Regional and Local Geologic Summary at the Combustion Engineering, Hematite, Missouri Plant

Combustion Engineering
Hematite, Missouri

May 30, 1997

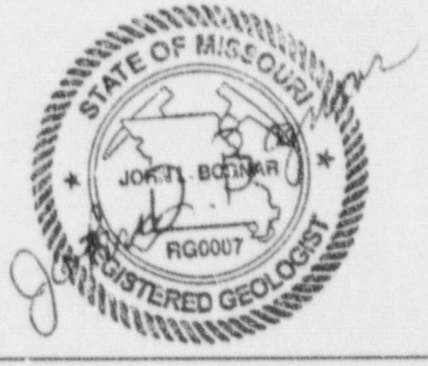
GATEWAY ENVIRONMENTAL ASSOCIATES, INC.

Regional and Local Geologic Summary at the Combustion Engineering Hematite, Missouri Plant

96A002

Prepared for

Combustion Engineering
Hematite, Missouri



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May 30, 1997

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Table of Contents

Introduction

This geologic summary was produced to demonstrate an understanding of the geologic features occurring at and near the Combustion Engineering (CE) plant in Hematite, MO and to document a thorough successful search for known information. Gateway Environmental Associates, Inc. (Gateway) procured data from public information sources , case files of the Missouri Department of Natural Resources (MDNR) Division of Geology and Land Survey (DGLS), the United States Geological Survey (USGS) and several private sources. Meetings were held between Gateway, DGLS and USGS to acquire the technical information cited and otherwise used in this report.

This document should be considered an executive summary for interested parties wishing to understand the geology and hydrogeology of the area. This document was produced to assist CE, their consultants and regulators who may wish to use the information to guide the negotiation and development of a site specific hydrogeologic investigation work plan.

1.0 Regional Geologic Setting

1.1 Bedrock and Structure

The site is in northern Jefferson County which is on the north, northeast flank of the Pre-Cambrian age St. Francis Mountains, Ozark Dome. Cambrian, Ordovician, Silurian, Devonian and Mississippian sedimentary formations of various depositional environments are draped on the flanks of the dome. CE's Hematite, Mo. plant is situated over these formations. Based upon the 1979 official Missouri Geologic Map and the Bedrock Geologic Map of the Festus 7.5 Minute Quadrangle by Whitfield and Middendorf, the uppermost bedrock beneath the site is the lower Ordovician Canadian series, Jefferson City Dolomite. Figure 1 from a 1991 DGLS publication, is an isopach map of the Jefferson City Dolomite. Figure 2 shows the site in reference to the DGLS bedrock geologic map.

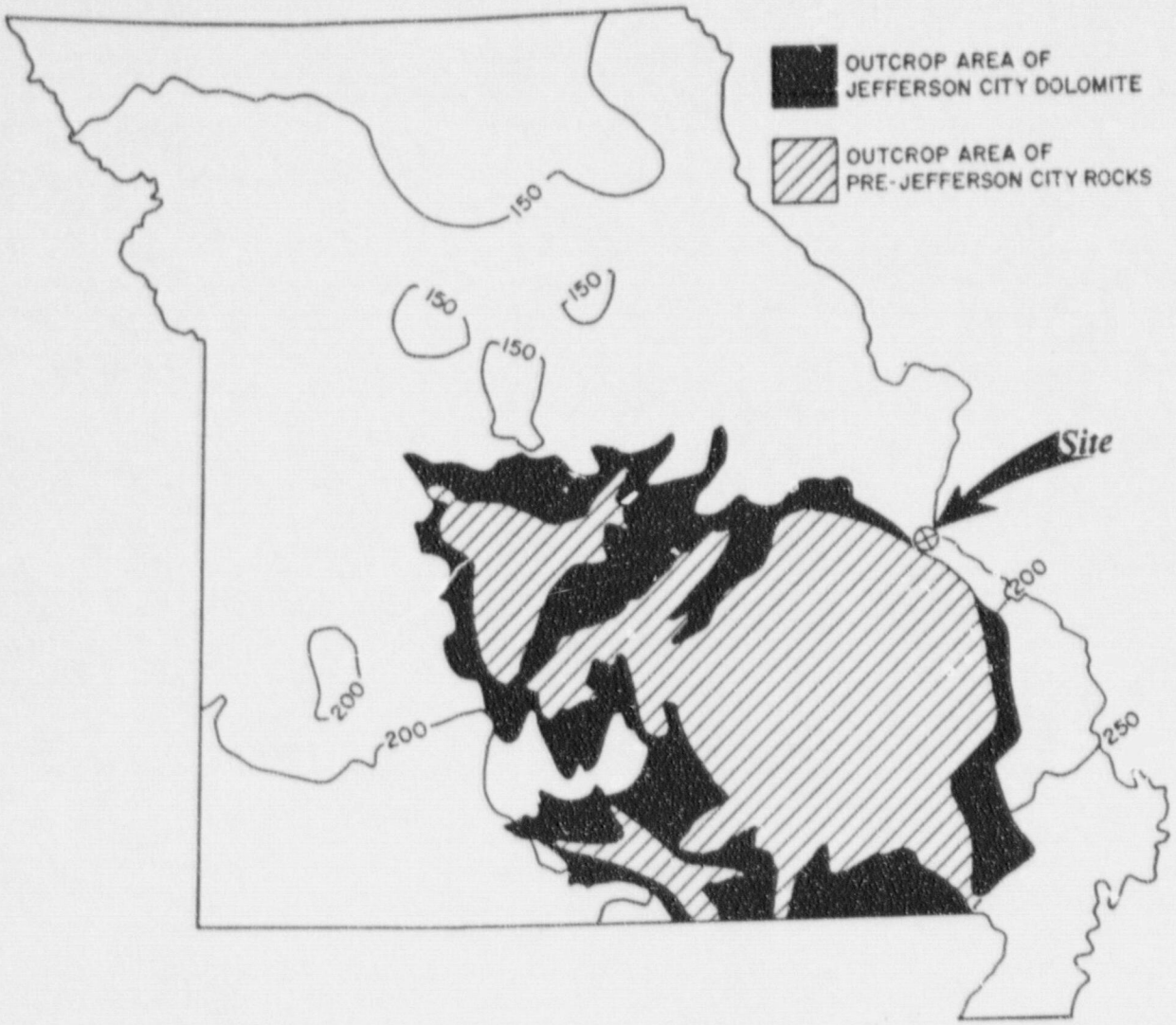
The Jefferson City Dolomite is described by Martin et al. (1961) as mostly light-brown to medium-brown, medium to finely crystalline dolomite and argillaceous dolomite. Chert which is not abundant, is typically oolitic, banded, mottled or sandy. Lithologic succession within the formation is extremely complex and varies among locations. The Jefferson City Dolomite, 125 to 325 feet thick in the state, is bounded by the overlying Cotter Formation and beneath by the Roubidoux Formation. Figure 3 is a stratigraphic column showing lithologies and the relationships of the formations taken from the Bedrock Geologic Map of the Festus 7.5 Minute Quadrangle by Whitfield and Middendorf.

The sedimentary rocks in this area dip very slightly and uniformly to the north, north-east. There are no mapped or suspected faults within several miles of the site.

1.2 Unconsolidated Deposits

The site is positioned in the valley of the Joachim Creek which has incised into the surrounding Cotter and Jefferson City Formations. During late Pleistocene glacial regression, terrace units were deposited in the Joachim Creek valley. These units are chiefly derived from loess and colluvium. Meier (1992) stated that three processes are responsible for the deposition of valley fill (terrace). They are changes in groundwater base level, changes in level of the sediment source area or significant change of climate in the source area and increase in sediment load from the contributing stream. Later during the Holocene, alluvium was deposited in the Joachim Creek valley. Figure 4 is a schematic cross-section depicting these stratigraphic relations.

The MDNR's Bedrock Geologic Map of the Festus 7.5 Minute Quadrangle by Whitfield and Middendorf describes the Holocene alluvium as clay, silt, sand and gravel chiefly derived from local loess and colluvium. Colluvium is described as a mixture of residuum, from fines to



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From: Paleozoic Succession in Missouri, Part 2, Ordovician System, Thomas Thompson, 1991

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Figure 1
Isopach Map
Jefferson City Dolomite
Hematite Facility

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SCALE: 1" = 60 miles | PREPARED BY: CEN

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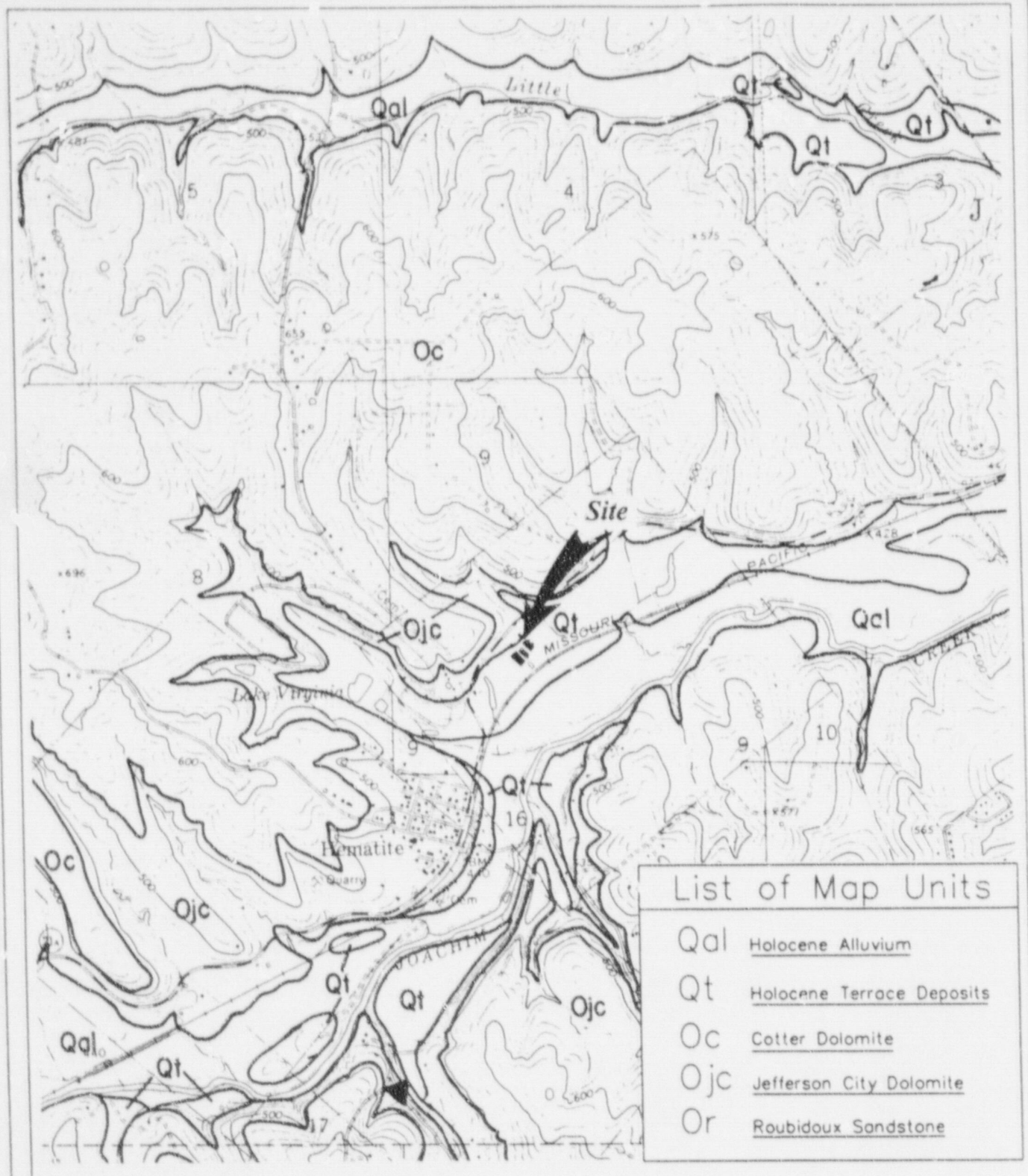

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From: Bedrock Geologic Map of the Festus 7.5 Min. Quadrangle, MDNR, DGLS Geological Survey Program, 1964 (Photorevised 1982)

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Figure 2

Bedrock Geologic Map

Hematite Facility

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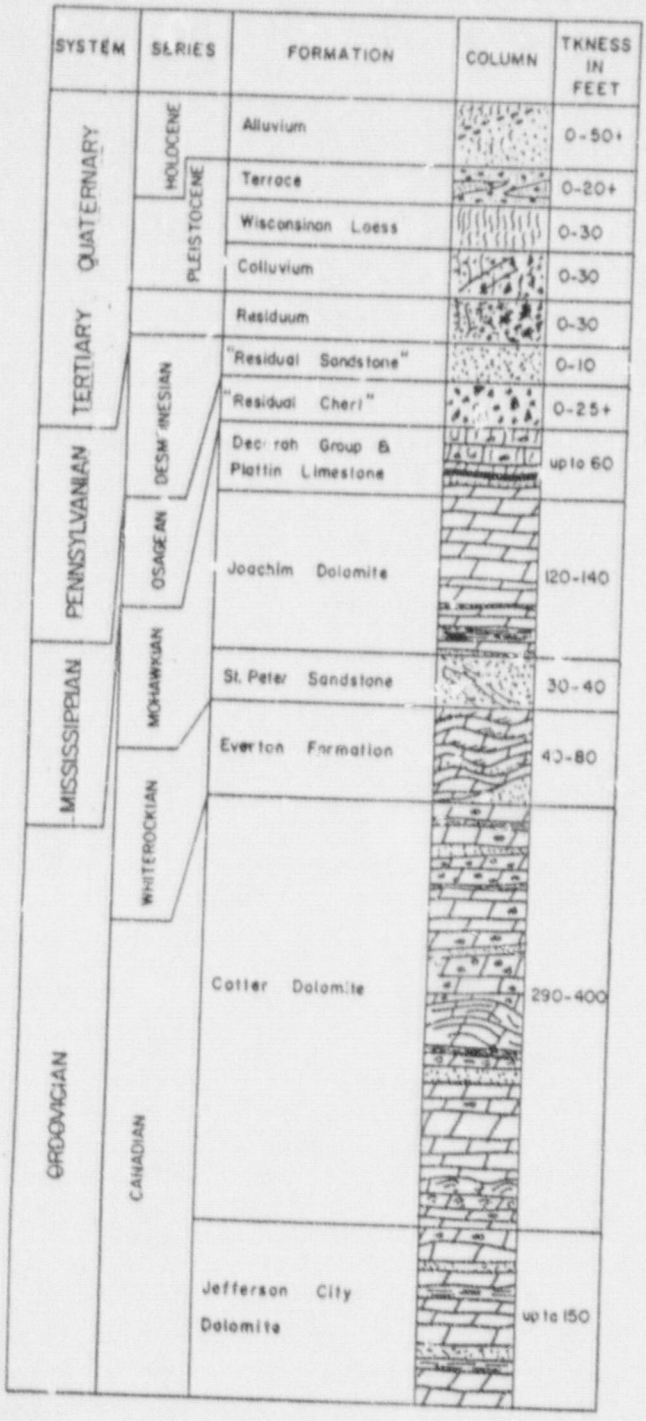

From: Bedrock Geologic Map of the Festus 7.5 Min. Quadrangle, MDNR, DGLS Geological Survey Program, 1964 (Photorevised 1982)

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Figure 3
Schematic Geologic Stratigraphic Column
Hematite Facility

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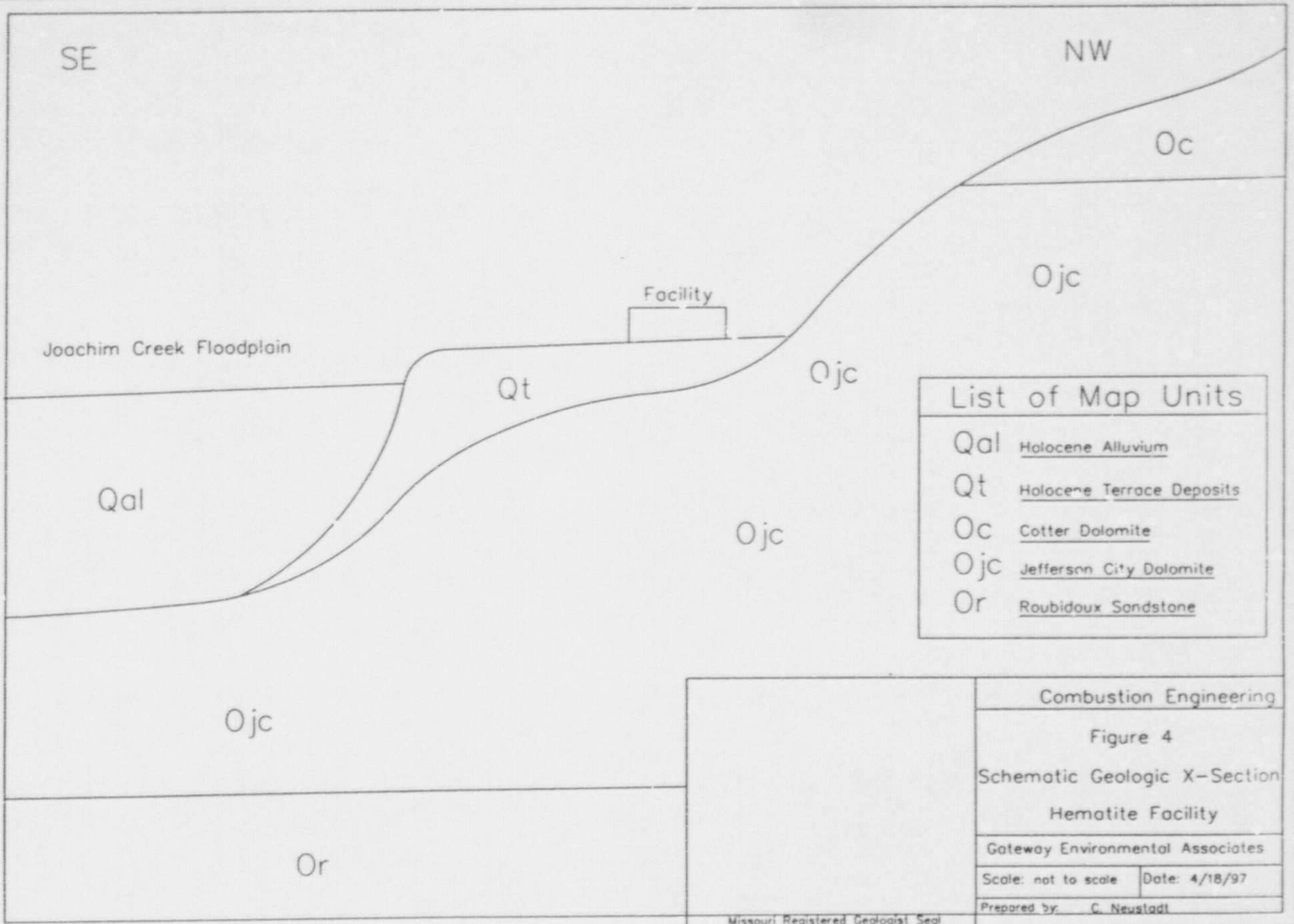


cobbles, and loess that is moving down slope as a result of slope wash and gravity. Colluvium accumulates at the base of valley slopes and in large valleys washes onto the floodplain, blending with the alluvium.

The MDNR's Bedrock Geologic Map of the Festus 7.5 Minute Quadrangle by Whitfield and Middendorf, describes terrace deposits as clay, silt, sand and gravel chiefly derived from local loess and colluvium. Terraces contain lenticular beds of sand and gravel interbedded with silt and clay.

2.0 Regional Hydrologic / Water Supply Information

2.1 Precipitation and Steam Characteristics

The Missouri Water Atlas produced by the MDNR in 1986 was referenced to determine the following. Figure 5 identifies that the area is in the Mississippi River drainage basin. The area receives 38 inches average of annual precipitation with 12 inches average of annual runoff. The maximum 10 day event expected precipitation is 9 inches in a given 25 year return.

Obtained from the atlas, Figure 6 shows that Joachim Creek is a permanent flowing stream indicative of a shallow groundwater discharge point. Figure 7 shows the losing streams in the basin. Incidentally, Figure 7 also shows major springs in the drainage basin, but does not show the spring (discussed later) near the site.

Water Resources Report 25 estimates the base flow recession, which is the amount of water which will flow in a stream after a 30 day rainless period. The base flow recession minimum observed flow from 1961 through 1965 on the Joachim Creek is 0.2 cubic feet per second. These data indicate the stream is gaining.

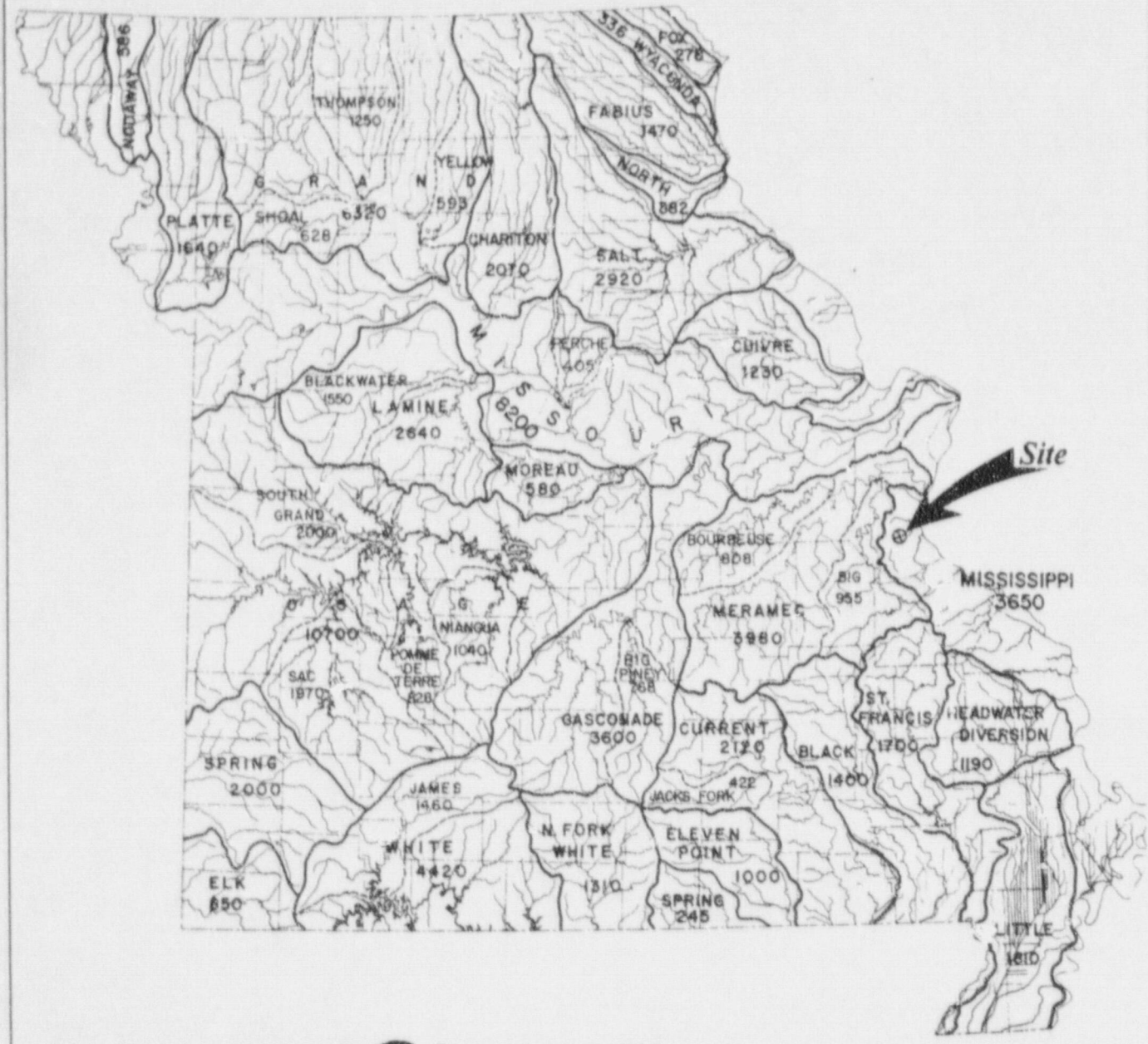
2.2 Water Supply

2.2.1 Surface Water

There are no public water supply intakes on Joachim Creek. According to the EPA field investigation report (1990) most of the residents of Hematite receive their drinking water from Rural Water District # 5. The report also states that surface water is not used for drinking water within a four mile radius of the site. This statement is probably correct but may be somewhat flawed in that the report incorrectly located the site on its map.

2.2.2 Groundwater

According to Water Resources Report 30 produced in 1974 by the USGS and the Missouri Geological Survey (currently named DGLS), domestic and industrial water wells in the vicinity produce water from the Powell - Gasconade aquifer group which includes the Jefferson City Dolomite. Wells in the area, especially to the west and southwest, intersect the Jefferson City Dolomite if it is present, but do not derive significant quantities of water from it. The Jefferson City Dolomite is generally not capable of sustained water production because of its low storage capacity. Report 30 states that small supplies can be developed in the Jefferson City Dolomite among other formations, but are subject to failure during drought or sustained pumping. Figure 8 from Report 30 shows the aquifer usage by group and areal extent.



Primary drainage basin divide

Secondary drainage basin divide

BIG 955 — Name of river and approximate area of drainage in Missouri in square miles

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Figure 5

Drainage Systems

From: MDNR Missouri Water

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Figure 6
Stream Flow Characteristics
Joachim Creek
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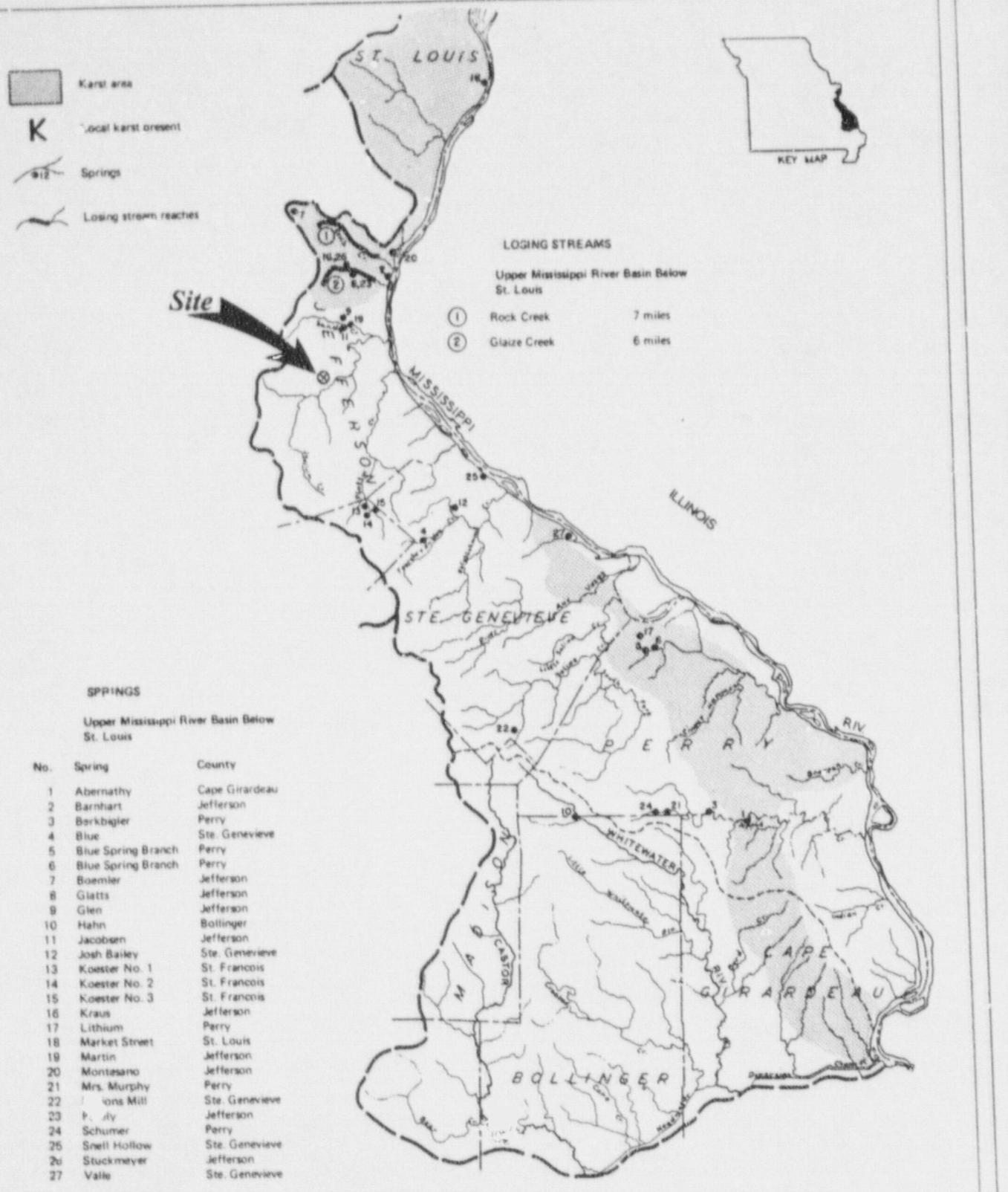

From: MDNR Missouri Water Atlas 1988

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Figure 7
Losing Streams, Springs
And Karst Features
Hematite Facility

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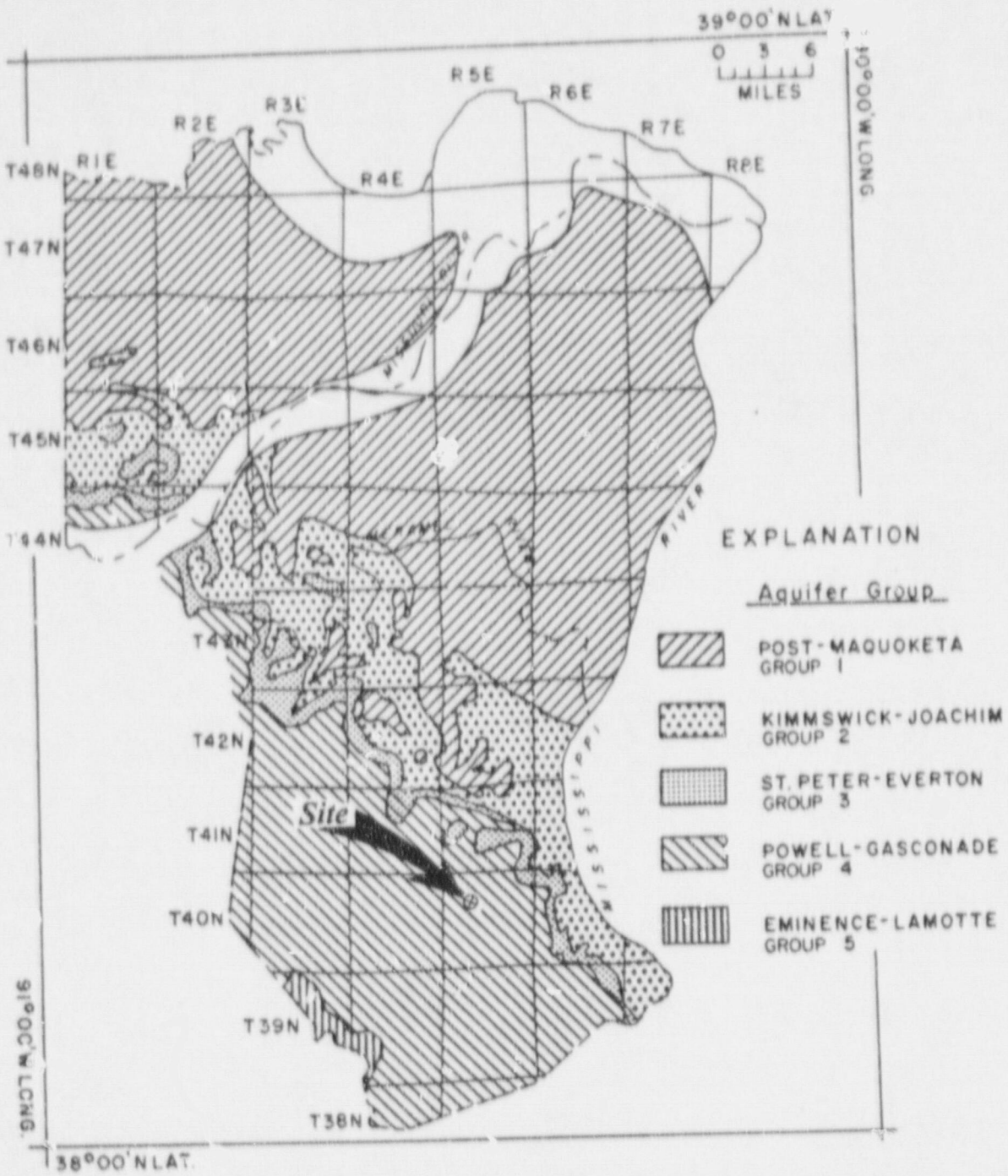
SCALE: 1" = 14 miles | PREPARED BY: CEN



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From: Water Resources Report Nc. 30, Missouri Geological Survey and Water Resources and USGS, 1974

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Figure 8
Aquifer Usage
Group And Areal Extent
Hematite Facility

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SCALE: 1" = 11 miles | PREPARED BY: CFN
DATE: 4/21/97 | PROJECT: 96A002

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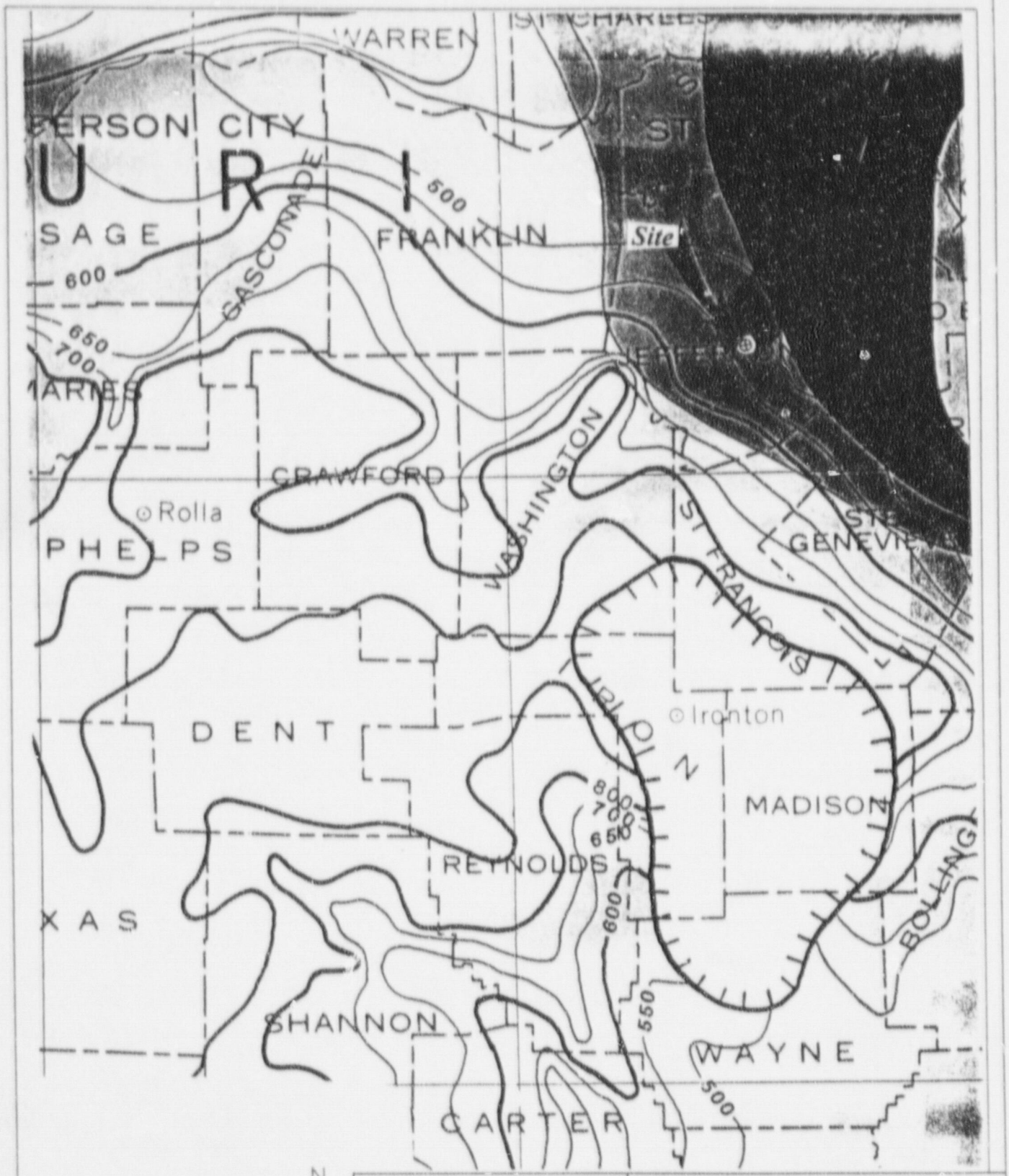
2.2.2.1 Specific Groundwater Use

The MDNR's Well Head Protection Division maintains records of specific private water wells. A two mile radius around the CE site was searched for records of private and public water supply wells. Information on twenty-two wells is in the MDNR files, including the site's own water supply well. Information pertaining to depth of well, casing intervals, stratigraphy, yield and static water level are included in the data. Appendix A contains the data set as acquired from the MDNR files and a figure showing a two mile radius of the site where the wells occur. (The specific addresses of the wells may have to be obtained to post the exact location of the wells.) This information may be used later if necessary, to determine potential groundwater receptors.

2.3 Regional Potentiometric Map

D.G. Jorgenson (1986) et. al produced an equivalent freshwater head and dissolved solids concentration map of the Cambrian, Ordovician and Mississippian aquifers. This map covers a large area of the mid-continent including the CE site. Figure 9 shows the portion of the map covering the site. The map demonstrates that the potential head of the Cambrian, Ordovician and Mississippian aquifers is high to the southwest and low to the northeast, thus illustrating that regional deep potable groundwater flows to the northeast in the area of the site.



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From: Equivalent Freshwater Head And Dissolved-Solids Concentrations of Water in Rocks of Cambrian, Ordovician, and Mississippian Age in the Northern Midcontinent, U.S.A., USGS, 1986

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Figure 9

Equivalent Freshwater Head

Hematite Facility

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DATE 4/21/97 | PROJECT: 95A002

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3.0 Site Specific Geology - Hydrology

3.1 Site Specific Physiography

The site is located in the physiographic subregion of the Ozark Mountains called the Salem Plateau which is characterized by gently rolling hills of moderate topographic relief and gradient. A topographic site figure showing the general location of the site along with generalized topographic features is included as Figure 10. It shows that the plant is located between the hills to the northwest and floodplain of the Joachim Creek to the southeast. The plant is located on a terrace deposit which has topography that dips gently to the southeast. Southeast of the plant approximately 400 feet, the ground surface elevation then drops into the alluvial plain of Joachim Creek. Northeast of the plant approximately 300 feet, the surface elevation drops into a tributary of Joachim Creek. Joachim Creek flows into the Mississippi River near Herculaneum.

3.1.1 Aerial Photography

Two major aerial photo search and archive firms were solicited for all available photos of the site. Gateway was only able to acquired aerial photographs of the site for the years of 1962 and 1971. Unfortunately, neither of these photo sets shows open burial pits. The DGLS has a 1967 aerial photo on file which Gateway reviewed, showing open burial pits.

3.2 Site Specific Stratigraphy

3.2.1 Unconsolidated Sediments (Pleistocene Quaternary)

Several subsurface investigations within the terrace deposit at and near the plant have produced geotechnical and geologic information which allows a general stratigraphic interpretation to be made.

In 1967 Woodward - Clyde - Sherard and Associates produced a subsurface geotechnical report which includes information on two borings. Boring B-1 found silty clay to 13.5 feet below ground surface (bgs), a stiff highly plastic (fat) clay from 13.5 feet bgs to 21.5 feet bgs which graded to a sandy silty clay which flowed water at 22 feet bgs. Water stabilized at 13 feet bgs. The boring continued through a sandy silty clay to 32 feet bgs where it encountered limestone pieces in a sandy clay matrix. Auger refusal occurred at 36.5 feet bgs where limestone pieces occurred. That point was probably at the Jefferson City Dolomite. Boring B-2 found a very similar sequence with similar depths of equivalent stratigraphic units.

In 1978 Woodward - Clyde installed two more geotechnical borings. Boring B-1 of this study encountered a silty clay to 16 feet bgs at which point it graded to a fat clay. In this boring the fat clay contained sand layers 2-3 inches thick. The fat clay with sandy stringers continued in this

boring to 34 feet bgs where a medium grain sand occurred. From 34 feet bgs to 44 feet bgs the log shows a poorly cemented calcareous sandstone which is likely limestone that was pulverized by the pounding split spoon sampler. Boring B-2 nearby showed a similar stratigraphic sequence.

In 1988 Shannon and Wilson, Inc. (SWI) installed six geotechnical borings which show similar stratigraphic sequence to the two previous Woodward- Clyde reports. During 1991 SWI conducted another geotechnical investigation, installing eight more borings. Only one of these eight was advanced below 22 feet. The eight logs report a silty clay shallow followed by a fat clay present at 8 feet to 10 feet bgs. Boring SW-3 was installed to 32 feet bgs, which encountered similar stratigraphy to other borings of equal depth.

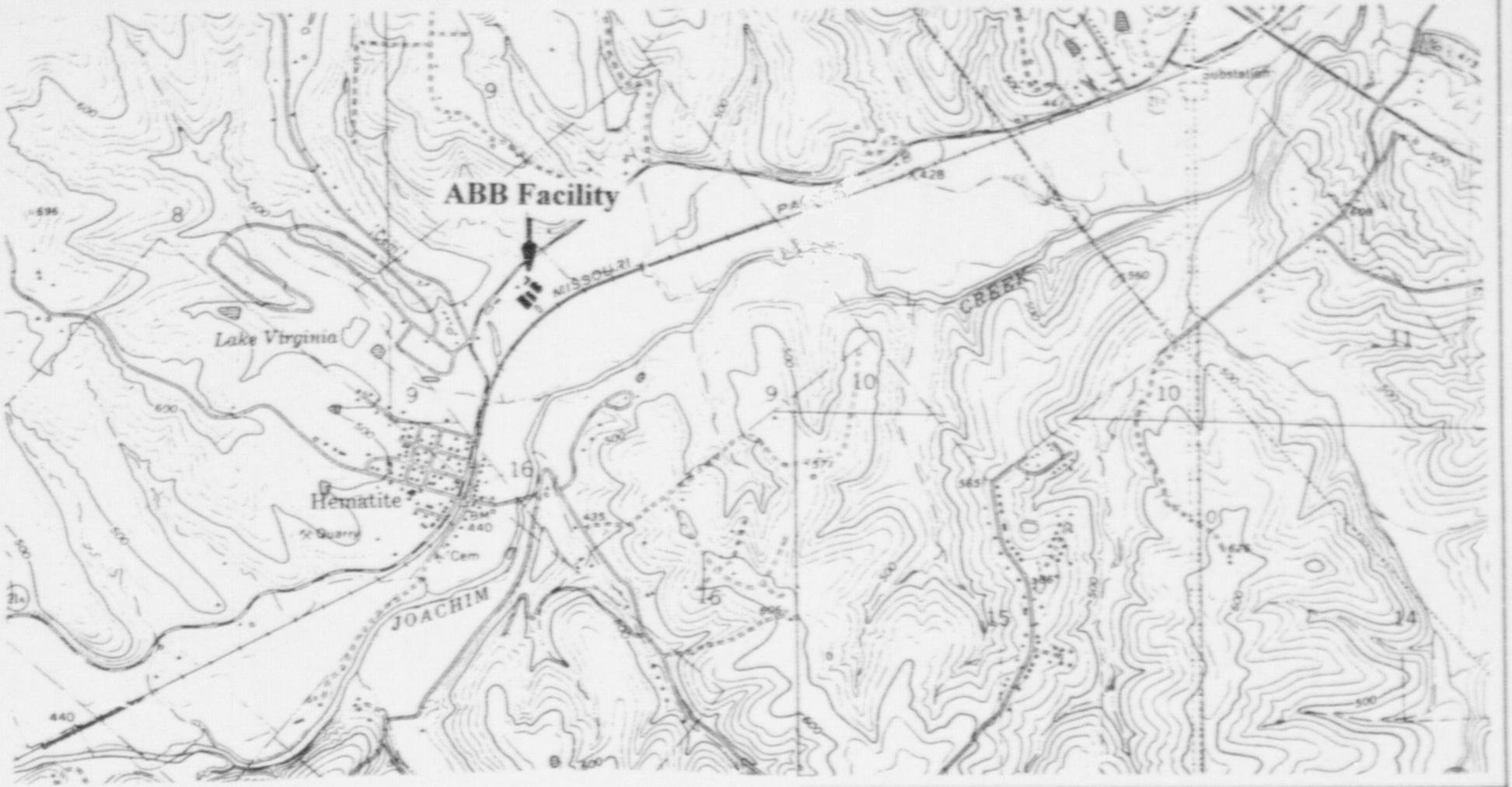
During August of 1996, Gateway performed a limited shallow stratigraphy and groundwater quality analysis to determine the source of technicium - 99 (^{99}Tc) in a specific groundwater monitoring well. Gateway installed twelve borings and temporary groundwater monitoring wells ranging from 15 feet to 22 feet bgs. Subsurface information generated from this study supports the concept that there is a silty clay unit near the surface bounded on the bottom by a fat clay unit.

Also in August of 1996, Gateway performed a limited shallow stratigraphic analysis of an area at the plant identified as the evaporation ponds. Six borings in that investigation were installed to 20 feet bgs. Each encountered 2 feet to 5 feet of silty fill initially, followed by a silty clay to 20 feet bgs. A fat clay was not noted in that area, likely because the borings did not reach sufficient depth. Boring EP-3 encountered a sandy silt 18.5 feet bgs to total depth.

Figure 11 shows the top of fat clay as determined from locations of the geotechnical borings installed for the four geotechnical studies as well as the 18 borings installed by Gateway. This map is useful for a gross determination only, because elevation assumptions are inherent in its construction. That map shows that a fat clay exist beneath the site at varying depths. Some borings may have not been advanced deep enough to encounter the fat clay.

3.2.2 Site Specific Bedrock Stratigraphy

In 1956 Mallinckrodt Chemical Company installed an industrial high capacity water supply well for the plant. The MDNR geologic log (number 14993) documents the bedrock stratigraphy encountered by the well. Unconsolidated sediments are present to 35 feet bgs. The Jefferson City Dolomite was present from 35 feet bgs to 125 feet bgs. The Roubidioux was encountered from 125 bgs to 255 feet bgs, the Gasconade from 255 feet bgs to 470 bgs, the Gunter Sandstone Member of the Gasconade from 455 feet bgs to 470 feet bgs and the Eminence Dolomite from 470 feet bgs to the total depth which is 600 feet bgs. The MDNR's stratigraphy data and log for this well is presented in Appendix B.



From: USGS 7.5 Min. Topographic Map
Festus, Missouri

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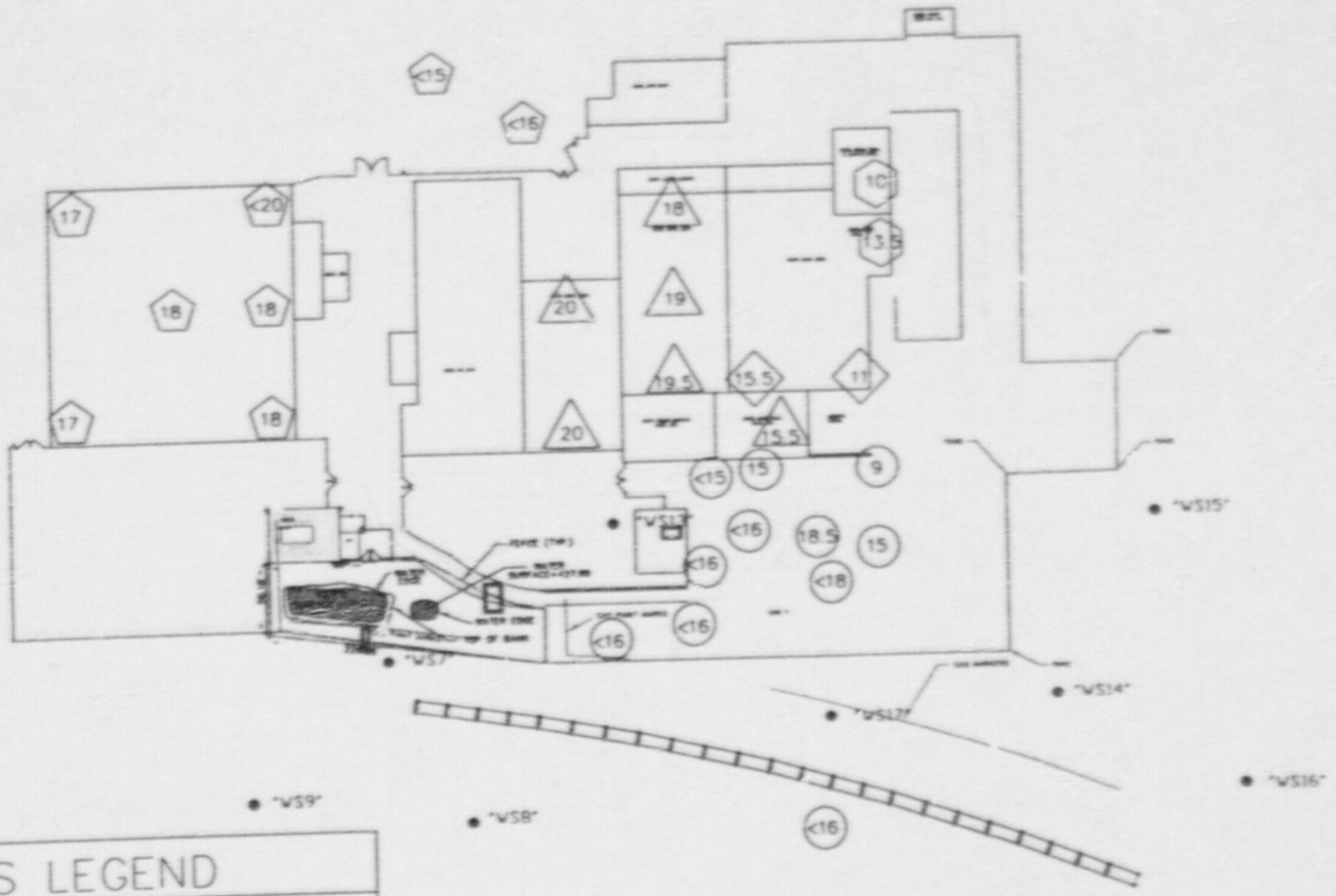
Figure 10
Regional Site Location
Topographic Map
Hematite Facility

Gateway Environmental Associates

Scale: 1:24,000 | Date: 4/21/97

Prepared by: C. Neustadt



SYMBOLS LEGEND

- 18 — Depth (feet below ground surface) to top of Fat (CH) Clay, Shannon & Wilson, December, 1991 Report
- 19 — Depth (feet below ground surface) to top of Fat (CH) Clay, Shannon & Wilson, July, 1988 Report
- 10 — Depth (feet below ground surface) to top of Fat (CH) Clay, Woodward – Clyde – Shepard & Assoc., July, 1967 Report
- 15.5 — Depth (feet below ground surface) to top of Fat (CH) Clay, Woodward – Clyde Consultants, February, 1978 Report
- <16 — Depth (feet below ground surface) to top of Fat (CH) Clay, Gateway Environmental Assoc., September, 1996

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Figure 11

Depth to Top of Fat Clay

Hematite Facility

Gateway Environmental Associates

Scale: 1" = 150'

Date: 4/23/97

Prepared by: C. Neustadt

teway Environmental Associates, Inc.

3.2.3 Pertinent Site Specific Well Completion Information

A very important note concerning this well is that upon completion, the well flowed, indicating artesian conditions in at least one of the hydrostratigraphic units it drilled through or into. The casing was set in this well from surface to 220 feet bgs, near the top of the high yield sandstone portions of the Roubidioux Formation.

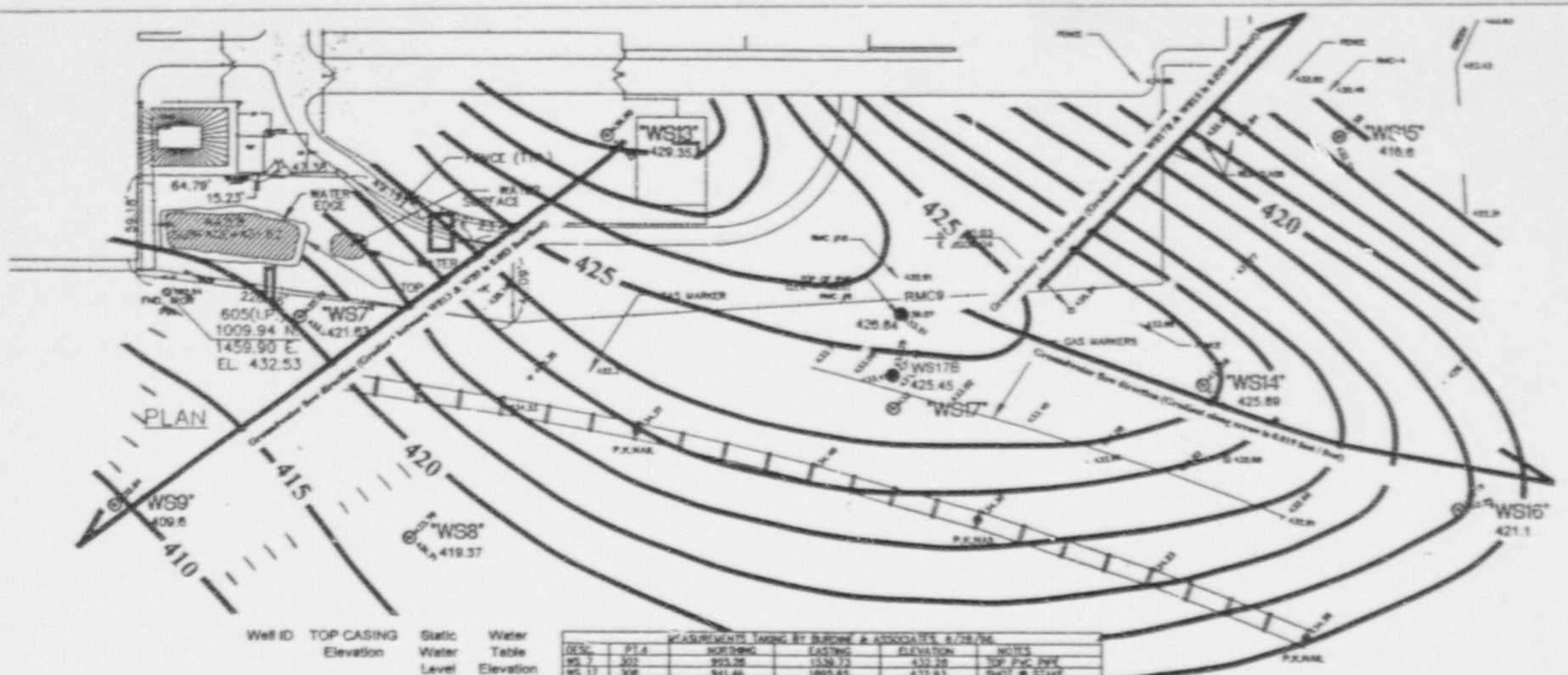
3.3 Site Specific Hydrology

3.3.1 Surface Water Features

There are five major surface water features at and near the site; Joachim Creek, a spring and its tributary to the Joachim Creek west of the plant, an intermittent tributary of the Joachim Creek north of the plant and the plants evaporation ponds. These features all play a roll in determining the movement of groundwater at the site.

3.3.2 Groundwater Surface

During the summer of 1996, Gateway Environmental Associates, Inc. created a groundwater elevation map. The map shown in Figure 12 is only as accurate as the limited hydrostratigraphic information would allow. This map shows a shallow groundwater high south of the plant with increasing gradients to the west, east and north. Since the lithology is unknown in some of the older piezometers used to create the map, there is a chance that hydrostratigraphic units and potentiometric surfaces may be mixed in the groundwater surface representation. It is apparent that shallow groundwater generally moves to the Joachim Creek.



Well ID	TOP CASING Elevation	Static Water Level 07/22/96	Water Table Elevation 07/22/96
WS7	432.28	10.65	421.63
WS8	433.7	14.33	419.37
WS9	432.84	23.24	409.6
WS13	435.8	6.45	429.35
WS14	435.65	9.76	425.89
WS15	432.76	16.16	416.6
WS16	432.25	11.15	421.1
WS17B	435.36	9.91	425.45
RMC9	436.07	9.23	426.84

MEASUREMENTS TAKING BY BURDINE & ASSOCIATES, 8/28/96

DESC.	PT.#	NORTHING	EASTING	ELEVATION	NOTES
WS 7	303	955.28	1539.73	432.28	TOP PVC PIPE
WS 13	308	941.46	1895.85	435.83	SHOT @ STAKE
WS 17B	309	961.20	1946.45	435.36	TOP PVC PIPE
RMC 8	320	908.52	2008.44	433.66	SHOT @ STAKE
RMC 11	323	873.83	2135.87	433.81	SHOT @ STAKE
WS 16	324	879.56	2231.53	432.25	TOP PVC PIPE
RMC 13	329	957.59	2227.98	428.74	SHOT @ STAKE
WS 15	330	1002.01	2158.27	432.76	TOP PVC PIPE
RMC 7	335	1018.41	2098.59	431.77	SHOT @ STAKE
WS 14	336	906.38	2079.06	435.65	TOP PVC PIPE
RMC 14	341	1204.45	2136.98	436.11	SHOT @ STAKE
RMC 5	342	1233.20	2041.20	435.07	SHOT @ STAKE
RMC 1	343	1458.31	2056.51	437.24	SHOT @ STAKE
WS 13	353	1103.44	1772.73	435.80	TOP PVC PIPE
WS 8	356	862.02	1806.14	433.70	TOP PVC PIPE
WS 9	360	881.73	1429.80	432.84	TOP PVC PIPE
RMC 4	367	1131.94	2154.42	430.48	SHOT @ STAKE
RMC 8	371	997.38	1895.47	436.07	TOP PVC PIPE

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Figure 12
Groundwater Elevation
Contour Map
Hematite Facility

Gateway Environmental Associates

Scale: 1" = 100' Date: 4\23\97

Prepared by: C. Neustadt

4.0 Summary

Sufficient general and site specific information is available to create a dependable understanding regarding the geology, hydrogeology and hydrodynamics of the area. Major aquifers in the area have been identified as well as actual uses of those aquifers, both deep and shallow. The bedrock structural features and stratigraphic relations have been recognized. Unconsolidated sediments, their depositional environment, lithology and stratigraphic relations have been distinguished. Information regarding surface water flow and usage has been included.

Deep groundwater flows to the northeast and is discharged to the Mississippi River Valley. In fact there is evidence that the bedrock aquifer(s) beneath the site is (are) artesian. The Jefferson City Dolomite the uppermost bedrock unit at the site is not hydraulically suitable for a water supply because it has low hydraulic conductivity. Shallow groundwater flows toward the Joachim Creek which has been identified as a permanent flowing gaining stream.

There is a low permeability fat clay unit present within the terrace deposit. That fat clay may act as a barrier to the downward movement of perched groundwater.

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United States Army Corp of Engineers, Water Resources Science CE890 Special Project, Pleistocene Fluctuations in Valley Levels at the Former Weldon Spring Ordnance Works Superfund Site, St.Charles Co. Missouri, Donald H. Meier, April,1992.

APPENDIX A
MDNR Specific Water Well Data

STATE OF MISSOURI

Mel Carnahan, Governor • David A. Shorr, Director

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF GEOLOGY AND LAND SURVEY

P.O. Box 250 111 Fairgrounds Rd. Rolla, MO 65402-0250

(573) 368-2100

FAX (573) 368-2111

The Water Well Driller's Act (256.600 - 256.640, RSMo) became effective on September 30, 1986. This law required that well drillers meet certain minimum construction requirements and report information on all wells drilled in the state of Missouri after this date. The enclosed data is the information we have on file for wells drilled after 1986 in the area you requested. The information supplied to us is considered accurate, but has not been verified in every instance. We are providing the data we have been given and hope the following list will clarify any questions you might have regarding abbreviations used in the attachment. If you have any questions or need additional information, please feel free to contact Sharon Beistel at (573) 368-2168.

ABBREVIATION	EXPLANATION
REFNUM	INTERNAL NUMBERING SYSTEM USED IN TRACKING THE WELL RECORDS SUBMITTED TO OUR OFFICE
SWL	STATIC WATER LEVEL - MEASURED IN FEET FROM THE LAND SURFACE DOWN
YIELD	MEASURED IN GALLONS PER MINUTE
USE	D- DOMESTIC WELL F- MULTI-FAMILY WELL H- HEAT PUMP WELL I- IRRIGATION WELL M- MONITORING WELL N- NON-COMMUNITY WELL O- OTHER P- PUBLIC WATER SUPPLY WELL
TOTAL_D	TOTAL DEPTH-MEASURED IN FEET

Mel Carnahan, Governor • David A. Shorr, Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
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(573) 368-2100
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Prior to the passing of the Water Well Driller's Act in 1986, well construction was reported on a voluntary basis. The well driller would submit drilling samples and a geologist would evaluate the samples and then compose a log based on the evaluation. Those logs have now been automated and are being reviewed for accuracy.

If you have any questions or need additional information, please feel free to call Sharon Beistel at (573) 368-2168.

Two Miles

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:WOLK, WALTER St:MO Cnty:JEFFERSON
021163 N2 SE SE TRS: S32 T41N R05E
Alias: Lat.:38,14,14.125N
Type well:Private Well Long.:90,29, 1.495W
Type log: S Quad:38090B4
Driller:SHEPARD WELL DRLG Date:04/1962
Driller Liscense #: Confidential:N Release Dt. /
Logger:C.E.ROBERTSON Date:04/1962

Elev.: 605 Elev.S Yield: 10 SWL:(a)150 H20 @:300-350'
T.D.: 350 base: DrDwn: SWL:(t) TL

Rock at: 10 Samples saved:Y Int. cored: 0 to 0
Top Fm.:POWELL DOLOMITE
Bot Fm.:JEFFERSON CITY DOLOMITE
Problems:
Remarks:

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Log #:021163 Date Completed:04/1962

CASING: Dpth: 40 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 6.25
0 0.00
0 0.00
0 0.00

GROUT: Type Sig Metad Dt Abnd Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Fill Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:POWELL DOLOMITE
Formations Bot:JEFFERSON CITY DOLOMITE
Other data sources:
Remarks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Log #:021163 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 10 NO SAMPLES 0 0 0
10 350 ORDOVICIAN SYSTEM 0 0 0
10 350 CANADIAN SERIES 0 0 0
10 50 POWELL DOLOMITE DL CH SH 0 0 0
50 280 COTTER DOLOMITE DL CH SD 0 0 0
280 350 JEFFERSON CITY DOLOMITE DL CH SH ZnS 1 0 0
350 350 TOTAL DEPTH 0 0 0

Printed on 05/22/97 at 07:44:56.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:BECK, FRANK St:MO Cnty:JEFFERSON
022655 TRS: S06 T40N R05E
Alias: Lat.:
Type well:Private Well Long.:
Type log: S Quad:UNKNOWN
Driller:WELCH BROS Date:10/1963
Driller Liscense #: Confidential:N Release Dt. /
Logger:H.M.GROVES Date:08/1964

Elev.: 530 Elev.S Yield: 12 SWL:(a) H20 @:200'
T.D.: 220 base: DrDwn: SWL:(b) TL

Bedrock at: 0 Samples saved:N Int. cored: 0 to 0
Top Fm.:COTTER DOLOMITE
Bot Fm.:COTTER DOLOMITE
Problems:
Remarks:2.5 MI S OF HWY A, 2.5 MI W OF HEMATITE

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Log #:022655 Date Completed:10/1963

CASING: Dpth: 15 Diam: 6.60 I/O:O Sz. Hole: 0.00 Sz. Below: 5.60
0 0.00
0 0.00
0 0.00

GROUT: Type Rig Metho Dt Annd Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Well Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:COTTER DOLOMITE
Formations Bot:COTTER DOLOMITE
Other data sources:
Remarks:
- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Log #:022655 --Lith-- ---------Minerals---------
Top Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 220 ORDOVICIAN SYSTEM 0 0 0
0 220 CANADIAN SERIES 0 0 0
0 220 COTTER DOLOMITE DL CH SD ZnS 4 0 0
220 220 TOTAL DEPTH 0 0 0

Printed on 05/22/97 at 07:46:00.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:MUELKER, WALTER St:MO Cnty:JEFFERSON
020371 NE SE NE TRS: S07 T40N R05E
Alias: Lat.:38,12,33.646N
Type well:Private Well Long.:90,26,56.673W
Type log: S Quad:38090B4
Driller:WELCH BROS Date:06/1961
Driller License #: Confidential:N Release Dt. /
Logger:C.E.ROBERTSON Date:03/1962

Prov.: 682 Elev.S Yield: 3.75 SWL:(a) 55 H20 @:65', 125', 275'
T.D.: 305 base: DrDwn: SWL:(b) TL

Rock at: 5 Samples saved:Y Int. cored: 0 to 0
Top Fm.:COTTER DOLOMITE
Bot Fm.:ROUBIDOUX FORMATION
Problems:
Remarks:

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Log #:020371 Date Completed:06/1961

CASING: Dpth: 24 Diam: 6.25 I/O:I Sz. Hole: 0.00 Sz. Below: 6.00
0 0.00
0 0.00
0 0.00

CASEOUT: Type Rig Metnd Dt Apnd Plug Date Top Bottom
/ / 0 0

PERMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Fill Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:COTTER DOLOMITE
Formations Bot:ROUBIDOUX FORMATION
Other data sources:
Remarks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Log #:020371 --Lith-- ----------Minerals----------
Top Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 5 RESIDUUM & TOP SOIL CL CH 0 0 0
5 305 ORDOVICIAN SYSTEM 0 0 0
5 305 CANADIAN SERIES 0 0 0
5 65 COTTER DOLOMITE DL CH SD 0 0 0
65 185 JEFFERSON CITY DOLOMITE DL CH SD FeS2 & 0 0
5 305 ROUBIDOUX FORMATION DL SD CH FeS2 1 0 0
5 305 TOTAL DEPTH 0 0 0

Printed on 05/22/97 at 07:46:12.

- - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - -

Log # Owner:JONES, WILLIAM JEWELL REV St:MO Cnty:JEFFERSON
016785 NE SW SW TRS: S09 T40N R05E
Alias: Lat.:38,12,21.779N
ype well:Private Well Long.:90,28,41.660W
e log: S Quad:3809084
iller:SCOTT DRLG CO Date:09/1957
Driller Liscense #: Confidential:N Release Dt. /
ogger:J.WELLS Date:11/1957

lev.: 447 Elev.S Yield: SWL:(a)000 H20 @:
.D.: 225 base: DrDwn: SWL:(b) .3 TL

rock at: 35 Samples saved:N Int. cored: 0 to 0
op Fm.:JEFFERSON CITY DOLOMITE
st Fm.:GASCONADE DOLOMITE
blems:
emarks:OLD WELL DEEPENED (#20923) IN 1960 225-590'

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

g #:016785 Date Completed:09/1957

SING: Dpth: 235 Diam: 6.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

OUT: Type Rig Metho Dt Abnd Plug Date Top Bottom
0 / / 0 0

MP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

il Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:GASCONADE DOLOMITE
ormations Bot:GASCONADE DOLOMITE
Other data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:016785 --Lith-- ---------Minerals-------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 35 NO SAMPLES 0 0 0
35 390 ORDOVICIAN SYSTEM 0 0 0
35 390 CANADIAN SERIES 0 0 0
35 90 JEFFERSON CITY DOLOMITE DL CH SD 0 0 0
90 215 ROUBIDOUX FORMATION DL CH SS ZnS 1 0 0
15 390 GASCONADE DOLOMITE DL SD CH 0 0 0
90 590 NO SAMPLES 0 0 0
590 590 TOTAL DEPTH 0 0 0

nted on 05/22/97 at 07:46:48.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log #
020923
Owner:JONES, WILLIAM J.
Alias:
St:MO Cnty:JEFFERSON
NE SW SW TRS: S09 T40N R05E
Lat.:38,12,18.512N
Long.:90,28,42.356W
Quad:38090B4
ype well:Private Well
e log: S
ller:SCOTT DRLG CO
Date:03/1960
Confidential:N Release Dt. /
riller Liscense #:
gger:C.E.ROBERTSON
Date:11/1962

ev.: 447 Elev.: Yield: 0 SWL:(a) H20 @:
.D.: 390 base: rDwn: 0 SWL:(b) TL

rock at:9999 Samples saved:N Int. cored: 0 to 0
op Fm.:JEFFERSON CITY DOLOMITE
se Fm.:UPPER GASCONADE DOLOMITE
oblems:
emarks:OLD WELL DEEPENEDC - SEE LOG #16785

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - -

g #:020923 Date Completed:03/1960

SING: Dpth: 235 Diam: 6.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

OKOUT: Type Rig Methd Dt Aband Plug Date Top Bottom
/ / 0 0

UMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ell Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

pen Top:JEFFERSON CITY DOLOMITE
Formations Bot:UPPER GASCONADE DOLOMITE
Other data sources:
marks:

Printed on 05/22/97 at 07:46:52.

- - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - -

Log # Owner:ENGLAND, W.R. #1 St:MO Cnty:JEFFERSON
002485 SE NW SW TRS: S09 T40N R05E
Alias: Lat.:
ype well:Private Well Long.:
e log: S Quad:UNKNOWN
iller:HAVERSTICK, C.W. Date:10/1931
riller Liscense #: Confidential:N Release Dt. /
gger:CHARLES GLEASON Date: /

lev.: 430 Elev.S Yield: 48 SWL:(a)000 H20 @:230', 275', 298', 380',
.D.: 528 base: DrDwn: SWL:(b) 450' TL

rock at: 25 Samples saved:Y Int. cored: 0 to 0
op Fm.:JEFFERSON CITY DOLOMITE
Fm.:EMINENCE DOLOMITE
blems:
emarks:"FLOWING WELL"; 2 LOGS

- - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - -

og #:002485

Base	Name	--Lith-- Pr	Sc	Mn	Pri	Oc	Sec	Oc	Mnr	Oc
0	25 NO SAMPLES					0		0		0
25	430 ORDOVICIAN SYSTEM					0		0		0
25	430 CANADIAN SERIES					0		0		0
25	100 JEFFERSON CITY DOLOMITE	DL	CH	SD		0		0		0
100	210 ROUBIDOUX FORMATION	DL	CH	SS		0		0		0
210	430 GASCONADE DOLOMITE	DL	CH	SD		0		0		0
0	250 UPPER GASCONADE DOLOMITE	DL		CH		0		0		0
0	250 "RICHLAND DOLOMITE MEMBER"	DL		CH		0		0		0
250	420 LOWER GASCONADE DOLOMITE	DL	CH			0		0		0
0	430 GUNTER SANDSTONE MEMBER	DL	CH	SD		0		0		0
0	528 CAMBRIAN SYSTEM					0		0		0
430	528 UPPER CAMBRIAN SERIES					0		0		0
430	528 EMINENCE DOLOMITE	DL		CH		0		0		0
8	528 TOTAL DEPTH					0		0		0

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- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:UNITED NUCLEAR CORP St:MO Cnty:JEFFERSON
4/993 SW NE SW TRS: S09 T40N R05E
Alias: Lat.:38,12,25.563N
ype well:Industrial High Capacity Well Long.:90,28,39.937W
e log: S Quad:38090B4
ller:HAVERSTICK WELL CO Date: /1956
riller Liscense #: Confidential:N Release Dt. /
gger:R.D.KNIGHT Date:09/1956

ev.: 436 Elev.S Yield: 125 SWL:(a) 13 H20 @:
.D.: 600 base: DrDwn: Y SWL:(b) TL

rock at: 35 Samples saved:Y Int. cored: 0 to 0
od Fm.:JEFFERSON CITY DOLOMITE
Fm.:EMINENCE DOLOMITE
blems:
emarks:@ HEMATITE; FORMERLY MALLINKRODT CHEMICAL CO; WELL ORIGINALLY FLOWED

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

eg #:014993 Date Completed: /1956

SING: Dpth: 220 Diam: 8.00 I/O:0 Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

OUT: Type Rig Metho Dt Abnd Plug Date Top Bottom
/ / 0 0

MP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ll Treat Type Dev Typ Comnl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:ROUBIDOUX FORMATION
rmations Bot:EMINENCE DOLOMITE
ther data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:014993 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 35 NO SAMPLES 0 0 0
35 470 ORDOVICIAN SYSTEM 0 0 0
35 470 CANADIAN SERIES 0 0 0
35 125 JEFFERSON CITY DOLOMITE DL CH SD ZnS 1 0 0
125 255 ROUBIDOUX FORMATION DL SS CH ZnS 5 0 0
35 470 GASCONADE DOLOMITE DL CH SD 0 0 0
35 315 UPPER GASCONADE DOLOMITE DL CH SD ZnS 2 0 0
255 305 "RICHLAND DOLOMITE MEMBER" DL SD 0 0 0
35 455 LOWER GASCONADE DOLOMITE DL CH 0 0 0
35 470 GUNTER SANDSTONE MEMBER DL CH SD 0 0 0
470 600 CAMBRIAN SYSTEM 0 0 0
470 600 UPPER CAMBRIAN SERIES 0 0 0
0 600 EMINENCE DOLOMITE DL CH ZnS 23 0 0
0 600 TOTAL DEPTH 0 0 0

- - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - -

Log # Owner:HARRISON, GEORGE St:MO Cnty:JEFFERSON
006712 NW SW NE TRS: S11 T40N R05E
Alias: Lat.:
ype well:Private Well Long.:
e log: S Quad:UNKNOWN
iller:SCOTT, C.N. Date: /1941
iller Liscense #: Conficential:N Release Dt. /
gger:MCCRACKEN Date: /

ev.: 505 Elev.S Yield: 3 SWL:(a) 90 H20 @:
.D.: 130 base: DrDwn: SWL:(b) TL

rock at: 15 Samples saved:Y Int. cored: 0 to 0
on Fm.:POWELL DOLOMITE
Fm.:POWELL DOLOMITE
blems:
marks:@ HARRISON LAKE, NEAR HEMATITE

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

g #:006712 Date Completed: /1941

GING. Dpth: 22 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

KOUT: Type Rig Methd Dt Abnd Plug Date Top Bottom
/ / 0 0

MP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ll Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:POWELL DOLOMITE
rmations Bot:POWELL DOLOMITE
Other data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:006712

Base	Name	--Lith-- Pr Sc Mn Pri	Minerals Oc	Sec Oc	Mnr Oc
0			0	0	0
15	NO SAMPLES		0	0	0
15	ORDOVICIAN SYSTEM		0	0	0
S	CANADIAN SERIES		0	0	0
5	POWELL DOLOMITE	DL CH SD	0	0	0
130	TOTAL DEPTH		0	0	0

nted on 05/22/97 at 07:47:26.

- - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - -

Log # Owner:PRICE, HOMER V. St:MO Cnty:JEFFERSON
020309 NW NW SE TRS: S11 T40N R05E
Alias: Lat.:39,20, 5.938N
ype well:Private Well Long.:94,38,55.806W
e log: S Quad:39094C6
ller:SCOTT DRLG CO Date:05/1961
riller Liscense #: Confidential:N Release Dt. /
gger:H.M.GROVES Date: /

ev.: 0 Elev.S Yield: 12 SWL:(a)150 H20 @:
.D.: 355 base: DrDwn: SWL:(b) TL

rock at: 225 Samples saved:Y Int. cored: 0 to 0
od Fm.:JEFFERSON CITY DOLOMITE
Fm.:ROUBIDOUX FORMATION
blems:
marks:3 MI E OF HEMATITE; OLD WELL DEEPENED; LOCATION QUESTIONABLE

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

g #:020309 Date Completed:05/1961

SING: Dpth: 21 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 6.00
0 0.00
0 0.00
0 0.00

ROUT: Type Rip Metho Dt Abnd Plug Date Top Bottom
/ / 0 0

MP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ell Treat Type Dev Typ Comol Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

pen Top:JEFFERSON CITY DOLOMITE
ormations Bot:ROUBIDOUX FORMATION
Other data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:020309 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 225 NO SAMPLES 0 0 0
225 355 ORDOVICIAN SYSTEM 0 0 0
225 355 CANADIAN SERIES 0 0 0
225 290 JEFFERSON CITY DOLOMITE DL CH SD 0 0 0
290 355 ROUBIDOUX FORMATION DL CH SS 0 0 0
355 355 TOTAL DEPTH 0 0 0

rinted on 05/22/97 at 07:47:31.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:LONG, HARRY St:MO Cnty:JEFFERSON
005678 SE NW NW TRS: S16 T40N R05E
Alias: Lat.:
ype well:Private Well Long.:
e log: S Quad:UNKNOWN
iller:SCOTT, C.N. Date: /1939
riller Liscense #: Confidential:N Release Dt. /
gger:MCCRACKEN Date:10/1939

ev.: 440 Elev.S Yield: 6 SWL:(a) 18 H20 @:
.D.: 67 base: DrDwn: SWL:(s) TL

rock at: 25 Samples saved:N Int. cored: 0 to 0
od Fm.:JEFFERSON CITY DOLOMITE
Fm.:JEFFERSON CITY DOLOMITE
blems:
marks:E SD OR RR TCK @ HEMATITE BEHIND LONG'S STORE; BTWN CK AND RR TRACK

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

g #:005678 Date Completed: /1939

SING: Dpth: 25 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

ROUT: Type Rig Metho Dt Aband Plug Date Top Bottom
/ / 0 0

MP: Cap Type Set at TDH Scrn Typ Size Lpth Slot
0 0 0 0 0 0

ll Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:JEFFERSON CITY DOLOMITE
rmations Bot:JEFFERSON CITY DOLOMITE
Other data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:005678 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 25 NO SAMPLES 0 0 0
25 67 ORDOVICIAN SYSTEM 0 0 0
25 67 CANADIAN SERIES 0 0 0
25 67 JEFFERSON CITY DOLOMITE DL CH SD 0 0 0
67 67 TOTAL DEPTH 0 0 0

nted on 05/22/97 at 07:52:28.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:BOUNK, E.B. St:MO Cnty:JEFFERSON
005672 SE SW NE TRS: S16 T40N R05E
Alias: Lat.:
ype well:Private Well Long.:
e log: S Quad:UNKNOWN
iller:SCOTT, C.N. Date: /1939
Miller Liscense #: Confidential:N Release Dt. /
ogger:MCCRACKEN Date:10/1939

ev.: 480 Elev.S Yield: 0.5 SWL:(a) 35 H20 B:
.D.: 70 base: DrDwn: SWL:(b) TL

rock at: 20 Samples saved:N Int. cored: 0 to 0
o Fm.:JEFFERSON CITY DOLOMITE
Fm.:ROUBIDOUX FORMATION
blems:
marks:0.5 MI E OF HEMATITE

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

g #:005672 Date Completed: /1939

SING: Dpth: 6 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

MOUT: Type Rig Metho Dt Abnd Plug Date Top Bottom
/ / 0 0

MP: Cap Type Set at Typ Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ll Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

on Top:JEFFERSON CITY DOLOMITE
ormations Bot:ROUBIDOUX FORMATION
Other data sources:
marks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

#:005672 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 20 NO SAMPLES 0 0 0
20 70 ORDOVICIAN SYSTEM 0 0 0
0 70 CANADIAN SERIES 0 0 0
20 60 JEFFERSON CITY DOLOMITE DL CH SD 0 0 0
60 70 ROUBIDOUX FORMATION DL CH SD 0 0 0
0 70 TOTAL DEPTH 0 0 0

inted on 05/22/97 at 07:52:36.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:WILLIAMS, SILAS St:MO Cnty:JEFFERSON
005673 SW NW NW TRS: S16 T40N R05E
Alias: Lat.:
Type well:Private Well Long.:
Type log: S Quad:UNKNOWN
Driller:SCOTT, C.N. Date: /1939
Driller Liscense #: Confidential:N Release Dt. /
Logger:MCCRACKEN Date:10/1939

Elev.: 472 Elev.S Yield: 6 SWL:(a) H20 @:60', 90'
T.D.: 95 base: DrDwn: SWL:(b) TL

Bedrock at: 17 Samples saved:N Int. cored: 0 to 0
Top Fm.:JEFFERSON CITY DOLOMITE
Bot Fm.:JEFFERSON CITY DOLOMITE
Problems:
Remarks:"CAN'T BAIL DRY", @ HEMATITE ONE BLK W OF RR TRACK ON SCHOOL HOUSE ST

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Log #:005673 Date Completed: /1939

CASING: Depth: 25 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

GROUT: Type Kind Method Dt Bond Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Well Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:JEFFERSON CITY DOLOMITE
Formations Bot:JEFFERSON CITY DOLOMITE
Other data sources:
Remarks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Log #:005673 --Lith-- ---------Minerals---------
Top Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 17 NO SAMPLES 0 0 0
17 70 ORDOVICIAN SYSTEM 0 0 0
17 70 CANADIAN SERIES 0 0 0
17 70 JEFFERSON CITY DOLOMITE DL CH SD 0 0 0
70 95 NO SAMPLES 0 0 0
95 95 TOTAL DEPTH 0 0 0

Printed on 05/22/97 at 07:52:42.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:STIS (STIG?), RICHARD St:MO Cnty:JEFFERSON
016248 SW NW NW TRS: S16 T40N R05E
Alias: Lat.:38,12, 6.413N
Type well:Private Well Long.:90,28,44.539W
Type log: S Quad:38090B4
Driller:BLOOMSDALE EXCAVATION CODate:05/1957
Driller Liscense #: Confidential:N Release Dt. /
Logger:R.D.KNIGHT Date:07/1957

Elev.: 480 Elev.S Yield: 10 SWL:(a) 55 H20 @:120-132'
T.D.: 140 Base: DrDwn: SWL:(b) TL

Bedrock at: 15 Samples saved:Y Int. cored: 0 to 0
Top Fm.:COTTER DOLOMITE
Bot Fm.:COTTER DOLOMITE
Problems:
Remarks:

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Reg #:016248 Date Completed:05/1957

Casing: Depth: 35 Diam: 6.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

Grout: Type Rig Method Dt Abnd Plug Date Top Bottom
/ / 0 0

Pump: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Well Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:COTTER DOLOMITE
Formations Bot:COTTER DOLOMITE
Other data sources:
Remarks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Reg #:016248

Base	Name	--Litn-- Pr	Sc	Mn	Pri	Oc	Sec	Oc	Mnr	Oc
0	15 RESIDUUM & TOP SOIL	CL		CH		0		0		0
15	140 ORDOVICIAN SYSTEM					0		0		0
15	140 CANADIAN SERIES					0		0		0
15	140 COTTER DOLOMITE	DL	CH	SD	ZnS	1		0		0
110	125 NO SAMPLES					0		0		0
0	140 TOTAL DEPTH					0		0		0

Printed on 05/22/97 at 07:52:48.

Header Data

Log # 012875 Owner:MOSER, HARRY
Alias:
Type well:Private Well
Type log: S
Driller:HAVERSTICK WELL CO Date: /1954
Driller Liscense #:
Logger:LEWIS AND CLARK Date:09/1954

St:MO Cnty:JEFFERSON
SE NW SE Twp: S16 T40N R05E
Lat.:38,11,38.063N
Long.:90,28,10.284W
Quad:38090B4
Confidential:N Release Dt. /

Elev.: 476 Elev.S Yield: S SWL:(a) 30 H20 @:
TD.: 140 Base: DrDwn: 100 SWL:(b) TL

Bedrock at: 5 Samples saved:Y Int. cored: 0 to 0
Top Fm.:COTTER DOLOMITE
Bse Fm.:JEFFERSON CITY DOLOMITE
Problems:
Remarks:

Construction Data

Log #:012875 Date Completed: /1954

CASING: Depth: 15 Diam: 0.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

GROUT: Type Rig Metho Dt Aband Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Well Treat Type Lev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:COTTER DOLOMITE
Formations Bot:JEFFERSON CITY DOLOMITE
Other data sources:
Remarks:

Stratigraphy Data

Log #:012875

Top	Base	Name	--Lith-- Pr	Sc	Mn	Pri	Dc	Sec	Dc	Mnr	Dc
0	5	NO SAMPLES					0		0		0
5	140	ORDOVICIAN SYSTEM					0		0		0
5	140	CANADIAN SERIES					0		0		0
5	45	COTTER DOLOMITE	DL	CH	SD	ZnS	1		0		0
45	140	JEFFERSON CITY DOLOMITE	DL	CH	SD	ZnS	1	PoS	1		0
140	140	TOTAL DEPTH					0		0		0

Printed on 05/22/97 at 07:52:54.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:HENNE, OTTO St:MO Cnty:JEFFERSON
012876 C NW SE TRS: S16 T40N R05E
Alias: Lat.:38,11,41.485N
ype well:Private Well Long.:90,28,13.046W
ype log: S Quad:38090B4
iller:HAVERSTICK WELL CO Date: /1954
riller Liscense #: Confidential:N Release Dt. /
ogger:LEWIS C. MARTIN Date:09/1954

lev.: 470 Elev.S Yield: 12 SWL:(a) 30 H20 @:
T.D.: 195 Base: DrDwn: 60 SWL:(b) TL

rock at: 5 Samples saved:Y Int. cored: 0 to 0
op Fm.:COTTER DOLOMITE
ase Fm.:ROUBIDOUX FORMATION
roblems:
emarks:LEMAY

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -
Rg #:012876 Date Completed: /1954

ASING: Dpth: 0 Diam: 0.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

HROUT: Type Rig Methd Dt Abnd Plug Date Top Bottom
/ / 0 0

UMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

ell Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

ven Top:COTTER DOLOMITE
ormations Bot:ROUBIDOUX FORMATION
Other data sources:
emarks:
- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Rg #:012876 --Lith-- ---------Minerals---------
Base Name Pr Sc Mn Pri Oc Sec Oc Mnr Oc
0 5 NO SAMPLES 0 0 0
5 195 ORDOVICIAN SYSTEM 0 0 0
5 195 CANADIAN SERIES 0 0 0
5 35 COTTER DOLOMITE DL SD CH 0 0 0
35 175 JEFFERSON CITY DOLOMITE DL CH SD ZnS 1 0 0
175 195 ROUBIDOUX FORMATION DL CH SD 0 0 0
175 195 TOTAL DEPTH 0 0 0

rinted on 05/22/97 at 07:53:00.

- - - - - - - - - - - - - - - - H e a d e r D a t a - - - - - - - - - - - - - - - -

Log # Owner:SMITH, DALE St:MO Cnty:JEFFERSON
018152 SE NE SW TRS: S17 T40N R05E
Alias: Lat.:38,11,45.452N
Type well:Private Well Long.:90,29.58.420W
Type log: S Quad:3809084
Driller:HAVERSTICK WELL CO Date: /
Driller Liscense #: Confidential:N Release Dt. /
Logger:J.WELLS Date:07/1959

Elev.: 452 Elev.S Yield: 8 SWL:(a) 20 H20 @:
T.D.: 100 Base: DrDwn: SWL:(b) TL

Bedrock at: 30 Samples saved:Y Int. cored: 0 to 0
1st Fm.:JEFFERSON CITY DOLOMITE
Last Fm.:JEFFERSON CITY DOLOMITE
Problems:
Remarks:

- - - - - - - - - - - - C o n s t r u c t i o n D a t a - - - - - - - - - - -

Log #:018152 Date Completed: /

CASING: Depth: 0 Diam: 0.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

GROUT: Type Rig Method Dt Abnd Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Oil Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:JEFFERSON CITY DOLOMITE
Formations Bot:JEFFERSON CITY DOLOMITE
Other data sources:
Remarks:

- - - - - - - - - - - - S t r a t i g r a p h y D a t a - - - - - - - - - - -

Log #:018152 --Lith-- ---------Minerals---------
Top Base Name Pr Sc Mn Pri Dc Sec Dc Mnr Dc
0 30 NO SAMPLES 0 0 0
0 100 ORDOVICIAN SYSTEM 0 0 0
0 100 CANADIAN SERIES 0 0 0
30 100 JEFFERSON CITY DOLOMITE DL CH ZnS 1 0 0
100 100 TOTAL DEPTH 0 0 0

Printed on 05/22/97 at 07:53:16.

- - - - - - - - - - - - - - Header Data - - - - - - - - - - - - - -

Log # 025337 — Owner:JEFFERSON CO PWSD #5 #2 — St:MO Cnty:JEFFERSON
Alias type: Facility ID — NE NE NE TRS: S17 T40N R05E
Alias:6024296 — Lat.:38,12,11.538N
Type well:Community Public well — Long.:90,28,56.570W
Type log: S — Quad:38090B4
Driller:SCOTT DRILLING CO Date:01/1968
Driller License #: — Confidential:N Release Dt. /
Logger:A.W.HEIDRANK Date: /

Elev.: 504 Elev.S Yield: 100 SWL:(a) 45 .20 @:
T.D.: 435 base: DrDwn: 335 SWL:(b) 35 TL

Bedrock at: 5 Samples saved:N Int. cored: 0 to 0
Top Fm.:JEFFERSON CITY DOLOMITE
Bottom Fm.:GASCONADE DOLOMITE
Problems:
Remarks:@ HEMATITE
Ph @:

- - - - - - - - - - - - - - Construction Data - - - - - - - - - - - -

Log #:025337 Date Completed:01/1968

CASING: Dpth: 230 Diam: 4.00 I/O:I Sz. Hole: 0.00 Sz. Below: 6.00

0	0.00
0	0.00
0	0.00

GROUT:	Type	Rig	Method	Dt Bond	Plug Date	Top	Bottom
	3			/	/	0	0

PUMP:	Cap	Type	Set at	TDH	Scrn Typ	Size	Len	Slot
	0		0	0		0	0	0

Well Treat	Type Dev	Typ Compl	Perf. Interval	Tube Pres.	Oil	Gas
	0		Top: 0 Bot: 0			

Open Formations Top:UPPER GASCONADE DOLOMITE
Bot:LOWER GASCONADE DOLOMITE
Other data sources:
Remarks:

- - - - - - - - - - - - - Stratigraphy Data - - - - - - - - - - -

Log #:025337

Top	Base	Name	Pr	Sc	Mn	Pri	Oc	Sec	Oc	Mnr	Oc
0	5	NO SAMPLES					0		0		0
5	435	ORDOVICIAN SYSTEM					0		0		0
5	435	CANADIAN SERIES					0		0		0
5	110	JEFFERSON CITY DOLOMITE	DL	CH	SD		0		0		0
110	245	ROUBIDOUX FORMATION	DL	CH	SS	ZNS	8	FES2	7		0
245	435	GASCONADE DOLOMITE	DL	CH			0		0		0
245	295	UPPER GASCONADE DOLOMITE	DL		CH		0		0		0
245	295	"RICHLAND DOLOMITE MEMBER"	DL		CH		0		0		0
295	435	LOWER GASCONADE DOLOMITE	DL	CH		ZNS	2		0		0
435	435	TOTAL DEPTH					0		0		0

Printed on 05/22/97 at 7:53:36.

---------------Header Data---------------

Log # Owner:MESTER, ROBERT C. St:MO Cnty:JEFFERSON
22355 NW NW NE TRS: S19 T40N R05E

Alias: Lat.:

ype well:Private Well Long.:

e log: S Quad:UNKNOWN

ller:SCOTT DRLG CO Date:07/1963

iller Liscense #: Confidential:N Release Dt. /

oper:J.WELLS Date:03/1964

v.: 5.8 Elev.S Yield: 7 SWL:(a) 80 H20 @:
.D.: 190 Base: DrDwn: SWL:(s) TL

rock at: 10 Samples saved:N Int. cored: 0 to 0
p Fm.:COTTER DOLOMITE
m Fm.:COTTER DOLOMITE
blems:
marks:1.5 MI FROM VICTORIA ON HWY 21A TOWARD HEMATITE

---------------Construction Data---------------

p #:022355 Date Completed:07/1963

SING: Dpth: 14 Diam: 6.25 I/O:O Sz. hole: 0.00 Sz. Below: 6.25

Dpth	Diam
0	0.00
0	0.00
0	0.00

ROUT: Type	Rip	Methd	Pt Pond	Plug Date	Top	Bottom
			/	/	0	0

MP: Cap	Type	Set at	TDH	Sn Typ	Size	Lpth	Glob
0		0	0		0	0	0

il Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:COTTER DOLOMITE
rmations Bot:COTTER DOLOMITE
her data sources:
marks:

---------------Stratigraphy Data---------------

#:022355

Top	Base	Name	Lith Pr Sc Mn Pri	Minerals Oc	Sec	Oc	Mnr	Oc
0	10	NO SAMPLES		0		0		0
0	190	ORDOVICIAN SYSTEM		0		0		0
0	190	CANADIAN SERIES		0		0		0
0	190	COTTER DOLOMITE	DL CH SD ZnS	1		0		0
0	190	TOTAL DEPTH		0		0		0

inted on 05/22/97 at 07:53:57.

- - - - - - - - - - - - - - - Header Data - - - - - - - - - - - - - - -

Log # Owner:PROPST, EZRA St:MO Cnty:JEFFERSON
022420 SW NE SW TRS: S22 T40N R05E
Alias: Lat.:38,10,40.061N
Type well:Private well Long.:90,27,27.660W
Type log: S Quad:3809084
Driller:SCOTT DRLG CO Date:03/1963
Driller Liscense #: Conficential:N Release Dt. /
Logger:H.M.GROVES Date:06/1964

Elev.: 702 Elev.S Yield: 12 SWL:(a)250 620 @:
T.D.: 415 Base: DrDwn: SWL:(b) TL

Bedrock at: 15 Samples saved:N Int. correc: 0 to 0
Top Fm.:COTTER DOLOMITE
Bot Fm.:ROUBIDOUX FORMATION
Problems:
Remarks:RT 3, FESTUS

- - - - - - - - - - - - - Construction Data - - - - - - - - - - -
Log #:022420 Date Completed:03/1963

CASING: Dpth: 21 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 6.25
0 0.00
0 0.00
0 0.00

GROUT: Type Rig Methd Dt Abnd Plug Date Top Bottom
/ / 0 0

PUMP: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

Well Treat Type Dev Typ Cmpl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

Open Top:COTTER DOLOMITE
Formations Bot:ROUBIDOUX FORMATION
Other data sources:
Remarks:
- - - - - - - - - - - - Stratigraphy Data - - - - - - - - - - -

Log #:022420

Top	Base	Name	Lith Pr	Sc	Mn	Pri	Oc	Sec	Oc	Tnr	Oc
0	15	NO SAMPLES					0		0		0
15	415	ORDOVICIAN SYSTEM					0		0		0
15	415	CANADIAN SERIES					0		0		0
15	250	COTTER DOLOMITE	DL	CH	SD	Fe2O3	5		0		0
250	390	JEFFERSON CITY DOLOMITE	DL	CH	SD	ZnS	3	Fe2O3	3		0
345	355	"QUARRY LEDGE"	DL		CH		0		0		0
390	415	ROUBIDOUX FORMATION	DL	SS	CH		0		0		0
415	415	TOTAL DEPTH					0		0		0

Printed on 05/22/97 at 07:54:27.

- - - - - - - - - - - - - - Header Data - - - - - - - - - - - - - -

Log # Owner:PROPST, EZRA | St:MO Cnty:JEFFERSON
22420 | Sw NE Sw TRS: S22 T40N R05E
Alias: | Lat.:38,10,48.06N
ype well:Private Well | Long.:90,27,27.6F0W
e log: S | Quad:38090B4
iller:SCOTT DRLG CO Date:03/1963
riller Liscense #: | Confidential:N Release Dt. /
ogger:H.M.GROVES Date:06/1964

v.: 702 Elev.S Yield: 10 SWL:(a)250 H20 @:
.D.: 415 base: DrDwn: SWL:(b) TL

rock at: 15 Samples saved:N Int. cored: 0 to 0
op Fm.:COTTER DOLOMITE
ot Fm.:ROUBIDOUX FORMATION
blems:
marks:RT 3, FESTUS

- - - - - - - - - - - - Construction Data - - - - - - - - - - - -

g #:022420 Date Completed:03/1963

SING: Dpth: 21 Diam: 6.25 I/O:O Sz. Hole: 0.00 Sz. Below: 6.25
0 0.00
0 0.00
0 0.00

ROUT: Type Rig Methd Dt Abnd Plug Date Top Bottom
/ / 0 0

/P: Cap Type Set at TDH Scrn Typ Size Lgth Slot
0 0 0 0 0 0

il Treat Type Dev Typ Compl Perf. Interval Tube Pres. Oil Gas
Top: 0 Bot: 0

en Top:COTTER DOLOMITE
ormations Bot:ROUBIDOUX FORMATION
Other data sources:
marks:

- - - - - - - - - - - - Stratigraphy Data - - - - - - - - -

#:022420

Top	Base	Name	Lith Pr	Lith Sc	Lith Mn	Minerals Pri	Dc	Sec	Dc	Mr	Dc
0	15	NO SAMPLES					0		0		0
5	415	ORDOVICIAN SYSTEM					0		[illegible]		0
5	415	CANADIAN SERIES					0		0		0
5	250	COTTER DOLOMITE	DL	CH	SD	Fe2O3	[illegible]		0		0
250	390	JEFFERSON CITY DOLOMITE	DL	CH	SD	ZnS		Fe2O3	3		0
5	355	"QUARRY LEDGE"	DL		CH		0		0		0
0	415	ROUBIDOUX FORMATION	DL	SS	CH		0		0		0
415	415	TOTAL DEPTH					0		0		0

nted on 05/22/97 at 07:54:48.

```
----------------Heacer Data----------------

Log #    Owner:MURPHY, PATRICK                St:MO Cnty:JEFFERSON
005555                                        SE (   )E  TRS: 523  T40N  R05E
         Alias:                               Lat.
Type well:Private Well                        Long.:
  e log:  S                                   Quad:UNKNOWN
Driller:McMULLINS BROS      Date:04/1939
Driller License #:                            Confidential:N Release Dt.  /
    er:MCCRACKEN            Date:08/1939

 lev.: 743 Elev.S  Yield:   28   SWL:(a) 19 H20 @:
T.D.:   27 Dase:   DrDwn: 0@0    SWL:(b)                          TL

Bedrock at:  10   Samples saved:N        Int. cored:     0 to     0
Top Fm.:COTTER DOLOMITE
   Fm.:COTTER DOLOMITE
Problems:
Remarks:3 MI S OF FESTUS ON W SIDE US HWY 61, 300 YDS W OF LONGVIEW TAVERN

------------Construction Data------------
Log #:005555   Date Completed:04/1939

CASING: Depth:   11 Diam: 6.25 I/O:0  Sz. Hole: 0.00 Dz. Below: 0.0
                  0       0.00
                  0       0.00
                  0       0.00

GROUT:  Type    Rip     Metho   Dt Aband    Plug Date     Top     Bottom
                                   /           /            0        0

PUMP:   Dao    Type   Set at   TDH   Scrn Typ  Size    Lgth    Slot
          0              0       0              0       0       0

Well Treat  Type Dev  Typ Compl  Perf. Interval    Tube Pres. Oil   Gas
                                  Top:   0 Bot:   0

           Top:COTTER DOLOMITE
Formations  Bot:COTTER DOLOMITE
Other data sources:
Remarks:
------------Stratigraphy Data------------

   #:005555                                --Lith-----------Minerals---------
      Base Name                            Pr Dc Sn Pr    Dc Sec    Dc Tnr    Dc
  0    .0 NO SAMPLES                                        0         0        0
 10    27 COTTER DOLOMITE                  D. Cs   CaSO4   3         0        0
       27 TOTAL DEPTH                                      0         0        0

Printed on 05/22/97 at 07:55:03.
```

APPENDIX B
MDNR Well Log # 14993

Header Data

Log # 014993 Owner:UNITED NUCLEAR CORP
Alias:
St:MO Cnty:JEFFERSON
SW NE SW TRS: S09 T40N R05E
Lat.:38,12,25.563N
Long.:90,28,39.937W
Quad:38090B4
Type well:Industrial High Capacity Well
Type log: S
Driller:HAVERSTICK WELL CO Date: /1956
Confidential:N Release Dt. /
Driller Liscense #:
Logger:R.D.KNIGHT Date:09/1956

Elev.: 436 Elev.S Yield: 125 SWL:(a) 13 H20 @:
T.D.: 600 base: DrDwn: Y SWL:(b) TL

Bedrock at: 35 Samples saved:Y Int. cored: 0 to 0
Top Fm.:JEFFERSON CITY DOLOMITE
Bot Fm.:EMINENCE DOLOMITE
Problems:
Remarks:@ HEMATITE; FORMERLY MALLINKRODT CHEMICAL CO; WELL ORIGINALLY FLOWED

Construction Data

Log #:014993 Date Completed: /1956

CASING: Dpth: 220 Diam: 8.00 I/O:O Sz. Hole: 0.00 Sz. Below: 0.00
0 0.00
0 0.00
0 0.00

GROUT:	Type	Rig	Methd	Dt Abnd	Plug Date	Top	Bottom
				/	/	0	0

PUMP:	Cap	Type	Set at	TDH	Scrn Typ	Size	Lgth	Slot
	0		0	0		0	0	0

Well Treat	Type Dev	Typ Compl	Perf. Interval	Tube Pres.	Oil	Gas
			Top: 0 Bot: 0			

Open Formations Top:ROUBIDOUX FORMATION
Bot:EMINENCE DOLOMITE
Other data sources:
Remarks:

Stratigraphy Data

Log #:014993

Top	Base	Name	--Lith-- Pr	Sc	Mn	Pri	Minerals Oc	Sec	Oc	Mnr	Oc
0	35	NO SAMPLES					0		0		0
35	470	ORDOVICIAN SYSTEM					0		0		0
35	470	CANADIAN SERIES					0		0		0
35	125	JEFFERSON CITY DOLOMITE	DL	CH		SD	1	ZnS	0		0
125	255	ROUBIDOUX FORMATION	DL	SS	CH		5	ZnS	0		0
255	470	GASCONADE DOLOMITE	DL	CH		SD	0		0		0
255	315	UPPER GASCONADE DOLOMITE	DL	CH		SD	2	ZnS	0		0
255	305	"RICHLAND DOLOMITE MEMBER"	DL			SD	0		0		0
315	455	LOWER GASCONADE DOLOMITE	DL	CH			0		0		0
455	470	GUNTER SANDSTONE MEMBER	DL	CH		SD	0		0		0
470	600	CAMBRIAN SYSTEM					0		0		0
470	600	UPPER CAMBRIAN SERIES					0		0		0
470	600	EMINENCE DOLOMITE	DL	CH		ZnS	23		0		0
600	600	TOTAL DEPTH					0		0		0