

***LOUISIANA  
WELLBORE  
COMPLETION  
SCHEMATICS  
AND  
FORMATION TOPS***

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## Introduction

The purpose of this report is to provide some typical wellbore completion designs used in drilling and completing wells in onshore oil and gas producing parishes of North and South Louisiana. Examples of selected wellbore schematics are presented for most of the producing intervals including lithologies and formation tops that are penetrated. The reader will observe that the producing areas of the state have been divided into a northern and a southern region in view of the fact that the regions possess a few fundamental differences that influence the drilling and completion methodologies that must be applied and thus their economics. Perhaps the more notable differences are: 1) the lithologies of the rocks that are drilled through, 2) the hydrocarbon fluids that are produced, and 3) the drilling depths to the reservoirs.

With respect to the first point, in North Louisiana the rock formations are older (Jurassic and Cretaceous in age), with the exception to localized Tertiary near surface deposits (Wilcox and Claiborne Groups and the Midway Formation), and contain both clastic (sandstone) and carbonate (chalk, limestone, marl) lithologies. In South Louisiana the formations that are drilled to reach the producing reservoirs are younger (Tertiary in age), with exception to the Upper Cretaceous Austin Chalk and Tuscaloosa plays. Also, the rocks are predominantly clastic in nature with minor Tertiary calcareous intervals and carbonates of the Austin Chalk. Regarding the second point, the northern reservoirs produce oil and abundant gas with large areas producing free gas (e.g. Monroe Gas Field). Although deeper gas plays (+ 17,000') are now being drilled, south Louisiana's shallower producing reservoirs tended to be more oil prone. Finally, in the north the reservoirs are shallower, averaging 6000 feet in depth. In the southern parishes of the State, except for earlier shallow production associated with salt domes, and scattered shallow (3500') Miocene gas in the Florida Parishes, they tend to be much deeper, averaging 12,000 feet in depth.

Regarding drilling costs, up-to-date information is more difficult to obtain because such costs are constantly changing as a function of drilling activity, which is ultimately driven by oil and gas prices and the availability of rigs. However, because of their importance in planning drilling operations, an attempt was made to obtain drilling cost data and approximate numbers are provided together with examples of authorizations for drilling expenditures (AFE). The costs shown on the AFE examples are also only approximations based on averages obtained from a variety of sources and in the published literature. These can be helpful because they indicate some of the parameters that should be taken into account when putting together a drilling program. It is worth mentioning that during the search for the data it was observed that drilling and completion practices are not standardized and vary a great deal from place to place. This can be attributed to the existence of a large number of small independent operators who have adopted their own "best practices" based on their experience in areas they operate, the characteristics of the reservoirs, and most importantly the size of their individual budgets. Nevertheless, useful drilling and completion data are generally reported and can be found in the public records of the Louisiana Department of Natural Resources.

### *A Blink at the History of Louisiana's Petroleum Industry*

The date that is given for the initiation of the petroleum industry in Louisiana is 1866. At this time, only seven years after Colonel Drake's oil discovery on August 28, 1859 in Pennsylvania, the first exploratory well was drilled by hand in Calcasieu Parish. However, it was not until 1901 that the first commercial production began at Jennings in South Louisiana, with the drilling of the Scott Heywood well. In North Louisiana, the first oil production began in Caddo Parish in 1906. The huge Monroe Gas Field was discovered in 1916 near Monroe and covers parts of Union, Morehouse, and Ouachita

Parishes. Drilling of the first well far offshore in the Gulf of Mexico, south of Morgan City, did not occur until 1947. From the beginning to the present day, petroleum professionals have constantly improved their drilling and production technologies allowing them to drill to deeper targets and to produce at higher rates. Details of these and other events regarding Louisiana's petroleum history have been well documented. Perhaps the two most interesting and thorough accounts about Louisiana's earlier developments in our industry can be found in the following publications:

*French, T. M. and M. Lam, (1986), "Oil and Gas Production Industry In Louisiana, A Short History With Long Term Projections," Louisiana Department of Natural Resources, Energy Division, Technology Assessment Division, 42 pp.*

*Lindstedt, D. M., L. L. Nunn, et al (1991), "History of Oil and Gas Development in Coastal Louisiana," Louisiana Geological Survey, Resource Information Series No. 7, 131 pp.*

### Available Information Systems

There are several commercial online information systems containing oil and gas databases (wells, fields, drilling costs, production, etc.) that are easily accessible for a price. Those in the public domain considered the most complete for Louisiana are the following:

*Department of Natural Resources "SONRIS 2000 Integrated Applications." Production data is from 1977 to the present. It functions well with Internet Explorer's web browser, but with difficulty using Netscape. The web site is <http://sonris-www.dnr.state.la.us>*

*Central Gulf Region/Petroleum Technology Transfer Council (CGR/PTTC) web site: <http://www.cgrpttc.lsu.edu>. In the Tech Transfer Section, oil and gas information for Louisiana is listed with production data reported from 1977 to 1999.*

### Publications and Reports

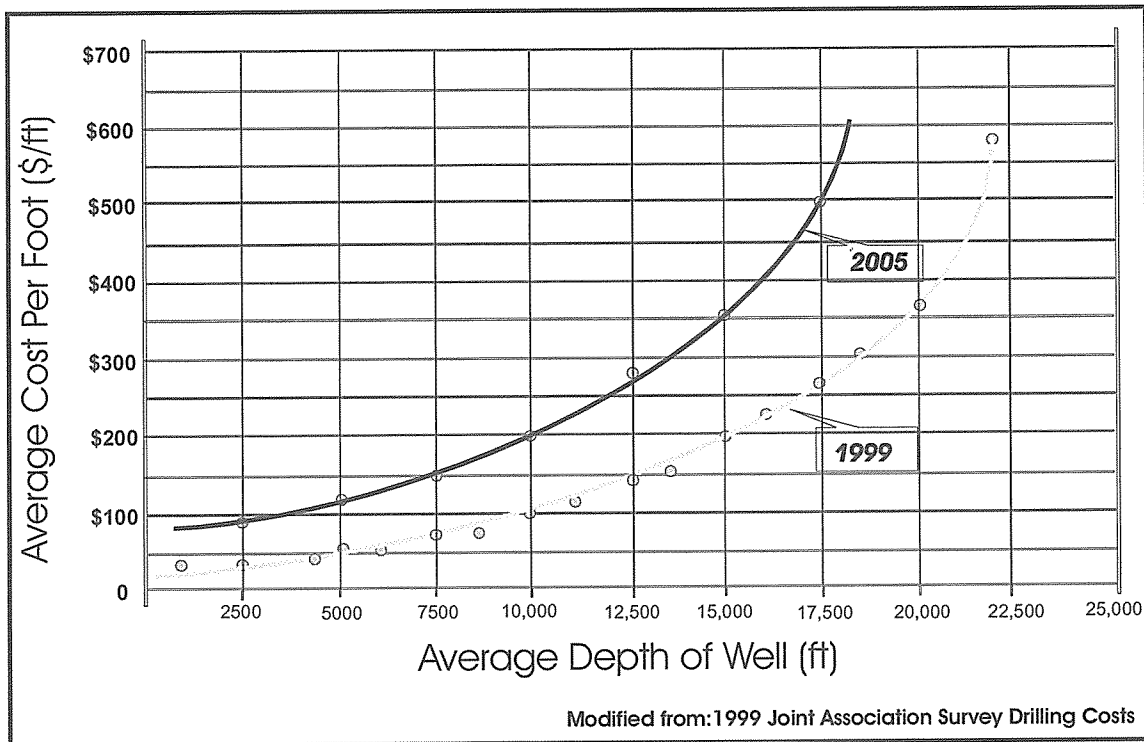
Information regarding Louisiana's petroleum producing formations and reservoirs is well documented in numerous technical publications and reports. The most important of these, and the sources of most of the geological data provided with the wellbore schematics presented in this report are the following:

- *Transactions of The Gulf Coast Association of Geological Societies (GCAGS), 1951 – 2000.*
- *Reports of the Lafayette Geological Society: "Typical Oil and Gas Fields of Southwestern Louisiana," vol 1, 1964; vol. 2, 1970; vol. 3, 1989.*
- *Reports of the New Orleans Geological Society: "Oil and Gas Fields of Southeast Louisiana," vol 1, 1965; vol. 2, 1967; vol. 3; 1983.*
- *Reports of The Shreveport Geological Society: "Reports of Selected Oil and Gas Fields of North Louisiana and South Arkansas," Vol. III, no.1, 1951; Vol. III, no. 2, 1953; Vol. IV, 1958; Vol. V, 1963; Vol. VI, 1980; vol. VII, 1987.*
- *Atlas of Major Central and Eastern Gulf Coast Gas Reservoirs, 1992, Sponsored by the Gas Research Institute and coordinated and edited by the Bureau of Economic Geology at The University of Texas at Austin. 88 pp.*
- *Bulletins of the American Association of Petroleum Geologists.*

## Acknowledgements

Louisiana State University Center for Energy Studies and the Central Gulf Region Petroleum Technology Transfer Council (CGR/PTTC) provided financial support for the publication of the document. Mr. Raymond J. Lasseigne, P.E. provided invaluable help in the design of the wellbore schematics and his critical review helped improve the quality of the information presented.

## Average Drilling Cost Per Foot 1999 & 2005



Well Depth(Ft)	1999 \$/Ft	2005 \$/Ft
2500	40	80
5000	55	110
7500	75	150
10,000	100	200
12,500	140	280
15,000	200	350
17,500	260	500

## Average Drilling Costs For Louisiana

Oil Wells	Average. Depth/Feet	1999(\$) Cost/Well	2005(\$) Cost/Well
North Louisiana	4,338	327,000	477,000
South Louisiana	11,807	2,428,000	2,775,000
<b>Gas Wells</b>			
North Louisiana	6,794	559,000	850,000
South Louisiana	11,974	3,058,000	3,300,000
<b>Dry Holes</b>			
North Louisiana	4,626	231,000	350,000
South Louisiana	10,380	1,764,000	2,000,750
<b>All Wells</b>			
North Louisiana	6,084	460,000	750,000
South Louisiana	11,284	2,448,000	2,825,000
<i>Modified from: 1999 Joint Association Survey on Drilling Costs</i>			

**Costs Per Foot of Crude Oil and Natural Gas Wells Drilled,  
1975-2003**

(Source: American Petroleum Institute,  
2003 Joint Association Survey on Drilling Costs)

Year	Costs per Foot (dollars)				
	Crude Oil <sup>1</sup>	Natural Gas <sup>2</sup>	Dry Holes <sup>3</sup>	All	
	Nominal	Nominal	Nominal	Nominal	Real
1975	34.17	46.23	33.86	36.99	97.34
1976	37.35	49.78	36.94	40.46	100.66
1977	41.16	57.57	43.49	46.81	109.49
1978	49.72	68.37	52.55	56.63	123.76
1979	58.29	80.66	64.60	67.70	136.64
1980	66.36	95.16	73.70	77.02	142.52
1981	80.40	122.17	90.03	94.30	159.51
1982	86.34	146.20	104.09	108.73	173.34
1983	72.65	108.37	79.10	83.34	127.81
1984	66.32	88.80	67.18	71.90	106.27
1985	66.78	93.09	73.69	75.35	108.09
1986	68.35	93.02	76.53	76.88	107.90
1987	58.35	69.55	51.05	58.71	80.21
1988	62.28	84.65	66.96	70.23	92.78
1989	64.92	86.86	67.61	73.55	93.63
1990	69.17	90.73	67.49	76.07	93.23
1991	73.75	93.10	83.05	82.64	97.86
1992	69.50	72.83	67.82	70.27	81.35
1993	67.52	83.15	72.56	75.30	85.20
1994	70.57	81.90	86.60	79.49	88.07
1995	78.09	95.97	84.60	87.22	94.70
1996	70.60	98.67	95.74	88.92	94.74
1997	90.48	117.55	115.09	107.83	113.01
1998	108.88	127.94	157.79	128.97	133.69
1999	156.45	138.42	182.99	152.02	155.33
2000	125.96	138.39	181.83	142.16	142.16
2001	153.72	172.05	271.63	181.94	177.68
2002	194.55	175.78	284.17	195.31	187.63
2003	221.13	189.95	345.94	216.27	204.03

## Authorization for Expenditure (AFE) (12/2005)

*Estimate for a 5000' Straight Hole w/1000HP Rig (Precompletion Estimate Included)*

				<u>ESTIMATED INTANGIBLE COSTS</u>		
				DRILLING COST	PRECOMPL. COST	TOTAL AFE
Surveys and Permits/Environmental				\$10,000	\$2,500	\$12,500
	<u>Day Rate</u>	<u>Days</u>	<u>Precompl.</u>			
Rig Move (Mob. & Demob.)	\$5,000	4		\$20,000	\$0	\$20,000
Drilling Per Day	\$5,000	5	3	\$25,000	\$15,000	\$40,000
Fuel, Lubes and Water	\$1,000	5	3	\$5,000	\$3,000	\$8,000
Rental Equipment	\$1,000	5	3	\$5,000	\$3,000	\$8,000
Drill Bits				\$20,000	\$2,000	\$22,000
Drilling Mud & Chemicals		5	3	\$75,000	\$0	\$75,000
Mud Logging	\$800	2		\$1,600	\$0	\$1,600
Cement & Squeeze Services				\$50,000	\$15,000	\$65,000
Casing Crews & Tools				\$15,000	\$10,000	\$25,000
Open Hole Logging+MWD/LWD				\$100,000	\$0	\$100,000
Sidewall Cores & Analysis				\$5,000	\$0	\$5,000
Transportation	\$5,000	5	3	\$25,000	\$15,000	\$40,000
Labor	\$2,000	5	3	\$10,000	\$6,000	\$16,000
Supervision	\$850	5	3	\$4,250	\$2,550	\$6,800
P&A Costs	\$25,000	3	0	\$75,000	\$0	\$75,000
Pipe Inspection				\$10,000	\$5,000	\$15,000
Overhead	\$500	5	3	\$2,500	\$1,500	\$4,000
Insurance	\$400	5	3	\$2,000	\$1,200	\$3,200
Communications	\$250	5	3	\$1,250	\$750	\$2,000
				<b>\$461,600</b>	<b>\$82,500</b>	<b>\$544,100</b>

<u>TANGIBLE COSTS</u>						
	<u>Depth (Ft)</u>	<u>Diameter</u>	<u>\$/Ft</u>			
Drive Pipe		30"	220 (not needed)	\$0	\$0	\$0
Conductor		20"	60 (not needed)	\$0	\$0	\$0
Surface Casing		16"	16 (not needed)	\$0	\$0	\$0
Intermediate Casing	400	8-5/8"	25	\$10,000	\$0	\$10,000
Production Liner	5,000	5 1/2 "	12	\$0	\$60,000	\$60,000
Wellhead Equipment				\$50,000	\$10,000	\$60,000
<b>TOTAL TANGIBLES</b>				<b>\$60,000</b>	<b>\$70,000</b>	<b>\$130,000</b>
<b>TOTAL AFE COSTS</b>				<b>\$521,600</b>	<b>\$152,500</b>	<b>\$674,100</b>

### Range of Total Costs

	<u>Base Case</u>	<u>Lower Limit</u>	<u>Higher Limit</u>
Total Rig Cost	\$60,000	\$51,000	\$66,000
Fuel, Lubes and Water	\$8,000	\$6,800	\$8,800
Rental Equipment	\$8,000	\$6,800	\$8,800
Drilling Mud & Chemicals	\$75,000	\$63,750	\$82,500
Mud Logging	\$1,600	\$1,360	\$1,760
Transportation	\$40,000	\$34,000	\$44,000
Labor	\$16,000	\$13,600	\$17,600
Supervision	\$6,800	\$5,780	\$7,480
P&A Costs	\$75,000	\$63,750	\$82,500
Insurance	\$3,200	\$2,720	\$3,520
Communications	\$2,000	\$1,700	\$2,200
Drive Pipe	\$0	\$0	\$0
Conductor	\$0	\$0	\$0
Surface Casing	\$0	\$0	\$0
Intermediate Casing	\$10,000	\$8,500	\$11,000
Production Liner	\$60,000	\$51,000	\$66,000

## Authorization for Expenditure (AFE) (12/2005)

*Estimate for a 10,000' Straight Hole w/1500HP Rig (Precompletion Estimate Included)*

### ESTIMATED INTANGIBLE COSTS

				<u>DRILLING COST</u>	<u>PRECOMPL. COST</u>	<u>TOTAL AFE</u>
Surveys and Permits/Environmental				\$20,000	\$5,000	\$25,000
	<u>Day Rate</u>	<u>Days</u>	<u>Precompl.</u>			
Rig Move (Mob. & Demob.)	\$12,000	7		\$84,000	\$0	\$84,000
Drilling Per day	\$12,000	30	5	\$360,000	\$60,000	\$420,000
Fuel, Lubes and Water	\$1,500	30	5	\$45,000	\$7,500	\$52,500
Rental Equipment	\$2,000	30	5	\$60,000	\$10,000	\$70,000
Drill Bits				\$50,000	\$5,000	\$55,000
Drilling Mud & Chemicals		30	5	\$250,000	\$0	\$250,000
Mud Logging	\$800	5		\$4,000	\$0	\$4,000
Cement & Squeeze Services				\$100,000	\$30,000	\$130,000
Casing Crews & Tools				\$30,000	\$20,000	\$50,000
Open Hole Logging+MWD/LWD				\$300,000	\$0	\$300,000
Sidewall Cores & Analysis				\$15,000	\$0	\$15,000
Transportation	\$8,000	30	5	\$240,000	\$40,000	\$280,000
Labor	\$2,000	30	5	\$60,000	\$10,000	\$70,000
Supervision	\$850	30	5	\$25,500	\$4,250	\$29,750
P&A Costs	\$80,000	5	0	\$400,000	\$0	\$400,000
Pipe Inspection				\$20,000	\$10,000	\$30,000
Overhead	\$700	30	5	\$21,000	\$3,500	\$24,500
Insurance	\$500	30	5	\$15,000	\$2,500	\$17,500
Communications	\$250	30	5	\$7,500	\$1,250	\$8,750
				<b>\$2,107,000</b>	<b>\$209,000</b>	<b>\$2,316,000</b>

### TANGIBLE COSTS

	<u>Depth (Ft)</u>	<u>Diameter</u>	<u>\$/Ft</u>			
Drive Pipe		30"	220 (not needed)	\$0	\$0	\$0
Conductor		20"	60 (not needed)	\$0	\$0	\$0
Surface Casing		16"	16 (not needed)	\$0	\$0	\$0
Intermediate Casing	3,100	9-5/8"	30	\$93,000	\$0	\$93,000
Production Liner	10,000	7 "	13	\$0	\$130,000	\$130,000
Wellhead Equipment				100,000	\$15,000	\$115,000
<b>TOTAL TANGIBLES</b>				<b>\$193,000</b>	<b>\$145,000</b>	<b>\$338,000</b>
<b>TOTAL AFE COSTS</b>				<b>\$2,300,000</b>	<b>\$354,000</b>	<b>\$2,654,000</b>

### Range of Total Costs

	<u>Base Case</u>	<u>Lower Limit</u>	<u>Higher Limit</u>
Total Rig Cost	\$504,000	\$428,400	\$554,400
Fuel, Lubes and Water	\$52,500	\$44,625	\$57,750
Rental Equipment	\$70,000	\$59,500	\$77,000
Drilling Mud & Chemicals	\$250,000	\$212,500	\$275,000
Mud Logging	\$4,000	\$3,400	\$4,400
Transportation	\$280,000	\$238,000	\$308,000
Labor	\$70,000	\$59,500	\$77,000
Supervision	\$29,750	\$25,288	\$32,725
P&A Costs	\$400,000	\$340,000	\$440,000
Insurance	\$17,500	\$14,875	\$19,250
Communications	\$8,750	\$7,438	\$9,625
Drive Pipe	\$0	\$0	\$0
Conductor	\$0	\$0	\$0
Surface Casing	\$0	\$0	\$0
Intermediate Casing	\$93,000	\$79,050	\$102,300
Production Liner	\$130,000	\$110,500	\$143,000



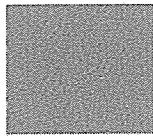


# COLUMNAR SECTION OF LOUISIANA

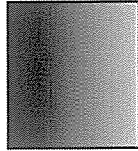
ERATHEM	SYSTEM	SERIES	GROUP	FORMATION MEMBER	
<b>CENOZOIC</b>	<b>Quaternary</b>	Holocene		Recent	
		Pleistocene	<i>Terrace - Associated Deposits, Valley Fill &amp; Loess</i>		
	<b>TERTIARY</b>	Pliocene		Upland Allogroup	
			Miocene		<b>Fleming</b> Anahuac
		Oligocene			<b>Catahoula Frio</b>
			Vicksburg		Nash Creek/Rosefield Sandel
		Eocene	Jackson		Mostey Hill Danville landing Yazoo Clay Moody's Branch
			Claiborne		Cockfield Cook Mountain Sparta Cane River Carrizo
		Paleocene		Wilcox	Sabinetown Pendleton Marthaville Hall Summit Lime Hill Converse Cow Bayou Dolet Hills Naborton
				Midway	Porter's Creek Clay Kincaid
				Navarro	Arkadelphia Nacatoch Saratoga
		<b>MESOZOIC</b>	<b>CRETACEOUS</b>	<b>Gulf</b>	Taylor
	Austin				Brownstown Tokio
	Eagle Ford				Upper Lower
Tuscaloosa	Upper Middle Lower				
Washita					South Tyler Buda Grayson Main Street PawPaw-Weno Denton Fort worth Duck Creek Kiamichi
	Fredricksburg				Goodland Paluxy
Comanche			Trinity	Rusk-Mooningsport Ferry Lake Rodessa James Pine Island	
	Coahuila		Nuevo Leon	Sligo Hosston	
<b>JURASSIC</b>	Upper		CottonValley	Dorcheat Shongaloo Terryville Bossler	
			Louark	Haynesville Smackover Norphlet	
	Middle Lower	Louisiana	Louann Werner		
<b>TRIASSIC</b>	Upper		Eagle Mills		

# **North Louisiana Wellbore Schematics**

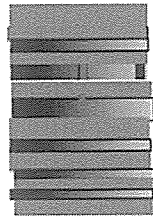
# **LITHOLOGY LEGEND**



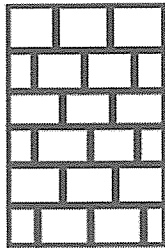
**Predominantly Sandstone**



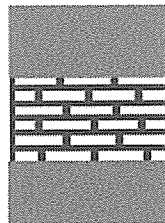
**Predominantly Shale & Siltstone**



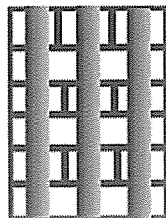
**Predominantly Interbedded  
Sandstone & Shale**



**Predominantly Limestone  
and/or Dolomite, Chalk & Marl**

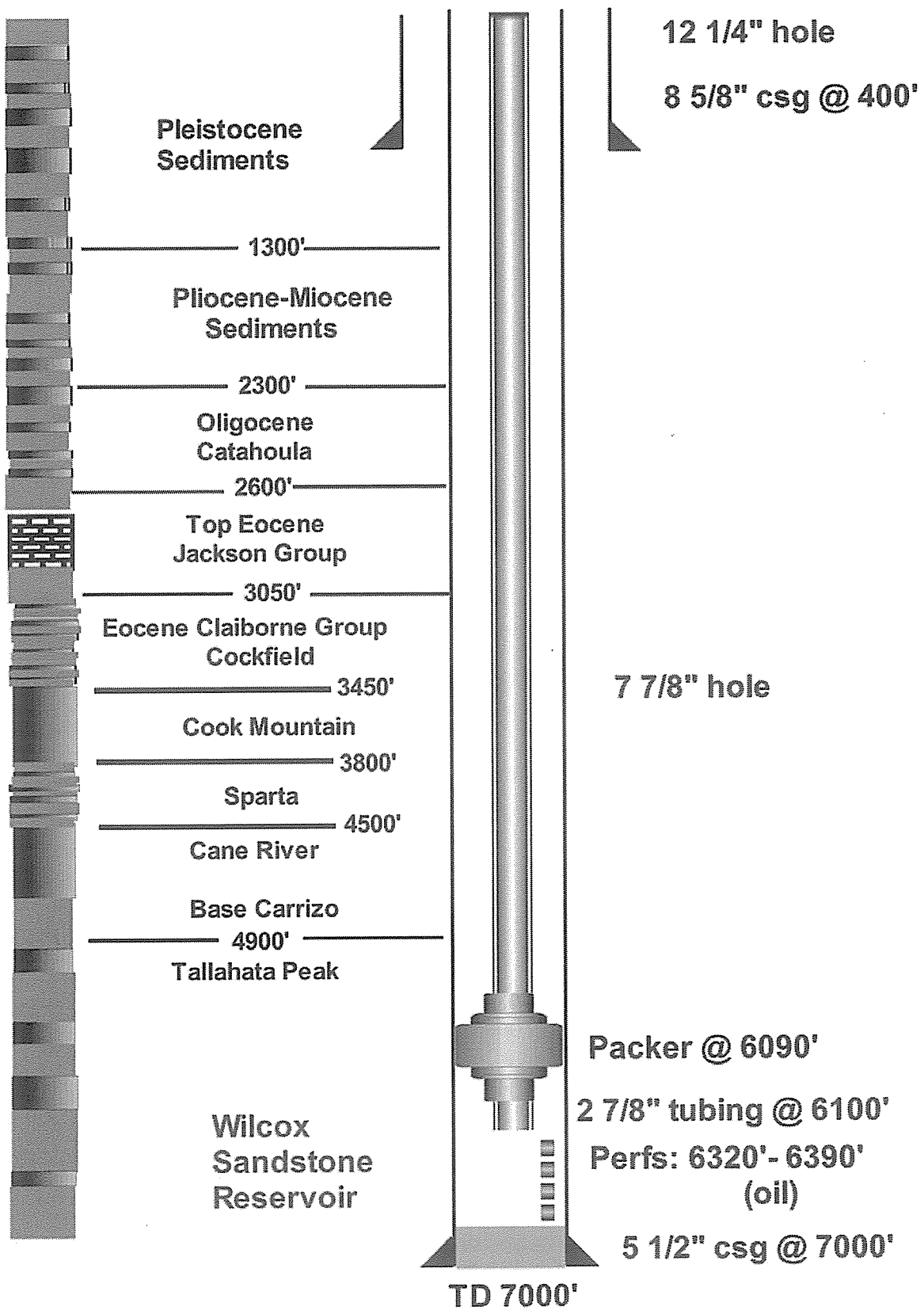


**Predominantly Calcareous  
Sandstone & Limestone**

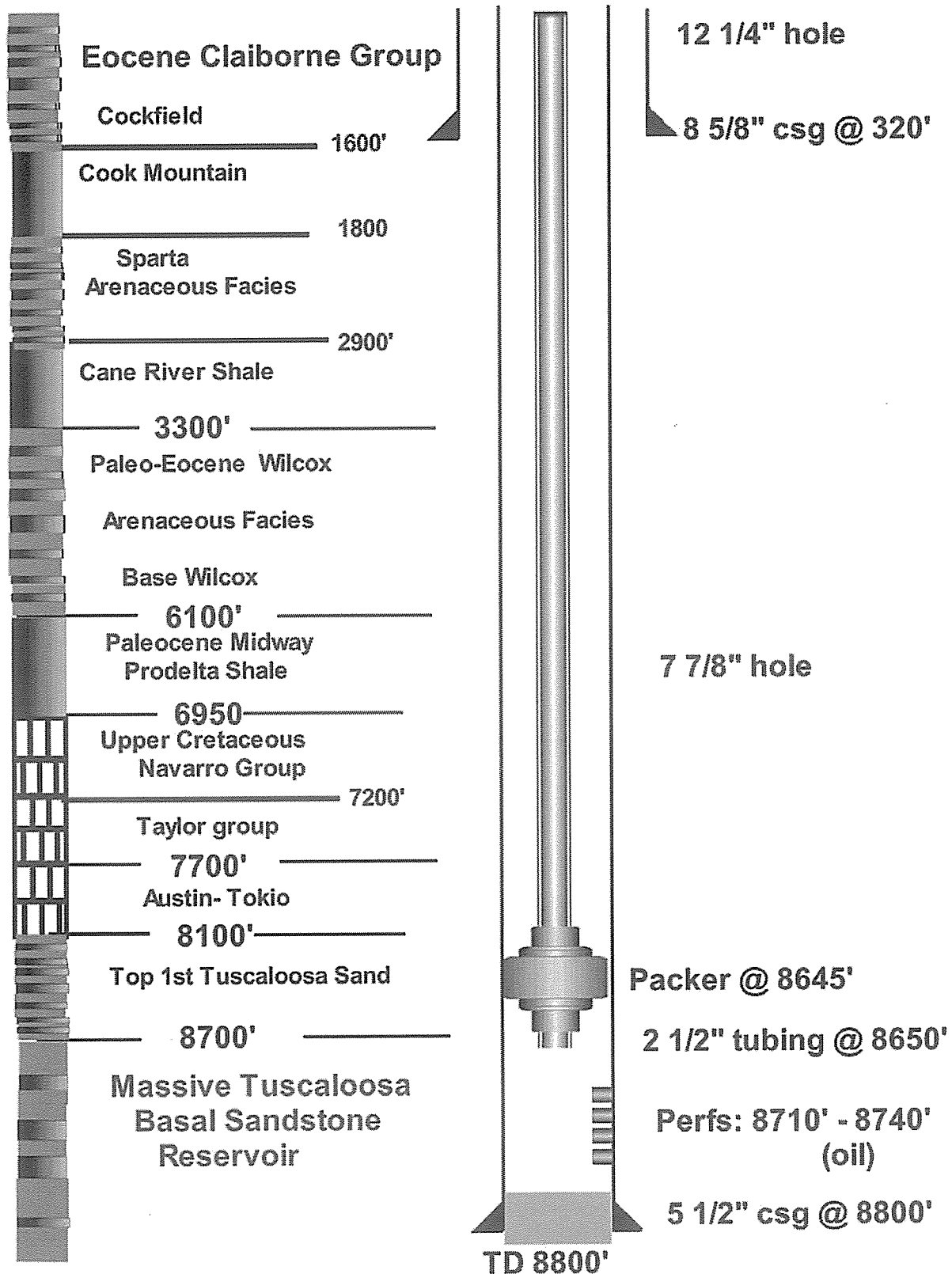


**Anhydrite**

**PALEO-EOCENE WILCOX 7000' WELL  
CONCORDIA PARISH**

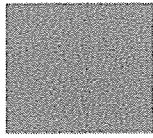


**UPPER CRETACEOUS TUSCALOOSA: 8800' WELL  
TENSAS PARISH**

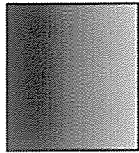


# **South Louisiana Wellbore Schematics**

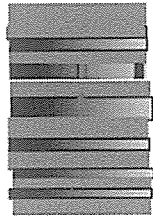
## **LITHOLOGY LEGEND**



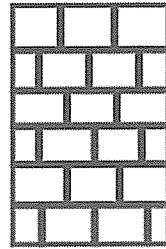
**Predominantly Sandstone**



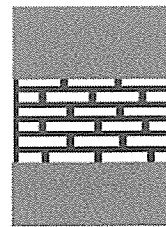
**Predominantly Shale & Siltstone**



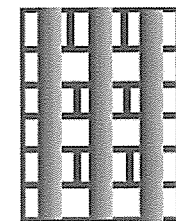
**Predominantly Interbedded  
Sandstone & Shale**



**Predominantly Limestone  
and/or Dolomite, Chalk & Marl**



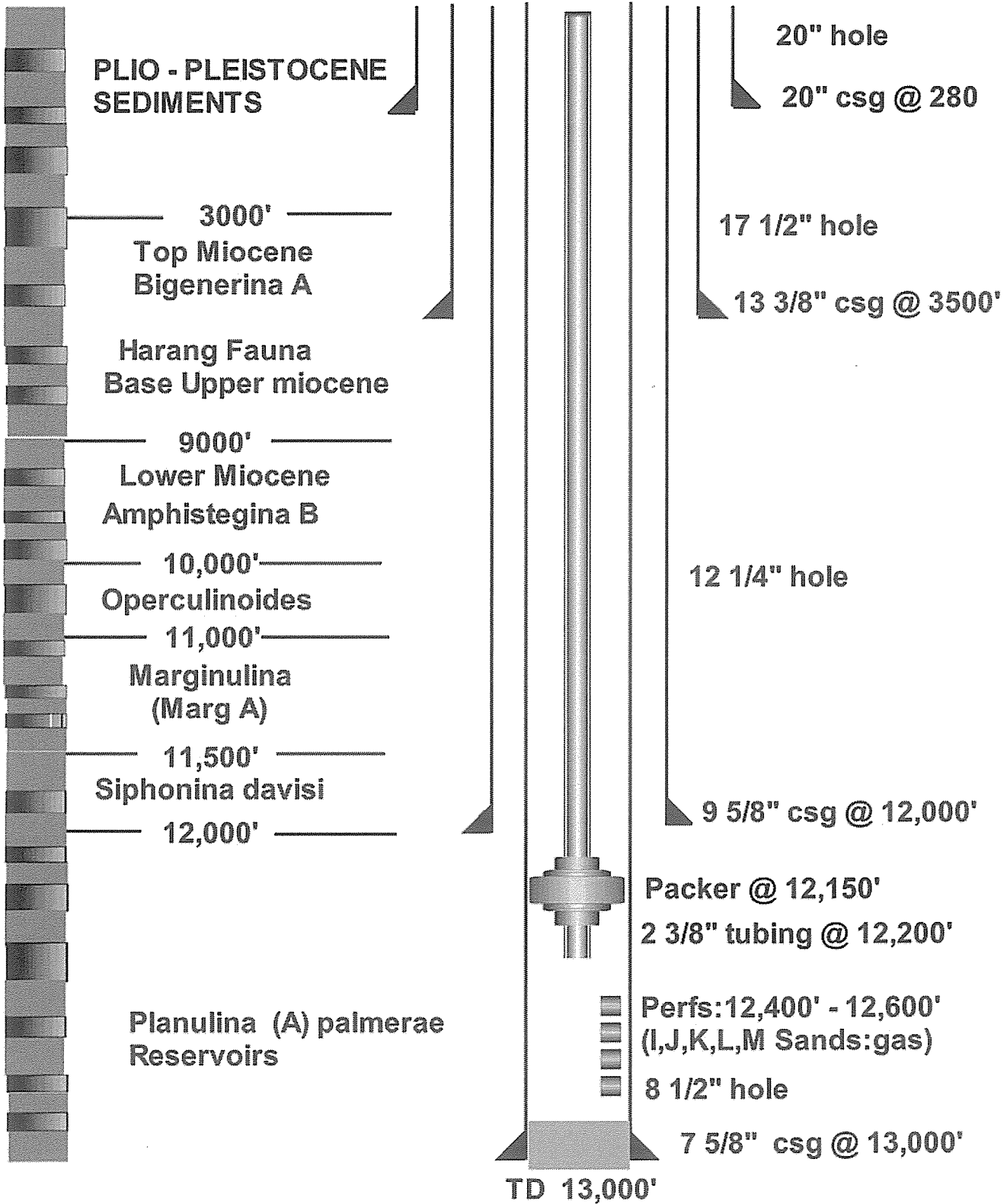
**Predominantly Calcareous  
Sandstone & Limestone**



**Anhydrite**



**LOWER MIOCENE 13,000' WELL  
ST. MARTIN PARISH**



**LOWER MIDDLE MIOCENE 17,800' WELL  
ST. MARTIN PARISH**

