1.0 INTRODUCTION

Cabot Corporation, located approximately 3 miles west of Tuscola, Illinois, operates two Class I disposal wells for the underground injection of slightly acidic wastes. The wells are currently operating under UIC authorization by rule (Subpart C of Illinois Administrative Code 704).

The purpose of this Application is to present the information necessary to repermit Cabot's Waste Disposal Well No. 1 (standby well) according to the newly promulgated Illinois Environmental Protection Agency's (IEPA) Underground Injection Control (UIC) program.

Waste Disposal Well No. 1 is located in the SEc of the SW/4 of the SE/4 of Section 31, Township 16 North, Range 8 East in Douglas County, Illinois. The topographic map included as Attachment 1 shows the location of the well and the plant site in relation to the surrounding communities.

EPA Region 5 Records Ctr.
298863

2.0 GEOLOGY

2.1 Historical Geology

The Precambrian history of east-central Illinois is a complex history of mountain building, metamorphism and erosion. Active deposition was taking place in the area during most of the Paleozoic Era as the Illinois Basin slowly sank, trapping sediments. During this time the Basin was structurally open only to the southwest. Much of the time the Basin was covered by shallow warm seas, but it was drained more than 50 times and its margins were dry land about 100 times (Swann, 1966).

At the close of the Paleozoic Era, much of the subsidence and uplift in the Basin had been completed. The Pascola Arch was uplifted on the southwestern flank of the Basin some time during the early Pennsylvanian or late Cretaceous. This uplifting of the southwestern flank structurally closed the Basin. Since this time, the area has generally been undergoing erosion.

During the Pleistocene, glacial drift was deposited over wide areas of the Basin. Four major ice sheets are known to have covered the northern parts of the Basin during this time.

2.2 Stratigraphy

Precambrian basement rocks comprised of essentially impermeable igneous and metamorphic rocks occur throughout Illinois. The Precambrian crystalline basement complex is overlain by sedimentary rocks ranging in age from Cambrian to Quaternary. These sedimentary rocks are several thousand feet thick and consist of dolomite,

limestone, shale, sandstone, chert, anhydrite and coal. Consolidated sediments of Cambrian through Pennsylvanian age make up the bedrock surface throughout much of the state. Pleistocene and recent age glacial and alluvial deposits blanket the consolidated sediments and fill stream channels that cut through the bedrock formations.

A stratigraphic column showing the lithologies, thicknesses and vertical relationship of the formations is included as Figure 1. The following, in ascending order, is a brief description of the stratigraphy beneath the well site.

Precambrian Basement Complex

The Precambriam basement rocks consist of granites and rhyolites and are extensive throughout Illinois. The basement complex is encountered at depths of approximately 15,000 feet in the Illinois Basin Region.

Mt. Simon Formation

The Mt. Simon Formation rests unconformably upon the Precambrian erosion surface. The Mt. Simon is a fine to coarse grained sandstone with silica cement. The sandstone is dominantly quartz with small lenses of shale and siltstone.

Eau Claire Formation

This is the lower confining zone. The Eau Claire is dominantly siltstone and shale in central and eastern Illinois, and dolomite and limestone in southern Illinois. The thickness of the Formation increases from less than 300 feet in western Illinois to more than 1000 feet in the deep part of the Illinois Basin.

Ironton-Galesville Formation

The Ironton-Galesville sandstone overlies the Eau Claire Formation and is approximately 100-200 feet thick in the area. It is a fine to coarse grained, poorly cemented sandstone with minor amounts of dolomite.

Franconia Formation

The Franconia Formation contains interbedded sandstones, shales and dolomites. The upper Franconia, a relatively pure dolomite, is considered to be part of the injection zone. The lower section of the Franconia is a silty shaly sandstone. The Franconia is approximately 200-300 feet thick in this region as shown in figure 2.

Eminence-Potosi Formations

The Eminence-Potosi dolomites were chosen as the injection zone because they have sufficient permeability and porosity to accept wastes, good areal extent and they are sandwiched between relatively thick beds of low porosity and vertical permeability. The Potosi Formation is comprised of finely crystalline, somewhat agrillaceous dolomites. The Eminence Formation is a slightly sandy, fine-medium grained dolomite. The Eminence-Potosi dolomites exhibit a vugular type of porosity and relatively low native formation pressures. Isopach maps showing the thickness of the Potosi and Eminence Formations in Illinois are shown in Figures 3 and 4 respectively.

Prairie du Chien Group

The Prairie du Chien Group consists of cherty dolomite with some interbedded sandstone layers. The group is subdivided into four formations;

In ascending order, the Gunter Sandstone, Oneota Dolomite, New Richmond Sandstone and the Shakopee Dolomite. The Prairie du Chien Group is approximately 700-800 feet thick throughout the study area (Figure 5). These beds directly overly the injection zone and the relatively "tight" dolomite formations act as an impermeable cap rock to prevent upward migration of fluids.

Ancell Group

The Ancell Group includes, in ascending order, the St. Peter Formation, the Glenwood Formation and the Joachin Formation. The St. Peter Formation is a fine to medium, well sorted, well rounded frosted quart sand. The Glenwood Formation consists of poorly sorted sandstones and impure dolomites and shales. The Joachin Formation is a silty sandy dolomite with interbedded sandstones, shales and limestone.

Galena-Platteville Groups

These groups are dominantly limestones with some dolomite, shales and chert. The Platteville and Galena Groups are locally 300-350 and 180-175 feet thick respectively, and increase to over 600 feet in the southern part of Illinois.

Maquoketa Group

The Maquoketa Group unconformably overlies the Galena-Platteville Groups. The Maquoketa Shale is considered to be a secondary upper confining layer because of its low permeability and thickness. The Maquoketa Shale is approximately 200-250 feet thick as shown on the thickness map in Figure 6.

Silurian-Devonian (Hunton Magagroup)

The Hunton Megagroup consists primarily of limestone and dolimites, some cherty, some vuggy, with interbedded shaly zones. The dolomites and limestones are approximately 500 to 600 feet thick. The Hunton Megagroup is sandwiched between two confining zones, the lower Maquoketa Shales and the upper New Albany Shales.

New Albany Group

The New Albany Group is locally 100 feet thick and consists of black, gray and green shales. The New Albany shales can also be considered an upper confining unit since it lies between the injection zone and formations containing <10,000 mg/l TDS.

Mississippian System

Shales and siltstones comprise the local lithology of the Mississippian System. The Mississippian Formations collectively are approximately 1000 feet thick.

Pennsylvanian System

The Pennsylvanian System is undifferentiated in the substrata. It consists chiefly of shales with some sandstones and limestones. Coal measures are present at various Formations and depths. The Pennsylvanian System is approximately 1100 feet thick in this region.

Pleistocene

The Pleistocene consists of fine-grained clays, silt, sand and [illegible] laid down as glacial drift deposits. Alluvium and loess [illegible] were deposited on the glaciated areas and in eroded bedrock valleys. The Pleistocene deposits are approximately 300 feet thick in the region.

2.3 Structure

Central and Southern Illinois and parts of Indiana, Kentucky and Missouri are part of a large subsurface structure known as the Illinois Basin, which is subdivided into several smaller areas. The basin is oval in shape, elongating in a north-south direction. Cabot Corporation's facility is located on the western flank of the Tuscola Anticline, a part of the LaSalle Anticlinal Belt in the Illinois Basin. The regional dip of the basin is to the south, however, the beds at the well dip southwest due to the influence of the Tuscola Anticline. Figure 7 illustrates the major structural features of Illinois. Regional cross-sections extending through Douglas County are included as Figures 8 and 9.

The well site is located midway up the sloping western flank of the Tuscola Anticline. From this point there is a rapid rise in structure to the east which amounts to as much as 1,000 feet/mile until a little over 2,000 feet of structure is gained. The Quarternary, Pleistocene, Pennsylvanian, Silurian, Ordovician and Cambrian Formations all exhibit good areal extent in the study area. The Devonian and Mississippian systems are limited laterally. The Mississippian Formations are bounded to the northeast by the La Salle Anticline. The Devonian Formations extend about 35 miles to the west of the proposed well site. A local cross-section illustrating the detailed geologic structure and stratigraphy of the Tuscola area in Douglas County is shown in Figure 10.

There appears to be no fracturing or faulting in the area. The nearest major fault is the Centralia Fault located 95 miles to the southwest.

2.4 Seismic History

Cabot Corporation's facility is situated within zone 1 on the seismic risk map of Illinois (Figure 11). As indicated by the national seismic risk map (Figure 12) only minor damage is expected within the region in the event of an earthquake. Except for changes in static water level, the effects of earthquakes on wells in the past is known to be quite minor.

2.5 Mineral Resources

Coal, crude oil, natural gas and limestone-dolomite are the major mineable resources in the area (Figure 13). The major oil and gas pay zones are the porous sandstones or creviced carbonates ranging in age from Ordovician to Pennsylvanian.

There are no mines or quarries located wthin a 2 1/2 mile radius of the well. The nearest mine is a coal mine located about 15 miles east of the well site near Murdock, Illinois. The majority of mineable coal in the area occurs in the Pennsylvanian strata. The nearest quarry is a gravel pit located approximately 5 miles east of the well site.

Underground storage of liquid normal-butane and liquid propane occurs within the area of review. The storage operations which began in 1954, are located on U.S.I. plant property approximately 3 miles west of Tuscola. The No. 1 cavern is located just west of Ficklin

Road. The storage capacity of the No. 1 cavern is 5 million gallons. The No. 2 cavern is located east of Ficklin Road. The storage capacity of the No. 2 cavern is 29 million gallons. The caverns are situated in the limestones and siltstones of the Pennsylvanian at an approximate depth of 360 feet (340 feet above mean sea level).

Sand and gravel outwash deposits in buried bedrock valleys form prolific aquifers throughout east-central Illinois (Refer Figure 9). A major east-west bedrock valley, the Pesotum Valley, occurs north of the plant and one of its northwest-trending tributaries appears to occur under and south of the plant site. However, no wide-spread, prolific aquifers are reported in the Pesotum Valley or its tributaries (Selkregg and Kempton, 1958, Visocky and Schicht, 1969). Regional cross-sections showing depths of sand and gravel aquifers in Douglas County are shown in Figure 16.

Past efforts to develop large-capacity wells in the area of the plant indicate no prolific aquifers occur in the immediate vicinity. From 1937 to 1945, nearly twenty test borings and a number of unsuccessful production wells were installed to develop a groundwater supply for the Panhandle Eastern compressor station located southwest of the plant. In 1945, Panhandle Eastern abandoned its attempts to obtain a ground-water supply and developed a surface-water supply from the Kaskaskia River. Borings drilled to bedrock in the area indicate that significant accumulations of permeable sand and gravel do not occur in the area.

3.3 Bedrock Aquifers

Bedrock formations in the east-central Illinois region consist of several thousand feet of sedimentary rocks. For the most part, the older, deeper rocks are composed of sandstones, dolomites and limestones. These formations are not important aquifers because of their high mineral content. A major structural uplift in the bedrock

several miles east of the plant, the LaSalle Anticline, brings permeable Silurian and Devonian limestone and dolomite units close to the ground surface. Here, limited supplies of slightly mineralized water can be developed from the bedrock aquifer. The city of Tuscola, located on the west limb of the LaSalle Anticline, develops some of its water supply from Silurian dolomites.

Much of the shallow bedrock in the vicinity of the Tuscola area is Pennsylvanian or Mississippian shale. These shallow formations are comprised mainly of non-water yielding shales with a few, thin interbedded layers of sandstone and limestone. The shallow bedrock aquifers are of minor importance due to their low permeability and poor groundwater quality. A map showing the areal distribution and water yielding character of upper bedrock formations is given as Figure 17.

There is insufficient data in the Central Basin area from which to construct potentiometric maps of the aquifer systems cited. The velocity and direction of flow of groundwater within the Central Basin area is not generally known. Information gathered in the area suggests that the groundwater movement is down basin at an extremely slow rate of flow.

3.4 Water Quality

The chemical quality of groundwater is determined to a great extent by the lithologic characteristics of the aquifer and the source areas. Other factors which influence water chemistry are permeability, hydraulic gradient, distance from the recharge area, and chemical character of the rainfall.

Data from public records allow only a partial characterization of regional ground-water quality data for wells in Township 16 North, Range 8 East. A few wells in Township 16 North, Range 7 East are also included in this summary. On the basis of this data, ground water in the region is hard, alkaline, high in total dissolved solids and contains objectional amounts of iron. Chloride concentrations are very low except in shallow wells. Average concentrations of the constituents are as follows: Iron, 3.5 mg/l; Chloride 12 mg/l, Alkalinity 331 mg/l; Hardness, 271 mg/l and Total Dissolved Solids, 463 mg/l.

There is insufficient information in the Tuscola area from which to construct maps showing vertical and lateral limits of all formation waters having total solids content of 10,000 ppm or less. The Underground Source of Drinking Water (USDW) limit of 10,000 ppm is probably exceeded in the strata of the lower Silurian or Upper Ordovician Systems. Water quality in the Silurian varies considerably in the Tuscola area due possibly to irregularities in groundwater circulation that are related to folds and crevices connected with the LaSalle Anticlinal Belt. Silurian water has a total solids content (TDS) of 14,160 ppm, as measured in the USI No. 1 well at a depth of 2412 to 2510 feet. Samplings from the Cabot No. 1 well only 3200 feet away indicated a TDS of 6,000 ppm at a depth of 2700 feet.

As indicated by the regional cross sections, wells penetrating the entire geologic column are a rarity in the Central Basin area. This fact makes it difficult to predict typical total solids content of the

deeper formation waters in this region. However, at least two tests of water samples from common aquifer systems are available from wells in the Tuscola area. The first of these is from the Ohio No. 1 Shaw, 36-16N-8E. Total solids for water recovered from the St. Peter, Oneonta, Trempealeau, and the Franconia Formations was reported in Illinois State Geological Survey Circular 470 as 24,864 ppm, 22,344 ppm, 22,548 ppm, and 26,868 ppm, respectively. A second well to recover water from the Cambro-Ordovician system in the area was the Botts No. 2 Buck, 31-16-8E. Total solids from the Potosi Formation 5130-5301' was reported as 16,900 ppm. (Copies of these sample analyses are enclosed in Appendix 1).

Since the formations tested in the above two wells are believed to be hydrologically connected to the disposal interval, it can be reasonably inferred that the native Eminence-Potosi water in the vicinity of the Cabot well site has a total solids content well in excess of the 10,000 ppm potable limit.

The presence of at least two major confining formations between the injection interval and the shallow glacial drift ground-water supply aquifers makes it extremely unlikely that there is any naturally occurring hydrological connection between these two zones of interest.

4.0 WELL DESIGN AND CONSTRUCTION

Waste Disposal Well No. 1 was constructed in 1966 and injection operations began in August of that year. The well was originally drilled to the St. Peter Sandstone at a depth of 4000 feet. This formation proved unsuitable for injection and the hole was deepened to Eminence and Potosi dolomites which have a gross thickness of 413 feet. The overlying strata of the Prairie du Chien Group serve as a confining layer.

WDW No. 1 was completed with a 8 5/8" OD surface casing extending to 815 feet (KB) and cemented to the surace with 350 sacks of Pozmix cement. A string of 5 1/2" OD API protection casing was then set to a depth of 4597 feet. A section of 4 1/2" OD fiberglass/epoxy pipe "Fibercast" was attached to the API protection casing extending the setting depth to 4898 feet. This mixed string of protection casing was cemented to the surface. The waste is injected through 3 1/2" OD Fibercast tubing. The tubing-casing annulus is filled with oil in order to prevent contact between the injection fluid and steel protection casing. Schematics showing the subsurface and surface details of the well are presented as Figures 18 and 19 respectively. The well was placed on standby status when Cabot's WDW No. 2 was made ready for injection.

5.0 OPERATING PROGRAM AND SURFACE FACILITIES

Cabot Corporation's waste disposal well No.. 1 was put ito service in August 1966. The maximum permitted injection rate and pressure are 400 gallons per minute and 50 pounds per square inch, respectively. The average operational injection rate and pressure are approximately 90 gallons per minute and 16 pounds per square inch, respectively. The casing tubing annulus is maintained under pressure at approximately 110 pounds per square inch. Annulus fluid is oil having a specific gravity of 0.913.

A flow diagram of the surface facility is shown in Figure 20. Injection occurs when the pump delivers liquid to the well head. As described below, the pond water is injected when the automatic valve is in the fully open position. When the automatic valve is closed, the well is under vacuum and the flow is diverted to the mix tank which overflows to the pond inlet. The higher density of the acid causes the well to go under vacuum during injection.

Flow to the well is regulated by changes in level in the ponds which feed the well. A signal indicating high pond level will open the automatic valve, allowing maximum flow to the well. A low level signal will shut off the flow completely. These levels are observed by the plant operators via an indicator light system, by visual surveillance of the ponds and by a chart recorder on the burner floor.

There are two ponds which receive the wastewater. Only one pond (north or south) is on stream at any given time; the pond not in use serves as an emergency or surge facility when not awaiting sludge removal.

WASTE FRONT RADIUS CALCULATIONS
WDW NO. 1

PARAMETERS

Porosity, Ø	.063
Hydraulic Conductivity, K	60 ft/yr
Injection Zone Thickness, H	413 feet
Storage Coefficient, S	0.86×10^{-4}
Well Diameter (Injection Zone)	7 7/8 in. = .66 ft
Radial Distance, r	ft
Injection Rate, Q	2.8×10^{7} gpy (400 gpm max. inj. rate)
Well Life	30 years
Constant, π	3.14
S. G. Formation Water	1.02

Waste Front Radius Equations

Radius Without Dispersion

$$r = \sqrt{\frac{Q}{\pi H Ø}}$$

Radius With Dispersion

$$r^1 = r + 2.3\sqrt{Dr}$$

Strata	Thickness	Top	Bottom
e, as above; some limestone, white		1775	1820
to, gray, silty, to sandy; trace red shale		1820	1890
, gray-green and red, silty; trace stone, tan		1890	1910
, gray, limy and somewhat sandy		1910	1975
, green-gray to gray; a little lime-e, white to pink		1975	1980
, gry, silty and sandy; a liattle shale		1980	2005
tone, gray, shaly; a little sandstone,		2005	2015
, gray-green silty; some limestone, tan		2015	2070
tone, gray, shaly		2070	2115
, gray, sandy		2115	2195
, gray, sandy; a little shale gray-green black		2195	2220
stone, light gray, fine, silty		2220	2234
, gray-green and black		2234	2240
stone, light gray, fine silty		2240	2250
, gray-green and black; a little shale		2250	2295
ite, light gray, very fine crystalline		2295	2302
gray-green and gray; some limestone,		2302	2322
lbany:			
, black and green		2322	2364
, gray; a little limestone, tan		2364	2380
stone, light brown to tan, dense shaly		2380	2402
IAH			
ite, tan to brown, crystalline; chert co		2402	2435
stone, tan to brown, finely crystalline		2435	2445
stone, white finely crystalline; a lo chert		2445	2460
stone, tan, finely crystalline, imbedded sand fine		2460	2465
ite, white with scattered sand grained		2465	2500
			TD

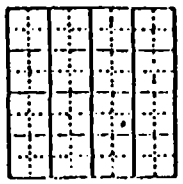
Panhandle Eastern Pipeline Co. Phillips #1
DOUGLAS 35-16N-7E

Strata	Thickness	Top	Bottom
Dry and abandoned. Plugged August 22, 1957			
Casing: 7" - 179' with 135 sacks cement.			
S.S.#39460			
Electric log filed			
Microlog filed			
Driller's log filed			
Time log filed.			

COUNTY Panhandle Eastern Pipeline Co. Phillips #1
DOUGLAS 35-16N-7E

Strata	Thickness	Top	Bottom
		0	90
dyanian			
gray		90	110
		110	120
red and green		120	160
limy		160	170
brown		170	180
description			
one, light gray, fine, limy		180	183
one, light gray, fine slightly			
eous		183	245
one, above; a little black platy	shale	245	255
gray, soft		255	280
gray, soft; some black shale; trace			
ime		280	319
sburg:			
one, white, dense		319	348
one, tan, sandy		348	355
dark gray micaceous		355	385
one, light gray, fine, limy		385	400
greenish-gray and reddish-gray		400	450
black platy; a little limestone,	light		
		450	465
gray soft, micaceous, sandy		465	480
one, white, medium fine, sub-angular		480	505
gray, limy		505	510
one, white, well cemented angular		510	520
one, tan to light brown, dense		520	550
one, above; some shale, gray		550	580
gray, trace of limes		580	620
black and gray; some limestone,	tan	620	635
one, tan, somewhat cherty		635	645
gray limy		645	660

Panhandle Eastern Pipeline Co.
Phillips NO. 1
CO August 1957 COUNTY NO. 439
D. H. Straight
675' KB - Company
330'S line, 330'E line of NW SE
DOUGLAS



38-16N-7E

Strata	Thickness	Top	Bottom
:o, partly oolitic; some shale reaks.	30		3215
omite, slightly galuconitic, buff, no.	10		3225
conia Formation			
omite, silty, sandy, fine, glau- nitic, gray, green, very fine, fin	.15		3240
o, little pink.	10		3250
e; shale, green, firm.	5		3255
dstone, dolomitic , glauconitic, ay, green, fine, medium.	10		3265
sville sandstone			
dstone, dolomitic, slightly luconitic, white, fine.	20		3285
Claire Formation			
omite, sandy, partly argillaceous, ay to dark gray.	5		3290
omite, argillaceous, partly auconitic, dark brown, dark gray, ndy at top.	45		3335
dstone, dolomitic, gray, brown, ne to medium.	15		3350
omite, very sandy, dark brown, ay, fine to medium.	15		3365
omite, argillaceous, brown, fine; ale, slightly glauconitic, green.	5		3370
omite, as above, but glauconitic; ale, gray, green, brown.	20		3390
le, dolomitic, brown; dolomite, above.	5		3395
estone, dolomitic, silty, buff, dium to coarse, glauconitic; ltstone, gray.	5		3400
le, green, firm; scattered dolomite	.12		3412
e; limestone, oolitic, brown, gray, ne, cal careous.	8		3420
sample	8		3428
estone, dolomitic, oolitic, brown			

Strata	Thickness	Top	Bottom
white, fine, very fine, sandy.	22		3450
Limestone, dolomitic, oolitic, buff, fine, granular, porous, very finely sandy.	15		3465
Limestone, dolomitic, oolitic, brown, buff, white, fine to very fine, sandy	.95		3560
Siltstone, glauconitic, micaceous, green, pink; oolitic limestone, as above.	30		3590
Siltstone; shale, micaceous, red, pink, brown, very tough.	10		3600
Siltstone, micaceous, pink; oolitic limestone.	10		3610
Siltstone, micaceous, pink, green.	25		3635
Siltstone, micaceous, pink; scattered oolites.	15		3650
Siltstone, micaceous, pink, little green; scattered red shale and oolitic limestone.	80		3730
Shale, red; siltstone, pink; oolitic limestone; siltstone, green.	15		3745
Siltstone, micaceous, pink; shale, red	.17		3762
Same, and oolitic, pink and brown dolomite; siltstone, green.	12		3774
Siltstone, pink, green; shale, red; dolomite, pink.	11		3785
Siltstone, pink; shale, red, little green.	27		3812
Shale, red, green, glauconitic; silt-stone, pink, gray.	58		3870
Shale, siltstone, buff, brown, reddish dolomitic,	35		3905
Shale, sandy, micaceous, green.	5		3910
Same; dolomite, glauconitic; shale, gray, brown, sandy, micaceous.	10		3920
Shale, green, sandy, micaceous, part glauconitic.	20		3940
Shale, green and red, micaceous.	20		3960

State	Thickness	Top	Bottom
e, gray, soft, muddy		660	740
, black; shale, gray; sandstone,			
e; trace of coal		740	750
tone, tan to gray		750	770
tone, light gray, fine, somewhat		770	870
tone, buff, dense		870	880
, black		880	890
, light gray, sandy and limy		890	950
, black; limestone, tan; trace of	coal	950	970
, gray, limy		970	980
tone, tan to gray; shale, black;			
e of coal		980	990
, gray; a little limestone, buff		990	1010
, gray and dark gray; limestone,	tan	1010	1020
, gray; a little limestone, tan		1020	1020
, black; a little limestone, tan		1080	1091
tone, white to light brown, hard	some-		
sandy		1091	1103
, black		1103	1120
, gray to dark gray; somewhat limy			
sandy		1120	1258
SSIPPIAN - Chester			
yl			
tone, white to light brown, cherty			
e of sand		1258	1276
tone, tan, dense, trace of sand;			
shale, dark gray		1276	1290
ga:			
tone, white, fine, limy and shaly		1290	1332
Creek:			
tone, white to tan, dense; shale, greenish			
and some red		1332	1340
, greenish-gray and red; some limestone,			
		1340	1360
ah:			
tone, light gray, very fine, limy		1360	1365
, gray; some limestone, tan		1365	1375

Panhandle Eastern Pipeline Co. Phillips #1

State	Thickness	Top	Bottom
Shale, greenish-gray and red; some limeston			
tan		1375	1415
Renault:			
Limestone, brown, dense		1415	1420
Shale, greenish-gray, platy; some red shale;			
trace of limestone		1420	1430
Limestone, brown dense		1430	1435
Aux Vases:			
Limestone, brown, dense; some sandstone,			
light gray, shaly		1435	1440
Shale, red and green; some sandstone, light			
gray, fie		1440	1448
St. Genevieve-Levias:			
Dolomite, white, very fine crystalline;			
slight porosity, oil stain and			
flousescence 1455-61		1448	1470
Limestone, brown, dense		1470	1485
Limestone, tan, very fine crystalline, cherty		1485	1505
Limestone, tan oolitic		1505	1520
Ste. Genevieve:			
Limestone, light gray to light brown, dense			
to slightly oolitic		1520	1541
Limestone, brown dense, slightly oolitic		1541	1570
Limestone, light gray, very fine crystal-			
line, somewhata cherty; trace of gypsum		1570	1601
Salem:			
Limestone, light brown, dense		1601	1610
Limestone, light tan to brown fine			
crystalline fossiliferous, no flourescence			
(Microlog porosity 1614-18'; 1624-26)		1610	1630
Limestone, light gray to white, fine			
cyrstalline; trace of chert		1630	1640
Limestone, gray, dense, argillaceous		1640	1645
Limestone, gray; chert, tan to gray		1645	1650
Shale, gray, limy		1650	1660
Limestone, gray, dense to finely crystalline		1660	1690
Shale, gray, limy		1690	1720
Shale, gray, silty to sandy; trace of red			
shale		1720	1775

Panhandle Eastern Pipeline Co. Phillips #1

Strata	Thickness	Top	Bottom
Tools			
ed by E. P. Dubois, 1944.			
amples	40		40
AN SYSTEM			
stone, buff, silty, fine to very o, slightly petroliferous.	5		45
stone, buff, white, medium to rse, crystalline, very fossilifer- .	5		50
mite, silty, brown, fine, granular, roliferous, porous.	10		60
mite, silty, brown, gray, very e, granular, partly sandy.	13		73
mite, partly sandy, gray, brown, ra fine, partly petroliferous.	7		80
, but very dense, more sandy.	15		95
mite, silty to sandy, gray, buff, ra fine.	35		130
, to sandstone, dolomitic, buff, y, fine, medium (last 5 feet).	15		145
AN SYSTEM			
ran Series			
mite, gray, fine, medium, crystall- .	20		165
, sandy, cherty.	10		175
mite, cherty, brown, buff, very e.	35		210
mite, cherty, gray, buff, very e.	40		250
mite, brown, very fine, petrolif- us.	35		285
mite, white, brown, fine, very fine, ghtly petroliferous.	20		305

Y The Ohio Oil Company
Shaw, Lewis NO. 1
MED January 1945 COUNTY NO. 799
TY E. P. Dubois
N 666' Grd.-Co.
N 330' S line, 330' W line, of Sec.

36-16N-8E

ILLINOIS GEOLOGICAL SURVEY, URBANA

Strata	Thickness	Top	Bottom
Dolomite, white to gray, very fine, dense.	70		375
Dolomite, argillaceous, greenish, gray, very fine.	15		390
Dolomite, argillaceous, silty, grayish-green, very fine, granular, little dolomite, gray, fine, dense.	35		425
Siltstone, very dolomitic, green.	20		445
Dolomite, white to gray, fine, oil stained, cherty.	10		455
Dolomite, very silty, grayish-green, very fine, granular; cherty; little siltstone, green.	100		555
Limestone, part very silty, dolomitic, green, little pink, buff, very fine.	25		580
Same: shale, calcareous, reddish-brown.	10		590
Limestone, argillaceous, silty, weak, pink, red, green, very fine, medium.	30		620
Limestone, light buff, red fossil casts, lithographic.	25		645
Same, partly argillaceous, greenish, pinkish.	25		670
Limestone, buff, pink casts, very fine, very coarse.	35		705
Alexandrian Series			
Limestone, partly argillaceous, partly glauconitic, brown, white, very fine, pyritic, very finely sandy.	10		715
Same, and brown.	10		725
ORDOVICIAN SYSTEM			
Maquoketa Formation			
Siltstone and shale, calcareous, green.	15		740
Shale, silty, tough, green; siltstone, argillaceous, green, tough (interbedded).	55		795
Shale, as above; limestone, argillaceous, brown, mottled, fossiliferous.	27		822

The Ohio Oil Company Shaw, Lewis #1
COUNTY Douglas S.S.#11355 36-16N-8E

Strata	Thickness	Top	Bottom
artitic, gray; shale, dolomitic, rk brown, petroliferous.	20		1590
dstone, dolomitic, white, fine to dium, pyritic; probably shale d dolomite partings.	20		1610
dstone, white, fine to medium, ritic, in part.	75		1685
e; shale, green; dolomite, brown, no.	10		1695
opeo Dolomite			
omite, cherty, white, very fine; ale, green.	10		1705
omite, cherty, grayish-buff, very ne; sandstone, dolomitic, buff; ale, green.	9		1714
omite, grayish-Buff, very fine, cherty.	21		1735
o, chert, oolitic, white; chert, ite; sandstone, siliceous, white, ium.	10		1745
omite, cherty, buff, very fine; ndstone, dolomitic, white, fine; ale, green.	10		1755
omite, as above; some oolitic chert; een shale; sand.	20		1775
omite, as above; sandstone, dolo- tic, and siliceous; greenshale, nd shale, gray and green, at 1810'.	40		1815
dstone, siliceous, dolomitic, white, uff, medium; dolomite as above.	13		1828
omite, buff, gray, very fine; olitic chert; little sandstone.	27		1855
ert, oolitic, brown, green; dolomite, above.	5		1860
lomite, sandstone and shale.	33		1893
stly dolomite, some chert (sandstone) nd shale as above.	72		1965
lomite, white, very fine, slightly nerty; scattered sand.	12		1977

The Ohio Oil Company — Shaw, Lewis #1
Douglas — S.S.#11355 — 36-16N-8E

Strata	Thickness	Top	Bottom
Dolomite, slightly sandy, cherty, gray, very fine to fine; shale, green.	4		1981
Dolomite, fine, sandy, white to buff, fine, very fine; shale, green.	9		1990
Dolomite, sandy, grayish-buff, greenish, very fine to fine; oolitic chert.	10		2000
Dolomite, buff, light gray, cherty, fine; sandstone, dolomitic, gray, brown.	10		2010
Dolomite, as above; oolitic chert, white.	10		2020
Dolomite, cherty, gray, very fine; little sand.	5		2025
Same, dolomite, gray, medium; sandstone, dolomitic, gray.	11		2036
New Richmond Formation			
Sandstone, dolomitic, siliceous, white, medium; oolitic chert; dolomite, as above.	34		2070
Oneota Dolomite			
Chert, dolomitic, oolitic, brown; dolomite, brown, fine; sandstone as above.	15		2085
Dolomite, brown, fine; chert, partly oolitic, white to brown; shale, green.	11		2096
Sand and sandy	4		2100
Dolomite, very cherty, brown, fine to medium, scattered sand.	20		2120
Dolomite, sandy, light gray to buff, fine, cherty.	13		2133
Dolomite, sandy, white, fine, medium; some chert.	17		2150
Same, more cherty, buff.	15		2165
Dolomite, cherty, buff, fine.	15		2180
Dolomite, cherty, white, fine; oolitic chert, white.	10		2190
Same, but gray, sandy.	10		2200

The Ohio Oil Company — Shaw, Lewis #1
County Douglas — S.S.#11355 — 36-16N-8E

Strata	Thickness	Top	Bottom
mite, cherty, sandy, very light			
f, fine, medium.	14		2214
mite, slightly sandy, gray, fine.	6		2220
, very cherty.	16		2236
mite, cherty, sandy, gray, medium.	24		2260
mite, sandy, gray, medium.	11		2271
mite, white, fine to medium;			
rt, white, oolitic in part.	44		2315
mite, very cherty, white to light			
y, medium.	93		2408
mite, cherty, gray, medium.	17		2425
, some brown, cherty oolites.	17		2442
mite, cherty, gray, medium, drusy			
rtz, green quartz.	8		2450
mite, cherty, gray, medium.	5		2455
mite, cherty, grayish-brown,			
lium.	20		2475
mite, cherty, gray, medium;			
litic chert.	6		2481
mite, cherty, sandy, gray; chert,			
usy quartz; scattered sand.	14		2495
mite, cherty, sandy, gray, fine,			
dium.	17		2512
mite, white, fine; oolitic chert;			
usy quartz.	10		2522
mite, fine to medium, sandy, white,			
ne; scattered cherty oolites.	48		2570
mite, argillaceous, gray to brown,			
ne, medium; oolitic cherty	15		2585
mite, gray, brown, medium; much			
litic chert.	10		2595
mite, brown, fine; much oolitic			
ert, brown.	20		2615
e and sand, fine to medium.	9		2624
mite, argillaceous, brownish-gray;			
ce sand; sandstone, argillaceous,			
een, fine; oolitic.	11		2635
mite, fine to very fine, sandy,			
ay, fine to medium; scattered chert			

Strata	Thickness	Top	Bottom
oolites.	20		2655
Dolomite, gray, fine, very fine; white			
chalky chert and cherty oolites.	10		2665
Dolomite, brownish-gray, fine; cherty			
oolites.	15		2680
Dolomite, fine to medium, sandy, gray,			
partly argillaceous.	5		2685
Sandstone, dolomitic, gray, fine to			
medium.	10		2695
CAMBRIAN SYSTEM :			
Trempealeau Dolomite			
Dolomite, fine, sandy, gray, fine.	45		2740
Same, not sandy.	20		2760
Dolomite, brown, gray, fine to medium.	15		2775
Same; and drusy quartz.	40		2815
Dolomite, brown, fine; drusy quartz.	50		2865
Dolomite, light brownish-gray;			
drusy quartz.	10		2875
Dolomite, brown, medium, drusy quartz,			
glauconitic flecks.	80		2955
Dolomite, slightly glauconitic,			
mottled, gray to brown, fine to			
medium.	35		2990
Dolomite, white, tinged brown, green,			
slightly galuconitic, medium.	10		3000
Dolomite, mottled, brown, gray, medium,			
oolitic (?).	8		3008
Same, some sandy, all glauconitic.	12		3020
Dolomite, sandy, glauconitic, brown			
to gray, fine to medium.	15		3035
Same, with brown shale partings.	18		3053
Dolomite, slightly glauconitic,			
oolitic, mottled, brown, gray, fine,			
very fine.	4		3057
Dolomite, brown, fine to medium.	13		3070
Same, and white.	10		3080
Dolomite, brown, fine, scattered very			
fine glauconite.	105		3185

State	Thickness	Top	Bottom
onite, white, very finely crystall-			
o; shale, dark gray, green, dark			
l, micaceous.	10		3970
le, dark green and dark red,			
aceous.	2		3972
o, and siltstone, dolomitic, gray,			
uconitic,	13		3985
o, mostly shale.	20		4005
lo, dark gray and red.	5		4010
o, dark gray and red, silty;			
tstone, pink, glauconitic.	10		4020
le; dolomite, silty to sandy,			
uconitic, gray; siltstone,	10		4030
	10		4040
le	5		4045
Simon Formation			
lstone, pyritic, quartzitic, fine			
medium, micaceous.	1		4046
lstone, very fine, quartzitic.	11		4057
lstone, very fine to medium,			
ose to compact.	7		4064
lstone, pink, very fine to coarse,			
t quartzitic.	6		4070
lstone, white, fine, incoherent.	26		4096
lstone, white, finte coarse,			
coherent.	9		4105
lstone, white, very fine to medium,			
coherent.	35		4140
lstone, white, fine to coarse,			
coherent.	5		4145
al depth, driller's log			
gged back to			165
and abandoned. Plugged to 165'	January 13, 1945.		
as water well at 165'			
electric log run.			
Drilling time log kept.			

e Ohio Oil Company	Shaw, Lewis #1
Douglas S.S.#11355	36-16N-8E