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MAY 09 2011

Aquifer Characterization Report

Former Chamberlain Manufacturing Corporation Facility

550 Esther Street

Waterloo, Iowa

May 5, 2011

Terracon Project No. 07107020

Prepared for:

Chamberlain Manufacturing Corporation

Elmhurst, Illinois

Prepared by:

Terracon Consultants, Inc.

Bettendorf, Iowa

Offices Nationwide
Employee-Owned

Established in 1965
terracon.com

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Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

May 5, 2011



United States Environmental Protection Agency
Region 7
Air, RCRA and Toxics Division
901 North 5th Street
Kansas City, KS 66101

Attn: Mr. Bruce Morrison

Re: Aquifer Characterization Report
Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo, Iowa 50703
Terracon Project No. 07107020

Dear Mr. Morrison:

Terracon Consultants, Inc. (Terracon) is pleased to submit this Aquifer Characterization Report (AC Report) for activities conducted at the above referenced site. The AC Report presents a summary of the activities conducted to evaluate the groundwater aquifer within unconsolidated geologic deposits and the underlying Silurian/Devonian bedrock. The activities conducted were performed in accordance with Terracon's Aquifer Characterization Work Plan (AC Work Plan) dated August 2, 2010.

If you have questions concerning the information in this report please contact us at 563-355-0702.

Sincerely,

Terracon Consultants, Inc.

A handwritten signature in blue ink, reading "John F. Brimeyer".

John F. Brimeyer, P.E.
Environmental Manager

A handwritten signature in blue ink, reading "Gerald T. Hentges".
Gerald T. Hentges, P.G.
Senior Project Manager

Enclosure

Terracon Consultants, Inc. 870 40th Avenue Bettendorf, Iowa 52722
P [553] 355 0702 F [553] 355 4789 terracon.com

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**AQUIFER CHARACTERIZATION REPORT
CHAMBERLAIN MANUFACTURING CORPORATION
FORMER FACILITY AT
550 ESTHER STREET
WATERLOO, IOWA**

**Terracon Project No. 07107020
May 5, 2011**

1.0 INTRODUCTION

Terracon has developed this Aquifer Characterization (AC) Report to evaluate the results of 24-hour pump test conducted at the above referenced site in order to evaluate the response and recovery of the unconsolidated aquifer and the Silurian/Devonian aquifer at the former Chamberlain Manufacturing Facility (Facility). The information in this AC Report was collected in accordance with the schedule listed in the AC Work Plan dated May 20, 2010 as revised August 2, 2010.

1.1 Site Description

Site Name	Former Chamberlain Manufacturing Corporation Facility
Site Location/Address	550 Esther Street, Waterloo, Blackhawk County, Iowa
General Site Description	The Facility is an irregularly shaped parcel containing approximately 22.8 acres.

The Facility manufactured metal washer wringers and projectile metal parts from approximately 1919 until 1996 when it was sold to Atlas Warehouse L.C. for use as a storage facility. The City acquired the Facility from Atlas Warehouse L.C in 2005 in an effort to facilitate redevelopment and has demolished all of the buildings at the location.

The Facility is zoned Heavy Industrial (M-2) by the City. The Facility is adjoined by park land to the north and south, single family residential housing west, and Virden Creek followed by a golf course to the east. Virden Creek is within approximately 100 feet of the Facility at its closest point. Gates Park adjoins the Facility to the north across Louise Street, to the east across Virden Creek, and to the south across the railroad tracks. Single family residences are located across East 4th Street to the west of the Facility. Single family residences are also located along the east side of East 4th between Anita and Louise Streets.

A topographic map and a site diagram are included as Figure 1 and Figure 2 of Appendix A, respectively.

Subsurface soils at the site consist of approximately 60 to 65 feet of sand and gravel deposits above Silurian and Devonian-aged limestone bedrock. The Devonian-age limestone deposits are about 125 feet thick and are composed of the Wapsipinicon and Cedar Valley formations. The Silurian-

Aquifer Characterization Report

Former Chamberlain Manufacturing Facility ■ Waterloo, Iowa
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age limestone deposits are about 100 feet thick. A continuous confining layer is not present between the sands and gravels and the limestone bedrock, so these units are believed to be hydraulically connected. The Devonian aquifer in this area is intensely fractured and has karst development.

Based on field observations, the upper groundwater unit, which underlies a large portion of the Facility, is a perched aquifer created by fill material overlying native soils. Depth to groundwater at the Facility ranges from less than 10 feet bgs in the area of the perched aquifer to 20 feet bgs. Depth to groundwater off the Facility ranges from approximately 10 feet bgs to greater than 20 feet. Groundwater in both the unconsolidated deposits and the Silurian-Devonian bedrock units likely flows to the southwest toward the Cedar River.

A municipal water supply well, used primarily as a peak well during periods of high demand (City Well No. 22), is located approximately 600 feet north of the Facility within Gates Park. The City Well No. 22 fully penetrates the Silurian-Devonian system. In addition, geothermal wells located at the Carver Academy School (formally Logan Middle School) and Allen Memorial Hospital, located west and northwest of the Facility, respectively, are developed in the Silurian-Devonian aquifer. The Carver Academy geothermal system discharges extracted groundwater into an injection well located between the geothermal well and the Facility. The Allen Hospital geothermal system discharges the groundwater to the storm sewer system. The locations of the wells are depicted on Figure 2, Appendix A.

1.2 Previous Aquifer Characterization Activities

In December 2008, following completion of the Carver Academy geothermal wells, an aquifer test was conducted to evaluate the system performance. In conjunction with aquifer testing activities, transducers were installed in groundwater monitoring wells at and near the Facility to evaluate the effects of groundwater withdrawal on the contaminant plume. Although a direct correlation could not be established between the operation of the geothermal system and the groundwater monitoring wells, the IDNR, IGS, and USGS concluded that sub-regional flow under large withdrawal conditions was not well defined and that additional testing was warranted. Letters requesting access to the various wells in the area were sent to Allen Hospital, the Waterloo School District and the City of Waterloo. A copy of the correspondence is contained in Appendix B.

1.3 Monitoring Well Installation

On February 15, 2011, Terracon installed two groundwater monitoring wells along Louise Street between Boston Avenue and Sherman Avenue (OSMW-15) and along East Dale Street between Hope Avenue and Logan Avenue (OSMW-16). A 4¼-inch inside-diameter (8¼-inch borehole) hollow stem auger was used to advance the boreholes through the un-consolidated deposits to the top of bedrock. Sections of flush-jointed, two-inch outside diameter, schedule 40, polyvinyl chloride (PVC) threaded pipe was used for installation of the monitoring wells. The monitoring wells were screened over the bottom ten feet of the well with 0.01-inch slotted PVC pipe. After installation of the

Aquifer Characterization Report

Former Chamberlain Manufacturing Facility ■ Waterloo, Iowa
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monitoring wells, a depth to water was taken by electronic tape. OSMW-16 was observed to be dry at time of measurement. The soil boring logs and monitoring well construction diagrams for OSMW-15 and OSMW-16 are contained in Appendix C.

2.0 PUMP TEST ACTIVITIES

On February 21, 2011, Terracon installed transducers in the Allen geothermal well and at the proposed monitoring points MW-12, MW-15, MW-16, OSMW-9, OSMW-15, Facility Well No. 3, City Well No. 22, and Carver Academy Geothermal Well Nos. 1 and No. 2. Prior to installing the transducers, Terracon measured the depth to water in each well using an electric water tape. The water level measurements were converted to elevations.

On February 23, 2011 at 11:40 AM, Terracon began an aquifer pumping test at the Allen Hospital geothermal well No. 3 for approximately 25 hours. The well was operated at 1,100 gallons per minute (gpm) and the water was discharged to the City of Waterloo storm sewer system. The Carver Academy Geothermal Wells operated during the aquifer testing activities.

Groundwater levels in the instrumented pumping well and observation wells were measured continuously using pressure transducers and a data logger. A graph representing the groundwater elevations measured at the observation points during aquifer testing are displayed in Figure D-1 of Appendix D.

Following the completion of the pumping activities, the aquifer recovery was monitored in the Allen geothermal well for approximately 24 hours.

3.0 DATA EVALUATION

Allen Hospital's Geothermal Well No. 3 was used as the test pumping well. This well was pumped at a constant rate of 1,100 gallons per minute for approximately 25 hours while time-draw down measurements were collected at the shallow on-site well MW-12, deep on-site wells MW-15 and MW-16, shallow off-site wells OSMW-9 and OSMW-15, the former on-site production well No. 3, City Well No. 22 in Gates Park and at the Carver Academy geothermal wells No. 1 and No. 2. A summary of the groundwater elevations measured at the observation points is presented in Figure D-1.

The data on Figure D-1 indicates that no drawdown occurred in the wells with the exception of the Carver Academy geothermal wells No. 1 and No. 2. Following the completion of the pumping activities, the aquifer recovery was monitored for approximately 24 hours. Recovery at the Allen Hospital Geothermal Well No. 3 approached pre-pumping levels within about two hours after the end of the test. Throughout the pump test, the Carver Academy Geothermal Well No. 1 (west) was pumping while Geothermal Well No. 2 (east) was recharging. The result appears to be cyclical decreases and increases of approximately 1 foot in the groundwater elevation measured in Geothermal Well No. 1.

3.1 Aquifer Characterization

After the data was collected in the field, the aquifer parameters were evaluated. Typically, time distance draw down measurements for the observation points would be analyzed. Since no draw down was observed at the observation points, secondary methods were used to estimate the aquifer transmissivity (T). The Theis Recovery Test method was used to estimate the transmissivity of the aquifer. This indicates that if a well is pumped for a known period of time, the well will recharge with the same flow properties. This principle sets up the governing equations for the response to pumping a confined or semi-confined aquifer as shown below:

$$s' = \frac{Q}{4\pi T} [W(u) - W(u')] \quad (1)$$

Where:

$$u = \frac{r^2 S}{4Tt} \quad \text{and} \quad u' = \frac{r^2 S}{4Tt'} \quad (2)$$

The value "t" is the time from the beginning of the pumping period until time pumping ceases, and "t'" is the time from when well recharge begins until the water level reaches the original non-pumping level (static level). This indicates for small r and large t', the well functions, W(u) and W(u'), can be approximated in Equation 1 as:

$$s' = \frac{2.30Q}{4\pi T} \log \frac{t}{t'} \quad (3)$$

where s' is the residual drawdown and,

$$T = \frac{2.30Q}{4\pi \Delta s'} \quad (4)$$

The pumping rate (Q) and the residual drawdown per log cycle of the time ratio (t/t') were obtained from the data collected during well testing. The pumping rate, in gallons per minute (gpm), was 1,100 gpm, and the residual drawdown per log cycle ($\Delta s'$) was 0.35 ft. Figure D-2 in Appendix D demonstrates how $\Delta s'$ was determined. Based on the well recovery data the transmissivity of the aquifer was estimated to be approximately 110,769 feet-squared per day (ft²/day).

3.2 Groundwater Occurrence and Movement

The horizontal hydraulic conductivity (K) is related to transmissivity and aquifer thickness by the following relationship:

$$T = Kb \quad (5)$$

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where: T = Transmissivity (ft²/day)
b = Aquifer thickness (ft)

Using the transmissivity and aquifer thickness data collected at the test well the estimated horizontal hydraulic conductivity for the aquifer is about 615 feet per day (ft/d) or about 0.217 centimeters per second (cm/sec).

4.0 CONCLUSIONS AND RECOMMENDATIONS

It is apparent from the data collected that pumping and injection did not impact elevations at the remaining monitoring points. The results of the characterization indicate that pumping at Allen Hospital and pumping and injection at the Carver Academy geothermal system does not influence groundwater elevations or flow at MW-12, MW-15, MW-16, OSMW-9, OSMW-15, Facility Well No. 3, and City Well No. 22 because drawdown was not observed at these locations. Observed water levels at these locations fluctuate uniformly due to variations in atmospheric pressure. Water level variations due to drawdown or recharge at the Allen and Carver Academy Wells cannot be detected in the observation wells.

5.0 GENERAL COMMENTS

The analysis and opinions expressed in this report are based upon data obtained from aquifer test and other wells installed at the indicated locations and from other information discussed in this report. This report does not reflect any variations in subsurface stratigraphy, hydrogeology, or aquifer parameters which may occur between production or injection wells or across the site. Actual subsurface conditions may vary and may not become evident without further exploration.

The estimated aquifer parameters listed are subject to uncertainties. Variations in well efficiency from those assumed in the analysis can result in discrepancies between aquifer transmissivity and hydraulic conductivity values estimated, and those which actually occur. The intermittent discharge and recharge of the wells at the Carver Academy geothermal system further complicate the data analysis.

In the event any changes in nature or location of production wells or pumping wells or other surface or subsurface conditions as outlined in this report are observed, the conclusions and recommendations contained in this report cannot be considered valid unless the changes are reviewed and the opinions of this report are modified or verified in writing by the hydrogeological engineer.

APPENDIX A



STATE OF IOWA

TERRY E. BRANSTAD, GOVERNOR
KIM REYNOLDS, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
ROGER L. LANDE, DIRECTOR

July 22, 2011

Mr. Mike Dolan
Jones, Day
77 West Wacker
Chicago, Illinois 60601-1692

Re: Review of pump test data for the Aquifer Characterization Report, Former Chamberlain Manufacturing Corporation Facility, 550 Esther Street, Waterloo, Iowa dated May 5, 2011

Dear Mr. Dolan:

The Iowa Department of Natural Resources, Contaminated Sites Section, (Department) has received and reviewed the requested pump test data for the above referenced report. During the review two major flaws were discovered, the transducer data was not compensated for changes in atmospheric pressure and the pump in the test well was running (cycling) several hours leading up to and then not running continuously during the 25 hour pump test.

The type of transducer used was 'non-vented' giving results as absolute pressure (water pressure plus atmospheric pressure). It is quite common for pump test data in observation wells to be masked by barometric pressure changes in the atmosphere. Terracon should have used a barometric pressure logger in order to subtract the change in atmospheric pressure from the transducer's absolute pressure reading. A 'vented' transducer has a cable with a small diameter tube that runs from the transducer to the surface automatically compensating the back side of the pressure sensor to changes in atmospheric pressure.

Because the pumping well pump was cycling on and off, the pump test was more like 41 mini-pump tests with durations of 36 minutes each (approximately 18 minutes run time and 18 minutes recover time). During the 25 hour pump test the well was off half the time. In the report the ripples in the Allen well transducer data, during the pump test, were noted as connectivity to the Carver wells. If the ripples found in the Allen well during the pump test were caused by the Carver wells the ripples would also be present in the Allen well prior to the pump test, but this is not the case. Since the aquifer was not truly stressed the transmissivity and horizontal hydraulic conductivity calculations are most likely wrong because of the artificial equilibrium caused by the cycling pump.

The Department is also concerned with the data indicating an almost - insignificant drawdown - in both the Allen well during the pump test and the Carver West well

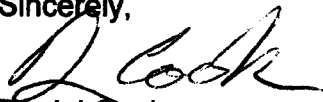
Mr. Mike Dolan
Page 2 of 2

when it was pumping. During the Allen well development in 1991 the drawdown for the pump test was 21 feet; the drawdown for this test was around 2 feet.

At this time the Department is rejecting the Aquifer Characterization Report as written, it is the Department's opinion the report does not truly describe the actual conditions found in the aquifer.

If you have any questions or need further information please feel free to call or e-mail at (515) 281-4171 or dan.cook @dnr.iowa.gov.

Sincerely,



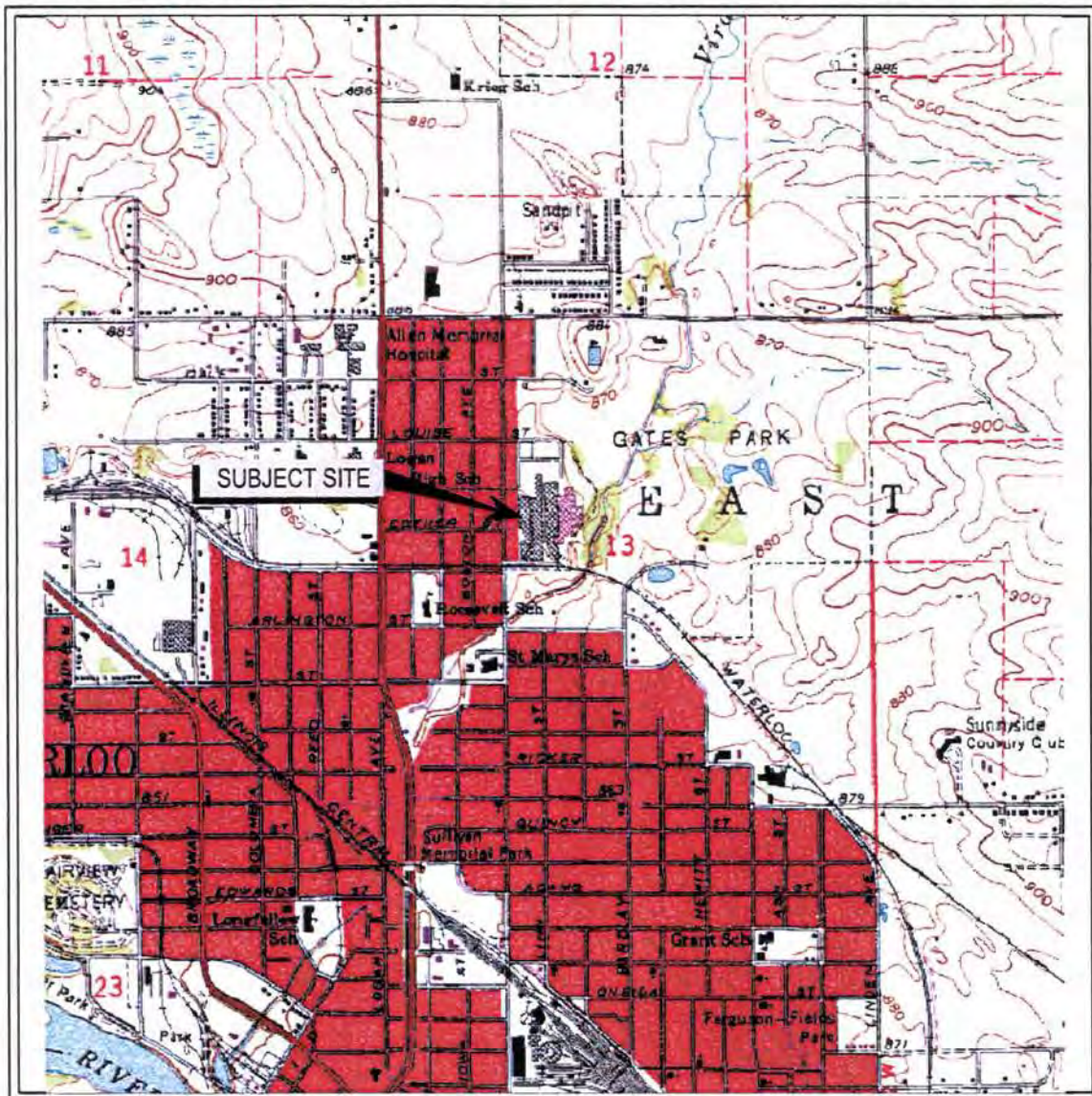
Daniel Cook
Environmental Specialist Senior
Contaminated Sites

c: Bruce A. Morrison US Environmental Protection Agency, 901 North 5th Street, Kansas City, Kansas 66101
John Brimeyer Terracon Consultants, 870 40th Avenue, Bettendorf, Iowa 52722
Deb Tinker Iowa DNR Field Office 1

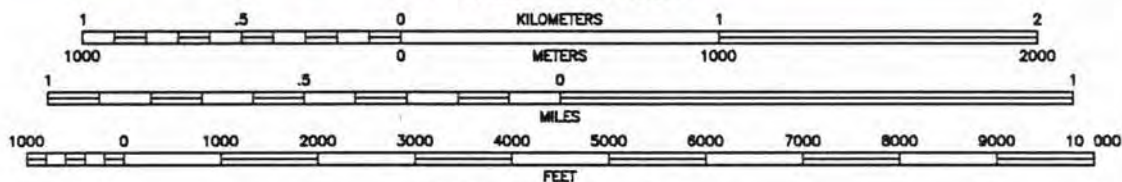
APPENDIX A

Figures

UNITED STATES – DEPARTMENT OF THE INTERIOR – GEOLOGICAL SURVEY



SCALE 1:24 000



CONTOUR INTERVAL FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
TOPO LINES REPRESENT 10-FOOT CONTOURS

WATERLOO NORTH QUADRANGLE

7.5 MINUTE SERIES (TOPOGRAPHIC)



Project Mgr:	JFB
Project No.	07107020
Drawn By:	JFB
Scale:	AS SHOWN
Checked By:	JFB
File No.	07107020-T3A-FIG1
Approved By:	JFB
Date:	MAY 2011

Terracon
Consulting Engineers and Scientists

370 40th Avenue Bettendorf, Iowa 52722
5631 355-0702 (563) 355-4789

TOPOGRAPHIC VICINITY MAP
AQUIFER CHARACTERIZATION REPORT
FORMER CHAMBERLAIN MANUFACTURING FACILITY
550 ESTHER ST.
WATERLOO, IOWA

FIG. No.
1

APPENDIX B

APPENDIX B

Project Correspondence



January 31, 2011

City of Waterloo
Planning & Zoning Development
715 Mulberry Street
Waterloo, Iowa 50703

Attn: Mr. Chris Western
City Planner

Re: Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo Iowa
EPA Docket Nos. RCRA-07-2010-002 and CERCLA-07-2010-0005
Project No. 07107020

Dear Mr. Western:

Chamberlain Manufacturing Corporation (Chamberlain) has entered into a Unilateral Administrative Order (UAO) with the United States Environmental Protection Agency (USEPA) dated April 20, 2010. In accordance with the terms of the UAO, Chamberlain is required to conduct aquifer characterization testing to evaluate the effects of geothermal wells in the area on observed groundwater contamination at the site. Terracon Consultants, Inc. (Terracon), on behalf of Chamberlain, has developed an Aquifer Characterization Work Plan (AC Work Plan) dated August 2, 2010 which presents proposed aquifer testing activities. The AC Work Plan was approved by the USEPA on January 6, 2011.

Terracon and Chamberlain are requesting your cooperation in completing the aquifer testing activities. In accordance with the approved AC Work Plan, and consistent with an Iowa Department of Natural Resources (IDNR) memorandum dated March 29, 2009, we are proposing to conduct a 24-hour pump test. The proposed test will consist of the pumping of the Allan Memorial Hospital Geothermal Well No. 2 or No. 3 and monitoring of water levels in six groundwater monitoring wells at and near the Chamberlain site, a former production well on the Chamberlain site, City of Waterloo Well No. 22 located in Gates Park, and Carver Academy Geothermal Wells No. 1 and No. 2.

Terracon will be responsible for coordinating the pump test activities including the removal of well equipment from the former Chamberlain production well and the placement of pressure transducers in existing monitoring, production, and geothermal wells or arranging for Terracon staff to manually monitor altitude gauges on existing wells if they cannot be accessed for



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Chamberlain Manufacturing ■ Waterloo, Iowa
January 31, 2011 ■ Terracon Project No. 07107020



transducer installation. Following the completion of the pump test, the wells will continue to be monitored through a 24-hour recovery period at which time, pressure transducers will be removed from the wells. Groundwater samples may also be collected for analysis of contaminants of concern. The data collected will be reviewed and compiled by Terracon and presented to the USEPA as an Aquifer Characterization Report.

It is anticipated that the pump test will be completed during February 2011.

Terracon and Chamberlain are requesting your assistance in coordinating pump test activities.

Thank you for your consideration of this issue. Should you have any questions concerning this request, please contact us at (563) 355-0702.

Sincerely,
Terracon Consultants, Inc.

John F. Brimeyer, PE
Environmental Manager

cc: Mr. Bruce Morrison, USEPA Region 7
Mr. Eric Reeves, Chamberlain Manufacturing
Mr. Mike Dolan, Jones-Day
Ms. Deb Tinker, IDNR Field Office No. 1
Mr. Jim Caldwell, United States Geological Survey
Mr. Mike Gannon, Iowa Geological Survey



January 31, 2011

Shawver Well Company, Inc.
2700 Stanley Avenue
Fredericksburg, Iowa 50630

Attn: Mr. Gary Shawver

Re: Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo Iowa
EPA Docket Nos. RCRA-07-2010-002 and CERCLA-07-2010-0005
Project No. 07107020

Dear Mr. Shawver:

Chamberlain Manufacturing Corporation (Chamberlain) has entered into a Unilateral Administrative Order (UAO) with the United States Environmental Protection Agency (USEPA) dated April 20, 2010. In accordance with the terms of the UAO, Chamberlain is required to conduct aquifer characterization testing to evaluate the effects of geothermal wells in the area on observed groundwater contamination at the site. Terracon Consultants, Inc. (Terracon), on behalf of Chamberlain, has developed an Aquifer Characterization Work Plan (AC Work Plan) dated August 2, 2010 which presents proposed aquifer testing activities. The AC Work Plan was approved by the USEPA on January 6, 2011.

Terracon and Chamberlain are requesting your cooperation in completing the aquifer testing activities. In accordance with the approved AC Work Plan, and consistent with an Iowa Department of Natural Resources (IDNR) memorandum dated March 29, 2009, we are proposing to conduct a 24-hour pump test. The proposed test will consist of the pumping of the Allan Memorial Hospital Geothermal Well No. 2 or No. 3 and monitoring of water levels in six groundwater monitoring wells at and near the Chamberlain site, a former production well on the Chamberlain site, City of Waterloo Well No. 22 located in Gates Park, and Carver Academy Geothermal Wells No. 1 and No. 2.

Terracon will be responsible for coordinating the pump test activities including the removal of well equipment from the former Chamberlain production well and the placement of pressure transducers in existing monitoring, production, and geothermal wells or arranging for Terracon staff to manually monitor altitude gauges on existing wells if they cannot be accessed for transducer installation. Following the completion of the pump test, the wells will continue to be monitored through a 24-hour recovery period at which time, pressure transducers will be



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Chamberlain Manufacturing ■ Waterloo, Iowa

January 31, 2011 ■ Terracon Project No. 07107020

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removed from the wells. Groundwater samples may also be collected for analysis of contaminants of concern. The data collected will be reviewed and compiled by Terracon and presented to the USEPA as an Aquifer Characterization Report.

It is anticipated that the pump test will be completed during February 2011.

Terracon and Chamberlain are requesting your assistance in removing the well pump and appurtenances from the former Chamberlain production well and installing a cap on the well casing. Terracon has been provided a copy of your proposal dated April 22, 2009 to Ms. Stephanie Doolan, USEPA. Please update your proposal and forward to my attention.

Thank you for your consideration of this issue. Should you have any questions concerning this request, please contact us at (563) 355-0702.

Sincerely,

Terracon Consultants, Inc.

John F. Brimeyer, PE
Environmental Manager

cc: Mr. Bruce Morrison, USEPA Region 7
Mr. Eric Reeves, Chamberlain Manufacturing
Mr. Mike Dolan, Jones-Day



January 31, 2011

Waterloo Community School District
1516 Washington Street
Waterloo, IA 50702

Attn: Mr. Marty Metcalf
Director of Operational Services

Re: Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo Iowa
EPA Docket Nos. RCRA-07-2010-002 and CERCLA-07-2010-0005
Project No. 07107020

Dear Mr. Metcalf:

Chamberlain Manufacturing Corporation (Chamberlain) has entered into a Unilateral Administrative Order (UAO) with the United States Environmental Protection Agency (USEPA) dated April 20, 2010. In accordance with the terms of the UAO, Chamberlain is required to conduct aquifer characterization testing to evaluate the effects of geothermal wells in the area on observed groundwater contamination at the site. Terracon Consultants, Inc. (Terracon), on behalf of Chamberlain, has developed an Aquifer Characterization Work Plan (AC Work Plan) dated August 2, 2010 which presents proposed aquifer testing activities. The AC Work Plan was approved by the USEPA on January 6, 2011.

Terracon and Chamberlain are requesting your cooperation in completing the aquifer testing activities. In accordance with the approved AC Work Plan, and consistent with an Iowa Department of Natural Resources (IDNR) memorandum dated March 29, 2009, we are proposing to conduct a 24-hour pump test. The proposed test will consist of the pumping of the Allan Memorial Hospital Geothermal Well No. 2 or No. 3 and monitoring of water levels in six groundwater monitoring wells at and near the Chamberlain site, a former production well on the Chamberlain site, City of Waterloo Well No. 22 located in Gates Park, and Carver Academy Geothermal Wells No. 1 and No. 2.

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January 31, 2011 ■ Terracon Project No. 07107020

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It is anticipated that the pump test will be completed during February 2011.

Terracon and Chamberlain are requesting your permission to allow us to monitor water levels in the Carver Academy Geothermal Wells No. 1 and No. 2 for the duration of the 24-hour test period and to allow us to observe and record water levels throughout the test period and the 24-hour recovery period.

Thank you for your consideration of this issue. Should you have any questions concerning this request, please contact us at (563) 355-0702.

Sincerely,

Terracon Consultants, Inc.

John F. Brimeyer, PE
Environmental Manager

cc: Mr. Bruce Morrison, USEPA Region 7
Mr. Eric Reeves, Chamberlain Manufacturing
Mr. Mike Dolan, Jones-Day
Ms. Deb Tinker, IDNR Field Office No. 1
Mr. Jim Caldwell, United States Geological Survey
Mr. Mike Gannon, Iowa Geological Survey



January 31, 2011

Allen Memorial Hospital
1825 Logan Avenue
Waterloo, Iowa 50703

Attn: Mr. Terry Flynn
Director of Plant Services /Safety Officer

Re: Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo Iowa
EPA Docket Nos. RCRA-07-2010-002 and CERCLA-07-2010-0005
Project No. 07107020

Dear Mr. Flynn:

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It is anticipated that the pump test will be completed during February 2011.

Terracon and Chamberlain are requesting your permission to allow us to operate the Allen Memorial Hospital Geothermal Well No. 2 or No. 3 for the duration of the 24-hour test period and to allow us to observe and record water levels throughout the test period and the 24-hour recovery period. We will be in contact with you to coordinate pump test activities.

Thank you for your consideration of this issue. Should you have any questions concerning this request, please contact us at (563) 355-0702.

Sincerely,

Terracon Consultants, Inc.

John F. Brimeyer, PE
Environmental Manager

cc: Mr. Bruce Morrison, USEPA Region 7
Mr. Eric Reeves, Chamberlain Manufacturing
Mr. Mike Dolan, Jones-Day
Ms. Deb Tinker, IDNR Field Office No. 1
Mr. Jim Caldwell, United States Geological Survey
Mr. Mike Gannon, Iowa Geological Survey



January 31, 2011

Waterloo Water Works
325 Sycamore Street
P.O. Box 27
Waterloo, Iowa 50704

Attn: Mr. Dennis Clark
General Manager

Re: Chamberlain Manufacturing Corporation
Former Facility at 550 Esther Street
Waterloo Iowa
EPA Docket Nos. RCRA-07-2010-002 and CERCLA-07-2010-0005
Project No. 07107020

Dear Mr. Clark:

Chamberlain Manufacturing Corporation (Chamberlain) has entered into a Unilateral Administrative Order (UAO) with the United States Environmental Protection Agency (USEPA) dated April 20, 2010. In accordance with the terms of the UAO, Chamberlain is required to conduct aquifer characterization testing to evaluate the effects of geothermal wells in the area on observed groundwater contamination at the site. Terracon Consultants, Inc. (Terracon), on behalf of Chamberlain, has developed an Aquifer Characterization Work Plan (AC Work Plan) dated August 2, 2010 which presents proposed aquifer testing activities. The AC Work Plan was approved by the USEPA on January 6, 2011.

Terracon and Chamberlain are requesting your cooperation in completing the aquifer testing activities. In accordance with the approved AC Work Plan, and consistent with an Iowa Department of Natural Resources (IDNR) memorandum dated March 29, 2009, we are proposing to conduct a 24-hour pump test. The proposed test will consist of the pumping of the Allan Memorial Hospital Geothermal Well No. 2 or No. 3 and monitoring of water levels in six groundwater monitoring wells at and near the Chamberlain site, a former production well on the Chamberlain site, City of Waterloo Well No. 22 located in Gates Park, and Carver Academy Geothermal Wells No. 1 and No. 2.

Terracon will be responsible for coordinating the pump test activities including the removal of well equipment from the former Chamberlain production well and the placement of pressure transducers in existing monitoring, production, and geothermal wells or arranging for Terracon staff to manually monitor altitude gauges on existing wells if they cannot be accessed for



Terracon Consultants, Inc. 870 40th Avenue Bettendorf, Iowa 52722
P [563] 355 0702 F [563] 355 4789 terracon.com

Geotechnical



Environmental



Construction Materials



Facilities

Aquifer Characterization Testing

Chamberlain Manufacturing ■ Waterloo, Iowa

January 31, 2011 ■ Terracon Project No. 07107020

Terracon

transducer installation. Following the completion of the pump test, the wells will continue to be monitored through a 24-hour recovery period at which time, pressure transducers will be removed from the wells. Groundwater samples may also be collected for analysis of contaminants of concern. The data collected will be reviewed and compiled by Terracon and presented to the USEPA as an Aquifer Characterization Report.

It is anticipated that the pump test will be completed during February 2011.

Terracon and Chamberlain are requesting your permission to allow us to monitor water levels in the Gates Park Well No. 22 for the duration of the 24-hour test period and to allow us to observe and record water levels throughout the test period and the 24-hour recovery period. We will contact Mr. Travis Larson, Plant Operator to coordinate pump testing activities.

Thank you for your consideration of this issue. Should you have any questions concerning this request, please contact us at (563) 355-0702.

Sincerely,

Terracon Consultants, Inc.

John F. Brimeyer, PE
Environmental Manager

cc: Mr. Bruce Morrison, USEPA Region 7
Mr. Eric Reeves, Chamberlain Manufacturing
Mr. Mike Dolan, Jones-Day
Ms. Deb Tinker, IDNR Field Office No. 1
Mr. Jim Caldwell, United States Geological Survey
Mr. Mike Gannon, Iowa Geological Survey

APPENDIX C

APPENDIX C

Monitoring Well Logs

LOG OF BORING OSMW-15

Page 1 of 1

CLIENT											
SITE 550 Esther Street Waterloo, Iowa				PROJECT Former Industrial Property							
GRAPHIC LOG	Boring Location: About 15' west and 2' north of NW corner of house on 322 Louis Street DESCRIPTION BOREHOLE DIA.: 6 in WELL DIA.: 2 in TOP OF PROTECTOR PIPE: 872.00 ft TOP OF CASING: 871.7 ft GROUND SURFACE ELEV.: 872.04 ft			WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES			TESTS	
							NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	WATER CONTENT, %
	0.33	SANDY GRAVEL , Light Brown		871.5			HS				
		FINE SAND , Brown									
	12			860							
	14	FINE SAND , Light Brown		858							
	17	FINE SAND, TRACE CLAY , Gray Brown		855							
	20.5	CLAYEY FINE SAND , Light Brown		851.5							
	24	LEAN CLAY WITH SAND , Light Brown		848							
	26.9	SANDY LEAN CLAY WITH COBBLES , Light Brown / Light Gray		845							
	27	HIGHLY WEATHERED LIMESTONE BOTTOM OF BORING		845							

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft

WL	16	WD	15	AB
WL	22	2/21/11		
WL				

Terracon

BORING STARTED	2-15-11
BORING COMPLETED	2-15-11
RIG	# 14e
FOREMAN	WE
JOB #	07107020

LOG OF BORING OSMW-16

Page 1 of 1

CLIENT

SITE **550 Esther Street
Waterloo, Iowa**

PROJECT

Former Industrial Property

GRAPHIC LOG	Boring Location: About 19' west and 16' south of SW corner of garage on 703 Hope Street DESCRIPTION		WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES			TESTS		
						NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	WATER CONTENT, %	FIELD VAPOR TEST (PPM)*
	BOREHOLE DIA.: 6 in WELL DIA.: 2 in TOP OF PROTECTOR PIPE: 877.40 ft TOP OF CASING: 877.01 ft GROUND SURFACE ELEV.: 877.39 ft										
	0.17 PEA GRAVEL WITH SAND	877					HS				
	FINE SAND, Brown										
	5.5	872		5							
	FINE SAND, Light Brown										
	9.5	868		10							
	LEAN CLAY WITH SAND, Brown										
	13	864.5		15							
	LEAN CLAY WITH SAND, Brown										
	17	860.5									
	17.5 FINE SAND, TRACE CLAY	860									
	17.9 AND COBBLES, Brown	859.5									
	18 SANDY LEAN CLAY WITH SAND, Brown	859.5									
	HIGHLY WEATHERED LIMESTONE										
	BOTTOM OF BORING										

Note: Soil boring was completed as a permanent monitoring well with flush mount well cover after completion.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft

WL	▽ 10	WD	▽ None	AB
WL	▽ None	2/21/11	▽	
WL				

Terracon

BORING STARTED	2-15-11
BORING COMPLETED	2-15-11
RIG # 14e	FOREMAN WE
JOB #	07107020

APPENDIX D

APPENDIX D

Aquifer Test Analysis

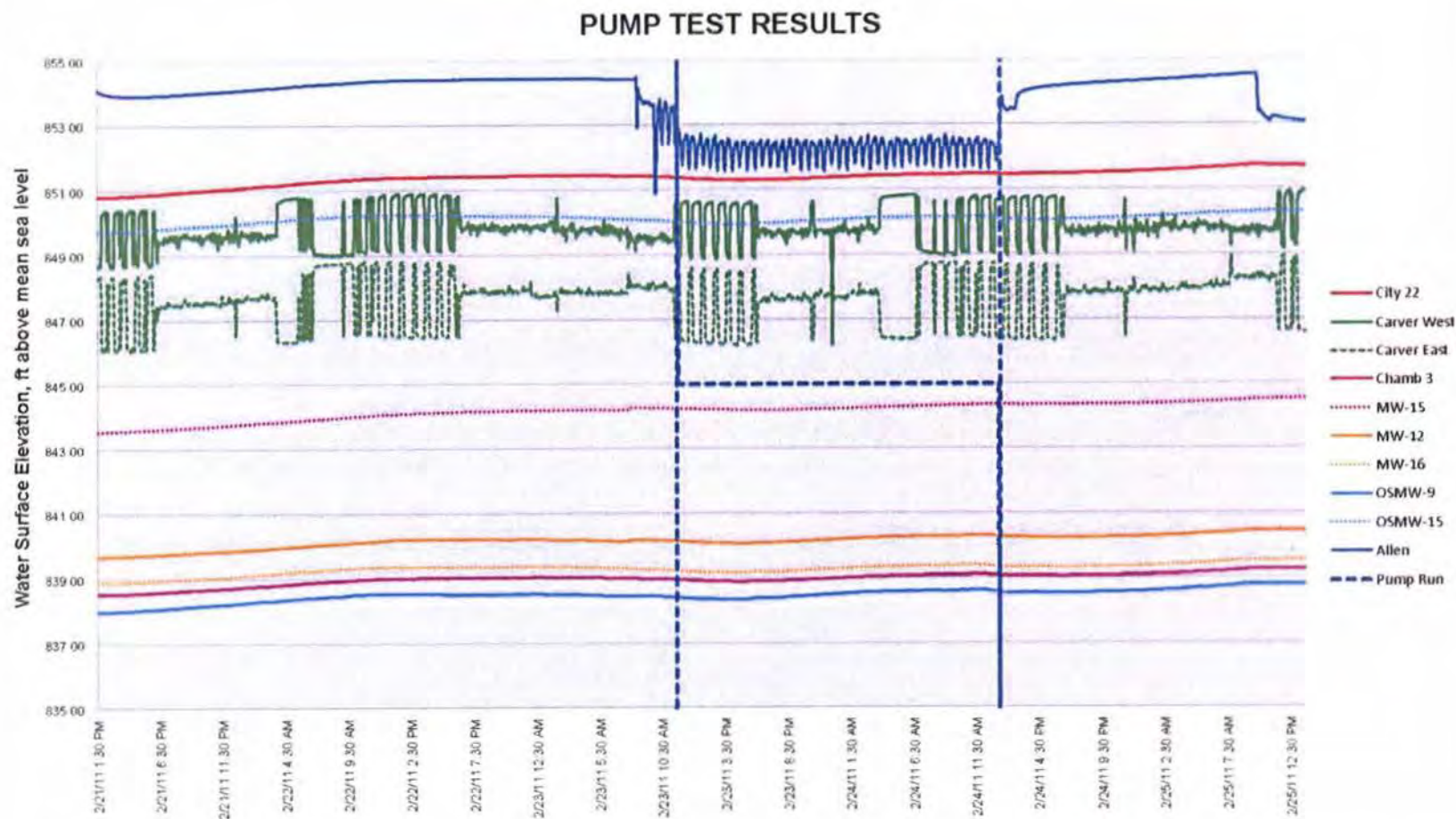


Figure D-1: TIME VS DRAWDOWN OBSERVATIONS

Proj. Mgr: JB

Designed by: CAK

Drawn by: CAK

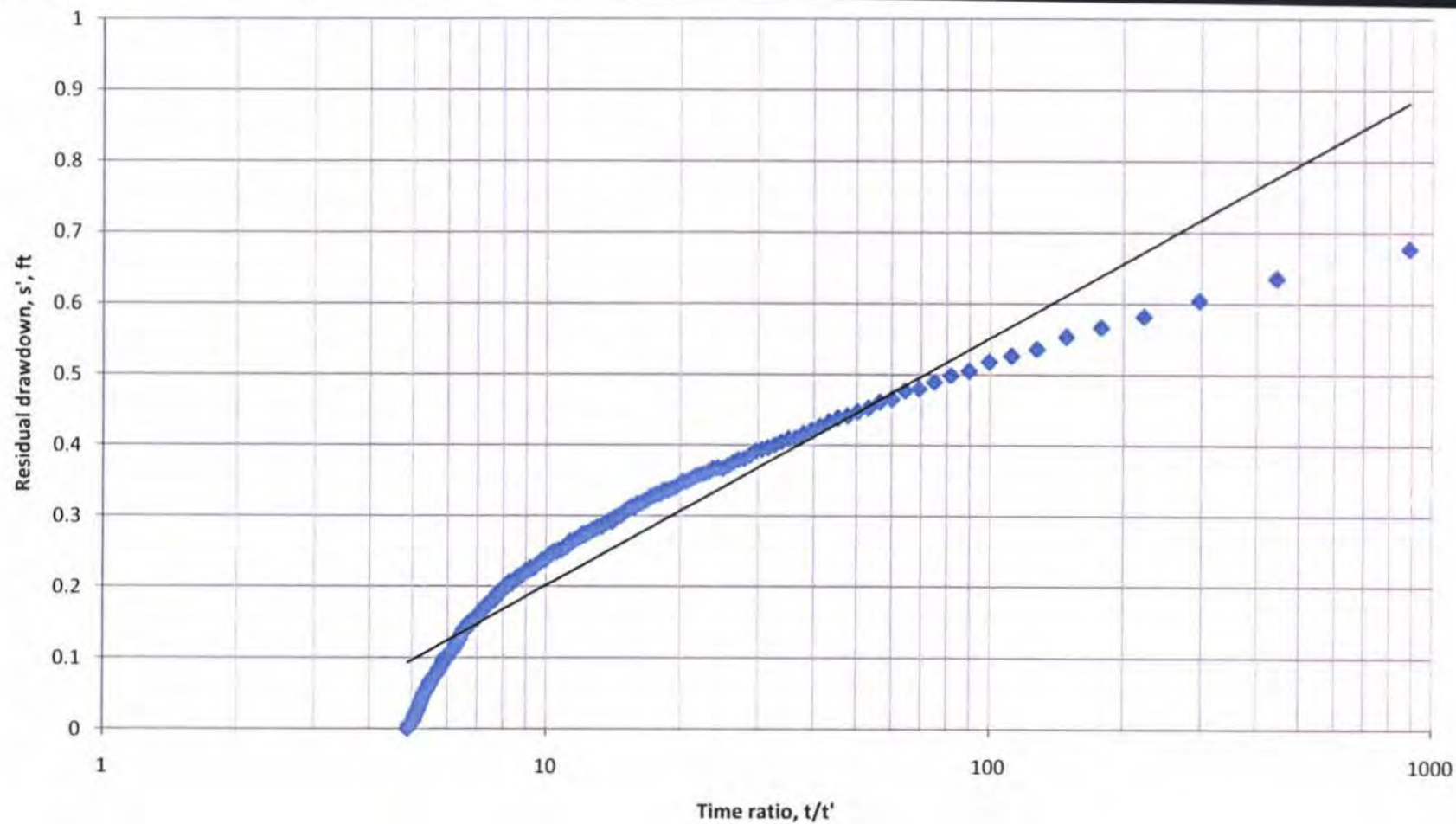
Terracon

870 40th Avenue
Bettendorf, IA 52722

Proj. 07107020

File Name:

Date: 04-26-2011



REGRESSION ANALYSIS

$$y = 0.1515 \ln(x) - 0.1467$$

$$R^2 = 0.9061$$

Ground Surface Elevation (ASL)	901.00	FT	Thickness of Aquifer	180	FT
Depth to Water Elevation (ASL)	854.00	FT		55	M
Pump Level Elevation (ASL)	850.90	FT	Transmissivity	110769	FT ² /D
Average Discharge	1100	GPM		10291	M ² /D
	5995	M ³ /D	Hydraulic Conductivity	615	FT/D
Residual Drawdown per log cycle	0.35	FT		2.17E-01	CM/SEC
	0.10668	M			

Figure D-2: THEIS RECOVERY TEST METHOD

Proj. Mgr: JB	Terracon 870 40 th Avenue Bettendorf, IA 52722	Proj. 07107020
Designed by: CAK		File Name:
Drawn by: CAK		Date: 04-26-2011