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Pilot Oil Atlas for Louisiana

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Final Report
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1. EXECUTIVE SUMMARY

In recent years, it has become increasingly difficult for major oil companies to economically produce many of the older domestic reservoirs because of declining well productivity and more stringent environmental regulations. Smaller independent operators are playing an increasingly important role in producing the remaining oil and gas, and it is anticipated that this trend will continue in the future. The small independent producers do not maintain research and development laboratories, nor do they have the large technical-support staffs found in the major oil companies. In mature fields with declining productivity, they seek to maintain profitability primarily through reduced overhead and hence rely, to a great extent, on technology and information available in the public domain. Thus, it is becoming increasingly important to maintain strong university components capable of supporting the domestic oil and gas producing industry.

Louisiana reservoirs account for about 10% of the known domestic oil, and it is estimated that about 20%, or 10 billion barrels, of this oil has been bypassed on a macroscopic scale due to reservoir heterogeneities or irregular frontal advance of water into the reservoirs. The greatest near-term potential for improving oil recovery in Louisiana is thought to be through determining the location of oil that has been bypassed at near-virgin oil saturations. Sufficiently large areas of such oil could be economically produced in the near term by using infill drilling instead of costly enhanced-oil-recovery methods.

An interdisciplinary research team of engineers, geologists, and computer scientists was assembled at LSU to develop improved methods for prospecting for bypassed oil and to support oil and gas producers in Louisiana. Grants from the Department of Energy (DOE) and the State of Louisiana, as agreed to in Annex 1 of the Memorandum of Understanding (MOU), supported the group's work. The overall objective of the project was to develop methods for extending the producing life of several types of reservoirs by reducing the amount of oil being bypassed and abandoned. As part of this work, the team collected information available from public sources for several example reservoirs. One task of the project was to develop a format for the compilation of the extensive but cumbersome Louisiana reservoir data so that it could be used by government and industry to evaluate the resource and plan future activities. The existing information system maintained by Louisiana is a Production Audit Reporting System (PARS). It was designed to allow auditing of oil and gas production and severance taxes associated with this production. It was not intended to be used as a database for determining reservoir recovery efficiency or prospecting for oil and gas. Its use for these purposes, however, has been increasing.

The database format suggested in this report would allow production information to be easily displayed by reservoir as well as by lease, unit, or well. Enlargement of the information base maintained by using other public input data sources is also recommended. The data collected as part of the bypassed-oil study was used to illustrate the proposed new format. This pilot database, or atlas, contains information available for 15 reservoirs.

It is recommended that LSU continue to compile and publish database information on the potential for bypassed oil in Louisiana's active reservoirs. This technology-transfer activity should focus each year on those active reservoirs involved in hearings of the Louisiana Office of Conservation. It should also focus on reservoirs being screened by LSU for EOR.

2. INTRODUCTION

Figure 1.1 shows historical and projected data on oil production rates in Louisiana. After 1970 oil production began declining rapidly. Rate of decline was arrested by a large increase in drilling activity during the late seventies and early eighties. New reservoirs discovered and placed on production during this period of high oil prices have helped to hold the production rate relatively steady. However, drilling activity has declined greatly since the early eighties. Thus, unless the recovery efficiency for known reservoirs is increased, the decline rate can be expected to increase in the near future. The upper projected line is based on recovery of an additional 5% of the original oil in place through use of improved methods of locating and producing bypassed oil. This is believed to be a realistic target.

Figure 1.1 – Oil Production Rate in Louisiana

The greatest near-term potential for improving oil recovery in Louisiana is thought to be through determining the location of oil that has been bypassed at near-virgin oil saturations due to the presence of reservoir inhomogeneities. Sufficiently large areas of such oil could be economically produced in the near term by using infill drilling instead of costly enhanced-oil-recovery methods. Prospecting for economical volumes of bypassed oil in old fields will require a relatively detailed reservoir description and knowledge of produced volumes for each reservoir. The primary public source of information on oil and gas resources in Louisiana is the Louisiana Department of Natural Resources. Fortunately, the state began a computerized database in 1975 that contains much of the needed information. However, this database was designed primarily for auditing oil and gas production and leveling severance taxes associated with this production. It was not intended to be used as a database for determining reservoir recovery efficiency or prospecting for oil and gas. Thus, the reports generated from this database cannot be easily used to determine the potential for bypassed oil in old fields that are nearing abandonment.

2.1 Objectives

The main objective for this phase of the project was to develop a format for the compilation of the extensive but cumbersome Louisiana reservoir data so that it could be used by government and industry to evaluate the resource and plan future activities. The database should contain all of the available public information that is needed to evaluate the potential for bypassed oil in a given reservoir. It should provide both easy access to general data that can be used for screening reservoirs for further detailed study as well as detailed data needed for more in-depth evaluation through use of reservoir-simulation software. An additional objective was to illustrate the use of the proposed new format in a pilot atlas, or database, with data from at least 10 reservoirs in a computer-readable format.

2.2 Approach

The initial work of this task was accomplished by the Louisiana Geological Survey under the leadership of Dr. George Hart, with support from Dr. Bill Evans and Mr. Michael Surman. A preliminary format for the pilot atlas was selected based on input from the various members of the interdisciplinary team and from independent operators. The proposed format was also discussed at a regional IOCC/DOE technology-transfer seminar held in Lafayette, Louisiana, in May 1989.

A computer tape of the PARS used by the Louisiana Department of Natural Resources (DNR) was obtained as a starting point for data retrieval. Considerable initial effort was expended in writing a translation program that would convert PARS files to ASCII format and extract information on oil fields containing the reservoirs of interest. After completing this initial phase of the task, progress was then interrupted by loss of personnel from the project. Dr. George Hart and Mr. Byron Miller resigned their positions with the Louisiana Geological Survey, and Mr. Michael Surman was called to active military duty because of the Persian Gulf Crisis.

In December 1990, responsibility for the pilot atlas was transferred from the Louisiana Geological Survey to the LSU Department of Petroleum Engineering, and was put under the direct supervision of Dr. A. T. Bourgoyne, Jr. Mr. Clay Kimbrell of the Louisiana Geological Survey and Mr. Weigang Gao of the Department of Computer Science performed much of the required work. The PARS files that had been converted to ASCII format were transferred to a DBASE format (*.DBS) that can be read by most database management systems. The PARS information was supplemented by additional public-domain data not normally kept in computer files, such as information from well-log headers, maps obtained from public-hearing files of the Louisiana Conservation Commission, and information released by well operators.

Once created, the pilot atlas was used as the primary source of information by various LSU researchers developing improved public-domain reservoir-simulation software used in searching for bypassed oil. The file structure was modified several times as various unanticipated needs arose. One area of special importance was the development of algorithms for easy retrieval of reservoir production information. The final file structure also made provisions for compatibility with the DOE TORIS database system.

3. RESERVOIRS STUDIED

The example reservoirs included in the pilot atlas were selected from three fields located as shown in Figure 3.1 . The Corney Bayou field is located in north Louisiana, just south of the Arkansas border, in Union Parish. Reservoirs in this field are in deep carbonate formations of the North Smackover Trend on the edge of the Monroe Uplift. They tend to have a very limited water drive production mechanism. The Fordoche field is located in Pointe Coupee Parish in central Louisiana about 40 miles north of Baton Rouge. Reservoirs in this field are deep, relatively shaley sandstone formations of the Eocene and Oligocene Trends that form as a result of growth faults in a deltaic environment. They tend to have a limited water-drive production mechanism. The Lafitte field is located in the wetlands of south Louisiana in Jefferson Parish, about 25 miles south of New Orleans. Reservoirs in this field are mioocene-aged fluvial deposits of the South Louisiana Salt Dome Basin. These reservoirs are relatively shallow and tend to have a strong water-drive production mechanism.

Figure 3.1 – Location of Fields Including Selected Reservoirs

Oil and gas fields were coded in the proposed database using the API well code number of the discovery well for the field (Table 3.1). This provided a unique identifier that could be easily applied to any domestic field. It also allowed for additional information about the field, such as discovery date, location, depth, etc., to be easily determined by accessing the database information for that well. State identification codes were also included for cross reference with the state existing database system.

Field Discovery API Well Code	State Field Code	Field Name	Parish	State	Basin	Trend
17111221320000	2892	Corney Bayou	Union	LA	Gulf Coast	North Smackover
17077001690000	3913	Fordoche	Pointe Coupee	LA	Gulf Coast	Eocene–Oligocene
17051005780000	4989	Lafitte	Jefferson	LA	Gulf Coast	So La Salt Dome

Table 3.1 – Field Codes used in Pilot Atlas

The first two digits of the API well number are a state code, with number 17 corresponding to Louisiana. The next three digits corresponds to a parish or county code. In Louisiana, the API parish code is different from the parish code used in the PARS database. However, the API parish code can be computed from the PARS parish code using the formula

$$\text{API parish code} = 2 \times \text{PARS parish code} - 1.$$

The next five digits of the API well number constitute an arbitrary well identification number assigned by the state. The last four digits generally are not used in the PARS system.

A list of the example reservoirs included in the pilot atlas is given in Table 3.2. The age of the reservoirs studied ranges from Miocene to Jurassic. API oil gravity ranges from 25.0 to 53.5, and the depth of the reservoirs ranges from 4,000 ft to 14,000 ft. The fields were selected on the basis of potential for bypassed oil, quality of available data, representation of different production mechanisms, representation of different depositional environments, and willingness of the operators to cooperate with LSU in the study. Extremely deep reservoirs were not considered because the relatively high cost of drilling made justification of additional wells more difficult.

Reservoir Disc. API Well Code	Field Disc. overy API Well Code	Reservoir Name	Age	API Gravity	Depth (ft ss)
17077200240000	17077001690000	Wilcox 8	Eocene	44.0	13,175
17077003380000		Wilcox 12		45.0	13,630
17077200030000		Wilcox 15		47.5	13,850
17077200830000		Sparta A, RA		47.0	11,300
17077200910000		Sparta A, RB		44.8	11,490
17077200970000		Sparta A, RC		53.5	11,443
17077201010000		Sparta B, RA		42.0	11,565
17077203770000		Sparta B, RB		42.0	11,380
17077203770000		Sparta B, RC		42.0	11,585
17111221320000	17111221320000	Smackover A	Jurassic	49.9	10,115
17111230440000		Smackover B		53.2	10,095
17051006440000	17051005780000	S 3900'	Miocene	25.0	4,070
17051006490000		4300'		25.0	4,470
17051006630000		4400'		25.0	4,580
17051006690000		N 3900'		25.0	4,070

Table 3.2 – Location of Fields Containing Selected Reservoirs

The example reservoirs included in the pilot atlas will be discussed in the order shown in Table 3.2, which is by date of discovery. The discussion will include a structure map, isopach map, type log, well completion summary table, and production summary plot for each reservoir. The depths shown on the logs and in the well completion summary table are log measured depths that have not been corrected to vertical depth or subsea depths. The depths shown on the structure maps are vertical subsea depths except when otherwise noted in the map legend.

3.1 Wilcox 8 Reservoir, Fordoche Field, Pointe Coupee Parish

The Wilcox 8 reservoir is developed in a shaly sand that has an average thickness of 40 ft and an areal extent of 3520 acres. Average reservoir properties are given in Table 3.1.1, and Figure 3.1.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 0.126 cp. The initial oil in place was estimated to be 33.8 MMSTB. This estimate was based on an initial oil saturation of 53%. Using an estimated residual-oil saturation of 29%, the recovery factor would be 45.2%. Thus, the displaceable mobile oil was estimated to be about 15.3 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
9	20	47	40	25	2.14	33.8	2381	10600	267

Table 3.1.1 – Average Reservoir Properties for Wilcox 8 Reservoir

Figure 3.1.1 – Structure Map for Wilcox 8 Reservoir

The structure map is shown in Figure 3.1.1 and the net pay map for the Wilcox 8 reservoir is shown in Figure 3.1.2. The structure is a deep-seated anticline associated with a large, down-to-the-south normal fault. This major fault has about 1,000 ft of displacement. A smaller fault that is not thought to be sealing cuts the northern part of the field. An oil/water contact bounds the northeastern and southwestern flanks of the anticline. The quality of the reservoir rock becomes poorer to the southeast, and a permeability barrier due to increasing shale content is believed to form the southeastern reservoir boundary.

The Wilcox and Sparta sands within Fordoche field are highly sensitive to water, and production declines rapidly when a well begins making water. Three stimulation techniques (hydrofluoric acid, acetic anhydride and hydrochloric acid) were attempted but showed only moderate success. They indicated, however, that the major cause of formation damage was migration and swelling of silicate fines. Therefore, a sequential hydrofluoric acid treatment (SHF) was initiated in 1977 to maintain well productivity and was successful for the Wilcox 8, 12 and 5 and the Sparta A and B (Holden, et al., 1981).

The Wilcox 8 reservoir initially experienced a rapid rate of reservoir pressure depletion. In 1971, a high-pressure miscible-gas-injection program was initiated. Natural gas and nitrogen were used to maintain the reservoir pressure. Miscibility could be achieved at reservoir conditions with nitrogen.

A typical well-log response for the Wilcox 8 reservoir is shown in Figure 3.1.3. The Wilcox 8 sand has an average net pay of 25 ft. Extensive coring and core analyses were performed on the Wilcox sands within the Fordoche Field. Starting at the bottom of the Wilcox 8 sand and proceeding upward, the depositional environment appears to be marine sand, delta front, pro-delta, marine clay, and then again marine sand. The sands are grey to tan, very-fine grained and micaceous (Eckles, et al., 1980).

Figure 3.1.3 — Type Log for Wilcox 8 Reservoir

The wells that have been completed in the Wilcox 8 reservoir are shown in Table 3.1.2. All depths are log-measured depth (md). During the early life of the reservoir, as many as 20 completions had been producing from this formation. However, the number of active wells has declined steadily since the mid seventies. In 1992, only five completions have contributed to the production. No wells penetrating this reservoir are currently producing from deeper horizons.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077003380000	KU	1	6S	8E	32	13240	13300	13242	13300	6/81	
17077003500000	LNB	1	6S	8E	33	13280	13345	13283	13301	1/68	
17077200030000	JB	1	6S	8E	42	13189	13230	13189	13204	3/68	3/84
								13189	13225	3/84	
17077200080000	JB	2	6S	8E	31	13240	13303	13240	13252	7/67	
17077200090000	NS	2	6S	8E	41	13222	13280	13222	13240	8/67	
17077200160000	AE	1	6S	8E	41	13280	13345	13282	13303	6/67	11/80
1707200240000	BB	1	6S	8E	42	13260	13300	13264	13272	5/67	4/77
								13263	13281	4/77	
17077200250000	KJ	1	6S	8E	33	13340	13405	13340	13350	5/67	11/74
17077200270000	BB	2	6S	8E	42	13234	13296	13234	13250	5/67	8/76
								13244	13266	8/76	
17077200390000	EP	1	6S	9E	110	13261	13313	13261	13273	7/67	12/67
17077200400000	NS	3	6S	8E	41	13265	13330	13266	13280	6/67	5/82
17077200470000	BB	3	6S	8E	42	13239	13300	13239	13249	9/67	
17077200480000	JH	1	6S	8E	41	13333	13400	13334	13338	9/67	6/84
17077200500000	BB	4	6S	8E	43	13280	13340	13281	13290	9/67	8/81
									13310	8/81	
17077200560000	BB	6	6S	8E	43	13325	13390	13332	13337	11/67	10/87
17077200660000	EP	2D	6S	9E	110	13300	13350	13298	13310	3/68	
17077200750000	JWA	1	6S	8E	32	13186	13337	13186	13208	4/68	
17077200900000	JWA	2	6S	8E	32	13268	13334	13270	13325	10/68	
17077200910000	EP	4D	6S	9E	110	13257	13310	13257	13271	9/68	8/74
17077201040000	EP	6D	6S	9E	113	13290	13350	13293	13303	7/69	8/76
17077201070000	JA	1	6S	8E	32	13265	13327	13267	13287	9/69	5/85
								13267	13314	5/85	
Gas Injection Wells:											
17077200160000	AE1	1	6S	8E	41	13280	13345	13310	13340	11/80	
17077201320000	NS	8D	6S	8E	41	13174	13230	13176	13225	8/71	
17077201380000	BB	7D	6S	8E	42	13220	13280	13224	13278	8/71	
17077201400000	EP	7D	6S	9E	110	13245	13410	13246	13294	11/71	

Table 3.1.2 — Wells Completed in Wilcox 8 Reservoir

Total annual oil production, producing gas–oil ratio, and producing water–oil ratio are shown in Figure 3.1.4. In 1971, pressure maintenance through gas injection was initiated. In 1989, a steep production decline began, and the reservoir is now in the blow–down phase. To date, total oil produced is approximately 12.5 MMSTB. It appears that about 12.6 MMSTB of the estimated 15.3 MMSTB of mobile oil will be produced, leaving approximately 2.7 MMSTB of bypassed mobile oil.

Figure 3.1.4 — Production History for Wilcox 8 Reservoir

3.2 Wilcox 12 Reservoir, Fordoche Field, Pointe Coupee Parish

The Wilcox 12 reservoir is in a shaly sand that has an average thickness of 127 ft and an areal extent of 3860 Acres. Average reservoir properties are given in Table 3.1.1, and Figure 3.2.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 0.13 cp. The initial oil in place was estimated to be 34.7 MM STB. Using an estimated residual oil saturation of 26%, the recovery factor would be 38.0%. Thus, the displaceable mobile oil was estimated to be about 13.2 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
5	19	58	127	34	2.34	34.7	2934	10800	274

Table 3.2.1 – Average Reservoir Properties for Wilcox 12 Reservoir

Figure 3.2.1 – Structure Map for Wilcox 12 Reservoir

The net pay isopach map for the Wilcox 12 reservoir is shown in Figure 3.2.2. The structure is a deep-seated anticline associated with a large, down-to-the-south normal fault. This major fault has about 1,000 ft of displacement and forms the northern field boundary. A smaller fault that is not thought to be sealing cuts the northern part of the field. An oil/water contact bounds the eastern and southwestern flank of the anticline. The structure thins in the middle of the reservoir.

The reservoir was put on production in the late sixties. By 1970, eighteen wells were producing from this formation. The number of active completions has declined steadily since the early seventies, and during 1992, only six wells produced from this reservoir.

The reservoir was extensively modelled and studied by the operator over a 15-year period. Eight different reservoir-simulation computer models were used in these studies. In 1985, the last model study was conducted using a three-phase, three-dimensional, multi-component compositional model that had a miscible displacement option. This model (MDOCS) was developed by Core Laboratories. Because of this extensive geological and engineering effort, the reservoir limits are thought to be well understood. Mobile oil is not expected to be bypassed in economical concentrations.

Figure 3.2.2 – Net Pay Map for Wilcox 12 Reservoir

A typical well-log response for the Wilcox 12 reservoir is shown in Figure 3.2.3. It has an average net pay of 34 ft. The upper shale/sand contact is sharper than the lower sand/shale contact, producing a characteristic funnel shape. Core data were available to provide detailed descriptions of the facies present. From top to bottom, there is porous to non-porous marine sand, thin marine clay, delta front with fresh water fossils, pro-delta marine sands, silts and clays with submarine levee deposits, and subaqueous natural levees. The main sand is grey, silty, glauconitic, and fossiliferous (Eckles, et al., 1980).

Figure 3.2.3 — Type Log for Wilcox 12 Reservoir

The wells that have been completed in the Wilcox 12 reservoir are given in Table 3.2.2. In 1971, gas injection was started to arrest the decline in bottom-hole pressure and upward water encroachment. No wells that penetrate this reservoir are currently completed in deeper zones.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077003330000	NS	1D	6S	8E	32	13655	13800	13735	13745	07/66	
17077003380000	KU	1D	6S	8E	32	13776	13850	13784	13796	01/66	10/81
								13758	13796	10/81	
17077000350000	LNB	1D	6S	8E	32	13772	13920	13810	13845	02/67	01/68
								13810	13845	01/68	09/76
17077200030000	JB	1D	6S	8E	42	13640	13776	13680	13694	11/66	03/68
								13680	13694	03/68	03/81
17077200080000	JB	2D	6S	8E	31	13705	13869	13778	13810	02/67	10/81
								13714	13796	10/81	
17077200090000	NS	2D	6S	8E	41	13694	13800	13739	13755	02/67	
17077200160000	AE	1D	6S	8E	41	13770	13878	13850	13878	03/67	02/71
								13797	13827	02/71	07/80
								13842	13871	07/80	01/81
17077200240000	BB	1D	6S	8E	42	13690	13840	13738	13768	05/67	
17077200250000	KJ	1D	6S	8E	33	13830	13985	13862	13887	06/67	07/68
								13862	13887	07/68	04/84
17077200270000	BB	2D	6S	8E	42	13891	13815	13720	13740	05/67	08/76
								13691	13712	08/76	
17077200390000	EP	1D	6S	9E	110	13695	13810	13715	13730	07/67	
17077200400000	NS	3D	6S	8E	41	13735	13886	13776	13792	05/67	03/71
17077200470000	BB	3D	6S	8E	42	13717	13815	13717	13748	08/67	
17077200500000	BB	4D	6S	8E	43	13730	13825	13749	13767	09/67	12/81
								13749	13825	12/81	
17077200660000	EP	2	6S	9E	110	13722	13830	13741	13763	03/68	06/90
17077200670000	NS	4	6S	9E	32	13740	13910	13802	13846	01/68	07/74
17077200910000	EP	4	6S	9E	110	13670	13770	13688	13706	09/68	08/74
17077200970000	EP	3	6S	9E	110	13690	13805	13718	13738	01/69	05/90
17077200990000	EP	5	6S	9E	113	13678	13790	13703	13723	03/69	09/73
17077201040000	EP	6	6S	9E	113	13660	13830	13741	13768	07/69	08/76
Gas Injection:											
17077200160000	AE	1D	6S	8E	41	13770	13878	13842	13871	11/80	
17077201320000	NS	8	6S	8E	41	13637	13770	13637	13756	06/71	
17077201380000	BB	7	6S	8E	42	13686	13799	13693	13796	08/71	
17077201400000	EP	7	6S	9E	110	13770	13674	13674	13750	11/71	

Table 3.2.2 — Wells Completed in Wilcox 12 Reservoir

Figure 3.2.4 shows the total annual oil production, producing gas-oil ratio, and producing water-oil ratio. In 1989, a steep production decline began, and the reservoir is now in the blow-down phase. To date, the total oil produced is approximately 11.5 MMSTB. It appears that about 11.6 MMSTB of the estimated 13.2 MMSTB of mobile oil will be produced, leaving an estimated 1.6 MMSTB of bypassed mobile oil. However, this bypassed oil is thought to be dispersed over a wide area.

Figure 3.2.4 — Production History for Wilcox 12 Reservoir

3.3 Wilcox 15 Reservoir, Fordoche Field, Pointe Coupee Parish

The Wilcox 15 reservoir is in a shaly sand that has an average thickness of 80 ft and an areal extent of 310 acres. Average reservoir properties are given in Table 3.3.1, and Figure 3.3.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 0.1 cp. The initial oil in place was estimated to be 1.6 MMSTB. Using an estimated residual oil saturation of 25%, the recovery factor would be 50.0%. Thus, the displaceable mobile oil was estimated to be about 0.8 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
10	20	47	80	16	2.55	1.6	3567	11000	278

Table 3.3.1 – Average Reservoir Properties for Wilcox 15 Reservoir

Figure 3.3.1 – Structure Map for Wilcox 15 Reservoir

The Wilcox 15 sand is the lowermost reservoir of the Wilcox and Sparta reservoirs within Fordoche Field. Structurally, it is a deep-seated anticline with a northwesterly trend (Figure 3.3.1).

The net pay map is shown in Figure 3.3.2. The northeastern reservoir boundary is formed by a major east-west fault with more than 1,000 ft of displacement. The northwestern boundary is thought to be formed by oil/water contact. A smaller fault that is not believed to be sealing cuts the northern portion of the reservoir along an east-west strike before dying into the major fault to the east. The eastern, southern, and western reservoir boundaries are permeability barriers caused by increasing shale content. The permeability barrier is defined by several wells drilled around the perimeter of the reservoir. These wells contained oil shows and were tested. However, the poor reservoir rock quality would not permit sustained production in commercial quantities.

Figure 3.3.2 – Net Pay Map for Wilcox 15 Reservoir

The type log for the Wilcox 15 sand is shown in Figure 3.3.3. This sand is very shaly and is a poor-quality reservoir rock. It was deposited in a deltaic to near-marine environment.

The SP deflection illustrates a highly laminated shaly sand. The middle portion of the sand has the greatest shale content. Facies that were determined from core analysis are described from bottom to top as firm-micaceous sandstone deposited in shallow brackish waters; hard-glaucconitic tan sandstone deposited in shallow marine waters; fine white sandstone deposited in shallow brackish waters; and a soft shale deposited in shallow brackish waters (Eckles, et al., 1980).

Figure 3.3.3 — Type Log for Wilcox 15 Reservoir

The wells completed in the Wilcox 15 reservoir are shown in Table 3.3.2. Since 1972, the reservoir has not produced. All completions except NS1 have been plugged and abandoned. No additional wells penetrate the reservoir that are completed in deeper zones.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077003330000	NS	1	6S	8E	32	13875	13952	13930	13952	07/66	
17077003380000	KU	1	6S	8E	32	13924	14007	13983	13993	01/66	06/81
17077003500000	LNB	1	6S	8E	33	13976	14035	13976	14006	01/67	01/68
17077200030000	JB	1	6S	8E	42	13835	13952	13835	13870	11/66	03/68
17077200080000	JB	2	6S	8E	31	13945	13045	13945	14032	12/66	07/67
17077200090000	NS	2	6S	8E	41	13882	14002	13882	13916	01/67	08/67
17077200160000	AE	1	6S	8E	41	13958	14070	13958	14002	03/67	06/67
17077200670000	NS	4	6S	8E	32	13992	14070	13992	14070	01/68	05/74
17077200910000	EP	4	6S	9E	110	13832	13900	13832	13842	12/87	04/90

Table 3.3.2 — Wells Completed in Wilcox 15 Reservoir

Figure 3.3.4 shows the total annual oil production, producing gas–oil ratio, and producing water–oil ratio. The total oil produced is approximately 0.3 MMSTB. It appears that about 0.5 MMSTB of the estimated 0.8 MMSTB remains in the reservoir.

Figure 3.3.4 — Production History for Wilcox 15 Reservoir

3.4 Sparta A, Reservoir A, Fordoche Field, Pointe Coupee Parish

The Sparta A, reservoir A, is in a shaly sand that has an average thickness of 21 ft and an areal extent of 674 acres. Average reservoir properties are given in Table 3.4.1, and Figure 3.4.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 0.83 cp. The initial oil in place was estimated to be 6.8 MMSTB. Using an estimated residual oil saturation of 28%, the recovery factor would be 52.9%. Thus, the displaceable mobile oil was estimated to be about 3.6 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
139	25	40	21	12	1.38	6.8	257	8200	226

Table 3.4.1 – Average Reservoir Properties for Sparta A, Reservoir A

Figure 3.4.1 – Structure Map for Sparta A, Reservoir A

The net pay map for Sparta A, reservoir A, is shown in Figure 3.4.2. Reservoir limits to the north and south are permeability barriers caused by increasing clay content. The western boundary is thought to be a water/oil contact at about 11,340 ft. The eastern boundary is thought to be either a permeability barrier due to increasing shale content or a water/oil contact. The sand thickens to the southwest, towards the water/oil contact.

Four wells have been completed in the reservoir. Two other wells penetrate the reservoir but are completed in deeper zones. If all six wells are eventually used, there will be an average well spacing of 112 acres per well.

Figure 3.4.2 – Net Pay Map for Sparta A, Reservoir A

A typical well-log response for the Sparta A formation is shown in Figure 3.4.3. The Sparta A zone generally consists of an upper and lower sand member separated by a shale stringer. The gross thickness varied from 14 ft to 48 ft in the wells completed in this zone. The Sparta A sandstone is thought to be an Eocene barrier-island complex.

Figure 3.4.3 — Type Log for Sparta A, Reservoir A

The wells that have been completed in Sparta A, reservoir A, are listed in Table 3.4.2. Wells that pass through the reservoir to deeper completions are shown in Table 3.4.3. During 1992, three of the five completions have produced.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077200830000	NS	5D	6S	8E	32	11295	11320	11301	11309	06/68	
17077200840000	NS	6D	6S	8E	41	11338	11368	11342	11356	06/68	
17077200960000	AE	2	6S	8E	41	11310	11342	11320	11331	11/68	05/71
								11311	11331	05/71	
17077201010000	NS	7	6S	8E	32	11292	11340	11298	11310	05/69	07/71
								11298	11320	05/72	

Table 3.4.2 — Wells Completed in Sparta A, Reservoir A

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17077200090000	NS	2	6S	8E	41	11330	11368	13222-240, 13739-755	0
17077207500000	JWA	1	6S	8E	32	13308	13344	13186-208, 13005-020	300

Table 3.4.3 — Potential Additional Completions in Sparta A, Reservoir A

Figure 3.4.4 shows the total annual production, producing gas-oil ratio, and producing water-oil ratio for the reservoir. Since the reservoir was first put on production, annual oil production has experienced a steady decline. Both the water-oil ratio and the gas-oil ratio have tended to increase with time. The total oil produced is currently about 2.9 MMSTB, and the estimated reserve is about 0.5 MMSTB. Thus, 3.4 MMSTB of the estimated 3.6 MMSTB of mobile oil is expected to be recovered from this reservoir. The potential for bypassed oil does not appear to be large enough to justify additional drilling.

Figure 3.4.4 — Production History for Sparta A, Reservoir A

3.5 Sparta A, Reservoir B, Fordoche Field, Pointe Coupee Parish

The Sparta A, reservoir B, is in a shaly sand that has an average thickness of 15 ft and an areal extent of 62 acres. Average reservoir properties are given in Table 3.5.1, and Figure 3.5.1 is a structure map. This reservoir is thought to be penetrated by a single well. Other wells penetrating the Sparta A sequence provide sufficient control for interpretation of structure and stratigraphy. The initial oil in place was estimated to be 0.5 MMSTB. Using an estimated residual oil saturation of 28%, the recovery factor would be 56%. Thus, the displaceable mobile oil was estimated to be about 0.28 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
30	23	40	15	11	1.38	0.5	3380	7766	250

Table 3.5.1 – Average Reservoir Properties for Sparta A, Reservoir B

Figure 3.5.1 – Structure Map for Sparta A, Reservoir B

The net pay map is shown in Figure 3.5.2. The northern, eastern, and western reservoir boundaries are thought to be permeability barriers caused by decreasing sand thickness and increasing shale content. A down-dip water level is thought to form the southern reservoir boundary. The reservoir structure is believed to be an Eocene barrier-island complex. A type log for the Sparta A formation is shown in Figure 3.4.3 with the data for Sparta A, reservoir A.

Figure 3.5.2 – Net Pay Map for Sparta A, Reservoir B

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077200910000	EP	4	6S	9E	110	11498	11513	11499	11510	08/74	12/87

Table 3.5.2 — Wells Completed in Sparta A, Reservoir B

Figure 3.5.3 shows the total annual production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. Annual oil production experienced a steady decline from the time the reservoir was first put on production until production stopped in 1988. Until 1980, essentially water–free production was obtained. After water production started, oil production dropped dramatically. The total oil produced was about 0.26 MMSTB, which is approximately equal to the estimated 0.28 MMSTB of mobile oil. The potential for bypassed oil does not appear to be large enough to justify additional study.

Figure 3.5.3 — Production History for Sparta A, Reservoir B

3.6 Sparta A, Reservoir C, Fordoche Field, Pointe Coupee Parish

The Sparta A, reservoir C, is in a shaly sand that has an average thickness of 14 ft and an areal extent of 29 acres. Average reservoir properties are given in Table 3.6.1, and Figure 3.6.1 is a structure map. The initial oil in place was estimated to be 0.22 MMSTB. Using an estimated residual oil saturation of 29%, the recovery factor would be 45.5%. Thus, the displaceable mobile oil was estimated to be about 0.10 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
139	25	46	14	10	1.38	0.2	3643	8100	248

Table 3.6.1 – Average Reservoir Properties for Sparta A, Reservoir C

Figure 3.6.1 – Structure Map for Sparta A, Reservoir C

The net pay map is shown in Figure 3.6.2. All reservoir boundaries are thought to be permeability barriers caused by decreasing sand thickness and increasing shale content. The reservoir structure is thought to be an Eocene barrier-island complex. A type log for the Sparta A formation is shown in Figure 3.4.3 with the data for Sparta A, reservoir A. The volumetric nature of this reservoir was verified both by declining reservoir pressure and the lack of water production. It further illustrates the highly compartmental nature of the Sparta A sand.

Figure 3.6.2 – Net Pay Map for Sparta A, Reservoir C

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077200970000	EP	3D	6S	9E	110	11465	11479	11465	11477	01/69	05/90

Table 3.6.2 — Wells Completed in Sparta A, Reservoir C

Figure 3.6.3 shows the total annual production, producing gas-oil ratio, and producing water-oil ratio for the reservoir. Annual oil production experienced a steady decline from the time the reservoir was first put on production until production stopped in 1984. This reservoir appeared to have no significant water influx. Production was essentially water-free throughout its entire life. The total oil produced was about 0.07 MMSTB, which is approximately equal to the estimated 0.10 MMSTB of mobile oil. The potential for bypassed oil does not appear to be large enough to justify additional study.

Figure 3.6.3 — Production History for Sparta A, Reservoir C

3.7 Sparta B, Reservoir A, Fordoche Field, Pointe Coupee Parish

The Sparta B, reservoir A, is in a shaly sand that has an average thickness of 55 ft and an areal extent of 240 acres. Average reservoir properties are given in Table 3.7.1, and Figure 3.7.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 0.36 cp. The initial oil in place was estimated to be 3.0 MMSTB. Using an estimated residual oil saturation of 24%, the recovery factor would be 53.3%. Thus, the displaceable mobile oil was estimated to be about 1.6 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
220	25	48	55	16	1.28	3.1	382	7970	228

Table 3.7.1 – Average Reservoir Properties for Sparta B, Reservoir A

Figure 3.7.1 – Structure Map for Sparta B, Reservoir A

Figure 3.7.2 is the net pay map for Sparta B, reservoir A. The northern reservoir boundary is a permeability barrier caused by decreasing sand thickness and increasing shale content. The other boundaries are thought to be formed by water/oil contact near 11,587 ft. The net pay thickens in the middle portion of the reservoir.

Four wells have been completed in the reservoir. Three other wells penetrate the reservoir but are completed in deeper zones. Two of these deeper completions are at the reservoir boundary and probably have no significant additional reserves. Also, two of the completions are very close together, and one of these produced only for about two months. If four wells are counted as effective completions, the average well spacing is about 60 acres per well.

Figure 3.7.2 – Net Pay Map for Sparta B, Reservoir A

A typical well-log response for the Sparta B formation is shown in Figure 3.7.3. The Sparta B zone generally consists of an upper and lower sand member separated by a shale stringer that is apparent on the resistivity curve. The upper sand/shale contact is usually sharp, and the lower shale contact is more gradual, displaying a coarsening upward sequence. The gross thickness varied from 30 ft to 85 ft in the wells completed in this zone.

The Sparta B, reservoir A, is thought to correspond to the muddier, lagoonal side of an Eocene barrier-island complex.

Figure 3.7.3 — Type Log for South Sparta B Reservoir

The wells that have been completed in Sparta B, Reservoir A, are listed in Table 3.7.2, and the wells that pass through the reservoir to deeper completions are given in Table 3.7.3. During 1992, none of the completions have produced.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077201010000	NS	7D	6S	8E	32	11569	11620	11570	11578	07/71	10/84
17077201500000	JB	4	6S	8E	31	11560	11605	11562	11568	03/73	05/89
17077201510000	NS	9	6S	8E	41	11576	11606	11570	11580	05/73	09/89
17077203460000	NS	10	6S	8E	32	11550	11590	11552	11562	10/84	05/85

Table 3.7.2 — Wells Completed in Sparta B, Reservoir A

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17077003330000	NS	1	6S	8E	32	11560	11635	13930-952	0
17077200030000	JB	1	6S	8E	42	11596	11676	13189-225	0
17077200750000	JWA	1	6S	8E	32	11562	11617	13186-208	100

Table 3.7.3 — Potential Additional Completions in Sparta B, Reservoir A

Figure 3.7.4 shows the total annual production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. The large amount of water produced and the available pressure data indicates a strong water–drive production mechanism. The total oil produced was about 1.0 MMSTB. Potential additional reserves of 0.1 MMSTB are estimated for JWA1, which is currently producing from a deeper reservoir. Thus, about 0.5 MMSTB of the estimated 1.6 MMSTB of original mobile oil could be bypassed using current operating conditions.

Figure 3.7.4 — Production History for Sparta B, Reservoir A

3.8 Sparta B, Reservoir B, Fordoche Field, Pointe Coupee Parish

The Sparta B, reservoir B, is in a shaly sand that has an average thickness of 82 ft and an areal extent of 360 acres. Average reservoir properties are given in Table 3.8.1, and Figure 3.8.1 is a structure map. The initial oil in place was estimated to be 6.2 MMSTB. Using an estimated residual oil saturation of 24%, the recovery factor would be 54.8%. Thus, the displaceable mobile oil was estimated to be about 3.4 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
220	25	48	92	22	1.28	6.2	546	7970	228

Table 3.8.1 – Average Reservoir Properties for Sparta B, Reservoir B

Figure 3.8.1 – Structure Map for Sparta B, Reservoir B

The net pay map is shown in Figure 3.8.2. The northern reservoir boundary is a major fault, and the other boundaries are formed by an oil/water contact at 11,437 ft. The reservoir structure is thought to be an Eocene barrier-island complex. A type log for the Sparta B formation is shown in Figure 3.7.3 with the data for Sparta B, reservoir A.

Figure 3.8.2 – Net Pay Map for Sparta B, Reservoir B

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077203770000	RL	1	6S	8E	29	11405		11384	11402	04/86	01/87
								11360	11402	01/87	
17077203800000	RL	2	6S	8E	29	11330	11400	11354	11386	09/86	01/87
								11332	11386	01/87	
17077203820000	CH	1	6S	8E	28	11370	11450	11393	11418	08/86	
17077203840000	D	1	6S	8E	31	11305	11367	11307	11346	11/86	
17077203860000	G	1	6S	8E	28	11400	11497	11426	11448	01/87	
17077204920000	F	1	6S	8E	28	11349	11420	11367	11387	02/92	

Table 3.8.2 — Wells Completed in Sparta B, Reservoir B

Figure 3.8.3 shows the total annual production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. To date, the total oil production is about 1.5 MMSTB and decline curve analysis indicates another 0.5 MMSTB should be recovered from existing completions. Thus, preliminary estimates show about 1.4 MMSTB of the estimated 3.4 MMSTB of original mobile oil could be bypassed using current operating conditions. However, it is too early in the life of this reservoir to extrapolate the production trend with any confidence.

Figure 3.8.3 — Production History for Sparta B, Reservoir B

3.9 Sparta B, Reservoir C, Fordoche Field, Pointe Coupee Parish

The Sparta B, reservoir C, is in a shaly sand that has an average thickness of 50 ft and an areal extent of 55 acres. Average reservoir properties are given in Table 3.9.1, and Figure 3.9.1 is a structure map. The oil viscosity at reservoir conditions was estimated to be 1.26 cp. The initial oil in place was estimated to be 0.36 MMSTB. Using an estimated residual oil saturation of 24%, the recovery factor would be 52.8%. Thus, the displaceable mobile oil was estimated to be about 0.19 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
95	23	48	50	9	1.28	0.36	367	7800	254

Table 3.9.1 – Average Reservoir Properties for Sparta B, Reservoir C

Figure 3.9.1 – Structure Map for Sparta B, Reservoir C

The net pay map is shown in Figure 3.9.2. The northern and western reservoir boundaries are thought to be formed by an oil/water contact at 11,590 ft. The eastern and southern boundaries result from a permeability barrier caused by increasing clay content. The reservoir structure is thought to be an Eocene barrier-island complex. A type log for the Sparta B formation is shown in Figure 3.7.3 with the data for Sparta B, reservoir A.

Figure 3.9.2 – Net Pay Map for Sparta B, Reservoir C

The well completed in this reservoir is given in Table 3.9.2. No other wells currently penetrate this reservoir that are producing from deeper zones.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17077200670000	NS	4	6S	8E	32	11581	11652	11583	11592	05/74	08/80
								11582	11586	08/80	

Table 3.9.2 — Well Completed in Sparta B, Reservoir C

Figure 3.9.3 shows the total annual production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. Early water production indicates a water–drive production mechanism. During 1992, there has been no production. The total oil production is about 0.08 MMSTB, and no additional reserves are anticipated. Thus, preliminary estimates show about 0.1 MMSTB of the estimated 0.2 MMSTB of original mobile oil could be bypassed using current operating conditions. This reservoir is very shaly and has poor reservoir quality.

Figure 3.9.3 — Production History for Sparta B, Reservoir C

3.10 Smackover A Reservoir, Corney Bayou Field, Union Parish

The Smackover A reservoir is in a limestone formation that has an average thickness of 169 ft and an areal extent of 1,425 acres. The initial oil in place was estimated to be 9.8 MMSTB. Using an estimated residual oil saturation of 25%, the recovery factor would be 65.3%. Thus, the displaceable mobile oil was estimated to be about 6.4 MMSTB.

The wells completed in the Smackover A reservoir are listed in Table 3.10.2. No wells penetrated this reservoir that are currently completed in deeper zones. In 1984, gas-cycling operations were started using RLL1. However, pressures have continued to fall, reaching 2590 psi as of 10/90. The minimum miscibility pressure is not known.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
40	11	28	30	24	2.11	9.8	1142	4875	212

Table 3.10.1 – Average Reservoir Properties for Smackover A Reservoir

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17111221320000	TWE	1	21N	1W	30	10188	10260	10182	10190	03/80	07/81
17111223070000	A	1	21N	1W	19	10159		10174	10189	06/80	
17111224890000	E	2	21N	1W	30	10065		10134	10144	08/80	11/89
								10080	10100	11/89	
17111225010000	C	1	21N	2W	24	10075		10152	10158	08/80	
17111225950000	LE	1	21N	1W	29	10060	10209	10141	10147	10/80	
17111226960000	E	A1	21N	1W	19	10085		10110	10128	11/80	
17111228020000	RE	1	21N	1W	29	10159		10173	10179	01/81	12/81
17111230430000	C	A1	21N	2W	25	10108		10166	10176	04/81	07/81
		A1						10129	10152	07/81	
17111232410000	E	B1	21N	1W	30	10048		10119	10122	07/81	
17111232420000	RLL	1	21N	1W	20	10089		10122	10131	09/81	01/84
								10098	10106	01/84	02/84
17111234170000	R	A1	21N	1W	20	10011		10124	10130	12/81	
17111235140000	F	1	21N	2W	24	10052	10190	10067	10075	01/85	01/86
								10081	10088	01/86	01/86
								10093	10100	01/86	
17111235390000	H	1	21N	1W	21	10072	10452	10144	10152	03/82	
17111236505000	B	B1	21N	1W	28	10138		10170	10172	11/82	
17111237880000	CJB	3	21N	2W	24	10092	10200	10116	10120	09/82	
Gas Injection											
17111232420000	RLL	1	21N	1W	20	10089		10098	10106	01/84	

Table 3.10.2 — Wells Completed in Smackover A Reservoir

Figure 3.10.1 is a structure map for the reservoir. The structure is a deep-seated anticline that dips to the south. The zone pinches out to the north, forming a stratigraphic trap.

Figure 3.10.1 – Structure Map for Smackover A Reservoir

The net pay map is shown in Figure 3.10.2. The reservoir is an isolated carbonate sand body that is wedged between less permeable siliciclastics. The northern boundary is a permeability barrier, and the other boundaries are formed by an oil/water contact at 9,954 ft.

Figure 3.10.2 – Net Pay Map for Smackover A Reservoir

A typical well-log response for the Smackover A South 3,900-ft reservoir is shown in Figure 3.10.3. The Smackover A zone is now thought to be part of the Buckner formation, which overlies the better-known Smackover formation (Tye, Moore, 1986). While the Smackover formation is a regional, thick ooid sand, the Smackover A occurs as individual sand bodies parallel to strike.

Core data has shown a gradual shallowing of the depositional environment from the base to the top of the zone. The base of the zone is believed to have evolved from ooid bearing, fossiliferous packstone-boundstone to an oolitic grainstone. This is overlain by a muddy oolitic wackestone-packstone. This muddy wackestone indicates a gradual dilution of energy levels and carbonate production. Primary porosity and associated hydrocarbon presence is intergranular and is greatest in the high-energy lithofacies, the ooid grainstone (Moore, et al., 1986).

Figure 3.10.3 — Type Log for Smackover A Reservoir

Figure 3.10.4 shows the total annual oil production, producing gas-oil ratio, and producing water-oil ratio for the reservoir. In 1984, gas-cycling operations were started. To date, the total oil produced is about 2.8 MMSTB. Estimated future production from existing completions is 1.3 MMSTB. It appears that about 4.1 MMSTB of the estimated 6.4 MMSTB of mobile oil will be produced, leaving approximately 2.3 MMSTB of bypassed mobile oil.

Figure 3.10.4 — Production History for Smackover A Reservoir

3.11 Smackover B Reservoir, Corney Bayou Field, Union Parish

The Smackover B reservoir is in a limestone formation that has an average thickness of 80 ft and an areal extent of 260 acres. The initial oil in place was estimated to be 1.8 MMSTB. Using an estimated residual oil saturation of 25%, the recovery factor would be 66.7%. Thus, the displaceable mobile oil was estimated to be about 1.2 MMSTB.

The Smackover B reservoir is within the Jurassic upper Smackover formation. This formation is a regional, thick, blanket-like ooid sand known to extend from Alabama to south Texas in the subsurface. It is overlain by the Buckner formation and underlain by the Norphlet formation.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
2	9.8	28	80	25	1.96	1.8	1846	5077	216

Table 3.11.1 – Average Reservoir Properties for Smackover B Reservoir

Figure 3.11.1 – Structure Map for Smackover B Reservoir

The net pay map is shown in Figure 3.11.2. The reservoir is a northwest-trending anticline bounded on the northwest by a shale out of the sand. The Lowery 1 and Rogers 1 wells showed oil, but the formation was not of sufficient reservoir quality to sustain production in commercial quantities. These wells were used to define the northwestern limits of the reservoir. It is bounded on all other sides by an oil/water contact of 10,077 ft subsea. A stratigraphic trap is formed by the up dip, shale out. The reservoir facies is known to have a high oolite content and is thought to result from deposition on a very shallow, turbulent shoal.

The reservoir is being produced using two units. The Bollier 1 is in Sand Unit C (SUC) and the Farris 1 is in Sand Unit B. The Adkins 1 and Collet 1 wells are producing from the Smackover A formation, which is a more shallow horizon.

Figure 3.11.2 – Net Pay Map for Smackover B Reservoir

A typical log response for the Smackover B formation is shown in Figure 3.11.3. The SP deflection has a smooth funnel shape. This corresponds with the known interpreted regional stratigraphy of the Smackover B as an extensive shallow shoal or barrier-bar buildup, as more fully described by Biship, 1969. Also shown for comparison is the SP response in the Smackover A formation, which has a higher permeability.

Figure 3.11.3 — Type Log for Smackover B Reservoir

The wells completed in the Smackover B reservoir are given in Table 3.11.2. No production has been reported since October 1989.

API Well Code	Well Name	No.	TwN	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17111230440000	CJB	1	21N	2W	24	10270	10351	10310	10326	04/81	10/89
17111235140000	F1	1	21N	2W	24	10237	10317	10257	10264	03/82	04/84

Table 3.11.2 — Wells Completed in Smackover B Reservoir

Figure 3.11.4 shows the total annual oil production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. To date, the total oil produced is about 0.21 MMSTB. It appears that about approximately 1.0 MMSTB of the estimated 1.2 MMSTB of mobile oil will be bypassed unless additional drilling is done. This reservoir may be a good prospect for a horizontal wellbore extension drilled from one of the existing wells.

Figure 3.11.4 — Production History for Smackover B Reservoir

3.12 South 3,900–Ft Reservoir, Lafitte Field, Jefferson Parish

The South 3,900–ft reservoir is in a relatively clean sand that varies in thickness from 2 ft to over 100 ft and has an areal extent of 64 acres. Average reservoir properties are given in Table 3.12.1, and Figure 3.12.1 is a structure map. The reservoir has a very strong water drive and reservoir pressure has remained essentially at its initial value. The oil viscosity at reservoir conditions was estimated to be 2.3 cp, causing an unfavorable mobility ratio. The operator has overcome a problem of severe water coning through the use of very small well spacings and by tolerating a high water–oil ratio. The initial oil in place was estimated to be 3.1 MM STB. Using an estimated residual oil saturation of 21%, the recovery factor would be 74.1%. Thus, the displaceable mobile oil was estimated to be about 2.3 MMSTB.

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
2050	33.0	22	50	28	1.17	3.1	366	1900	130

Table 3.12.1 – Average Reservoir Properties for South 3,900–ft Reservoir

Figure 3.12.1 – Structure Map for South 3,900–ft Reservoir

Well logs on the western edge of the reservoir show evidence of a channel fill that is not in communication with the main body of the South 3,900-ft sand. This channel fill is probably a separate small reservoir. The reservoir limit to the south is a down-dip oil/water contact that extends under much of the reservoir. Reservoir limits to the north and east are permeability barriers caused by increased shale content. A small, non-sealing fault that trends to the northeast begins in the eastern portion of the reservoir.

The net pay map is shown in Figure 3.12.2. Fifteen wells have produced from this reservoir, and four additional wells that penetrate the reservoir are currently producing from deeper reservoirs. These wells could be completed in the future. If all of these wells are eventually used, the average well spacing will be less than four acres per well.

The productive sand is of Miocene age and is located above a deep-seated salt dome. The Miocene trend in south Louisiana was a huge progradational megacycle with several thick depocenters centered in different parts of the gulf coast. Each general depocenter is made up of a complex of shifting deltas and delta lobes. Mid-Miocene to Pliocene depocenters were concentrated in southeastern Louisiana.

Figure 3.12.2 – Net Pay Map for South 3,900-ft Reservoir

A typical well-log response for the South 3,900-ft reservoir is shown in Figure 3.12.3. The SP response varies from a thick cylinder to a slightly fining upwards sequence. Its thickness varies from 2 ft to over 100 ft over a small geographic area. This type of response is characteristic of an alluvial deposit. The deposit demonstrates a classic channel-fill, point bar, and clay plug sequence. To the extreme west, the thicker sections of the sand represents a channel-fill deposit. It is clean and cylindrical shaped and contains no shale stringers. Moving to the east, the sand thins by half or more very rapidly and contains some shale stringers of varying intensity, but the sand remains relatively clean. This has been interpreted as a point-bar deposit and contains the bulk of the oil reservoir. To the extreme east, the deposit trends into a clay plug and the sand shales out completely. The South 3,900-ft reservoir is separated from the North 3,900-ft sand by an east-west trending permeability barrier. This barrier was inferred because of differences in the recent oil-water level observed by later drilled wells and the thick-thin-thick sequence observed trending south-north. These two reservoirs have, therefore been interpreted as separate but related point bar deposits with a narrow clay plug or shale-out trending between them. (Kimbrell)

The logs show a relatively sharp oil-water transition zone that is generally seen in a high-permeability sandstone. Water-coning problems in this reservoir were severe in some areas. There is evidence that significant interbedded shale reduced the vertical permeability and therefore the water coning problem in some areas.

Figure 3.12.3 — Type Log for South 3,900-ft Reservoir

The wells that are or have been completed in the South 3,900-ft reservoir are listed in Table 3.11.2. Two wells were recently recompleted in this reservoir after abandoning deeper completions in other reservoirs. Table 3.12.3 lists wells that could potentially be recompleted in the South 3,900-ft reservoir after abandoning their current completions in deeper reservoirs. SLM 2 and SLM 22 penetrate the 3,900-ft reservoir near the original water-oil contact and probably have no significant reserves. However, LLE 120 and LLE 121 are located in favorable structural positions, and the potential reserves from these wells is estimated to be about 200,000 STB.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17051006440000	LLE	78D	17S	24E	20	4075	4130	4078	4082	05/64	07/80
17051006450000	LLE	70	17S	24E	20	4092	4154	4078	4082	10/85	05/86
17051006490000	LLE	77	17S	24E	20	4078	4140	4076	4088	08/70	07/91
17051006500000	LLE	41	17S	24E	20	4077	4143	4075	4081	07/87	
17051006510000	LLE	75	17S	24E	20	4087	4150	4082	4092	09/75	
17051006680000	SLM	3	17S	24E	21	4070	4116	4064	4076	02/85	03/92
17051010350000	SLM	13	17S	24E	21	4057	4102	4058	4066	07/65	08/65
17051200650000	LLE	107	17S	24E	20	4080	4183	4080	4090	08/84	
17051201850000	LLE	118	17S	24E	20	4060	4110	4060	4070	11/84	
17051206200000	LLE	184	17S	24E	20	4032	4130	4072	4090	08/85	08/90
17051206120000	SLM	25	17S	24E	21	4067	4120	4067	4076	01/91	
17051207520000	SLM	26	17S	24E	21	4070	4127	4067	4086	08/87	
17051207740000	LLE	190	17S	24E	20	4095	4180	4130	4136	04/91	
17051207830000	SLM	27	17S	24E	21	4030	4106	4064	4075	01/88	11/91

Table 3.12.2 — Wells Completed in South 3,900-ft Reservoir

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17051006710000	SLM	2	17S	24E	21	4095	4147	4518-40	-
17051201980000	LLE	120	17S	24E	20	4081	4143	4323-30	120,000
17051202110000	LLE	121	17S	24E	20	4080	4140	4466-76, 9988-96	80,000
17051205800000	SLM	22	17S	24E	21	4063	4117	4308-12	-
								Total	200,000

Table 3.12.3 — Potential Additional Completions in South 3,900-ft Reservoir

Figure 3.12.4 shows the total annual Oil Production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. The overall potential for bypassed mobile oil in this reservoir is thought to be small. About 1.9 MMSTB of the 2.3MMSTB estimated mobile oil present has been produced. The reserves from the existing and potential future completions is thought to be about 0.37 MMSTB. Thus, the estimated bypassed mobile oil is less than 0.1 MMSTB.

Figure 3.12.4 — Production History for South 3,900-ft Reservoir

3.13 4,300-Ft Reservoir, Lafitte Field, Jefferson Parish

The 4,300-ft reservoir is a shaly sand that has an average thickness of about 65 ft and an areal extent of 150 acres. Figure 3.13.1 is a structure map, and average reservoir properties are given in Table 3.13.1. The reservoir has a very strong edge water drive, and reservoir pressure has remained essentially at its initial value. The oil viscosity at reservoir conditions was estimated to be 2.2 cp, causing an unfavorable mobility ratio. The initial oil in place was estimated to be 4.4 MMSTB. Using an estimated residual oil saturation of 27%, the recovery rate would be 63.6%. Thus, the displaceable mobile oil was estimated to be about 2.8 MMSTB.

Figure 3.13.1 – Structure Map for 4,300-ft Reservoir

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MM STB)	Init GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
587	29.0	27	45	22	1.24	4.4	514	2080	130

Table 3.13.1 – Average Reservoir Properties for 4,300-ft Reservoir

Figure 3.13.2 – Net Pay Map for 4,300-ft Reservoir

The net pay map is shown in Figure 3.13.2. Fourteen wells have been completed in this reservoir, and two additional wells that penetrate the reservoir are currently producing from deeper reservoirs. These wells could be completed in the future. If all of these wells are eventually used, the average well spacing will be about nine acres per well.

A typical well-log response for the 4,300-ft reservoir is shown in Figure 3.13.3. The SP response typically has a serrated slightly fining upward sequence with gradational upper and lower sand contacts. Its thickness averages about 65 ft. This type of response is characteristic of an alluvial-deltaic point bar. There is evidence of considerable inter bedded shale that could reduce the effective vertical permeability. However, water-coning problems in this reservoir were severe. The approximate intersection of the original oil/water contact with both the top of the sand and the base of the sand is shown on the structure map of Figure 3.13.1.

Figure 3.13.3 — Type Log for 4,300-ft Reservoir

The wells that are or have been completed in the 4,300-ft reservoir are listed in Table 3.13.2. Only one well is currently producing, and it has a water/oil ratio of about six. Listed in Table 3.13.3 are wells that could potentially be recompleted in the South 4,300-ft reservoir after abandoning their current completions in deeper reservoirs. These wells include SLM 11 and SLM 21. Neither of these wells has a favorable structural position, and it appears likely that no reserves remain in their vicinities.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17051006440000	LLE	78	17S	24E	20	4520	4580	4532	4538	04/63	05/64
17051006490000	LLE	77	17S	24E	20	4525	4583	4538	4541	01/63	08/70
17051006500000	LLE	41	17S	24E	20	4522	4585	4524	4544	05/77	10/77
17051006640000	SLM	1	17S	24E	21	4484	4544	4484	4511	06/72	09/75
17051006650000	SLM	7	17S	24E	21	4497	4541	4526	4530	12/63	10/72
17051006660000	SLM	5	17S	24E	21	4484	4539	4506	4532	08/63	01/66
17051006670000	SLM	10	17S	24E	21	4484	4539	4497	4511	10/74	01/86
17051006700000	SLM	8	17S	24E	21	4495	4544	4519	4522	11/63	07/90
17051000671000	SLM	2	17S	24E	21	4518	4576	4518	4540	10/84	
17051000674000	LAM	14	17S	24E	21	4514	4568	4514	4537	01/78	05/87
17051200650000	LLE	107	17S	24E	20	4529	4586	4528	4536	02/82	08/84
17051201930000	SLM	19	17S	24E	21	4479	4533	4496	4518	04/76	08/77
17051206200000	LLE	184	17S	24E	20	4520	4569	4512	4531	07/82	11/85
17051207870000	SLM	31	17S	24E	21	4527	4582	4548	4573	02/92	

Table 3.13.2 — Wells Completed in 4,300-ft Reservoir

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17051009920000	SLM	11	17S	24E	21	4535	4606	5594–5601	0
17051203340000	SLM	21	17S	24E	21	4544	4590	8234–8263	0

Table 3.13.3 — Potential Additional Completions in 4,300-ft Reservoir

Figure 3.13.4 shows the total annual oil production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. The overall potential for bypassed mobile oil in this res-

ervoir is thought to be economically attractive. About 1.5 MMSTB of the 2.8MMSTB estimated mobile oil present has been produced. The reserves from the existing and potential future completions is thought to be about 0.05 MMSTB. Thus, the estimated bypassed mobile oil is approximately 1.25 MMSTB.

Figure 3.13.4 — Production History for 4,300-ft Reservoir

3.14 4,400-Ft Reservoir, Lafitte Field, Jefferson Parish

The 4,400-ft reservoir is a sand that has an average thickness of about 135 ft and an areal extent of 115 acres. A structure map is shown in Figure 3.14.1 and average reservoir properties are listed in Table 3.14.1. The reservoir has a very strong bottom water drive, and reservoir pressure has remained essentially at its initial value. The oil viscosity at reservoir conditions was estimated to be 2.2 cp, causing an unfavorable mobility ratio. This unfavorable mobility ratio and the presence of bottom water has resulted in severe water-coning problems. The operator has attempted to overcome the water-coning problems by using a very close well spacing and by tolerating a high water-oil production ratio. The initial oil in place was estimated to be 4.0 MMSTB. Using an estimated residual oil saturation of 22%, the recovery factor would be 72.5%. Thus, the displaceable mobile oil was estimated to be about 2.9 MMSTB.

Figure 3.14.1 – Structure Map for 4,400-ft Reservoir

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (SCF/STB)	Init BHP (psi)	BHT (Deg F)
564	28	20	40	25	1.24	4.0	1045	2130	130

Table 3.14.1 – Average Reservoir Properties for 4,400–ft Reservoir

Figure 3.14.2 – Net Pay Map for 4,400–ft Reservoir

The net pay map is shown in Figure 3.14.2. Eleven wells have produced from this reservoir, and two additional wells that penetrate the reservoir are currently producing from deeper reservoirs and could be completed in the future. If all of these wells are eventually used, the average well spacing will be about nine acres per well. The entire area of the reservoir is underlain by bottom water.

A typical well-log response for the 4,400-ft reservoir is shown in Figure 3.14.3. The SP response usually has a smooth cylindrical shape with gradational upper shale/sand contact and an abrupt lower sand/shale contact. Its thickness averages about 135 ft. It is thought to be either a distributary channel fill or an alluvial-deltaic point bar similar to the 3,900-ft sand, except it does not contain any permeability barriers, observed or inferred. The reservoir is bounded on all sides by an oil-water contact of -4,579 subsea (Kimbrell). There is evidence of some interbedded shale that could reduce the effective vertical permeability. However, water-coning problems in this reservoir were severe.

The initial water level was 4,579 ft subsea, and water filled about two-thirds of the sand thickness near the middle of the structure. The cleanest part of the sand appeared to be near the bottom, in the water-filled portion of the sand. Shale stringers in the upper part of the sand probably helped in reducing water production. However, all of the wells produced at high water-oil ratios.

Figure 3.14.3 — Type Log for 4,400-ft Reservoir

The wells that are or have been completed in the 4,400-ft reservoir are listed in Table 3.14.2. A maximum of four completions has produced simultaneously. In 1992, three completions have been produced; one of these was abandoned in February 1992. The producing water-oil ratio for the past two years has been about six.

Table 3.14.3 lists wells that could potentially be recompleted in the 4,400-ft reservoir after abandoning their current completions in deeper reservoirs. LAM 22 has a favorable structural position and is assigned reserves of 100,000 STB. LAM 31 is near the original water contact and probably has no significant reserves in the 4,300-ft reservoir.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17051006600000	LAM	17	17S	24E	21	4560	4675	4579	4583	06/76	07/76
17051006620000	SLM	9	17S	24E	21	4556	4668	4542	4567	05/75	07/77
17051006630000	SLM	6	17S	24E	21	4562		4577	4581	06/63	09/75
17051006660000	SLM	5	17S	24E	21	4574	4686	4580	4596	08/73	05/87
17051006670000	SLM	10	17S	24E	21	4570	4672	4578	4604	10/70	10/74
17051006730000	LAM	19	17S	24E	21	4557	4686	4567	4574	01/64	12/74
17051202500000	SLM	20	17S	24E	21	4558	4672	4542	4584	04/91	
17051203020000	LAM	40	17S	24E	21	4554	4665	4568	4575	09/79	01/86
17051206220000	LAM	44	17S	24E	21	4566	4684	4584	4590	07/82	12/84
17051207850000	SLM	30	17S	24E	21	4618		4618	4638	02/88	
17051207870000	SLM	31	17S	24E	21	4626		4632	4638	02/88	02/92

Table 3.14.2 — Wells Completed in 4,400-ft Reservoir

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17051009770000	LAM	22	17S	24E	21	4566	4687	5242-5252	100
17051200980000	LAM	31	17S	24E	21	4598	4698	5205-5215	0

Table 3.14.3 — Potential Additional Completions in 4,400-ft Reservoir

Figure 3.14.4 shows the total annual oil production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. Oil production to date has totaled about 1.1 MMSTB. Estimated future production from the existing completions is 0.1 MMSTB, and estimated production from potential future recompletions is 0.1 MMSTB. Thus, it is expected that the recovery from existing wells will total 1.3 MMSTB. Approximately 1.6 MMSTB of the estimated 2.9 MMSTB of mobile oil could be bypassed. Thus, the potential for bypassed oil in this reservoir appears to be significant, and further study is economically justified.

Figure 3.14.4 — Production History for 4,400-ft Reservoir

3.15 North 3,900–Ft Reservoir, Lafitte Field, Jefferson Parish

The North 3,900–ft reservoir is a relatively clean sand with a thickness that varies from 2 ft to more than 100 ft with an areal extent of 46 acres. A structure map is shown in Figure 3.15.1, and average reservoir properties are given in Table 3.15.1. The reservoir has a very strong edge water drive, and reservoir pressure has remained essentially at its initial value. The oil viscosity at reservoir conditions was estimated to be 2.3 cp, causing an unfavorable mobility ratio. The strong natural water drive and unfavorable mobility ratio has resulted in some water–coning problems. However, the producing water–oil ratio has tended to be lower in this reservoir than in the other nearby reservoirs because water encroachment is primarily from one side. The initial oil in place was estimated to be 3.1 MMSTB. Using an estimated residual oil saturation of 22%, the recovery factor would be 71.0 %. Thus, the initial displaceable mobile oil was estimated to be about 2.2 MMSTB.

Figure 3.15.1 – Structure Map for North 3,900–ft Reservoir

Avg. Perm (md)	Avg. Porosity (%)	Initial Water Sat (%)	Avg. Gross Pay (ft)	Avg. Net Pay (ft)	Init. Oil FVF (Bbl/STB)	Init. Oil in Place (MMSTB)	Init. GOR (MCF/STB)	Init BHP (psi)	BHT (Deg F)
1600	34	25	50	40	1.17	3.1	1446	1900	130

Table 3.15.1 – Average Reservoir Properties for North 3,900–ft Sand

Figure 3.15.2 – Net Pay Map for North 3,900–ft Reservoir

The net pay map is shown in Figure 3.15.2. Ten wells have been completed in this reservoir, and two additional wells that penetrate the reservoir are currently producing from deeper reservoirs and could be completed in the future. If all of these wells are eventually used, the average well spacing will be about four acres per well.

The northern, western, and southern boundaries of the reservoir are thought to be permeability barriers caused by decreasing sand thickness and increasing shale content. A fault cuts the eastern portion of the reservoir, but this fault is not large enough to form a seal. The eastern boundary is an oil–water contact. The reservoir thickens both to the east and west.

A typical well-log response for the North 3,900-ft reservoir is shown in Figure 3.15.3. The SP response normally has a smooth slightly fining upward sequence with gradational upper shale/sand contact and an abrupt lower sand/shale contact. Its thickness averages about 70 ft. This type of response is characteristic of an alluvial-deltaic point bar as discussed earlier for the South 3,900-ft reservoir. There is evidence of gradually decreasing clay content towards the bottom of the sand. This could be expected to result in a higher permeability towards the base of the sand.

Figure 3.15.3 — Type Log for North 3,900-ft Reservoir

The wells that are or have been completed in the North 3,900-ft reservoir are listed in Table 3.15.2. Production was from nine completions during the late eighties. During 1992, four of the nine completions have produced.

Listed in Table 3.15.3 are wells that could potentially be recompleted in the North 3,900-ft reservoir after abandoning their current completions in deeper reservoirs. SLM 30 is on the downthrown side of a fault that is thought to be non-sealing. However, in view of the inhomogeneities present in this portion of the reservoir, testing of this zone is recommended. SLM 31 is in a favorable structural position and is located in the thicker portion of the reservoir. All of the nearby wells have produced in excess of 300,000 STB. SLM 29 has produced about 700,000 STB.

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Upper Perf (ft md)	Lower Perf (ft md)	Comp. Date	End Date
17051006370000	LLE	57	17S	24E	20	4040	4189	4038	4046	04/86	12/87
17051006380000	LLE	73	17S	24E	20	4030	4170	4029	4046	01/63	04/73
17051006640000	SLM	1	17S	24E	21	4017	4083	4016	4034	02/79	
17051006650000	SLM	7	17S	24E	21	4020	4090	4037	4040	11/63	12/72
								4020	4030	12/72	10/72
17051006670000	SLM	10	17S	24E	21	4039	4100	4036	4048	01/86	
17051006690000	BN	2	17S	24E	21	4040	4080	4040	4065	02/44	05/73
17051201930000	SLM	19	17S	24E	21	4015	4083	4013	4030	08/77	
17051206660000	SLM	24	17S	24E	21	4030	4100	4030	4040	11/83	06/85
								4030	4040	08/85	07/91
17051207840000	SLM	28	17S	24E	20	4083	4169	4084	4104	08/88	
17051006370000	SLM	29	17S	24E	21	4038	4093	4033	4042	04/91	

Table 3.15.2 — Wells Completed in North 3,900-ft Reservoir

API Well Code	Well Name	No.	Twn	Rge	Sec	Form Top (ft md)	Form Bottom (ft md)	Current Perf Interval (ft md)	Estimated Reserves (M STB)
17051207850000	SLM	30	17S	24E	21	4080	4150	4618-4638	50
17051207870000	LM	31	17S	24E	21	4040	4125	4548-4573	150

Table 3.15.3 — Potential Additional Completions in North 3,900-ft Reservoir

Figure 3.15.4 shows the total annual oil production, producing gas–oil ratio, and producing water–oil ratio for the reservoir. The overall potential for bypassed mobile oil in this reservoir is thought to be small. About 1.8 MMSTB of the 2.2 MMSTB estimated mobile oil has been produced. The reserves from the existing and potential future completions are thought to be about 0.3 MMSTB. Thus, the estimated bypassed mobile oil is approximately 0.1 MMSTB.

Figure 3.15.4 — Production History for North 3,900-ft Reservoir

4. LOUISIANA'S PRODUCTION-AUDIT REPORTING SYSTEM (PARS)

The primary source of public data on oil and gas fields in Louisiana is the public files of the Office of Conservation of the Louisiana Department of Natural Resources. In 1975, a computer database system was installed, and much of the data routinely collected by the state has been entered into this database. Beginning in 1976, some reports were computerized, while other forms were not entered until 1979. Older data are maintained on file for manual access. The computer database system is called the Production Audit Reporting System (PARS).

4.1 Purpose

The primary purpose of PARS is to allow audits of oil and gas production in the state to be easily accomplished. The system also permits annual state income from taxes and royalties on oil and gas production to be determined and future income to be projected. Information on the location and status of both active and abandoned wells is also made available to agencies concerned with public health or safety problems that could be related to leaking wells. PARS also supports the Office of Conservation in its activities to prevent waste, conserve the natural resources of the state, and promote equitable allocation of production in competitive situations.

A secondary purpose of PARS is to provide information to companies, landowners, and other individuals interested in oil and gas exploration activities. Computer terminals are maintained at the Department of Natural Resources building to allow public access to the PARS database. Another terminal is maintained in the offices of the Louisiana Geological Survey at LSU. Computer tapes containing the database can also be purchased by interested operators or service companies. Information users must generally write their own software to readily extract the desired information from the tape. Commercial oil and gas information service companies obtain much of their data for Louisiana in this manner.

4.2 Sources of Information for PARS

Oil and gas companies operating in Louisiana are required by law to submit a number of forms to the Department of Natural Resources. Some forms are required to obtain the necessary permits to drill or perform remedial work on a well or to transport oil and gas. Other forms either provide information on well completions or well tests, or they report produced or injected volumes. These forms are processed by the staff of the Department of Natural Resources and are the source of information for the PARS database.

An application for a permit to drill (Form MD-10-R) initiates recordkeeping on an individual well. A state serial number and an API well number is assigned to the well, and its proposed location is entered into the database when this form is received. Information about the well operator is also recorded. The permit to drill expires if not exercised within 90 days, but can be renewed by filing another application. A related form (MD-10-R-A) is used to amend information submitted on the original form.

After a well is drilled or when a well is re-entered to do additional work, a Well History and Work Resume Report (Form WH-1) must be filed giving the well name, numbers, location, current status, elevations, perforations, tubular-size data, and initial well-test data. If the well is plugged and abandoned, information concerning the removal of tubing and placement of plugs must be given. Also requested are a resume of the work performed and a list of the important formations penetrated.

Wells with multiple completions are given a serial number for each completion. However, only one API well number is assigned to a given well. Even when a well is renamed, it retains the same API well number.

If the well is productive, a Lease, Unit, or Well (LUW) code will be assigned to the well based on the current interpretation of the probable geographic limits of the productive property. In many cases, sufficient information is not available to define reservoir limits. Thus the LUW code will correspond to a geographic area that may be different from the reservoir limits eventually accepted after the reservoirs have been fully developed. LUW codes for a given well can change over the life of the well, even when the perforations do not change. This results from periodic adjustments in the production units as new geologic information is obtained. These matters are decided at hearings held by the commissioner of conservation.

Periodic well tests (bimonthly) for an oil well must be reported on a Form DM-1-R. Information recorded includes well name, serial number, perforated interval, test date, oil and water production, GOR, choke size, oil API gravity, flowing tubing pressure, and any shut-in tubing pressure or bottom-hole pressure data taken since the last test. Gas-well test data is reported on a similar form (D-T-1). Inactive wells must be reported using an appropriate status code. Since January 1979, such test data has been entered in the PARS database.

Monthly production by LUW code must also be reported by the operator. Produced volumes of oil and gas from an oil well are reported on a Form R-1, while produced volumes of gas and condensate from a gas well are reported on a Form R-5-P. When gas is reinjected for pressure maintenance or secondary recovery, only net gas produced is submitted and an injection flag is set. An auxiliary form is used for gas-cycling operations. Produced-water or injected-water volumes in a secondary recovery project are not reported.

Authorization to transport oil from the lease is obtained by filing an Operator's Certificate of Compliance and Authorization to Transport Oil from Lease (Form R-4). Transported volumes must be periodically balanced with produced volumes.

After a previously completed well has been plugged and abandoned, a Plug and Abandon Report (Form P-8) must be filed. This report provides information on the tubulars removed from the well and the type and locations of the plugs that were used.

4.3 Reports Available

The type of reports that can be obtained using the PARS computer terminal is broken into two general categories: the production-audit screens and the well-files screens. The production-audit screens allows access to total monthly oil and gas production that has been reported by the operators for each field or each LUW code. The well-file screens allow access to information about individual wells. Reports that list wells within either a given radius from a specified point, a defined rectangle, a given field, or a given LUW code can be obtained. Data about the tubulars used in a well, the perforation history of a well, well scout reports summarizing work done on a well, and periodic well-test reports are all readily available. Basically, these screens or printouts display the information reported by the operator as described above.

4.4 Other Public Information Sources for Louisiana's Oil and Gas

The Louisiana Department of Natural Resources also has considerable information related to the oil and gas resources of the state that is not in the PARS database. Well files are maintained that pre-

ceed the installation of PARS in 1975. Well logs and directional surveys are also maintained for every well. In addition, transcripts of hearings held by the Office of Conservation contain considerable geologic and engineering interpretations for many of the reservoirs. Structure maps, isopach maps, cross sections, reservoir pressure history, operator production history, core data, and well-log-interpretation data are often submitted by interested parties at these public hearings. Unfortunately, access to this information is limited, and no means are available for easily retrieving a desired type of information on a given reservoir.

Well logs that have been released to the state generally can be purchased through commercial information service companies. This is also true for information included in the PARS database. These companies also provide base maps showing locations of various wells and fields.

Core data and reservoir-fluid data that has been released to the public can sometimes be obtained from the laboratories that performed the analysis. In some cases, access to useful data is essentially lost to the exploration effort in the state when a company goes out of business without releasing its data to the public.

5. PILOT ATLAS DATABASE FILE STRUCTURE

Although extensive public information is available concerning Louisiana's oil and gas activities, data is not compiled for easy retrieval. In this study, available information on 15 example reservoirs was compiled in a form that would allow the potential for commercial quantities of bypassed oil to be estimated. The new database structure would also support more detailed studies of reservoir recovery efficiency using reservoir-simulation software. This pilot atlas reservoir database is currently being studied as a potential system for routinely reporting on active Louisiana reservoirs that were considered at reservoir wide hearings of the Office of Conservation during the year.

The pilot atlas database was set up completely separate from the PARS database to avoid any possible impact on the routine operations of the Department of Natural Resources by the LSU students and staff working on the bypassed-oil study. Thus it was necessary to duplicate much of the data already available in the PARS system. It is envisioned that eventually the reservoir analysis features of the pilot atlas can be linked with the existing PARS system so that duplication of data is not required.

The pilot atlas database was stored in a form that could be easily used on a personal computer or workstation. DBASE IV operating in a Microsoft DOS 5.0 environment and DBFAST operating in a Microsoft Windows 3.0 environment were used to access the data during the pilot study. However, DBASE file format (*.dbf) can be read by many other database software packages as well as by most spreadsheet programs.

5.1 Oilfield Identification Codes (FIELDDID.DBF)

This file contains information about the oil fields in which the reservoirs are located. The primary field identification code used in the pilot atlas database is the API well number of the discovery well for the field. The state field code used in the PARS database is also provided for easy cross referencing between the two databases. The file structure used is described in Table 5.1. The formation name was not included in this file because oil fields in Louisiana often produce from multiple formations that are discovered at different dates.

No	Field Name	Type	Width	Dec	Description
1	FLDDISAPI	Numeric	15	0	Field Identification Number API Well Number for Field Discovery Well
2	FIELDSTCD	Numeric	5	0	Field State Code used in PARS database
3	FIELDDNAME	Character	15		Field Name
4	PARISH	Character	30		Parish of Field Discovery Well (Surface Location)
5	STATE	Character	15		State of Field Discovery Well (Surface Location)
6	BASIN	Character	15		Name of Geologic Basin in which Field is Located
7	TREND	Character	30		Name of Geologic Trend in which Field is Located

Table 5.1 — File Structure for FIELDDID.DBF

5.2 Lease, Unit, or Well Monthly Production (LUWPROD.DBF)

This file contains the monthly produced volumes reported for each LUW code. It also contains information about the LUW codes used in the various oil fields in which the reservoirs are located. The operator reports oil and gas production to the state according to these LUW codes. In this file, the LUW codes are cross listed with the state field-identification numbers for the fields containing the geographic areas that correspond to the LUW codes. Each oil or gas field can contain more than one LUW code. LUW codes assigned to a given well and perforation interval can change as new geologic information is obtained. Because of the uncertainty associated with defining subsurface geology, LUW codes do not necessarily correspond to reservoirs. LUW codes can include more than one reservoir, and reservoirs can include more than one LUW code. The file structure used is shown in Table 5.2.

No	Field Name	Type	Width	Dec	Description
1	FIELDSTCD	Numeric	5	0	State Field Code used in PARS Database
2	LUWCODE	Numeric	6	0	Lease Unit or Well (LUW) Identification Code
3	YRMO	Character	5		Year and Month for Reported Production
4	NOOILWELL	Character	2		Number of Oil Wells included in Reported Production.
5	OILPROD	Character	5		Monthly LUW Crude Oil Production from Oil Wells, STB
6	CASGASPROD	Character	6		Monthly LUW Gas Production from Oil Wells, MSCF
7	NOGASWELL	Character	2		Number of Gas Wells included in Reported Production.
8	CONDPROD	Character	5		Monthly Condensate Production from Gas Wells, STB
9	GASPROD	Character	6		Monthly LUW Gas Production from Gas Wells, MSCF

Table 5.2 — File Structure for LUWPROD.DBF

5.3 Reservoir Identification Codes and Average Properties (RESID.DBF)

This file identifies all of the reservoirs in the pilot atlas database, gives the oil and gas fields in which they are located, and provides estimates for various average initial reservoir properties. The file structure used is shown in Table 5.3. The API well number of the reservoir discovery well is used as the reservoir identification code. This identification scheme allows considerable additional information about the reservoir to be obtained by looking at the available data for this well.

Average reservoir properties given in this file were not available in the PARS database and were obtained from various public and private sources. Much of the needed information was available in transcripts and other public records associated with hearings held by the Office of Conservation.

No	Field Name	Type	Width	Dec	Description
1	RESDISAPI	Numeric	15	0	Reservoir Identification Number API Well Number for Reservoir Discovery Well
2	FLDDISAPI	Numeric	15	0	Field Identification Code
3	RESNAME	Character	15		Reservoir / Formation name
4	TYPE	Character	15		Reservoir Fluid Description
5	AGE	Character	8		Geologic Age of Reservoir
6	AVGDEPTH	Numeric	8	0	Average Subsea Depth of Reservoir, ft
7	INIBHP	Numeric	6	0	Initial Bottom Hole Pore Pressure at Avg Depth, psi
8	PRIMDRIVE	Character	30		Primary Source of Reservoir Energy
9	INIGOR	Numeric	6	0	Average Initial Gas Oil Ratio, SCF/STB
10	AVGPORE	Numeric	7	1	Average Porosity, %
11	INISW	Numeric	5		Average Initial Water Saturation, %
12	AVGPERM	Numeric	7	1	Average Permeability, md
13	AVGNETPAY	Numeric	9	0	Average Net Pay, ft
14	AVGGROPAY	Numeric	9	0	Average Gross Pay, ft
15	AVGH2OLEV	Numeric	9	0	Average Subsea Depth of Water Level, ft
16	BHT	Numeric	3	0	Average Formation Temperature
17	BPP	Numeric	5	0	Average Bubble Point Pressure
18	EINIOFVF	Numeric	6	2	Estimated Initial Formation Volume Factor, Bbl/STB
19	GASSG	Numeric	6	2	Gas Specific Gravity
20	APIGR	Numeric	5	1	Oil API Gravity
21	OILVISC	Numeric	7	3	Estimated Oil Viscosity at Reservoir Conditions, cp
22	EOOIPMSTB	Numeric	7	0	Estimated Original Oil in Place, MSTB
23	EOGIPMMCF	Numeric	8	0	Estimated Original Gas in Place, MMSCF
24	STRUCMAP	Character	8		File Name for Structure Map of Reservoir
25	ISOPACH	Character	8		File Name for Isopach Map of Reservoir
26	TYPELOG	Character	8		File Name for Type Log for Formation

Table 5.3 — File Structure for RESID.DBF

5.4 Well Identification Codes and Locations (WELLID.DBF)

This file identifies all of the wells in the fields containing the reservoirs in the pilot atlas database. The file structure used is given in Table 5.4. Both the API well number of the well and the well serial numbers are provided to allow easy cross reference with the PARS database. A new serial number is issued for each formation perforated. Wells with multiple completions will have multiple serial numbers.

In the PARS database, the last four digits of the API well number are normally all zeros. However, these digits were used in the Pilot Oil Atlas database for wells with multiple completions. This permitted each state serial number to have a unique API well number.

No	Field Name	Type	Width	Dec	Description
1	FLDDISCAPI	Numeric	15	0	API Well Number for Field Discovery Well
2	WELLAPI	Numeric	15	0	Well API Number
3	WELLNAME	Character	25		Well Name
4	NUM	Character	6		Well Number
5	SERIAL	Numeric	7	0	State Serial Number
6	TWN	Character	4		Township of Surface Well Location
7	RNG	Character	4		Range of Surface Well Location
8	SEC	Character	4		Section of Surface Well Location
9	DV	Character	2		Directional Well (Y=Yes), N=NO)
10	LAT	Character	12		Latitude of Surface Location, Deg, Min, Sec
11	LONG	Character	12		Longitude of Surface Well Location, Deg, Min, Sec
12	TD	Numeric	7	0	Total Measured Well Depth, ft RKB
13	TVD	Numeric	7	0	Total True Vertical Well Depth, ft RKB
14	SDATE	Character	9	0	Start Date
15	STATUS	Numeric	5	0	Well Status Code used in PARS Database

Table 5.4 — File Structure for WELLID.DBF

5.5 Lease or Unit Wells (WELLLUW.DBF)

This file defines the time period when various API well numbers were included in a given LUW code. The file structure used is shown in Table 5.5.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	API Well Number
2	SERIAL	Numeric	7	0	Well Serial Number
3	LUWCODE	Numeric	6	0	Lease, Unit, or Well Code used in PARS Database
4	STATUS	Numeric	6	0	Well Status Code
5	BDATELC	Character	6		Year/Month Well Assigned this LUW Code
6	EDATELC	Character	6		Year/Month Well Removed from this LUW Code
7	OPERCODE	Numeric	5	0	Well Operator Identification Code
8	UPERF	Numeric	8	0	Measured Depth of Upper Perforations, ft RKB
9	LPERF	Numeric	8	0	Measured Depth of Lower Perforations, ft RKB
					Number of Records in File = 1550

Table 5.5 — File Structure for WELLLUW.DBF

5.6 Reservoir Wells (WELLRES.DBF)

This file defines all of the wells penetrating each reservoir. It also gives the depths of the formation tops and bottoms in each well and the net reservoir thickness. This data was obtained from well logs in the public domain. The information is not contained in the PARS database. Table 5.6 describes the file structure.

No	Field Name	Type	Width	Dec	Description
1	RESDISCAPI	Numeric	15	0	Reservoir Identification Code
2	WELLAPI	Numeric	15	0	Well API Code
3	STATUS	Numeric	4	0	Well Status code
4	SSCORECT	Numeric	4	0	Correction to add to convert from Log Depth to Subsea
5	NETSAND	Numeric	7	0	Net Sand Thickness, ft
6	RESTOPMD	Numeric	9	0	Measured Depth shown on Log to Reservoir Top, ft
7	RESBTMMD	Numeric	11	0	Measured Depth shown on Log to Reservoir Base, ft
8	RESDEPENV	Character	37		Description of Depositional Environment
9	PRIMEPROD	Character	10		Primary Fluid Contained in Reservoir
10	AGE	Character	15		Geologic Age

Table 5.6 — File Structure for WELLRES.DBF

5.7 Reservoir Completions (RESCOMP.DBF)

This file defines all of the wells completed in each reservoir. It also gives the depths of the formation tops and bottoms in each well and the net reservoir thickness. This data was obtained from well logs in the public domain. The information is not contained in the PARS database. Table 5.7 describes the file structure.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	Well API Code
2	SERIAL	Numeric	6	0	Well Serial Number used in PARS System
3	MAPNAME	Character	15		Abbreviated Well Name Used on Maps
4	RESDISCAPI	Numeric	15	0	Reservoir Identification Code
5	RES_NAME	Character	15		Reservoir Name
6	BDATE RC	Character	6		Beginning Date for Reservoir Completion
7	EDATE RC	Character	6		Ending Date for Reservoir Completion
8	UPERF	Numeric	7	0	Measured Depth of Upper Perforation, ft RKB
9	LPERF	Numeric	7	0	Measured Depth of Lower Perforation, ft RKB
10	OPER	Numeric	5	0	Operator Description Code
11	INJ	Logical	1		Injection Well Flag
12	INJ_FLUID	Character	15		Description of Injected Fluid

Table 5.7 — File Structure for RESCOMP.DBF

5.8 Well Work History (WELLHIST.DBF)

This file gives well work descriptions that are similar to a scout report. The data was obtained from the PARS database. The file structure used is shown in Table 5.8.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	Well API Code
2	HISTORY	Memo	10		Cross referenced to text file in WELLHIST.DBT & FRG

Table 5.8 — File Structure for WELLHIST.DBF

5.9 Well Core Data (COREDATA.DBF)

This file gives available code data by well and by reservoir descriptions that are similar to a scout report. The data was obtained from Core Laboratories and released by well operators. The file structure used is shown in Table 5.9.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	Well API Number
2	RESDISCAPI	Numeric	15	0	Reservoir Identification Code
3	LAB	Character	16		Lab Name
4	LABFILE	Character	16		Lab File Number or Reference Number
5	CORECO	Character	15		Core Lab Company
6	CORETYPE	Character	9		Type of Core (Sidewall or Whole Core)
7	DEPTH	Numeric	8	1	Measured Depth of Core Sample, ft RKB
8	INCHES	Numeric	8	1	Length of Sample, in.
9	PERMMD	Numeric	8	1	Absolute Permeability of Sample, md
10	POREPC	Numeric	8	1	Porosity of Sample, %
11	SO	Numeric	8	1	Oil Saturation of Sample, %
12	SG	Numeric	8	1	Gas Saturation of Sample, %
13	SW	Numeric	8	1	Water Saturation of Sample, %
14	SWI	Numeric	8	1	Irreducible Water Saturation, %
15	FLUORESC	Character	32	0	Description of Sample Fluorence, etc

Table 5.9 — File Structure for COREDATA.DBF

5.10 Well Log Headings (LOGHEAD.DBF)

This file gives information from well-log headings by field and well. The information was obtained from well logs in public files of the Department of Natural Resources. The file structure used is shown in Table 5.10.

No	Field Name	Type	Width	Dec	Description
1	FLDDISCAPI	Numeric	15	0	Field Identification Code
2	WELLAPI	Numeric	15	0	API Well Identification Code
3	COMPANY	Character	13		Company Name
4	WELL	Character	23		Well Name
5	KB	Numeric	6	1	Kelly Bushing Elevation, ft above MSL
6	DF	Numeric	7	1	Derrick Floor Elevation, ft above MSL
7	GL	Numeric	8	1	Ground Level Elevation, ft above MSL
8	DATE	Character	6		Log Date
9	RUN_NO	Numeric	3	0	Log Run Number
10	DEPTHDR	Numeric	7	0	Measured Depth of Well by Driller, ft RKB
11	DEPTHLOG	Numeric	7	0	Measured Depth of Well by Logger, ft RKB
12	BTMINT	Numeric	7	0	Bottom of Interval Logged, ft RKB
13	TOPINT	Numeric	7	0	Top of Interval Logged, ft RKB
14	CSGDR	Numeric	10	0	Measured Depth of Casing Seat by Driller, ft RKB
15	CSGLOG	Numeric	10	0	Measured Depth of Casing Seat by Logger, ft RKB
16	CSGSZ	Numeric	7	0	Casing Size, in.
17	BITSIZE	Character	8		Bit Size, In.
18	TYPE_FLUID	Character	32		Type of Drilling Fluid in Well
19	DENS	Numeric	7	1	Density of Drilling Fluid in Well, Lb/Gal
20	VISC	Numeric	5	0	Plastic Viscosity of Drilling Fluid in Well, cp
21	PH	Numeric	5	1	pH of Mud Sample
22	FLLOSS	Numeric	7	1	API Water Loss of Mud Sample, ml /30 min
23	SAMSOURCE	Character	10		Source of Mud Sample
24	RM	Numeric	8	2	Resistivity of Mud Sample, ohm-m
25	RMTEMP	Numeric	8	0	Temperature of Mud Resistivity Measurement, Deg F
26	RMF	Numeric		3	Resistivity of Mud Filtrate Sample, ohm-m
27	RMFTEMP	Numeric	8	0	Temperature of Filtrate Resistivity Measurement, Deg F
28	RMC	Numeric	6	3	Resistivity of Mud Cake Sample, ohm-m
29	RMCTEMP	Numeric	8	0	Temperature of Cake Resistivity Measurement, Deg F
30	RMFSOURCE	Character	10		Source of Mud Filtrate Resistivity
31	RMCSOURCE	Character	10		Source of Mud Cake Resistivity
32	RMBHT	Numeric	6	3	Resistivity of Mud at Bottom Hole Temperature, ohm-m
33	BHT	Numeric	4	0	Bottom Hole Temperature, Deg F
34	CIRCSTOP	Character	9		Time that Circulation of the Well was Stopped
35	LOGONBTM	Numeric	10	0	Time that the Logging Tool was on Bottom
36	MAXRECTEMP	Numeric	10	0	Maximum recorded Temperature during Log, Deg F
37	EQUIP	Numeric	6	0	Identification Number of Logging Tool
38	LOCATION	Character	10		Home Location of Logging Tool
39	TIMESICIRC	Numeric	14	1	Time Since Circulation
40	TYPE_LOG	Character	13		Description of the Types of Logs that were run

Table 5.10 — File Structure for LOGHEAD.DBF

5.11 Well Tubulars Headings (WELLTUB.DBF)

This file gives information concerning the size and setting depths of the tubulars used in the well. The information was obtained from the PARS database. The file structure used is shown in Table 5.11.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	Well API Number
2	FIELDSTCD	Numeric	6	0	Field State Code used in PARS Database
3	SERIAL	Numeric	9	0	State Well Serial Number used in PARS Database
4	TUBING	Numeric	13	0	Measured Depth to Bottom of Tubing, ft RKB
5	DATE	Character	12		Date this Configuration of Tubulars became effective
6	CASINGSIZE	Numeric	7	3	Casing Size, in.
7	CASINGTOP	Numeric	11	0	Measured Depth to Casing Top, ft RKB
8	CASINGBTM	Numeric	11	0	Measured Depth to Bottom of Casing, ft RKB
9	HOLESIZE	Numeric	7	3	Hole Size, in.
10	TESTPRES	Numeric	9	0	Test Pressure for Casing, psi
11	TESTTIME	Numeric	13	0	Length of Time of Pressure Test, min

Table 5.11 — File Structure for WELLTUB.DBF

5.12 Well Test Data (WELLTEST.DBF)

This file gives information concerning well-production tests which should be reported bimonthly for each well. In practice, reported well tests may not occur at regular intervals. The information was obtained from the PARS database. The file structure used is shown in Table 5.12.

The production tests are cross referenced both by API well number and by state serial number. The perforated interval corresponding to the tests is also given. Use of this file and WELLLUW.DBF allows the well tests to be associated with the various LUW codes for a given time.

A reservoir identification-code field has been added to allow well-test data to be quickly grouped by reservoir. Adding this field quickens production-rate retrieval by reservoir software. Reservoir identification is also possible by using the file RESCOMP.DBF to determine the wells completed in a specific reservoir of interest at a given time.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	API Well Number for tested well
2	SERIAL	Numeric	8	0	Well Serial Number used in PARS Database
3	RESDISCAPI	Character	15		Reservoir Identification Code
4	TESTDATE	Character	8		Test Date
5	UPERF	Numeric	6	0	Measured Depth of Upper Perforation, ft RKB
6	LPERF	Numeric	6	0	Measured Depth of Lower Perforation, ft RKB
7	BOPD	Numeric	7	0	Oil Rate during Test, STB/D
8	MCFPD	Numeric	7	0	Gas Rate during Test, MSCF/D
9	BCPD	Numeric	7	0	Condensate Rate during Test, STB/D
10	BWPD	Numeric	7	0	Water Flow Rate Per Day, STB/D
11	GASGR	Numeric	6	1	Gas Specific Gravity
12	OILGR	Numeric	6	1	Oil API Gravity
13	GOR	Numeric	11	0	Gas Oil Ratio of Oil Well, SCF/STB
14	CHOKE	Numeric	9	0	Choke bean Size, 64th of an inch
15	FTP	Numeric	10	0	Flowing Tubing Pressure During Test, psi
16	SITP	Numeric	8	0	Last Shut in Tubing Pressure since the Last Test, psi
17	CASING	Numeric	7	0	Observed Casing Pressure, psi
18	SIBHP	Numeric	7	0	Last BHP measured since the Last Test, psi
19	LINE	Numeric	12	0	Line Pressure, psi
20	P	Character	3		Code used in PARS System (v = verified).

Table 5.12 — File Structure for WELLTEST.DBF

5.13 Well Production Data (WELLPROD.DBF)

This file gives information concerning monthly well production rates for the reservoirs of interest. Data were obtained from various sources. When available, operator data were used. In some cases, monthly operator-production data were available. In other cases, only quarterly or yearly data were available for some wells. For these latter cases, monthly production was obtained assuming a constant rate over the quarter or year in question. The CODE data field identifies whether operator data were monthly, quarterly, or yearly. When no operator data were available for a well, production rates were estimated from the PARS database as described in the next chapter. The file structure used is shown in Table 5.13.

No	Field Name	Type	Width	Dec	Description
1	DATE	Date	8		Date giving year and month for monthly production
2	WELLAPI	Numeric	15	0	API Well Number for produced well
3	RESDISCAPI	Character	15		Reservoir Identification Code
4	LIQ_STB	Numeric	7	0	Oil Production for Month, STB
5	GAS_MCF	Numeric	8	0	Gas Production for Month, MCF
6	WATER_STB	Numeric	6	1	Water Production for Month, STB
7	MISC_MCF	Numeric	8	0	Gas Injected, MCF
8	MISC-STB	Numeric	10	0	Liquid Injected, STB
9	CODE	Character	8		Code for time period of original operator data
					(M= monthly data, Q=quarterly data, Y=yearly data)

Table 5.13 — File Structure for WELLPROD.DBF

5.14 Well Shut-in Formation-Pressure Data (WELLSIFP.DBF)

This file gives information concerning shut-in bottom-hole pressure tests. These data were obtained from various sources other than the PARS system. The file structure is given in Table 5.14.

No	Field Name	Type	Width	Dec	Description
1	WELLAPI	Numeric	15	0	API Well Number
2	SERIAL	Numeric	8	0	Serial Number for Completion used in PARS System
3	RESDISCAPI	Character	15		Reservoir Identification Code
4	DATE	Date	8	0	Date of Pressure Test
5	DATUM	Numeric	6	0	Depth at which Bottom Hole Pressure is Referenced, ft
6	SIBHP	Numeric	8	0	Shut-in Bottom Hole Pressure, psi

Table 5.14 — File Structure for WELLSIFP.DBF

5.15 Code Description Files (AREACODE.DBF, OPERCODE.DBF, STATCODE.DBF)

These files describe the code fields adopted from the PARS database. AREACODE.DBF identifies the different areas of the state used in the reports of the Department of Natural Resources. OPERCODE.DBF gives the company names corresponding to the various company codes used by the state. STATCODE.DBF defines the well status code field used in the PARS database.

5.16 ASCII File Format (*.TXT)

The Pilot Oil Atlas database software has the capability of exporting data into an ASCII file format. These files are given a "TXT" file name extension. The database user must provide the name of the file where the desired data is to be exported. The file export capabilities are described in more detail in Chapter 7.

6. ALGORITHMS FOR PRODUCTION BY RESERVOIR

As discussed in the previous chapters, public domain production data in Louisiana is entered by LUW code rather than by individual well. This sometimes makes it difficult to retrieve production data by reservoir. Without production data, an analysis of the recovery efficiency of a reservoir cannot be achieved. Because most of the oil resources of the state have already been produced, only marginal benefits could be achieved by a change in the reporting system. Such a change would also be costly to both the state and the operating companies and thus is not recommended.

In this study, two algorithms were tried for estimating reservoir production from the available data. The results from use of these algorithms were then compared to data released to us by the operators. It was found that in the cases studied, reasonably accurate reservoir production rates could be estimated from the available public data.

6.1 Algorithm Descriptions

The general procedure followed to obtain reservoir production rates was to first estimate the production of each well on a monthly basis, and then sum the production from all the wells completed in the reservoir of interest during each month. The manner in which the monthly production was estimated varied, depending on the complexity of the relationship between wells and LUW code.

The simplest situation occurred when there was only one well included in the LUW code. In this case, the monthly production for the well was equal to the reported LUW production. The file WELLLUW.DBF permitted the API well number corresponding to the LUW code to be determined for the time of interest.

When a LUW code corresponded to more than one well, an attempt was made using well-test data to allocate the LUW production among the wells included in the total. The well production is then given by:

$$Q_{i,t} = \frac{q_{t,i}}{\sum_{l=1}^{nl} q_{t,l}} Q_{1,t} \dots\dots\dots (6.1.1)$$

where :

- $Q_{i,t}$ = the monthly production for well i at time t.
- $q_{i,t}$ = the well daily flow rate for well i at time t from well test data.
- $\sum_{l=1}^{nl} q_{t,l}$ = the sum of the daily flow rates from well test data at time t for all nl wells included in the LUW code.
- $Q_{1,t}$ = the total monthly production at time t reported by LUW code.

This approach was used to allocate production among wells even when the set of wells included in the LUW code were the same as the set of wells for the reservoir. For this situation, the total reservoir production corresponded to the reported LUW production. However, it was still desirable to have production by well for use in reservoir-simulation software.

In some cases, Equation (6.1.1) could not be used because of missing data in the database. For these cases, the monthly production rate was estimated from well-test data alone. This was accomplished using the following formula:

$$Q_{i,t} = q_{t,i} n_t \dots\dots\dots (6.1.2)$$

where : $Q_{i,t}$ = the well monthly flow rate for well i at time t.
 $q_{t,i}$ = the well daily flow rate for well i at time t from well test data.
 n_t = the number of days of the month at time t.

Equation (6.1.2) always had to be used to obtain water production because only hydrocarbon production is reported by LUW code.

Once the monthly production is determined for each well, the total production for the reservoir can be obtained by summing the production for all wells in the reservoir. The reservoir in which each well is completed in at time t is available in RESCOMP.DBF. The monthly production by well is then stored in WELLPROD.DBF.

The relative accuracy of Equation (6.1.1) and Equation (6.1.2) was tested for a number of wells for which operator data were available. Although Equation (6.1.1) is forced to yield the correct total production by LUW code, it did not necessarily produce more accurate results than Equation (6.1.2) on a per-well basis. As the number of wells included in the LUW code increased, the ability to accurately prorate production to the various wells decreased. Using either Equation (6.1.1) or Equation (1.1.2), errors in monthly production for a given well sometimes reached 50%. However, the errors tended to average out with either longer time periods or more wells. Yearly production errors for a given well were usually less than 20%. Overall errors for the total yearly reservoir production tended to be negligible for the reservoirs studied. In many cases, the LUW codes corresponded to reservoirs after a reservoir-wide unit was formed.

6.2 Example Application

In Table 6.2.1, the determination of reservoir production from the PARS system is illustrated for the year of 1979 for the Sparta B sand, reservoir A, Fordoche field, in Pointe Coupe Parish, Louisiana.

We first determine that Fordoche field has a field identification code of 17077001690000 and a state field code of 3913 using FIELDID.DBF. The reservoir identification code is determined to be 17077201010000 using RESID.DBF. The wells completed in this reservoir during 1977 are given in RESCOMP.DBF. They include API well number 17077201010000, perforated 11570–78 ft RKB; well number 17077201500000, perforated 11569–572 ft RKB; and well number 17077201510000, perforated 11562–68 ft RKB. Finding these well identification numbers in WELLLUW.DBF showed that during 1977 all of these wells had a LUW code of 32397. Using this LUW code in LUWPROD.DBF indicated that the reported production was for three wells. Thus, for this case, the reported LUW production corresponded to the total production from the reservoir.

The reported production for LUW code 32397 is given in the third column of Table 6.2.1. The crude-oil production reported for each of the three wells during 1979 was obtained from WELLTEST.DBF and are shown in columns 5–7. The monthly production, Q_{t1} , for API well number 17077 20101 0000 was allocated using both Equation (6.1.1) and (6.1.2). The results are shown in columns 10 and 11, respectively. The monthly production released to us by the well operator is given in column 12 for comparison. Note that errors approaching 40% are present for some monthly production values using either equation. However, the total yearly production for this well is off by less than 20%. Of course, if the calculations were done for all three wells, the error in the total reservoir production would reduce to zero. This is true in this case because the LUW code wells are the same as the reservoir wells.

Year	Month	LUW Oil Prod (STB)	No. Wells	q_{t1} 20101 (STB/D)	q_{t2} 20150 (STB/D)	q_{t3} 20151 (STB/D)	Σq_t (STB/D)	$\frac{q_{t1}}{\Sigma q_t}$	Q_{t1} Eqn 6.1.1	Q_{t1} Eqn 6.1.2	Q_{t1} (Oper)
1979	Jan	7685	3	66	80	114	260	0.2538	1950	2046	2865
	Feb	6029	3						1530	1848	2385
	Mar	6541	3	76	55	72	203	0.3654	2390	2356	2502
	Apr	6306	3						2304	2280	1968
	May	6547	3	53	60	88	201	0.2637	1726	1643	2623
	Jun	7437	3						1961	1590	2210
	Jul	6388	3	59	64	76	199	0.2965	1894	1829	2305
	Aug	7085	3						2101	1829	2332
	Sep	5794	3	71	71	87	229	0.3100	1796	2130	2050
	Oct	5790	3						1795	2201	2487
	Nov	5304	3	53	52	84	219	0.2420	1284	1590	2214
	Dec	5469	3						1323	1643	2175
	TOTAL	76375	3						22054	22985	28116

Table 6.2.1— Example Production Allocation by Well

7. USE OF DATABASE

The database is in a DBASE format that can be read by many database systems and spreadsheets. We primarily used the Ashton-Tate DBASE IV database management system with Microsoft DOS 5.0. The DBASE IV system that we used cannot be distributed without a license for each copy. Some work was also done in Microsoft Windows 3.0 using dBFast for Windows by genSoft. The dBFast package makes provisions for developing applications that can run without the main database software package and without the need of a license for each copy. We have included on the diskettes a DBFAST application program that illustrates the use of an oil atlas database for screening reservoir performance. However, not all of the database records can be accessed using this DBFAST program. The user must have access to a database software package to be able to view all data fields of the files. Fields of the "memo" type cannot be seen using the view option of the DBFAST program. Also, files having a large number of data fields may appear truncated.

7.1 Program Requirements

It should be possible to run the program on any IBM personal computer or clone that will run Microsoft Windows version 3.0 or higher and has at least 2 megabytes of memory. Program development was done on a Compuadd 433E with 4 megabytes of memory.

7.2 Pilot Atlas Installation

Installation of the demonstration module for the pilot atlas on drive "C" is accomplished by inserting the install diskette, changing the current directory to the drive containing the diskette, and then typing "INSTALL C." A sub-directory \ATLAS\ will be created on the hard drive for the database files. A sub-directory \ATLAS\IMG will be created for the map and type log image files. A sub-directory \ATLAS\DBFAST\ will be created for the executable application programs. In addition, a sub-directory \ATLAS\OUTPUT will be created for ASC II output files that could be generated when running the application software.

7.3 Program Use

Two executable files are included. The first file, VIEW.EXE, allows the basic database files (*.dbf) to be viewed on the screen when a DBASE software package such as DBASE IV is not available to the user. The second executable file, DEMO.EXE, extracts the type of information presented in chapter 3 from the database. It also permits exporting the data to an ASC II file. The program can be started after starting windows, by selecting the **Run** command of the **File Menu** in **Program Manager**. The fully qualified name of the executable file should be given. For example, assuming the C drive is the root drive, use C:\ATLAS\DBFAST\DEMO for the file name to run DEMO.EXE. The program can also be started by double-clicking on the executable file in **File Manager**. In addition, A run "icon" can be made by dragging the executable file from a window containing **File Manager** to a window containing an applications group within **Program Manager**.

7.4 Field Menu

The first menu shown by the program allows the user to select the oil field of interest. The user simply clicks the appropriate button.

7.5 Reservoir Menu

The next menu shown by the program allows the user to select the reservoir of interest. The user simply clicks the appropriate button.

7.6 Data Type Menu

The next menu shown by the program allows the user to select the reservoir data of interest. The user simply clicks the appropriate button. For each reservoir, the information that can be recalled is the same information given in chapter 3. In addition, a TORIS report can be requested that will give database information in a TORIS format.

7.7 Production-Data Menu

The next menu shown by the program allows the user to select the desired form of the production data. Production can be shown by month or year, well or reservoir. The user clicks the appropriate buttons. If desired, the production data can also be exported to a file in the ATLAS\OUTPUT sub-directory. A file name will be requested when the confirm selection box is checked. If Windows supported spreadsheet software such as Microsoft EXCEL is available, the production data can be imported or even automatically linked to graphical display files.

Pilot Oil Atlas for Louisiana

Select Production Data Format

Start Showing Production Data

Exit Program Reservoir Menu

Field Menu Data Type Menu

Select Time Interval

☐ Monthly

☒ Yearly

☒ Export File

File Name

4400.TXT

Confirm Selection

Cancel

Select Type of Report

☐ By Reservoir

☒ By Well

Well Chooser

Wells

LLE 78

SLM1

SLM7

7.8 Toris Database Information

If the TORIS report button is selected, a menu is shown allowing the user to either view the data on the screen by TORIS record number or export all five TORIS records to an ASCII output file. If the Export-to-File button is selected, the user will be asked for a file name. Exported files will be placed in the ATLAS\OUTPUT\ sub-directory.

Pilot Oil Atlas for Louisiana

Toris Database Information

Display Information

Export to File

Record 1

Record 2

Record 3

Record 4

Record 5

Field Menu

Reservoir Menu

Data Type Menu

Exit Program

8. RECOMMENDATIONS

The pilot oil atlas was intended to serve as a model for possible future expansions of electronic databases that would be useful to industry and government in evaluating Louisiana's remaining oil and gas resources and in planning future activities. As a result of the work done on the pilot atlas in this study, the following recommendations have been made.

1. Technology-transfer activities within the LSU Department of Petroleum Engineering, the Louisiana Geological Survey, and the Basin Research Institute should continue to include efforts to improve the available information on oil and gas resources in the state. These activities should be especially directed at assisting small independent operators.

2. The Pilot Atlas database structure should be modified to handle gas and oil reservoirs in the same database. While it is not envisioned that extensive changes are needed, the database should be used in the study of several gas reservoirs to determine the additional data requirements. Future exploration in Louisiana will tend to be directed more toward gas reservoirs than oil reservoirs. Although the market for gas is currently poor, this situation will likely change in the future.

3. An on-line facility for downloading PARS data to disk files on a personal computer should be installed at the LSU Department of Petroleum Engineering. This would permit the supplementary data needed for reservoir recovery efficiency studies to be easily merged with PARS data without having to duplicate information already in the PARS database system.

3. Reservoir data should continue to be added to the database. Reservoirs should be selected for study based on current interest. They could be carried out each year in connection with reservoir wide hearings that are held by the Office of Conservation. Annual publications of public data on selected reservoirs would be useful to the industry and the state. An added benefit would be the training afforded the students involved in the studies.

4. Consideration should be given to introduce legislation that would make public any core, log, or fluids-properties data collected by operating companies that are no longer in business. Currently, service companies holding such data may not release the information if they were not given permission by the operating company. In general, insufficient core data were generally available in the public domain to permit reservoir heterogeneity features (type, scale, effect on pore systems) to be addressed.

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