETERIA AND  
WATER TREATMENT PLANT**

**TECHNICAL MEMORANDUM NO. 1**

**EXPLORATORY WELL #2 FLOW  
TEST RESULTS**



October 31, 2008

Prepared for:

City of Port Heiden  
P.O. Box 49050  
Port Heiden, Alaska 99549

and

Village Safe Water  
555 Cordova Street  
Anchorage, Alaska 99501



Prepared by:

CRW Engineering Group, LLC 3940 Arctic Blvd., Suite 300 Anchorage, Alaska 99503  
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**PORT HEIDEN WASHETERIA AND WTP  
TECHNICAL MEMORANDUM No. 1  
Exploratory Well #2 Flow Test Results**

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**A. INTRODUCTION**

Exploratory Well #2 is located 72 feet southeast of the existing well serving Ray's Place. The well was drilled on September 25, 2007 by the Johnson Drilling Company of Anchorage, Alaska. The well depth is 58.1 feet through sand and pumice, sand and gravel, and thin silt layers. No bedrock was encountered in the full depth of the well. The water bearing sand and gravel layer is between 39 feet below ground surface (BGS) and 58 feet BGS. Stainless steel, 30 mesh screen was installed from 55 to 58 feet BGS. Six-inch diameter steel casing was installed in the well with a stickup height of 2.5 feet. The well was developed using a surge and pump method for 2 hours. The static water was 18.6 feet below top of casing (BTOC) and dropped to 34 feet BTOC after pumping at 15 gallons per minute (GPM) for 15 minutes. The driller's well log is included in Attachment A.

Mike Hendee, P.E. of CRW Engineering Group, LLC and Marie Steele, P.E. of ADEC travelled to Port Heiden on July 24<sup>th</sup>, 2008 to perform a flow test on the well and collect samples for water quality testing. The following tasks were conducted during the well flow test:

- ◆ Install a  $\frac{3}{4}$  horsepower well pump.
- ◆ Install digital pressure transducer data loggers in the Exploratory Well #2 and in the Ray's Place Well.
- ◆ Pump Exploratory Well #2 at various flow rates to determine the maximum sustainable flow rate.
- ◆ Pump the well at the maximum sustainable flow rate for 24 hours and record the drawdown in both wells.
- ◆ Collect water samples from Exploratory Well #2 for analysis.

**B. WELL FLOW TEST**

On the evening of July 23, 2008, a Grundfos 30SQ07-90 200-240 groundwater pump with a  $\frac{3}{4}$  horsepower electric motor was installed in Exploratory Well #2 with the top of the pump 50 feet BTOC. The pump was attached to 1.5-inch reinforced hose with an inline flow meter and a ball valve. Figure 1 depicts the testing apparatus.



**Figure 1. Exploratory Well #2 Flow Test Setup**

Two digital pressure transducer data loggers were placed in the bottom of Exploratory Well #2 and one was placed in the bottom of the Ray's Place Well. The data loggers were calibrated to record water level at a polling interval of 30 seconds. In addition, analog water level meters were installed in each well. The static water levels (SWL) in Exploratory Well #2 and Ray's Place Well were 17.8 feet BTOC and 18.4 feet BTOC, respectively.

The well pump was switched on and the flow rate was adjusted with a ball valve. The pump ran continuously overnight at 10 GPM and the 24-hour flow test began the next morning when the static water levels could be closely monitored with the analog meters. The digital data loggers were left in the two wells to record the data.

At 0845 on the morning of July 24<sup>th</sup>, the flow rate was increased to 20 GPM, beginning the 24-hour constant rate flow test. The water levels were measured with the analog meters at approximately 30 minute intervals until 1:00 PM on July 24<sup>th</sup>. At that point, the flight back to King Salmon arrived and we had to leave Port Heiden. The static water levels measured with the analog meters and the corresponding water level drawdown for each level are shown in Table 1 for Exploratory Well #2 and in Table 2 for Ray's Place Well.

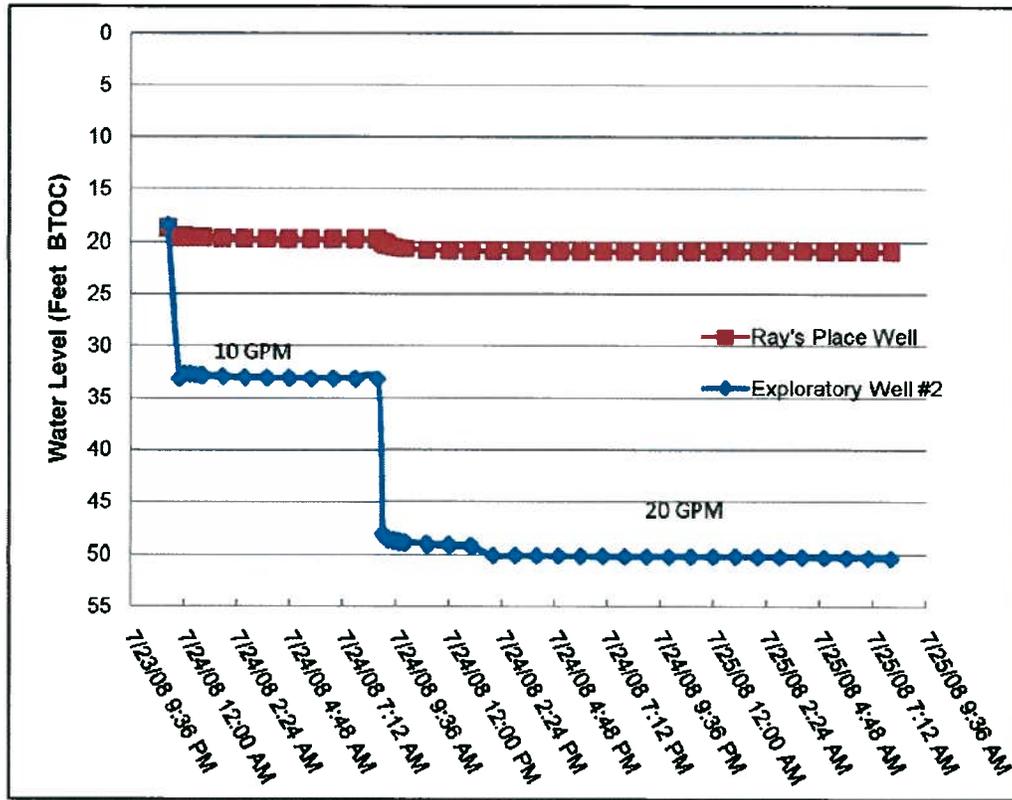
**Table 1. Exploratory Well #2 Analog Water Level Data**

Date	Time	Flow Rate	Exp. Well #2	
			SWL (BTOC)	Drawdown
7/23/08	11:17 PM	N/A	17.8 ft	N/A
7/23/08	11:47 PM	10 gpm	32.1 ft	14.3 ft
7/24/08	7:00 AM	10 gpm	32.6 ft	14.8 ft
7/24/08	8:54 AM	20 gpm	47.5 ft	29.7 ft
7/24/08	9:05 AM	20 gpm	48.1 ft	30.3 ft
7/24/08	9:20 AM	20 gpm	48.2 ft	30.4 ft
7/24/08	9:50 AM	20 gpm	48.3 ft	30.5 ft
7/24/08	10:20 AM	20 gpm	48.5 ft	30.7 ft
7/24/08	11:30 AM	20 gpm	48.6 ft	30.8 ft
7/24/08	12:30 PM	20 gpm	48.7 ft	30.9 ft
7/24/08	1:00 PM	20 gpm	48.5 ft	30.7 ft

**Table 2. Ray's Place Well Analog Water Level Data**

Date	Time	Flow Rate	Ray's Place Well	
			SWL (BTOC)	Drawdown
7/23/08	11:17 PM	N/A	18.4 ft	N/A
7/23/08	11:47 PM	10 gpm	19.3 ft	0.9 ft
7/24/08	7:00 AM	10 gpm	19.6 ft	1.2 ft
7/24/08	8:54 AM	20 gpm	20.2 ft	1.8 ft
7/24/08	9:05 AM	20 gpm	20.2 ft	1.8 ft
7/24/08	9:20 AM	20 gpm	20.2 ft	1.8 ft
7/24/08	9:50 AM	20 gpm	20.3 ft	1.9 ft
7/24/08	10:20 AM	20 gpm	20.5 ft	2.1 ft
7/24/08	11:30 AM	20 gpm	20.6 ft	2.2 ft
7/24/08	12:30 PM	20 gpm	20.6 ft	2.2 ft
7/24/08	1:00 PM	20 gpm	20.7 ft	2.3 ft

The data loggers continued to record the water level in the wells until the pump was shut off on the morning of July 25<sup>th</sup> by a local resident, Mr. James Christianson. The data loggers were returned to Anchorage and downloaded onto a computer for analysis. The data logger results are shown in Figure 2.



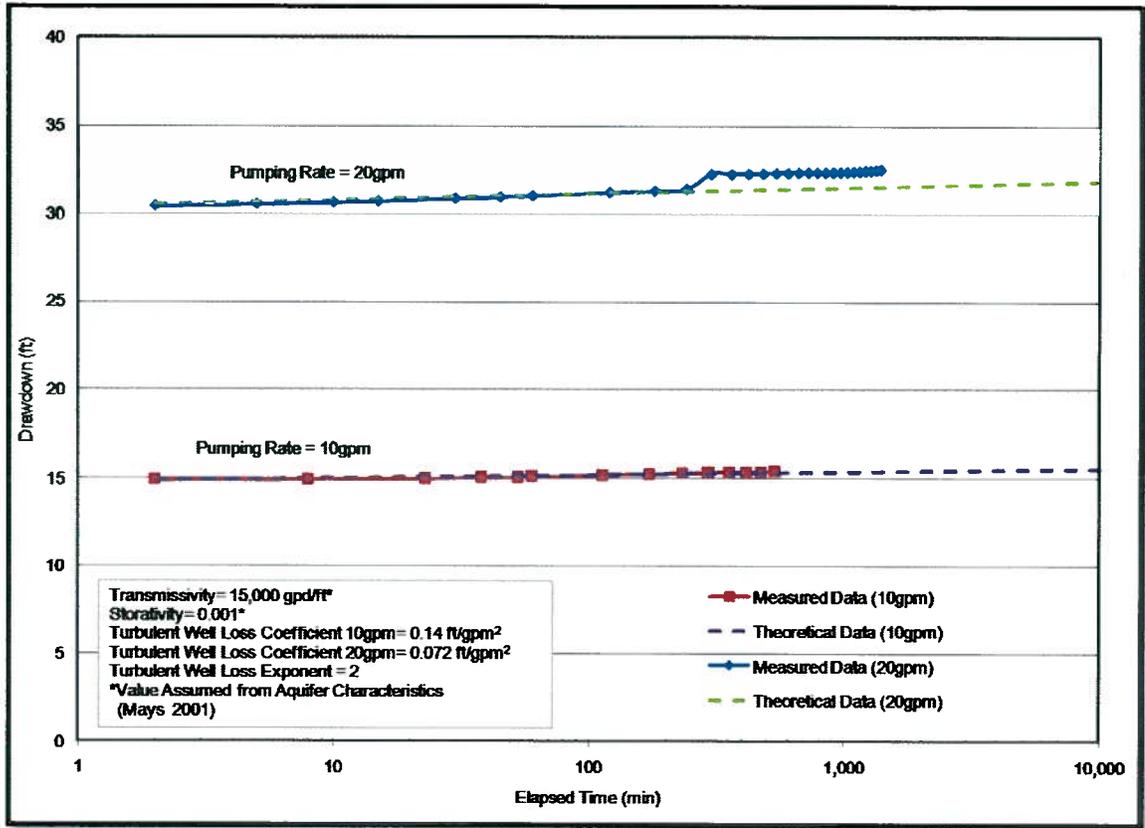
**Figure 2. Data Logger Results**

At a flow rate of 20 GPM, the water level recorded by the data logger in Exploratory Well #2 was 48.1 feet BTOC, for a drawdown of approximately 30.3 feet. After pumping at 20 GPM for 24 hours, the water level was 50.4 feet BTOC for a drawdown of approximately 32.6 feet. The drawdown increased approximately 2.3 feet in 24 hours for an approximate average of 0.1 foot per hour. There is a steep slope in the logger graph that occurred at approximately 1:00 PM on July 24<sup>th</sup>. This is probably due to a momentary power failure that caused a surge in the well pump when the power was restored.

The data logger installed in Ray's Place Well measured the water level at 20.1 feet BTOC for a drawdown of approximately 1.7 feet while the Exploratory Well #2 flow rate was 20 GPM. After pumping for 24 hours, the water level was 20.9 feet BTOC for a drawdown of approximately 2.5 feet. The drawdown increased approximately 0.8 feet in 24 hours, but appeared to stabilize at 0.8 feet after 7 hours.

### C. WELL CAPACITY ESTIMATES

The drawdown of Exploratory Well #2 for both the 10 GPM and 20 GPM flow rates is shown graphically in Figure 3. The graph contains both the measured drawdown and the theoretical drawdown based on the Hantush method for a horizontally anisotropic confined aquifer.



**Figure 3. Exploratory Well #2 Measured and Theoretical Drawdown Over Time**

The theoretical drawdown data shown in Figure 3 was calculated from the Hantush equation:

$$s = BQ + CQ^2$$

where,

- s = drawdown in the well
- Q = volumetric flow rate
- B = linear well loss coefficient
- C = turbulent well loss coefficient

The linear well loss coefficient (B) increases with time as predicted by the Theis analysis while the turbulent well loss coefficient (C) remains constant for a given flow rate based on

the aquifer characteristics. The Theis analysis makes the following assumptions regarding a confined aquifer:

- The aquifer is isotropic, homogeneous, and uniform thickness.
- The well fully penetrates the aquifer.
- Flow is laminar.
- The areal extent is infinite.
- There is no recharge.

The aquifer characteristics were based on the driller's well log included in Attachment A and values obtained from *Water Resources Engineering* by Larry Mays (Mays, 2001).

#### **D. WATER QUALITY TESTING RESULTS**

Water samples were collected from Exploratory Well #2 by Mr. Hendee at 1:00 PM on July 24<sup>th</sup> and were shipped to Anchorage. Mr. Hendee delivered the samples to the Anchorage laboratory of SGS Environmental Services, Inc. on July 25<sup>th</sup>. All the samples were acceptable for the Alaska Department of Environmental Conservation (ADEC) Class A well tests except for the volatile organic compound (VOC) test samples.

Additional sample bottles for the VOC tests were sent to Port Heiden and Mr. James Christianson collected the samples from Exploratory Well #2 on August 1, 2008. The samples were shipped to Anchorage and delivered to the SGS laboratory on August 4, 2008 by Mr. Hendee.

The test results indicate that the water from Exploratory Well #2 is excellent quality and meets or exceeds the ADEC standards for a Class A well. The SGS laboratory results are included in Attachment B. One concern was the concentration of iron and manganese in the water after pumping the well for 24 hours, since the adjacent Ray's Place Well contains iron and manganese in excess of the secondary maximum contaminant levels (SMCL). The test results for Exploratory Well #2 indicated an iron level of 0.03 mg/L far below the SMCL of 0.3 mg/L. The manganese level was 2.23 µg/L also far below the SMCL of 50 µg/L.

#### **E. CONCLUSIONS AND RECOMMENDATIONS**

The aquifer has favorable hydraulic properties that are capable of a flow rate of 20 GPM for short periods. Since the flow demand on the washeteria/WTP is greater than 20 GPM, a water storage tank will be required. The well pump should be limited to a flow rate of 15 GPM for long term use with a design head of 50 feet plus system and pipe friction losses.

The water in Exploratory Well #2 does not require treatment at this time. The adjacent Ray's Place Well, that is drilled to nearly the same depth and only 72 feet away, however, contains water that is high in iron and manganese. Space should be made available in the water treatment plant to install equipment that can filter the water from Exploratory Well #2 in the event that iron and manganese concentrations increase. Water quality should be monitored continuously to document any future changes so that treatment equipment can be installed if necessary before the quality exceeds any of the ADEC standards.

**F. REFERENCES**

1. Mays, L.W. 2001. *Water Resources Engineering*. John Wiley & Sons. Hoboken, NJ.

**G. ATTACHMENTS**

- A. Exploratory Well #2 Driller's Log
- B. SGS Laboratory Test Results

*END OF MEMORANDUM*

**ATTACHMENT A**

**EXPLORATORY WELL #2  
DRILLER'S LOG**

**STATE OF ALASKA**  
**DEPARTMENT OF NATURAL RESOURCES**  
**DIVISION OF MINING, LAND & WATER**  
**WATER WELL LOG**

Drilling Started: 9 / 24 / 2007 , Completed: 9 / 25 / 2007

City/Borough:	Subdivision:	BLOCK	LOT	Property Owner Name & Address:
Port Heiden				Ray's Place, Port Heiden, Alaska
Meridian <u>Seward</u> Township <u>37S</u> Range <u>59W</u> Section <u>35</u> , <u>1/4</u> of <u>1/4</u> of <u>1/4</u> of <u>1/4</u>				
<b>BOREHOLE DATA:</b> (from ground surface) Depth			Drilling method: <input checked="" type="checkbox"/> Air rotary, <input type="checkbox"/> Cable tool <input type="checkbox"/> Other _____	
Material: Type, Color & wetness			Well use: <input checked="" type="checkbox"/> Public supply, <input type="checkbox"/> Domestic, <input type="checkbox"/> Other _____	
	From	To		
Organics SILT (topsoil)	0.0	1.0	Depth of hole: <u>58.1</u> ft, Casing stickup: <u>2.5</u> ft	
SAND and PUMICE, brown, tan, soft	1.0	15.0	Casing type: <u>Steel</u> Thickness _____ inches	
Silty SAND with Gravel (SM), brown	15.0	35.0	Casing diameter: <u>6</u> inches Casing depth <u>58.1</u> ft	
SAND with Gravel (SP), brown	35.0	38.5	Liner type: <u>none</u> Diameter: _____ inches Depth: _____ ft	
SILT, brown, dense	38.5	39.0	Note: .....	
SAND with Gravel (SP), brown,	39.0	58.0	Static water (from top of casing): <u>18.6</u> ft on <u>9 / 25 / 2007</u>	
water bearing, estimate 30 gpm			Pumping level & yield: <u>34</u> feet after <u>0.25</u> hours at <u>15</u> gpm	
SILT, brown, dense	58.0	59.0	Recovery rate: _____ gpm, Method of testing: <u>bucket meas</u>	
			Development method: <u>surge &amp; pump</u> Duration: <u>2 hrs</u>	
			Well intake opening type: <input type="checkbox"/> Open end <input type="checkbox"/> Open hole, Other <input type="checkbox"/>	
			<input checked="" type="checkbox"/> Screened; Start: <u>55</u> ft, Stopped <u>58</u> ft	
			Screen type: <u>stainless steel</u> Slot/mesh size <u>30 slot</u>	
			<input type="checkbox"/> Perforated; Start: _____ ft, Stopped _____ ft	
			Start: _____ ft, Stopped _____ ft	
			Gravel packed <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No From _____ ft to _____ ft	
			Note: .....	
			Grout type: <u>bentonite</u> Volume _____	
			Depth; from <u>ground surface</u> ft, to <u>approx 10</u> ft	
			Pump intake depth: _____ ft	
			Pump size _____ hp Brand name _____	
			Was well disinfected upon completion? <input type="checkbox"/> Yes <input type="checkbox"/> No	
			Method of disinfection: .....	
			Driller comments/ disclaimers: .....	
			Well driller name: <u>Steve Johnson</u>	
			Company name: <u>Johnson Drilling Company</u>	
			Mailing address: <u>3705 Arctic Blvd., Unit 412</u>	
			City: <u>Anchorage</u> State: <u>AK</u> Zip <u>99503</u>	
			Phone number : ( <u>907</u> ) <u>250</u> - <u>5051</u>	
			Drillers signature: _____	
			Date: _____ / _____ / _____	

Alaska state law requires that a copy of this well log be forwarded to the Department of Natural Resources within 45 days (AK statutes 38.05.020, 38.05.035, 41.08.020, 48.15.020 and AK regulations 11 AAC 93.140). **Faxes are acceptable.**

Alaska DNR, Division of Mining, Land and Water,  
 550 W 7<sup>th</sup> Avenue, Suite 1020  
 Anchorage, AK 99501-3562

Phone (907)269-8639 and fax (907)269-8947

If the well is within city limits, the City of Anchorage requires that a copy of this well log be forwarded to the city within 60 days and another copy of this log be forwarded to the owner of the property, on which the well is located, within 30 days.

City Permit Number: \_\_\_\_\_  
 Date of Issue: \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

Parcel Identification Number: \_\_\_\_\_ - \_\_\_\_\_ - \_\_\_\_\_

Is well located at approved permit location? Yes  or No

**ATTACHMENT B**

**EXPLORATORY WELL #2  
WATER QUALITY LABORATORY RESULTS**



# Laboratory Analysis Report

200 W. Potter Drive  
Anchorage, AK 99518-1605  
Tel: (907) 562-2343  
Fax: (907) 561-5301  
Web: <http://www.us.sgs.com>

Mike Hendee  
CRW Engineering Group  
3940 Arctic Blvd.  
Anchorage, AK 99503

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<b>Work Order:</b>	1083690	
	Pt. Heiden WTP	<b>Released by:</b>
<b>Client:</b>	CRW Engineering Group	
<b>Report Date:</b>	August 25, 2008	

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Enclosed are the analytical results associated with the above workorder.

As required by the state of Alaska and the USEPA, a formal Quality Assurance/Quality Control Program is maintained by SGS. A copy of our Quality Assurance Plan (QAP), which outlines this program, is available at your request.

The laboratory certification numbers are AK971-05 (DW), UST-005 (CS) and AK00971 (Micro) for ADEC and 001992 for NELAP (RCRA methods: 1020A, 1311, 6010B, 7470A, 7471A, 9040B, 9045C, 9056, 9060, 9065, 8015B, 8021B, 8081A/8082, 8260B, 8270C).

Except as specifically noted, all statements and data in this report are in conformance to the provisions set forth by the SGS QAP, the National Environmental Laboratory Accreditation Program and, when applicable, other regulatory authorities.

If you have any questions regarding this report or if we can be of any other assistance, please contact your SGS Project Manager at 907-562-2343.

The following descriptors may be found on your report which will serve to further qualify the data.

PQL	Practical Quantitation Limit (reporting limit).
U	Indicates the analyte was analyzed for but not detected.
F	Indicates value that is greater than or equal to the MDL.
J	The quantitation is an estimation.
ND	Indicates the analyte is not detected.
B	Indicates the analyte is found in a blank associated with the sample.
*	The analyte has exceeded allowable regulatory or control limits.
GT	Greater Than
D	The analyte concentration is the result of a dilution.
LT	Less Than
!	Surrogate out of control limits.
Q	QC parameter out of acceptance range.
M	A matrix effect was present.
JL	The analyte was positively identified, but the quantitation is a low estimation.
E	The analyte result is above the calibrated range.
R	Rejected

Note: Sample summaries which include a result for "Total Solids" have already been adjusted for moisture content.



SGS Ref.# 1083690001  
Client Name CRW Engineering Group  
Project Name/# Pt. Heiden WTP  
Client Sample ID Heiden Exp. Well #2  
Matrix Drinking Water

Printed Date/Time 08/25/2008 15:20  
Collected Date/Time 07/24/2008 14:00  
Received Date/Time 07/25/2008 9:25  
Technical Director Stephen C. Ede

PWSID 0

Sample Remarks:

5440C - MBAS (Surfactants) was analyzed by Analytica International of Anchorage, AK.

Parameter	Results	PQL	Units	Method	Container ID	Allowable Limits	Prep Date	Analysis Date	Init
Total Nitrate/Nitrite-N	0.289	0.100	mg/L	SM20 4500NO3-F	E			08/04/08	JDZ

Waters Department

Cyanide	0.0036 J	0.0050	mg/L	SM20 4500-CN C,E	G	(<0.2)	08/01/08	08/02/08	LCP
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Microbiology Laboratory

Colony Count	0		col/100mL	SM20 9222B	A	(<200)		07/25/08	DLC
Total Coliform	0		col/100mL	SM20 9222B	A	(<1)		07/25/08	DLC
Fecal Coliform	0		col/100mL	SM20 9222B	A	(<1)		07/25/08	DLC

Inorganic Contaminants

Antimony	ND	1.00	ug/L	EP200.8	H	(<6)	07/30/08	08/01/08	NRB
Arsenic	ND	5.00	ug/L	EP200.8	H	(<10)	07/30/08	08/01/08	NRB
Barium	ND	3.00	ug/L	EP200.8	H	(<2000)	07/30/08	08/01/08	NRB
Beryllium	ND	0.400	ug/L	EP200.8	H	(<4)	07/30/08	08/01/08	NRB
Cadmium	ND	0.500	ug/L	EP200.8	H	(<5)	07/30/08	08/01/08	NRB
Chromium	0.800 J	2.00	ug/L	EP200.8	H	(<100)	07/30/08	08/01/08	NRB
Fluoride	0.375	0.100	mg/L	EPA 300.0	F	(<2)	08/04/08	08/05/08	LCP
Mercury	ND	0.200	ug/L	EP245.1	H	(<2)	07/27/08	07/27/08	KAR
Nickel	0.690 J	2.00	ug/L	EP200.8	H	(<100)	07/30/08	08/01/08	NRB
Selenium	ND	5.00	ug/L	EP200.8	H	(<50)	07/30/08	08/01/08	NRB
Thallium	ND	1.00	ug/L	EP200.8	H	(<2)	07/30/08	08/01/08	NRB

Secondary Contaminants

Calcium	10.4	0.100	mg/L	EP200.7	H		07/30/08	08/16/08	KAR
Aluminum	ND	20.0	ug/L	EP200.8	H	(<200)	07/30/08	08/01/08	NRB
Chloride	12.4	0.100	mg/L	EPA 300.0	F	(<250)	08/04/08	08/05/08	LCP



**SGS Ref.#** 1083690001  
**Client Name** CRW Engineering Group  
**Project Name/#** Pt. Heiden WTP  
**Client Sample ID** Heiden Exp. Well #2  
**Matrix** Drinking Water

**Printed Date/Time** 08/25/2008 15:20  
**Collected Date/Time** 07/24/2008 14:00  
**Received Date/Time** 07/25/2008 9:25  
**Technical Director** Stephen C. Ede

**PWSID** 0

Parameter	Results	PQL	Units	Method	Container ID	Allowable Limits	Prep Date	Analysis Date	Init
<b>Secondary Contaminants</b>									
Color	5.00	5.00	PCU	SM20 2120B	L	(<15)		07/25/08	EHC
Copper	0.670 J	1.00	ug/L	EP200.8	H	(<1000)	07/30/08	08/01/08	NRB
Fluoride	0.375	0.100	mg/L	EPA 300.0	F	(<2)	08/04/08	08/05/08	LCP
Hardness as CaCO3	43.1	2.50	mg/L	SM20 2340B	H		07/30/08	08/16/08	KAR
Langlier Index @ 40 degree F	-2.189			SM2330B	L			08/20/08	KAW
Alkalinity	52.1	10.0	mg/L	SM20 2320B	L			07/31/08	SYH
Langlier Index @ 140 degree F	-1.109			SM2330B	L			08/20/08	KAW
CO3 Alkalinity	ND	10.0	mg/L	SM20 2320B	L			07/31/08	SYH
Iron	0.0300	0.0200	mg/L	EP200.7	H	(<0.3)	07/30/08	08/16/08	KAR
HCO3 Alkalinity	52.1	10.0	mg/L	SM20 2320B	L			07/31/08	SYH
OH Alkalinity	ND	10.0	mg/L	SM20 2320B	L			07/31/08	SYH
Manganese	2.23	1.00	ug/L	EP200.8	H	(<50)	07/30/08	08/01/08	NRB
Odor (TON)	ND	1.00	T.O.N.	SM20 2150B	K	(<3)		07/25/08	EHC
pH	6.75	0.100	pH units	SM20 4500-H B	L	(6.5-8.5)		07/25/08	SYH
Magnesium	4.14	0.100	mg/L	EP200.7	H		07/30/08	08/16/08	KAR
Silver	ND	1.00	ug/L	EP200.8	H	(<100)	07/30/08	08/01/08	NRB
Sodium	14.0	1.00	mg/L	EP200.7	H	(<250)	07/30/08	08/16/08	KAR
Sulfate	2.50	0.100	mg/L	EPA 300.0	F	(<250)	08/04/08	08/05/08	LCP
Total Dissolved Solids	124	10.0	mg/L	SM20 2540C	L	(<500)		07/30/08	SYH
Zinc	ND	5.00	ug/L	EP200.8	H	(<5000)	07/30/08	08/01/08	NRB