

DATE: June 14, 2010

TO: Mr. Victor Gregoire
Kean Miller Hawthorne D'Armond McGowen & Jarman LLP
301 Main St., 22nd floor, One American Place
Baton Rouge, LA 70801

Ms. Shelby Wilson
King & Spalding, LLP
1100 Louisiana, Suite 4000
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FROM: Mary L. Barrett, Ph.D.
639 Stephenson St.
Shreveport, LA 71104

RE: Barrett Expert Report, *VPSB v. LL & E et al.*, East White Lake Field, Vermilion Parish, LA

Dear Mr. Gregoire and Ms. Wilson,

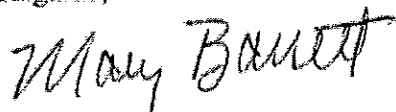
I am submitting to you my expert report concerning the VPSB litigation area, section 16, East White Lake Field. My report focuses upon Union Oil's development history and its related impact/waste history of the specific litigation site.

For this work, I collected and reviewed information from LA regulatory agencies and libraries and also studied documents supplied to me. I have cited documents which I relied upon for my opinions. This reference list is given at the end of the text. I reserve the right to update this report if any additional documents become available. My fee for this work is \$250/hour plus expenses. My current vita is also sent with this report. Included in the vita is a listing of my legal depositions and trial testimony.

I hold a Ph.D. in geology and have research and applied experience in sediment and sedimentary rocks, rock/fluid interactions, petroleum geology, improved recovery in aging fields, and the history of oil field wastes. I am currently a consulting petroleum geologist, Adjunct Professor and Professor Emeriti of Geology at Centenary College of Louisiana, Shreveport, LA.

My expert report begins on the following page.

Regards,



Mary L. Barrett, Ph.D.

Expert Report, VPSB vs. LL&E et al., East White Lake Field, Vermilion Parish, Louisiana

Mary L. Barrett, Ph.D.
June 14, 2010

SUMMARY OF EXPERT OPINIONS

- The East White Lake Field is located in a tidally-influenced, coastal marsh setting. The field site was first described in a 1935 LA Department of Conservation report as a salt marsh, but later descriptions define it as an intermediate-type marsh.
- The shallow upper 40' geological section is described by the ICON and Pisani reports as clay and silty clay with interbedded peat decreasing downward, also containing rare lenses of silt and silty sand.
- The granting clause of the 1935 mineral lease states the general and broad rights of the lessee to develop the field. Legal scholars have interpreted that this clause "includes the right to build pits, erect tanks, and install all other equipment necessary for ordinary prudent operations". It also includes the right to "impound salt water or other refuse" and "the right to dispose of saltwater by re-injection into non-productive formations."
- Various field orders, unitization agreements and commingling agreements were in existence throughout the history of Union Oil's field development.
- A closed saltwater disposal system was installed for the East White Lake Field in 1948. The injection well was the LA Furs #A-4 in section 15. Most VPSB wells produced little to no water prior to this first injection well.
- Prior to this saltwater injection well, produced water from this relatively new field would have been disposed of into the canals after removal of oil. Disposal of produced water into canals was legal and followed the regulations of both the Department of Conservation and the Stream Control Commission for this timeframe.
- Beginning in 1965, saltwater disposal wells were also placed in section 16. Union Oil converted the VPSB # A-12 (SN 30046) to a SWD well in 1965. This was followed by additional Union SWD wells: VPSB # A-16 (SN 40010) in 1973; VPSB # A-30 (SN 89035) in 1974; VPSB # A-37 (SN 970723) in 1981; VPSB # A-39 (SN 971154) in 1983; and VPSB # 34 (SN 162006) in 1994.
- General permits were not required for oilfield produced water disposal into surface water under Stream Control Commission regulations. Information concerning produced water disposal into surface water was to be provided upon request by the SCC.
- The Louisiana Water Pollution Control Regulations of November, 1985, first addressed the requirement for permits in previously-unpermitted oil and gas facilities. A letter dated April 21, 1986 from the DEQ was sent to the oil and gas industry as a notification of procedures regarding water discharge permit applications. Union Oil submitted its timely application forms in May of 1986 for water discharges at its 14 coastal fields.
- The field was developed by drilling barges which accessed sites through dredged canals. Land-based drilling-related pits were not used, as drilling was conducted from barges. All

drilling barge types have their drilling mud system, including “pits” and/or “tanks”, on the barge.

- Records indicate legacy pits on the property were associated with tank batteries. Three tank battery areas had emergency/flare pits—VPSB tank battery A, VPSB tank battery B, and the La Furs A tank battery (pit, not battery, on sec. 16).
- Separation facilities and saltwater tanks of the closed SWD system were at tank battery A; the emergency pit associated with the closed SWD system was used for emergency purposes, not day-to-day settling and cleaning of produced water prior to injection.
- Emergency pits at the tank batteries have also been described as flare pits in regulatory paperwork and by former East White Lake Field employees. These same employees who worked in the 1970s-1980s timeframe stated that “almost never” were these pits used to hold produced water from an emergency situation.
- General industry knowledge of the late 1920s-early 1930s and onward, as reflected in publications, archival documents and historic oil field regulations, was that clays were regarded as relatively impervious to leakage.
- Modern work from the 1980s and onward in Louisiana recognized that possible clay imperfections might render these deposits more permeable than previously described.

INTRODUCTION

This expert report concerning Vermilion Parish School Board vs. LL&E et al., section 16 of East White Lake Field, is divided into two major sections—first, an evaluation based on reviewed documents of the field history as it relates to field development and regulatory framework, especially of that related to wastes; and second, a discussion of the history of knowledge concerning the relatively impervious nature of oilfield pits in clay.

Although specific documents referenced in this report are given in the Reference section, I reviewed the following documents in this case:

1) documents I obtained at different agencies—LA Office of Conservation well and field records from the online SONRIS system, and paper and microfilm files of the Lafayette and Baton Rouge offices; LA DEQ records from the online LDEQ EDMS system; coastal permit records of the Coastal Division of the Department of Natural Resources, both online and at the Baton Rouge office; U. S. Corps of Engineers records, New Orleans district; related regulations and published documents; and

2) documents provided during discovery—company documents, plaintiff expert reports, records of M. Veazey and future additional records produced during ongoing discovery. If necessary, a supplemental report will be provided based on these additional records.

EAST WHITE LAKE FIELD

This litigation site is located in the East White Lake Field, Vermilion Parish, LA, section 16, township 15S, range 1E.

SITE SETTING

The East White Lake Field is located in a tidally-influenced, marsh setting. The field area is affected by the old Intracoastal Canal, constructed through section 16 in 1911. East White Lake was first described in a 1935 LA Department of Conservation report as a salt marsh (Howe and others, 1935), but later descriptions define it as an intermediate-type marsh (Pisani site evaluation plan, April 2010). Miller (2010) references the 1949 map of O'Neil, the first map of LA coastal marsh vegetation types, where O'Neil did not map this area as fresh water marsh but as saw grass marsh. A 1958 affidavit signed by a local resident described the region as "primarily marsh land, the terrain and conditions of such being very unsuitable for living" (statement by George Veazey, 1958; VPSB-LaLand/Peak 08884).

The shallow upper 40' geological section is described by the ICON and Pisani reports as clay and silty clay with interbedded peat decreasing downward, also containing rare lenses of silt and silty sand. The clay-rich confining unit in southwest Louisiana was historically described in the 1930s and onward as a relatively impermeable barrier to downward movement of water and contaminants (Stanley and Maher, 1944, p. 13; Jones and others, 1954, p. 6-7; Sargent, 2004, introduction).

EAST WHITE LAKE FIELD OVERVIEW

The East White Lake Field is a faulted anticlinal structure over a deep-seated salt dome; the faults created local down-dropped fault blocks (grabens) over the crest of the field. Union developed the section 16 area and other field areas from 1940 through 1995. The field was developed by drilling barges which accessed sites through dredged canals. It produced oil, gas and condensate under Union's development. Crude oil analysis indicates a produced light oil with an API gravity in the mid- to high 30s.

Oil and Gas Leases

Union Oil operated its section 16 lease under an oil and gas lease between the Vermilion Parish School and Louisiana Land & Exploration (LL & E) dated April 4, 1935. LL & E was the original lessee, and then lease was assigned to Union Oil in 1940. LL & E and Union entered into a 50:50 joint operating agreement at this time. Other 50:50 joint operating agreements between LL & E and Union Oil included the "R" Sand and the La Furs-VPSB units established on this property as well.

Contrary to Charles Norman's interpretation of the lease in terms of field development, pits, and saltwater disposal, these general rights of the lessee are stated in the granting clause (Sullivan, 1955). The lease granting clause states: "lessor... hereby grants, leases and lets exclusively unto lessee for the purpose of testing by any method for formations or structures and prospecting and drilling for and producing oil and gas, laying pipe lines, building tanks, storing oil and building powers, stations telephone lines and other structures thereon (including houses for employees), to produce, save, take care of, treat and transport said products.." Legal scholars such as Sullivan (1955) have interpreted that this clause "includes the right to build pits, erect tanks, and install all other equipment necessary for ordinary prudent operations. It also includes the right to impound

salt water or other refuse..” and “the right to dispose of saltwater by re-injection into non-productive formations”.

A 1994 surface lease agreement between the VPSB and Union Oil provided for a lease payment to the VPSB based on rental of surface land and a \$5000 per year per injection well, with a total of two wells. The damage clause referenced by Mr. Norman (expert report, 2010) was only applicable to damages related to this surface lease agreement which commenced November 1, 1994.

Field Orders and Unitization Agreements

The East White Lake Field field orders are the 283 series. Table 1 lists and briefly states the different order purposes.

Order #	Order Date	Order Purpose
283	July 29, 1954	Dual completion of “O” and “Q” Sands
283-A	March 30, 1970	Creation of the “R” Sand Unit (EWLK R SU)
283-B	Nov. 14, 1979	Creation of Siphonina Davisi Sand, Reservoir A Unit (Siph.Dav. RA SUA)
283-C	May 23, 1980	Creation of Discorbis 10 Sand, Reservoir A Unit (Disc. 10 RA SUA)
283-D	April 13, 1982	Creation of Discorbis 8 Sand, Reservoir A Unit (Disc. 8 RA SUA)
283-E	Feb. 27, 1984	Recognition of Discorbis 7 Sand, Reservoir A, as a new onshore reservoir under provisions of Natural Gas Policy Act, 1978

TABLE 1. East White Lake Field Order 283 series.

Voluntary unitization agreements also covered some parts of section 16. In 1945, a unitization agreement signed between the VPSB, Union, LL & E, and La. Furs, Inc., provided for the pooling and unitization of 20-acre operating units on lands of sections 16 and 15. Three operating units were created under this contract, and a total of four wells were drilled on these units (SN 30564, 30680, 48951, 59448).

Commingling Agreements

Different commingling agreements have also existed during the field’s and lease’s history. Statewide Order 29-D, 1955, governs the unprotested applications for commingling of production and methods of production allocation. An amendment to Order 29-D, 1957, requires that applications from that date onward also include an executed agreement copy in which affected royalty and working interest owners voluntarily agreed to the proposal.

Order #	Order Date	Purpose of Commingling Agreement
29-D-1	1957	Commingle La Furs-VPSB unit production w/ Mixon (Hebert # 4) well
29-D-2	1967	Changed oil purchasers, approval for commingle of VPSB A & B leases
29-D-3	1970	Commingle "R" unit (EWLK R SU) with previously approved commingled production
29-D-4	1980	Commingle Siph.Dav. RA SUA with previously-approved commingled production
29-D-5	1980	Commingle Disc. 10 RA SUA with previously-approved commingled production
29-D-?	1982	Commingle Disc. 8 RA SUA with previously-approved commingled production
29-D-8	1986	Commingle LA Furs Inc. A with previously-approved commingled production
29-D-?	1994	Commingle VUA, VPSB A-42, with previously-approved commingled production

TABLE 2. East White Lake, VPSB-related commingling agreements based on Order 29-D.

Commingling also occurred with the La. Furs-VPSB unit wells and other production gathered at the La Furs tank battery. This was set up in 1945 after the La. Furs-VPSB unit agreement and the drilling of La. Furs-VPSB #1-1 (SN 30564) and prior to Order 29-D. A letter was sent to the Vermilion Parish School Board from Union Oil after receiving approval of this commingling from the Conservation Commission (VPSB LALand/Peak-11131).

SALTWATER DISPOSAL HISTORY

A closed saltwater disposal system was installed for the East White Lake Field in 1948 (letter dated 1/28/48, SN 24642 well files). The injection well was the LA Furs #A-4 in section 15. The saltwater tanks at the VPSB tank battery "A" for the closed system are described in the deposition of Roy Briggs (2010), on a 1983 injection and mining form (SN 971154; "settling tanks") and on commercial waste disposal records of Campbell Wells (1997; "saltwater tank" or "SWT").

Prior to this time, produced water from this relatively new field would have been disposed of into the canals after removal of oil. This was legal and followed the regulations of both the Department of Conservation and the Stream Control Commission for this timeframe (see regulatory review below). At the time just prior to SWD well installation (1948), the fairly new wells of this field produced low amounts of water. After the installation of the saltwater injection system, produced waters may have been disposed of legally into brackish tidally-affected waters (and fresh waters up to 1967) in an emergency situation with failure of the SWD injection system (see regulatory summary below).

Saltwater disposal wells were also placed in section 16 beginning in 1965. Union Oil converted the VPSB # A-12 (SN 30046) to a SWD well in 1965. This was followed by additional Union SWD wells: VPSB # A-16 (SN 40010) in 1973; VPSB # A-30 (SN 89035) in 1974; VPSB # A-37 (SN 970723) in 1981; VPSB # A-39 (SN 971154) in 1983; and VPSB # 34 (SN 162006) in 1994.

In addition to disposal of produced waters, the saltwater disposal system was also used to dispose of well cleaning and workover fluids (Briggs deposition; UIC-16 form, La. Furs-VPSB unit well #1 dated 2/3/88; ENG-16 form, VPSB #A-34 dated 5/10/94).

REGULATIONS PERTAINING TO OILFIELD WASTES AND THE HISTORY OF EAST WHITE LAKE FIELD

By the time that Union Oil began developing East White Lake Field in the early 1940s, two main regulatory bodies were important regarding field development and wastes—the Department/Office of Conservation and the Stream Control Commission (and the later related agencies).

Department/Office of Conservation

Regulation of oilfield wastes into surface waters was exclusively under the Department of Conservation prior to the 1940 creation of the Stream Control Commission. The first regulation concerning produced water in Louisiana was Act 183 of 1910 which regulated produced water disposal into stream waters used for irrigation purposes. This regulation created “open” and “closed” seasons for surface water disposal. Act 133 of 1924 prohibited discharge of produced water or other substances in quantities sufficient to kill the fish.

The modern Conservation office was created in 1940 by Act 157; the statewide Order 29 series were soon promulgated over the next few years to regulate drilling and development (Order 29, 1941; Order 29-A, 1942; order 29-B, 1943). Salt water production (reported as “BS & W”) was reported on DM1-R forms (Oil & Gas Journal, 1953; Department of Conservation letter, 1963). The statewide Order 29-B amendment of 1967 (as well as the Stream Control Commission order of 1968) addressed statewide changes in produced water surface water disposal, in that produced water discharge was no longer allowed in freshwater bodies, but “may be disposed of in tidally affected waters, brackish waters or any other waters unsuitable for human consumption or agricultural purposes”. The Order 29-B amendments of 1986 defined pit types and regulated the closure methodology of pits.

Stream Control Commission (SCC), Office of Environmental Affairs (OEA), and the Department of Environmental Quality (DEQ)

The Stream Control Commission (SCC) was created in 1940 by Act 367 to have control of surface waters of the State and waste disposal in these waters. Shortly after its creation the SCC put forth “Rules Governing Disposal of Oilfield Wastes” that were adopted in 1941, 1943, and 1949. These regulations and previous regulations dealing with saltwater disposal were codified as Title 56 in 1950. Similar oil field waste rules were put forward in 1953. It was legal to dispose of produced water in fresh, brackish or saline waters under all of these regulations provided that the SCC did not determine that such discharge was a pollution hazard. When requested by the SCC, companies provided information concerning produced water disposal. Another regulation, Act 203 of 1952, restated the “closed” season of produced water discharge when produced water could not be released in water bodies used for irrigation, but the legislative act exempted brackish and saline waters. Similar to the Department of Conservation’s state-wide Order 29-B amendment of 1967, an order put forth by SCC in 1968 prohibited produced water into freshwater streams, but “saltwater may be disposed of in normally saline waters, tidally

affected waters, brackish waters or other waters unsuitable for human consumption or agricultural purposes". When disposal occurred in areas not clearly defined by these parameters, the SCC rendered an individual judgment. The updated Title 56 which concerned the Stream Control Commission was put forward in a 1972 publication.

General permits for oilfield produced water disposal were not required under these previously-described regulations. Information concerning waste disposal into surface water was to be provided upon request, and the rule for providing for the filing, on request, of a report on waste discharge is given in the Stream Control Commission minutes of 11/19/1940. The SCC was empowered to allow, restrain or stop a given discharge and set parameters for any discharge in question if they judged such discharge unreasonable and against the public interest. Oil-based muds and associated cuttings were not allowed to be disposed of in coastal and offshore area waters, but freshwater muds and cuttings were. Freshwater muds and cuttings were not viewed as a pollution hazard and thus were allowed to be disposed of in coastal and offshore areas during the SCC time frame (1940-1979); an exception was that any muds used in and around oyster communities could not be disposed of in those waters (SCC letter of 10/17/1960, EDMS 17317626).

The Office of Environmental Affairs (OEA) was created after the SCC was dissolved in late 1979. The Department of Environmental Quality (DEQ) was created after the OEA was dissolved in 1983. In the early 1980s, permits for oil field discharges in coastal areas continued to not be required (OEA correspondence, Givens, 1982 letter). The Louisiana Water Pollution Control Regulations of November, 1985, first addressed the requirement for permits in previously-unpermitted oil and gas facilities. A letter dated April 21, 1986 from the DEQ was sent to the oil and gas industry as a notification of water discharge permit application procedures. Union Oil submitted its completed application forms in May of 1986 for water discharges at their 14 coastal fields.

The fact that plaintiff experts only reported water discharge permits from 1994 and onward for East White Lake Field points to the poorly-preserved historic records of the DEQ's EDMS system. In fact, the EDMS system does contain issued water permit records concerning Union Oil and this field back to 1986 and again in 1988 and onward. The submission of the earlier 1986 application letter, plus no record of violation concerning these permit applications from the DEQ in the late 1980s and onward, indicate Union Oil was in compliance concerning permits. The DEQ permitted Union to dispose of cuttings overboard with adhering freshwater mud in 1988 (VPSB # 41) and 1989 (LA Furs # 20) under its water quality permit (see listed DEQ records, permit and discharge reporting forms). No further discharge of cuttings/adhering mud by Union occurred after 1989.

Union also filed its EPA-required notification requirements in November of 1993 and was granted the NPDES general permit for the coastal waters of Louisiana (including East White Lake Field).

HISTORY OF PIT USAGE AT EAST WHITE LAKE FIELD

Today, no pits are present on section 16 of East White Lake Field. Records indicate that the main pits that existed in the field were emergency/flare pits associated with tank batteries.

The Pit Term as Applied to Barges

Drilling-related mud pits were not used, as drilling was conducted from barges. All drilling barge types have their drilling mud system, including “pits” and/or “tanks”, on the barge. Terms to describe barge mud storage and circulation containers included “pits”, “mud pits”, “reserve pit”, “main mud pit”, “slush pit” and “reserve mud tank” (Oil & Gas Journal, 1935; Oil Weekly 1934a, b, c; company documents describing modern barges). This “pit” term is/was also used on workover rigs mounted on barges (Miller deposition, 2010). Drilling wells were cleaned into these “mud pits” (example of VPSB # 2-B drilling record, Conservation well files SN 29368) as were fluids produced during testing and completion (workover report and pollution barge, 1974, VPSB-LALand/Peak-0266; “pits”, example VPSB # 9-A treatment report 12/17/45, well files SN 29271; backflow into “tanks”, completion job, 1962, LLE-001374). And as stated previously from the Briggs deposition (2010), workover fluids were either barged off or disposed of into the SWD system. Barges were also used to flare wells (flaring on the pollution barge, Union letter 6/21/71; Bates no. 0001332). Although most records indicate that the “pit” term usage with barge drilling and workovers referred to containment areas on the barge, the term “burn pit” associated with flaring may also refer to a pit constructed in the built-up dredge spoils area near a well. No clear evidence of such well-site pits were observed in historic aerial photography.

Pits Associated with Tank Batteries

Records indicate 3 areas of legacy pits associated with tank batteries. Pits were placed and built up in spoil areas of dredged canal muds. Three tank battery areas had emergency/flare pits—VPSB tank battery A, VPSB tank battery B, and La Furs A tank battery.

VPSB Tank Battery A Pits. VPSB tank battery “A” had two emergency pit/flare pits over time as revealed in historic aerial photography. The first small pit was directly southwest of the tank battery on the east side of a canal. The small pit is present in 1951 and 1955 aerial photography. The larger and later pit (pit id # 57P235) was also southwest of the tank battery “A” but was on the west side of the same canal. This second pit is present in 1965 through 1987 aerial photography and is also drawn on a 1974 map of the East White Lake closed SWD well system. The pit was an emergency pit associated with the tank battery “A” saltwater system (1974 map of SWD system, well file SN 89035; Briggs deposition). Closed salt water disposal systems (well file, 1948 letter, p.43) used tanks, not pits, to process production water prior to injection. Emergency pits were used to temporarily collect fluids during failure of SWD wells. While the second pit’s early history experienced limited emergency times of holding produced waters (Briggs deposition), by 1983, this emergency pit was described as a “flare pit” on a Conservation Injection and Mining form (SN 971154). Roy Briggs (deposition) could not recall the use of this pit for emergency purposes, thus reflecting its infrequent usage. Steven Miller (deposition) stated that during his timeframe in the field from 1986 onward, produced water was not placed into pits and that this second pit was used to flare gas (flare pit).

The UIC-15 pit notification form of 1986 identifies this pit as the VPSB A lease emergency pit, built in natural clay. Campbell Wells commercial waste disposal forms describe tank bottoms and sands/solids waste disposal from the VPSB A battery in May 1987 and October 1988. In preparation for pit closure in late 1988, pit liquids were removed and disposed of in VPSB # A-3 prior to well plug and abandonment. The 1989 production pit inspection report from the Office of Conservation (5/18/89) describes the pit as an emergency pit, closed and in compliance. These records also have pre- and post-closure data requested by the Office of Conservation in early 1989.

VPSB Tank Battery B Pits. The next identified pit area was that associated with VPSB tank battery "B". This battery operated until 1985. No pit is visible on a 1951 aerial photograph, but a pit is present on aerial photographs from 1955 through 1979. The photographs indicate two different pits over time. The first pit was directly west of the tank battery, visible on aerial photographs of 1955, 1965, and 1968. The 1979 aerial photograph indicates this emergency pit was closed by 1979, but another smaller pit exists to the southeast of the tank battery. Roy Briggs (deposition) identified this second, smaller pit as a flare pit based on his work in East White Lake Field from 1970 to 1986.

The 1979 aerial photo also illustrates man-made drainage modification south of the tank battery. The modification is not a pit, as lease inspection reports of the "B" lease (7/1/88) and the "A" and "B" leases of the VPSB (8/21/90), state that no pits exist on these leases, yet the man-made drainage modification existed then as it does today.

The second smaller pit was closed in 1985. A facilities map labels the B battery as "razed in 1985" (map, Conservation Injection and Mining file, SN 162006), and an aerial photo dated 1985 shows the pit as leveled. Campbell Wells commercial disposal records received "tank bottoms" wastes from the VPSB tank battery B on 6/5/85. Finally, a lease inspection form from the Office of Conservation dated 7/1/88 states that the "B" lease pit had previously been closed.

LA Furs A Lease Tank Battery Pit. An emergency/flare pit (pit id 57P236) associated with the LA Furs tank battery occurred to the southwest of the tank battery on the east side of a canal and in the LA Furs-VPSB unit 1 area. Production pit UIC-15 form (7/11/86) submitted by Union Oil identifies the pit as the emergency pit in section 16, built in natural clay. A small pit is present in 1951 aerial photography; this same size pit is also present in 1955, 1965, and 1968 aerial photography. The 1979, 1985, and 1987 aerial photography document a larger pit in the same general area.

The La Furs battery served the production of the La Furs A lease and the La Furs-VPSB unitized production. Usage of the La Furs battery was discontinued in 1986 when this production was commingled with production at the VPSB tank battery A. Pit fluids were removed in late 1988 and disposed of in VPSB # A-3 to prepare the pit for closure. The Office of Conservation pit inspection report (5/18/89) states that "pit has been closed and backfilled 1/27/89, analysis on record".

GENERAL HISTORY OF SWD PITS AND LEAKAGE KNOWLEDGE

Reviewed documents indicate that pits in the East White Lake Field litigation area were used as emergency pits and/or flare pits. Prior to saltwater well injection in 1948, the small pit at VPSB tank battery "A" may have served to temporarily hold produced water before release into the canals. These pits were constructed within the built-up spoils areas from the canal dredging of muds.

Not until the 1980s were clay pits in Louisiana described to potentially have underground leakage issues. A paper published by a LA DEQ scientist in 1988 (George Cramer, Administrator, Ground Water Protection Division, DEQ) states that *"Traditionally clay soils have been regarded as being relatively impermeable to the migration of water and contaminants. Recent studies in Louisiana are beginning to show, however, that laboratory permeability tests are not true indicators of the ability of an in-situ soil to retain or transmit fluids"* (Cramer, 1988, abstract and introduction, first page).

The history of knowledge concerning oilfield pits and clay is related to pit usage for saltwater disposal. General industry knowledge of underground seepage developed by the late 1920s and onward. The following knowledge is reflected in publications and archival documents, which is: 1) produced water placed into pits in sandy soils could seep to the underground, and 2) pits in clay soils were relatively impervious to leakage.

PITS AND SANDS

One of the first widespread trade journal publications giving this information was Oberg (1929); the paper was also presented at a district American Petroleum Institute (API) meeting. Oberg described the use of seepage/evaporation pits in sandy soils of West and North Texas. Seepage was also later described in porous soils in areas of Kansas (Jones, 1945) and Oklahoma (Taylor and Owens, 1942, p.6). It was this seepage concern by disposing into evaporation pits that Martin (1932) also was addressing when he presented his paper at a chapter API chapter meeting in Pampa, (North) Texas.

Neither the Oberg (1929) nor the Martin (1932) papers were reports of the API (see American Petroleum Institute, 2004; listing of historical publications). The Martin and Oberg papers were presentations given at either district or chapter API meetings. In the early 1930s, individuals presented papers at different API meetings—the annual and mid-year (national) meetings, the district (regional) meetings, or at chapter (local) meetings. Papers and their later distribution had a hierarchy. Papers presented at the annual and mid-year meetings were fully published in annual books. However, papers presented at district and chapter meetings were not published in API books. If the presenter prepared a written paper, the mimeographed copies were handed out to attendees at the meeting. If a person not at the meeting learned of the paper, he could write to the Dallas office or the local chapter to receive a copy (API Quarterly, 1931).

The Martin paper was only reproduced as a mimeographed copy and not published, while Oberg (1929) published his paper in a major trade journal. Both Oberg and Martin served on the API Committee on Disposal of Production Wastes (API Quarterly, 1932).

PITS AND CLAYS

About the same time frame as the Martin paper, a committee of oil company representatives working in conjunction with the Kansas Board of Health sought out “sufficiently impervious” clay-rich soils in Kansas to impound or hold produced waters (Lacy, 1934). The group conducted laboratory work on clay from recently-dried lake beds and found that the clay did not allow produced water to flow through it. The U. S. Bureau of Mines conducted produced water disposal research in Illinois (Taylor and others, 1940), and observed that produced water pits in clay soils held the water as long as the water level stayed below the levees.

Jones (1945) also observed the difference between pits built in sands versus pits built in clays: *“A makeshift earthen reservoir built in a porous soil area is seldom full of brine due to the fact that downward infiltration quite often is equal to or in excess of the input. In areas of tight nearly impervious shales (a rock made of clay—author’s note) the same input would quickly fill the pond to the overtopping point”* (Jones, 1945, p. 24).

The development of oil field regulations concerning produced water (disposal and holding) pits also reflects the historic knowledge that pits in clay soils were regarded as relatively impermeable. Kansas was one of the first states to regulate produced water pits (1935) due to the generally “extremely porous” nature of Kansas soils and the common water-shortage drought conditions (“Dust Bowl”) experienced in the 1930s and onward (Grandone and Schmidt, 1943, p. 2-3). While this prevented the major use of salt water pits due to the state’s overall porous soils, in 1963, Kansas had over 1000 earthen pits *“permitted primarily in areas where impermeable surface formations prevent seepage”* (Enright, 1963, p. 81, box).

REFERENCES CITED

As stated at the beginning of this report I reviewed the following documents in this case: 1) documents I obtained--regulatory documents from different agencies, related regulations and published papers, and 2) documents provided to me.

Below are documents that I made reference to and/or evaluated aspects related to my opinions.

CITED DOCUMENTS PROVIDED TO ME

Expert Reports, VPSB vs. LL& E, Vermilion Parish, LA
Miller, G., ICON Expert reports dated March and April, 2010.
Norman, C., Expert report dated March 2010
Templet, P., Expert report dated April 2010
Barbee and Castille, Expert report dated April 2010
Kilpatrick, K., Expert report dated April 2010

Coastal Environments, Expert report dated April 2010
Pisani and Associates, Site evaluation plan dated April 2010
Historical aerial photographs provided by ICON and Pisani and Associates

Depositions, VPSB vs. LL& E, Vermilion Parish, LA

Roy Eddie Briggs, April 23, 2010
Steven P. Miller, April 27, 2010

Union Oil Company Documents (Bates no. C1074021 -----)

0000328 – 0000397
0001332
0001683-1791
0001609-1675
0000172-176

LLE Documents (6-digit number)

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