ELECTROFACIES, DEPOSITIONAL ENVIRONMENTS AND PETROLEUM GEOLOGY OF THE HARTSHORNE FORMATION IN PARTS OF HUGHES AND PITTSBURG COUNTIES, OKLAHOMA

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NOMENCLATURE

bcf	billion cubic feet
CBM	coal bed methane
FCP	flowing casing pressure
FTP	flowing tubing pressure
mcf	thousand cubic feet
mcfd	thousand cubic feet per day
mmcf	million cubic feet
mmcfd	million cubic feet per day
OGIP	original gas in place
psi	pounds per square inch
RGIP	recoverable gas in place
Rw	formation water resistivity
SITP	shut-in tubing pressure
SP	spontaneous potential
Sw	formation water saturation
tcf	trillion cubic feet

Electrofacies, Depositional Environments, and Petroleum Geology of the Hartshorne Formation in parts of Hughes and Pittsburg Counties, Oklahoma

CHAPTER I

INTRODUCTION

Purpose

The Hartshorne Formation is an important source of natural gas in the Arkoma Basin. Natural gas is produced from the sandstone and coal within the Hartshorne Formation. The purpose of this study is to interpret the depositional facies from subsurface logs, establish depositional environments, and describe the occurrence of petroleum within the Hartshorne Formation in parts of Pittsburg and Hughes Counties, Oklahoma.

The Hartshorne Formation is composed of a succession of shale, sandstone, and coal. Three models for the deposition of the Hartshorne Formation are presented and examined. The first model is that the Hartshorne Formation was deposited within two primary cycles of delta progradation and delta abandonment represented by widespread coal. The second is a modified version of the first with the inclusion of entrenched distributary channels resulting from processes outside of the delta system. The third model suggests that a drop in sea level and formation of incised valleys followed each delta progradation. This was followed by a rise in sea level that flooded the old delta plain and formed a mire or marsh system in which the coal forming peat was deposited.

The occurrence of coal and natural gas within the Hartshorne Formation is well known and the exploitation of these hydrocarbons has a long history. A better understanding of the Hartshorne depositional model is needed to help identify bypassed reserves in mature areas. In addition, a modern conceptual model is required to gain a greater understanding of the overall distribution of gas-producing Hartshorne lithofacies in order to predict new exploration trends. This study is not designed to identify new reserves, but rather to establish a model that can be applied to development of mature area and locate new reserves in underexplored areas. The final purpose of the study is to use the depositional model to help predict gas producing facies.

Location

The study area is located within the Arkoma Basin geologic province of Oklahoma and Arkansas (Figure 1). The Arkoma Basin is bordered on the south by the Ouachita Mountains/Ouachita Thrust Belt. To the northeast is the Ozark Uplift, a likely source area for much of the Hartshorne Sandstone. To the northwest is the Northeast Oklahoma Platform, also known as the Cherokee Platform. To the southwest is the Arbuckle Uplift. The Arkoma Basin is bordered/covered to the east in Arkansas by the onlapping Gulf Coastal Plain. The study area is comprised of a nine township block that includes T.5N. to T.7N. and R.11E. to R.13E. in Pittsburg and Hughes County, Oklahoma (Figures 2).

Methods

An extensive literature search was conducted to establish a history of previous work on the Hartshorne Formation and coal-bearing strata. Wireline electric logs from more than 500 wells within the nine township study area were collected and correlated using a grid of East-West and North-South trending cross-sections. A stratigraphic framework was established using accepted economic and oil and gas industry nomenclature. The upper and lower members of the Hartshorne were identified, where both are present.

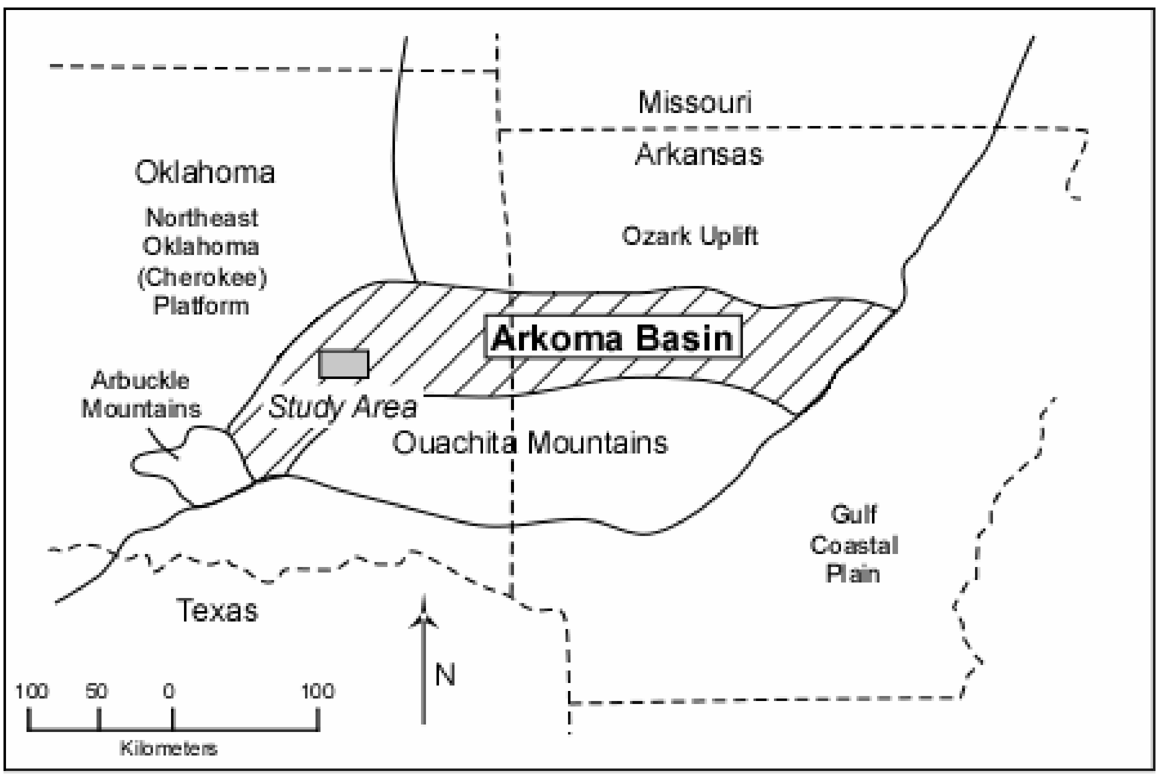


Figure 1: Regional tectonic map (Modified from Matteo, 1983)

A series of maps were constructed to analyze gas production, establish sandstone trends, interpret structural attitude and define coal thickness. The first map that was constructed was a production map that shows the cumulative gas production for wells that produce gas from the Hartshorne Formation. Data for this map were compiled to assess the area's potential for additional gas production. The second map that was constructed was a gross sandstone map of the Lower Hartshorne Member (Plate 3). For this map, a 50% "clean" sandstone cut-off was established based on the gamma ray curve. A second gross sandstone map was built for the southernmost thicker sandstone body (Plate 4). Houseknecht et al (1983), Matteo (1981), Fields (1987), and Andrews (1997) have divided thick, linear sandstone bodies that lie south of the coal split into the Lower and Upper Hartshorne Members. This interpretation was based on the premise that distributary channels or incised valley/channels of the Upper Hartshorne delta system eroded into the Lower Hartshorne Member and are superimposed on the Lower Hartshorne channel sandstones, giving the appearance of a thick stacked channel succession. The boundary between the Upper and Lower Hartshorne Members within this sandstone body is typically interpreted to occur at a shale break within the sandstone. Two wells encountered a coal within the thick sandstone body. This coal has been interpreted as the Lower Hartshorne Coal, and supports the division of the sandstone body into Upper and Lower Hartshorne. However, the depth of the coal within the sandstone body does not correlate to the Lower Hartshorne Coal away from the thick sandstone body, and does not fit with the gradual thickening of the Upper Hartshorne Member away from the coal-split. Instead, the coal within the thick sandstone body appears to be lower in the section than the Lower Hartshorne Coal in wells that show a distinctive Lower and Upper Hartshorne division. This difference in position could be a result of differential compaction of the sand and adjacent mud, but the vertical difference in position appears to be too great. Therefore it was decided to map the southern sandstone body as Hartshorne "Undifferentiated," and suggest that the entire sandstone body may be composed of sediments deposited during Upper Hartshorne time.

After the gross sandstone maps were completed and the overall sandstone trends were defined, net sandstone and net pay maps were constructed, and compared to the gross sandstone map to determine if similarity exists. Net sandstone is simply defined as all clean sandstone (mapped as gross sandstone as explained previously) that has porosity equal to or greater than a defined minimum porosity. Net pay is defined as all clean sandstone that has a porosity greater than or equal to a defined minimum value and a water saturation (Sw) less than or equal to a defined maximum value.

The porosity cut-off was established after examining the porosity values in wells that produced natural gas in varying quantities and comparing those values to porosity values in reservoirs that are too "tight" (too low of porosity) to produce economic volumes of natural gas. It should be noted that low porosity is not the only reason gas is not produced from a sandstone reservoir. Low permeability (the connectedness of the pore space and the ability of fluid to move through the rock) is often more important than porosity in determining the ability of the reservoir to hold and produce fluids, including oil and gas. After comparing numerous resistivity and density porosity logs of high-volume and low-volume, gas-producing wells, as well as dry holes, two porosity cut-offs were established for mapping. These are density porosities of 8% and 12%. Both values

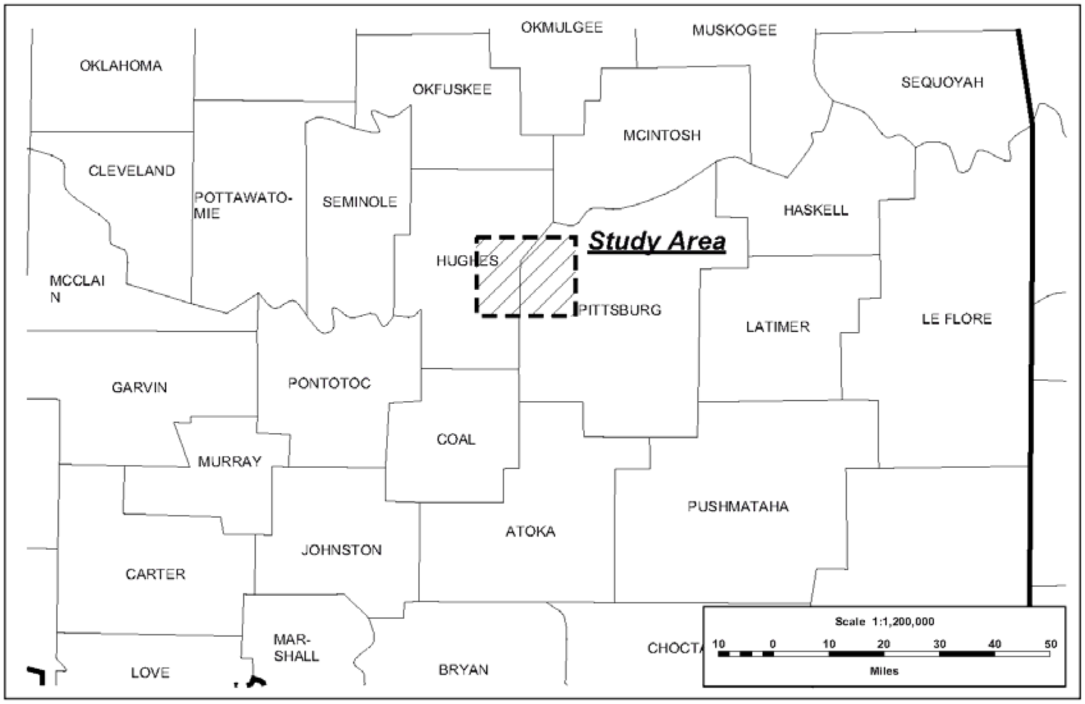


Figure 2: Location of study area along the boundary between Hughes and Pittsburg Counties, Oklahoma.

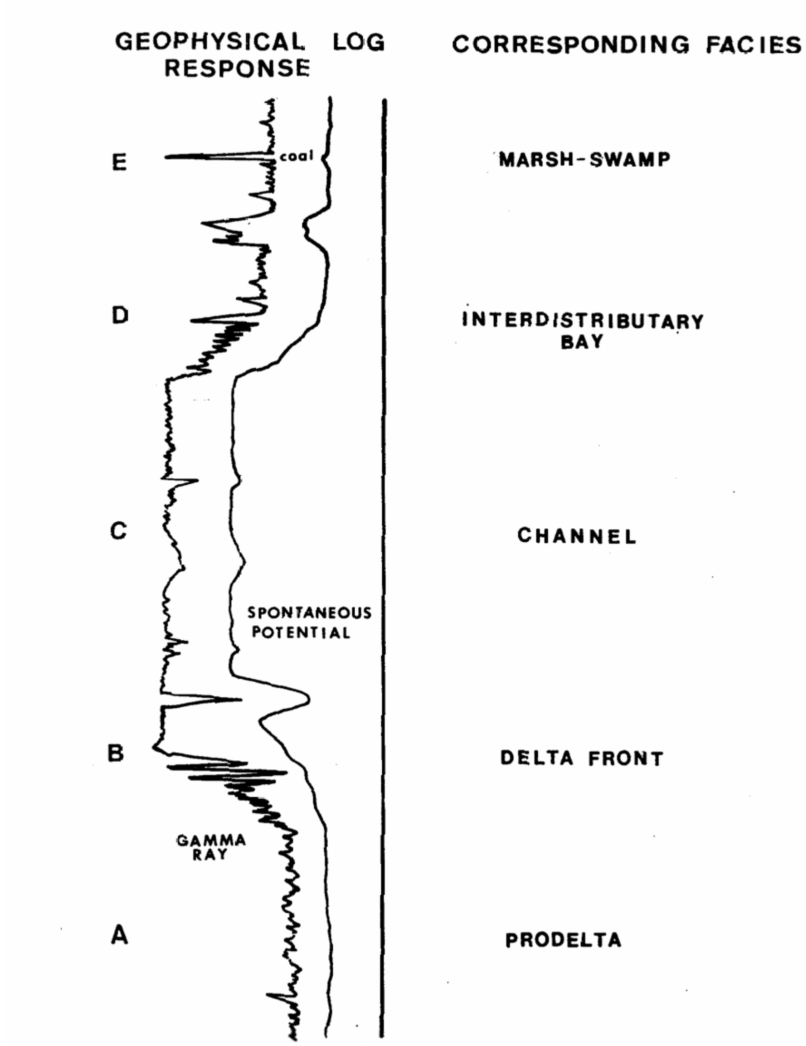


Figure 3: Type log of gamma ray response profiles through the various deltaic facies (Matteo, 1983)

were used to establish net sandstone and net pay, which was subsequently mapped (Plate 5-8). The thickness of net sandstone was compared to production volume to determine which porosity cut-off value was a better predictor of gas production volumes and trends. The primary porosity cut-off value that effectively predicted economic gas production is the 8% density porosity value. The net sandstone map based on the 12% density porosity cut-off is still useful for high-grading potential drilling locations. The next step was to define a water saturation cut-off so that net pay could be mapped. Net pay maps were constructed using the 8% and 12% porosity cut-offs. A water saturation value of 40% was used in combination with both the 8% and 12% porosity cut-off to construct net pay maps and define the trend of gas-producing Hartshorne sandstone. The resulting net pay maps support the production trends seen on the Hartshorne production map.

Two structure maps were then constructed using various formation tops and subsurface markers. The first structure map was constructed on the top of the Lower Hartshorne Coal (Plate 13), which is assumed to be correlative to the single Hartshorne Coal north of the coal-split line. The second structure map was constructed using the base of the "hot shale" marker in the McAlester Formation above the Hartshorne Formation (Plate 14). The Lower Hartshorne Coal is very extensive, and therefore a good subsurface marker. Coal-forming peat tends to be deposited on relatively flat surfaces near sea level; therefore it serves as a very good structural marker. The only difficulty that arose during mapping the structure of the Lower Hartshorne Coal is that it is absent or unidentifiable within the wells that penetrate the southern-most thick sandstone body. This relationship indicates that during Upper Hartshorne time a channel eroded down into the Lower Hartshorne, removing the coal. There is also some question as to the true identity of the Hartshorne coal that lies to the north of the coal split. Is it solely Lower Hartshorne Coal equivalent, or does it represents continuous peat deposition that began in Lower Hartshorne time and continued, uninterrupted, into Upper Hartshorne time? Houseknecht et al (1983), Andrews (1998), and others have stated that the Hartshorne Coal north of the coal split is correlative to the Lower Hartshorne Coal that is identified south of the coal split line. It is possible that this single Hartshorne coalbed north of the coal split line is correlative to the Upper Hartshorne Coal. Therefore a structure map of the Lower Hartshorne Coal may not present an accurate depiction of the structural attitude. Fortunately the "hot shale" marker that lies about 40 to 80 feet above the Hartshorne Formation in the McAlester is widespread and easily recognized. It is used during drilling of horizontal Hartshorne coalbed methane wells to establish a vertical position of the Hartshorne Coal. The "hot shale" marker also represents the top of the Lower Booch Sandstone interval. The Lower Booch Sandstone is present in the southeastern part of the study area. This hot shale marker was the primary structural marker used in this study, despite being located more than fifty feet above the Hartshorne Formation. Comparison of the "hot shale" marker and the Lower Hartshorne Coal structure maps indicates that there is no significant change in structural attitude and grain between the two. Stratigraphic thickening from north to south is evident in McAlester, Hartshorne, and Atoka Formations. A structure map was not constructed on the boundary between the Hartshorne and the Atoka since the identification of the boundary is questionable. Workers who have mapped the Hartshorne-Atoka boundary on the surface place it at the base of the lowermost sandstone in the Hartshorne Formation (Andrews, 1998). Workers who have mapped the boundary in the subsurface place it at a resistivity marker lower in the Hartshorne Formation. Two "hot shale" markers are evident in the upper part of the Atoka, but sparse well control in most of the study area prevented their use. Based on correlations evident on the grid of cross-sections, structure does not change appreciably from below to above the Hartshorne. Therefore, it was determined that the two structure maps are suitable. The structure maps indicate an overall structural dip to the south-southeast, which is the same as the general direction of overall thickening of the stratigraphic column.

Electrofacies were interpreted using published log signatures for the various deltaic facies (Visher et al, 1971; Brown, 1979; Matteo, 1981; Houseknecht et al, 1983; Fields, 1987; Galloway and Hobday, 1997; Suneson, 1998; Andrews, 1998). The primary electric log curve used to determine lithofacies within the Hartshorne Formation was the gamma-ray curve.

Figure 3 illustrates the accepted gamma ray log profiles for the various lithofacies within a deltaic system (Matteo, 1983). The gamma-ray curve reflects clay content within the rock. The gamma-ray curve is almost always located on the left track of an electric log display. The more volume of shale (clay) within the rock the higher the gamma ray curve will read (high gamma ray deflects to the right). The scale on the gamma ray is usually 0 (or negative) to the left and 150 units on the right, with some variation in the scale based on logging preferences of companies and individuals. The highest reading will represent the shale baseline and any deflection to the left indicates a decrease in shale, thus an increase in sandstone or limestone. The spontaneous potential (SP) curve may be used to interpret lithofacies, but is not as reliable as the gamma-ray tool because it is influenced by porosity, permeability, and formation fluid types. It should be noted that gamma ray curve profiles are not unique to specific facies. A delta front sandstone has a coarsening-upward profile caused by an upward increase in sand and decrease in clay content. Bed thickness will also increase upward in a delta front succession. A prograding barrier bar system will exhibit a similar profile. Distributary channel sandstones typically have a blocky to fining upward (bell shaped) electric log pattern (gamma-ray and resistivity). Shaley facies such as prodelta, interdistributary bay, and lower (distal) delta front will have very little deflection away from the shale base line on the gamma ray curve. Distributary mouth bar sandstones will have a blocky to upward coarsening profile. Because the distributary channel and distributary mouth bar share a common blocky profile, as well as their proximity to one another within the depositional system, it is often difficult to distinguish between the two facies on the electric log. Coal can be a very distinctive marker on an electric log given the proper log and thickness. If the coal is 2 or more feet thick, a very distinctive negative or leftward deflection in the gamma-ray curve is present. Coal will also read anomalously low on the bulk density curve (less than 2 grams per cubic centimeter) and high on the neutron and density porosity curves (greater than 30% porosity). This combination of log curve signatures can form a very distinctive subsurface marker. Without the gamma-ray and porosity curves, coal is very difficult to identify. It is almost indistinguishable on wireline logs with only SP and resistivity curves.

Volumetric calculations were used to determine the original gas in place (OGIP) and the recoverable gas in place (RGIP). These equations and explanations of their use are in Chapter IV.

Previous Work

Chance (1890) first described rocks of the Hartshorne Formation, calling the coal the Grady Coal Group and the sandstone the Tobucksy Sandstone. Taff (1899) later renamed these units the Hartshorne Coal and the Hartshorne Sandstone. Taff (1899) defined the top of the Hartshorne Sandstone as the first sandstone below the Hartshorne Coal, with the Hartshorne Coal being grouped with the overlying McAlester Formation (Suneson, 1998). Taff and Adams (1900) identified a second Hartshorne Coal and named them the Upper and Lower Hartshorne Coals. The Lower Hartshorne Coal and the shale separating it from the sandstone were defined as part of the Hartshorne Sandstone, whereas the Upper Hartshorne Coal was still grouped with the overlying McAlaster Formation. The base of the Hartshorne Sandstone now became the base of the lowermost sandstone. Oakes and Knechtel (1948) noted, "The two coals coalesce or are separated by only a few inches of bony coal or coaly shale" (Matteo, 1981). Branson (1956) suggested the Hartshorne Sandstone be changed to the Hartshorne Formation. McDaniel (1961) suggested that the Hartshorne be divided into Upper and Lower Members, with the Upper Member containing the Upper Hartshorne Coal and all sandstone and shale between the upper and lower coal, and the Lower Member consisting of the Lower Hartshorne Coal and all sandstone and shale between the lower coal and the top of the Atoka Formation.

Housknecht (1983) at the University of Missouri, with the help of numerous graduate students, did extensive work on the Hartshorne Formation in both Oklahoma and Arkansas. His work was the foundation for the current accepted model for

Hartshorne deposition. The most important contribution, to this study was the work of Matteo (1981), who focused on the Hartshorne Formation within an area in eastern Pittsburg County and western Haskell and Latimer Counties, Oklahoma. The work done by Housknecht (1983) and his students was the most important contribution to the accepted Hartshorne depositional model. The model of Hartshorne deposition developed by earlier workers and further refined by Houseknecht et al (1983) was that of a multiple cycle high destructive deltaic system.

McQueen (1982) examined the Hartshorne Formation in a generalized study that covered the entire Arkoma Basin McQueen's (1982) study contained a broad overview of the Hartshorne Formation within the Arkoma Basin and was useful in establishing the basic regional depositional system.

Fields' (1987) subsurface study covered an area in parts of Pittsburg, Hughes, and Haskell Counties, and in fact overlaps the area in this study. Fields (1987) described the petrologic characteristics of the Hartshorne Formation using two cores that were taken from the Hartshorne Formation in Oklahoma. Fields (1987) determined the mineralogical composition of the Hartshorne Sandstone and reported that the sandstone is primarily composed of quartz (76% in the cores examines). The sandstone also contained rock fragments, feldspar, and minor amounts of muscovite, tourmaline, and zircon. The sandstone contained 2% detrital matrix. There were also trace amounts of organic matter. Fields (1987) also examined core from a well within the current study area, the Hunt Garrett #1 (Section 34-T.6N.-R.13E.), located in South Pine Hollow Field. Two intervals were cored, 3555 to 3561 feet and 3561 to 3601 feet, and the overall condition of the core was poor. Fields (1987) interpreted these cores to contain Upper Hartshorne distributary channel sandstone, stacked on top of Lower Hartshorne distributary sandstone. Neither the upper or lower contacts were cored.

The Oklahoma Geological Survey has published a significant volume of work on the Pennsylvanian of southeastern Oklahoma. Hemish (1988) reported on coal core drilling program. Hemish (1991, 1992, 1993, and 1995) and Hemish, Suneson, and Furgeson (1990) also constructed several surface geologic maps of quadrangles in Le Flore, Latimer, and Pittsburg Counties. The most recent stratigraphic and sedimentological work done was by Andrews and others (1998). Andrews et al (1998) introduced sequence stratigraphy into the depositional model of Hartshorne deposition.

Suneson (1998) published a field trip guide containing numerous measured section descriptions. Many of the measured sections correlated back to nearby wireline logs. The field trip stops are south and east of the study area but were valuable in interpreting the Hartshorne depositional history.

General Stratigraphy

The Hartshorne Formation, which is named for the town of Hartshorne Oklahoma, is the oldest formation in the Krebs Group, Desmoinesian Series (Pennsylvanian). The Hartshorne, which is composed of shale, sandstone, and coal, is immediately underlain by the Atoka Formation (Atoka Series) and overlain by the McCurtain Shale Member of the McAlester Formation (Krebs Group) (Figure 4).

The Atoka Formation is composed primarily of shale with some interbedded sandstone. The lower part of the Atoka Formation is considered to be of deep marine origin, while the Upper Atoka is thought to be composed shallow marine shelf and transition deposits. The uppermost part of the Atoka may represent the distal prodelta facies of the Hartshorne delta system (Matteo, 1981). Within the uppermost Atoka there are sandstone stringers that are known by various local names, one of the sandstones can is present in several wells in the northwest part of the study area.

The overlying McAlester Formation is dominantly shale. Within the McAlester there are localized sandstone, coal, and limestone beds and stringers, including the Booch sandstones and coals. The lower Booch sandstone develops in the southeast part of the study area, the top of which is represented by the upper "hot-shale" marker. The "hot-shale" marker may represent a marine maximum flooding surface or highly carbonaceous shale of paralic or terrestrial origin. Based on the interpretation of Pennsylvanian hot shales (Marshall, 2002) this "hot shale" may be the key to interpreting the sequence stratigraphic of the Hartshorne and McAlester Formations.

As mentioned previously, the Hartshorne Formation was originally defined as the sandstone lying directly beneath the Hartshorne Coal (Taff, 1899). Later the Hartshorne was redefined to include both the Lower and Upper Hartshorne Coals. The Hartshorne was subsequently divided into two members, the Upper and the Lower. The Upper Hartshorne Member includes the Upper Hartshorne Coal and sandstone between the Upper Hartshorne Coal and the Lower Hartshorne Coal. The lower member includes the sandstone body below the Lower Hartshorne Coal, as well as the coal itself. The historical development of the Hartshorne nomenclature is illustrated in Figure 5.

The Upper Member is only present in the southern part of the Arkoma Basin in Oklahoma (Matteo, 1982). In the northern part of the Oklahoma portion of the Arkoma Basin and the entire basin in Arkansas, the Hartshorne Formation is represented by a

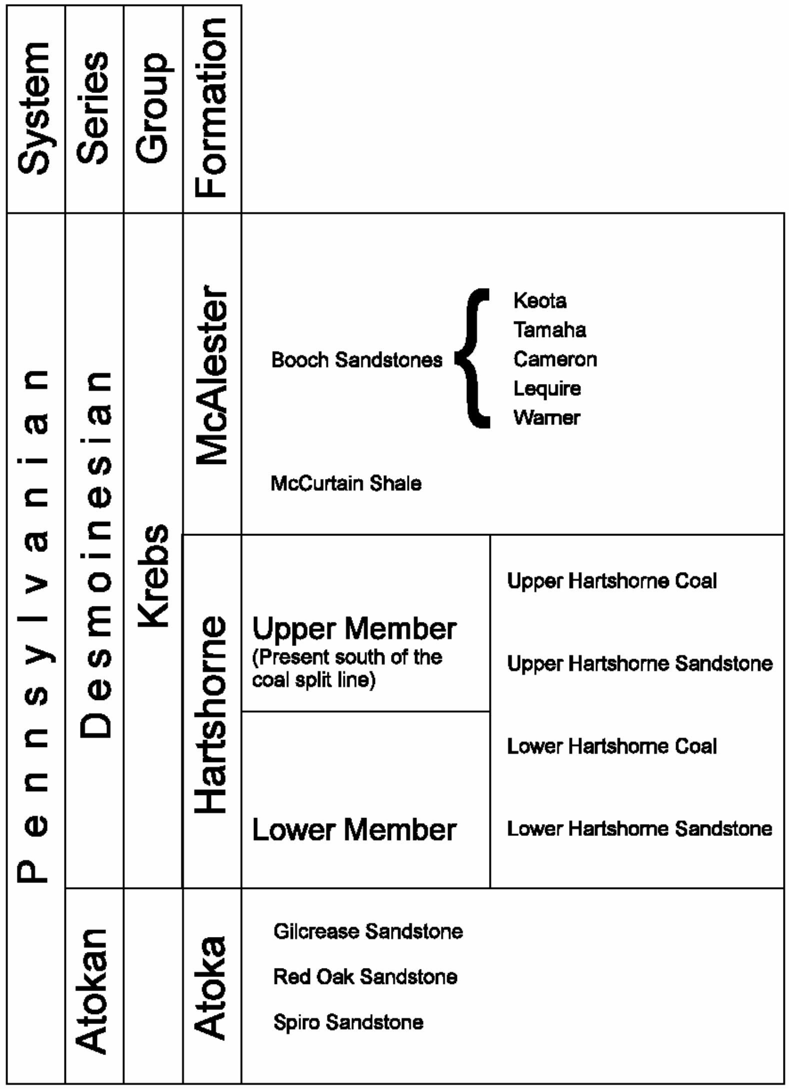


Figure 4: Generalized stratigraphic column, Arkoma Basin, Oklahoma (Modifiedf from Andrews, 1997 and Hemish & Suneson, 1997).

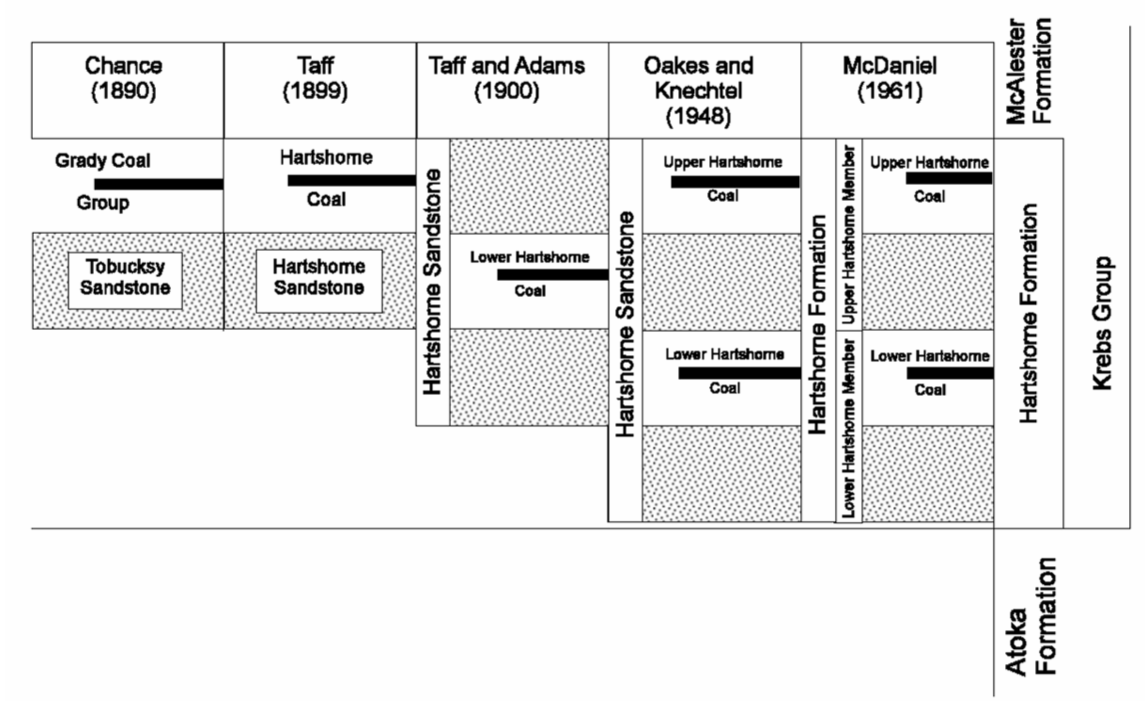


Figure 5: Summary of the history of the Hartshorne Formation nomenclature.

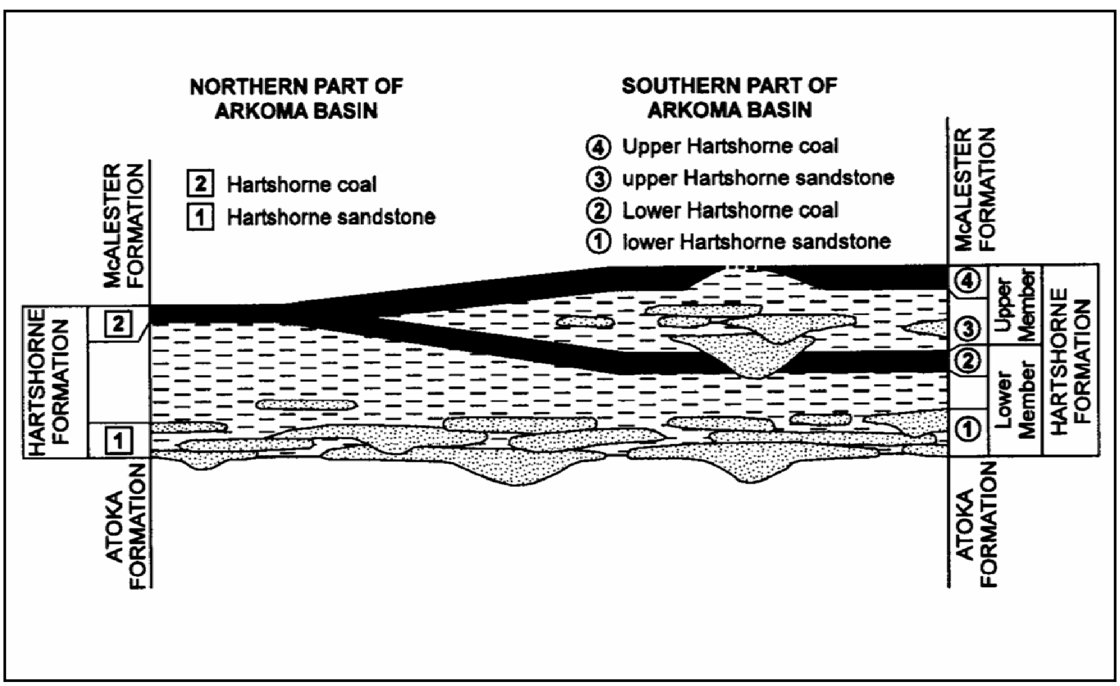


Figure 6: Illustration of the coal-split that occurs within the Hartshorne Formation from north to south in the Arkoma Basin, Oklahoma (From Hemish & Suneson, 1997).

single sandstone-coal package that is presumed to be correlative to the Lower Member in the south (Figure 6). For the purpose of this study and simplicity, the term "Lower Hartshorne Member" will be used to indicate that part of the formation below the Upper Hartshorne Member where both members are present. In addition, Lower Hartshorne will be used to describe the Hartshorne Formation (undivided) north of the coal-split line. This nomenclature is the same as reported by Houseknecht et al (1983) Andrews (1998).

The Hartshorne Formation in Arkansas differs in several ways to the Hartshorne in Oklahoma.. In most of the Arkoma basin within Arkansas, the Hartshorne Formation consists of a single coal and sandstone package and no coal-split is evident, except in the far western part (Houseknecht et al, 1983). The Hartshorne Formation is interpreted to be of dominantly fluvial origin and described as a series of thick, broad channel sandstones (Houseknecht et al, 1983). Near the Arkansas-Oklahoma border these channel sandstones become narrower and thinner (Houseknecht et al, 1983).

CHAPTER II

GEOLOGIC SETTING

Tectonic and Depositional History

The Arkoma Basin extends from south-central Oklahoma into central Arkansas (Figure 1). Bounding structural features include the Ouachita and Arbuckle Uplifts to the south and the Ozark Uplift to the northeast. To the southeast is the Gulf Coastal plain that extends from southeastern Arkansas to the Gulf of Mexico. To the northwest is the Oklahoma Platform, also known as the Cherokee Platform, which extends into Kansas. The history of the Arkoma Basin begins in the Late Precambrian. During this period of time, rifting occurred as the North American plate began to separate from Africa and South America. All were previously sutured together to form the supercontinent "Proto-Pangea." As rifting continued into the Paleozoic, a passive margin developed along the southern edge of North America. During the Early Mississippian, part of the present day trough within the Arkoma Basin was structurally high (Rieke and Kirr, 1984). During the passive margin stage of the Early and Middle Paleozoic, shallow water carbonates and clastics were deposited on a broad shelf. This passive margin continued into the Late Devonian and Early Mississippian, at which time the ocean basin began to close and a southward dipping subduction zone formed (Houseknecht et al, 1983). This is supported by evidence for a Devonian metamorphic event (Denison, 1982). During this transition from passive to active continental margin the rate of sedimentation increased.

Throughout most of the Mississippian, the depositional setting remained a shelf, which was dominated by clastic deposition (Houseknecht et al, 1983). During the Pennsylvanian, sediment continued to be shed into the basin as it transformed into an active continental margin. Sediment was deposited in the basin in fluvial dominated deltaic systems during the Pennsylvanian. During the Late Pennsylvanian, the Arbuckle orogeny formed the Arbuckle Uplift in southern Oklahoma, which separated the present Ft. Worth and Arkoma Basins (Rieke and Kirr, 1984). The tectonic evolution of southern Oklahoma is illustrated in Figure 7 (Houseknecht et al, 1983).

Overview of Deltaic Depositional Systems

Deltaic depositional models have dominated the interpretations of the Hartshorne Formation. Therefore, an overview of deltaic processes and resulting facies is included. A delta forms at the point where a flowing river enters a standing body of water such as the ocean or a lake. The delta represents the building out or progradation of the river plain into the body of water. As the river enters the standing water, the fluvial system gradually loses current energy and deposits its sediment load. The sediment load contains grains with a wide variety of sizes and densities. The particles with the greatest mass, which are typically larger, are deposited first, proximal to the stream mouth, whereas less massive, smaller sediment is deposited at increasing distances from the mouth. The result is a lateral gradation of grain sizes from the mouth of the river to the more distal part of the delta. There is also a vertical gradation of grain sizes that results as the delta builds out into the standing body

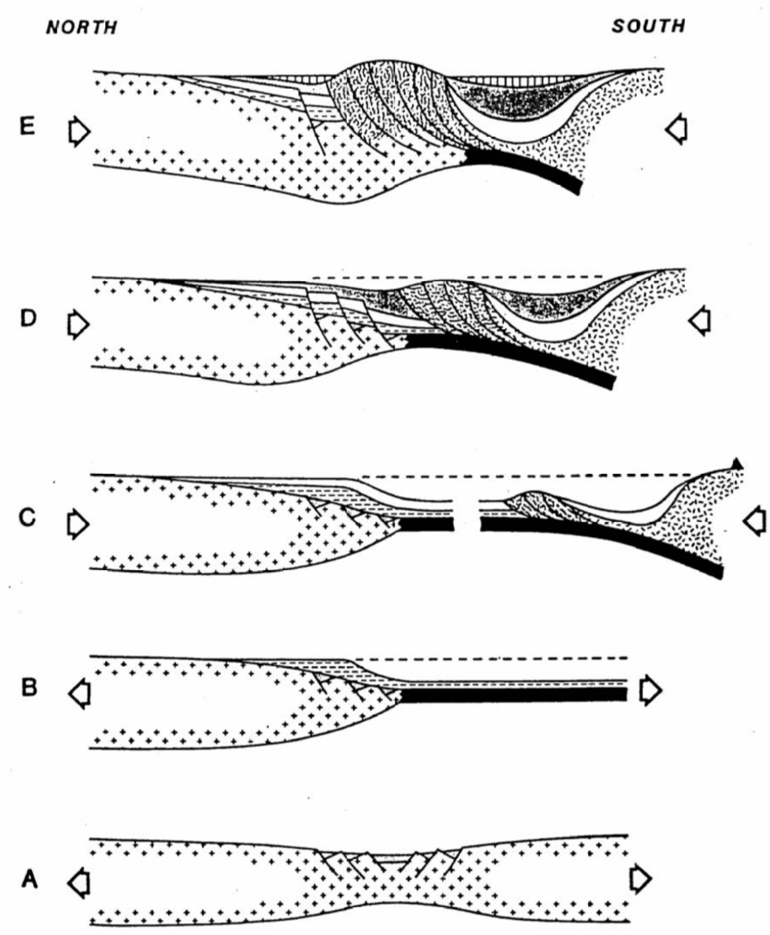


Figure 7: Idealized model for the evolution of the Arkoma Basin (from Houesknecht et al, 1983).

of water. Proximal, coarser grain facies are deposited above the more distal, finer grain facies.

The processes that control the formation of a delta system can be divided into three categories, fluvial, wave, and tidal, with wave and tidal often being grouped together (and with other basin processes) as marine processes. In any delta system, all three of these processes are present and act upon the delta in varying degrees. This interaction creates a unique type of delta, which is then defined and named by the dominant process, hence fluvial-dominated deltas, wave-dominated deltas, and tide-dominated deltas.

There are several factors outside of fluvial and marine processes that influence the morphology and evolution of a delta system. These factors include tectonic setting, relative sea level changes, climate and the geometry of the depositional basin The most important factor is relative sea level, which may be influenced by tectonic activity, eustatic sea level changes, and subsidence (basin wide and local).

Tectonic Influence

Tectonic activity can affect a delta system in several ways. Regional uplift may create topographically high areas that increase river gradient and sediment supply. This increase in gradient and sediment load will directly affect the delta system by rejuvenating the constructive phase. This can change a wave-dominated delta to a fluvial-dominated delta system as the influence of river processes increase. The magnitude of the affect of tectonic activity on the delta system is controlled by both the intensity of the tectonic event as well as the proximity of the uplift to the delta system. For example, if uplift occurs close to the shoreline, a fan-delta may form, or a pre-existing fluvial-dominated delta may transform into a fan delta system.

Sea Level Change

The evolution of sequence stratigraphy has redefined and enhanced the role of sea level change on defining patterns of deposition within coastal environments. Typically, changes in sea level can be placed into two categories, (i) regional and (ii) eustatic.

Regional changes in sea level are restricted to a particular basin and are not seen at a global level. Eustatic sea level changes are those that are recognized globally. Relative changes in sea level typically result from the interaction of tectonic uplift, basin subsidence, lobe switching, delta subsidence, and other events that are confined to the basin, as well as the ongoing eustatic fluctuations of sea level.

A delta forms at the point at which a river enters a basin or intersects shoreline. Changes in sea level cause the shoreline to migrate, thus affecting any depositional system linked to the shoreline, including a delta. The effect on the delta system can vary. Minor fluctuations will have a minimal affect on the delta system and result in a redistribution of deltaic facies. Major regressive or transgressive events induce a much larger affect on the depositional system, including the complete destruction of the delta system in both cases. In the case of a major regressive event, the delta will be cannibalized by its own distributaries as they erode or incise into it. A major transgressive event, which overtakes fluvial discharge, will flood the delta plain, and sediments may be reworked and redistributed by marine processes, leaving little evidence of the former deltaic system. In instances of regional tectonic activity or subsidence, there may be a localized, drops or rises in sea level that are not related to global eustatic processes.

Climatic Conditions

Regional climate is a controlling factor in the formation and evolution of delta systems. For sediment to be delivered to the basin by the delta system, there must be a flow of water. In an arid climate the amount of rainfall runoff may be minimal and small volumes of sediment is delivered to the delta system. This is especially true if the sediment source is distal to the delta. In an area that receives seasonally high discharges, a delta may form, but because of the lack of constant discharge, may be dominated by marine processes. In more moderate climates, a year round discharge would allow for continual delta building. Periods of high water discharge may cause both the upstream fluvial system and the deltaic distributary systems to erode into their underlying substrate.

Fluvial-Dominated Deltaic Systems

Deltas are composed of a proximal and distal framework facies. The proximal framework for all deltas (wave-, tide- and fluvial-dominated) is the distributary channel sand (Galloway and Hobday, 1996). The differences between the delta types are exposed in the distal framework facies. For fluvial-dominated deltas, the distal framework facies include distributary mouth bars and delta front sheet sands. The distal framework facies component for wave-dominated and tide-dominated deltas are beach ridge or strand plain sands and tidal ridge/bar sands, respectively (Galloway and Hobday, 1996).

Both fluvial and tide-dominated deltas contain a high amount of mud and clay, whereas wave-dominated deltas are cleaner or sand rich as a result of wave action that winnows away the finer material. Although the composition of fluvial and tide-dominated deltas is similar, geometry and sedimentary structures are quite different. Tidal inundation often creates irregular geometries; the Me-Kong Delta is a good example of a tidal dominated delta. Fluvial-dominated deltas show a greater protuberance as the influx of sediment builds the delta basinward in a lobate or elongate (birdsfoot) pattern. The Mississippi Delta is a good example of a fluvial-dominated delta. Sand bodies in fluvial-dominated deltas contain sedimentary structures that indicate a singular direction of flow, whereas sedimentary structures in sands associated with tide-dominated deltaic sediments show patterns indicating bimodal directional water flow associated with the ebb and flow of tidal currents. Fluvial-dominated deltas may contain some marine influenced sedimentary structures that occur mostly in the distal delta front. In contrast, marine influence in a tide-dominated delta may extend up into the distributary channel during high tide. Wave-dominated deltas also contain sedimentary structures that display patterns indicating bimodal sediment transport resulting from wave action. Both fluvial- and wave-dominated deltas may display a lobate geometry, but they are different in that the distal framework of wave-dominated systems is composed of sands (beach ridge/strandplain) that strike subparallel with the coastline. The distal framework facies of a fluvial-dominated delta system (distributary mouth bars and delta front sands) will strike perpendicular to the coastline and extend basinward.

Some delta descriptions have characterized fluvial dominated deltas as "constructive," whereas deltas that are more heavily influenced by wave and tidal energy are "destructive" (Houseknecht et al, 1983). The origin of this description is understandable as river-dominated deltas will typically prograde basinward more than either wave- or tide-dominated deltas. The description is also accurate in that sediments that are deposited in wave- and tide-dominated deltas are heavily reworked by marine processes, often exhibiting characteristics that are more indicative of shallow-marine deposition than fluvial. In reality, these delta types are all influenced, to varying degrees, by both fluvial and marine processes. The terms "constructive" and "destructive" are more aptly applied to phases within the lifespan of the delta. As long as a river is depositing sediment at its mouth and supply exceeds accommodation space, it should be considered to be in its constructive phase. Once that fluvial input diminishes and the delta is dominated by marine processes, it may be considered to be in a destructive phase. This is an important distinction because in major delta systems there are typically multiple phases of construction and destruction occurring simultaneously as one delta lobe is abandoned and another develops as a result of lobe switching. This process is evident in modern deltas such as the Mississippi and most likely was the case for large ancient delta systems such as the Hartshorne, which had multiple active distributaries.

Relative sea level change must be considered when describing the evolution of a delta system. Change in sea level may be the result of subsidence due to compaction of the sediment, tectonic uplift in the hinterlands, basin subsidence, or global sea level changes. A fluvial-dominated delta system develops because a river feeds sediment to a system than can be altered by marine processes. Marine processes can dominate the fluvial process if flooding that results from a relative rise in sea level and increasing accommodation space. If this occurs at a rate that exceeds the rivers sediment supply, the fluvial system will be unable to maintain the delta. It should be noted that sand and mud within the delta contain a high volume of water and will compact over time, resulting in subsidence and a relative rise is sea level. Unlike the “constructive” and “destructive” phase in delta evolution, sea level changes do not necessarily end the existence of the delta. Fluctuations in sea level may simply adjust the location of the delta lobes and the distribution of sediment. Given a relatively stationary sea level and sediment input exceeding the rate of delta subsidence resulting from compaction, a delta will build out or prograde into the basin. This is referred to as a progradational delta stage. If the sediment input remains constant and the rate and magnitude of sea level rise increases, but is not so great as to overtake it, the delta may backstep away from the basin or retrograde. Older deltaic sediments will be flooded, but sufficient sediment delivery will maintain a delta system as the coastline. This is the retrogradational delta stage. While the progradational stage of deltaic development is always in the constructional phase, retrogradational stages may be either in the constructional or destructional phase of development. If marine incursion overtakes the sediment input volume the distributary channels will be flooded and an estuarine-type environment may form, which is similar to a tide-dominated delta. This would be classified as a destructional phase of delta evolution. If sea level is maintained and sediment is delivered to the delta at a rate that is approximately equal to the amount needed to fill the accommodation space created by deltaic subsidence, then a delta will simply aggrade, or build upon itself at its current location. This is referred to as the aggradational stage of delta development, which is constructional because fluvial process still dominate.

Deltaic Facies

There are three primary facies within a deltaic depositional system, prodelta, delta front, and delta plain (Bhattacharya and Walker, 1992). Each of these can be divided into subfacies. Figure 3 illustrates the typical vertical succession of deltaic facies and their gamma ray response profile on an electric log. Figure 8 illustrates the distribution of the deltaic facies and their respective electric log response profiles.

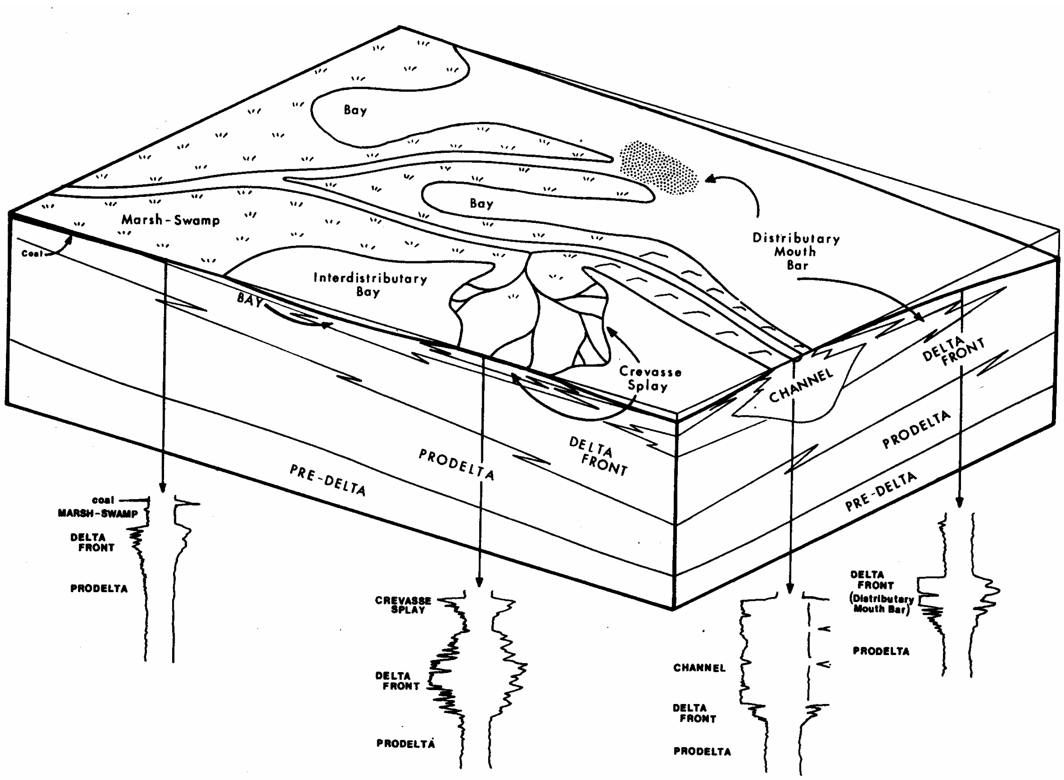


Figure 8: Distribution of facies within a deltaic system and their representative log curve signatures (From Matteo, 1981)

Prodelta

The prodelta represents the most distal part of the delta system. This is where the smallest-sized material is deposited. The prodelta is often divided into distal and proximal subfacies. The prodelta facies of the delta depositional system is composed primarily of clay or mud with minor amounts of silt and sand. The minor amounts of silt and sand are deposited as a result of periods of high stream discharge. The volume of sand will increase up section in a prograding delta system. This represents the initial coarsening upward vertical profile that is characteristic of a prograding delta system.

Delta Front

The delta front facies consists of the delta fringe (distal delta front) and distributary mouth bar subfacies. The delta fringe represents the transition from proximal prodelta deposition to delta front deposition. The delta fringe or distal delta front is composed of fine-grained sandstone, with interbedded shale and siltstone (Brown, 1979). The thickness and frequency of sandstone beds will increase upward as the delta fringe grades into the distributary mouth bar. The distributary mouth bar represents the point of the most active deposition and is deposited at the head of the distributary channels as elongate sand bodies. The distributary mouth bar consists of fine- to medium-grained sand. Sedimentary structures include medium- to large-scale trough cross bedding within a thick sand body. In both delta fringe and distributary mouth bar deposits where there is a high rate of deposition, water-laden sediment is deposited. As more sediment is deposited and overburden increases, the water is forced out of the sediment and the result is a variety of soft-sediment deformation features including flame structures and ball and pillow structures. The proximal part of the delta front is represented by the distributary mouth bar subfacies.

Delta Plain

The delta plain facies is the most diverse of the three primary facies. Subfacies within the delta plain facies includes distributary channel, interdistributary bay, marsh and swamp, and crevasse splay.

The distributary channel subfacies is the local fluvial component of the delta system. Distributary channels may, like their terrestrial counterpart, have a tendency to migrate laterally or meander. Distributary channels may also become well entrenched and take on a more linear trend.

Crevasse splays develop when the distributary channels breach their natural levees and the sediment load spills into the low energy environment of the interdistributary bay. The result is the formation of a small scale delta system, compared to the larger delta system of which it is a part. Some crevasse splays may be very large, depending on the nature of the flooding event. The crevasse splay facies may exhibit a coarsening upward profile that reflects the progradational nature of the deposit.

Incised Valley Fill/Entrenched Distributary Channel

Incised valley systems and incised valley fills, including those in the Hartshorne, have become a very important topic because of their significance as oil and gas reservoirs and their role in sequence stratigraphy. The recognition of incised valley deposits is not new, but their interpretation in the context of sequence stratigraphy has accentuated their importance to interpreting depositional systems.

Incised valley systems form when a river erodes underlying sediment to create a topographic low river valley. The erosion is a response to disequilibria with base level, which may result from uplift or the lowering of base level relative to the current river mouth. If the base level begins to rise and marine waters inundate the valley, stretches of the valley may fill with marine sediment. The drop of base level is often a result of relative sea level fall and the resulting valley may represent a sequence boundary (Van Wagoner et al, 1990).

The presence of an incised valley system is one of the primary criteria for identifying a sequence boundary, as the base of the valley is correlative to the regional sequence boundary. During the regressive event, the existing deltaic, marginal marine, and marine sediments are often exposed and evidence for exposure within the interfluve areas can be identified (Zaitlin et al 1994). The valley will incise underlying strata, including any regionally significant markers in the area (Zaitlin et al, 1994). In the sequence stratigraphic framework, the incised valley is an important indicator of a sequence-scale event; the base of the valley (and the correlative interfluve) is defined as a sequence boundary. The fill of the incised valley may contain fluvial deposits toward the base that represent deposition during the lowstand systems tract. During the subsequent transgression, these fluvial deposits are flooded and the valley transitions into an estuarine-type depositional system. Thus the valley-fill shows an upward transition from fluvial to marine deposition. However, not all incised valleys and incised valley fill deposits represent a sequence boundary or are a result of relative sea-level fall. Incision may result from climatic change, stream capture, or a tectonic uplift in the sediment source area, all of which may increase discharge that results in channel entrenchment or incision.

Channel-fill sandstone that are interpreted as valley fill deposits are the most important economic facies within the Hartshorne delta system. This facies was added to the Hartshorne depositional model by workers at the Oklahoma Geological Survey (Andrews, 1998). Van Wagoner et al (1990) and Dalrymple et al (1994) explain that not all valleys are “incised valleys” of sequence stratigraphic definition. Van Wagoner et al (1990) and Dalrymple et al (1994) indicate that some distributary channels erode through the delta front deposits and into, but not through, the prodelta deposits, juxtaposing fluvial distributary sands on prodelta marine shale. The result is an apparent basinward shift in facies. The distributary channels become entrenched and may form a large aggradational channel complex, as it is unable to migrate laterally.   As there is no major regression, the delta plain is not exposed.

CHAPTER III

HARTSHORNE DEPOSITIONAL MODEL

Overview

The Hartshorne depositional model has evolved as most geological models change in response to new information and ideas. The first and most widely accepted model for Hartshorne deposition is that of a widespread fluvial-deltaic system (Figures 9 and 10). Houseknecht (1983) described it as a high-constructive lobate delta system that prograded from northeast to southwest during two primary phases (Matteo, 1981). A high-constructive delta is one that is dominated by fluvial processes and is continually prograding basinward. A high-constructive delta may also be subject to high frequency multiple lobe abandonment and lobe switching. This original interpretation was based on the widespread coal beds that were thought to have formed during multiple destructive phases that punctuated the delta progradation cycles. Peat deposition was first suggested to have occurred during delta progradation within the large interdistributary bays and within the distributary channels during channel abandonment. Later interpretations suggested that the peat was deposited within a widespread coastal marsh during a large-scale delta-system abandonment. However, studies of modern systems suggest that economically viable coal forming peat is not deposited close to clastic deposition and may be separated from underlying strata by a significant hiatus (McCabe, 1984). The high influx of clastic sediments into the interdistributary bay cause the peat, and subsequent coal, to have a ash content that is too high for economical coals to form (McCabe, 1987; Hobday, 1987; Cohen et al , 1987).

The depth of the water into which the Hartshorne delta system prograded was relatively shallow and there is compelling evidence for a strong wave influence in the form of extensive mud rip-ups and eroded bedding surfaces (Andrews, 1998). The Hartshorne delta morphology is thought to be lobate, which also indicates the influence of wave action. Sources of Hartshorne are believed to include the Ozark Uplift to the north-northeast, the Ouachita Mountains to the south, and other sources to the east (Andrews, 1998).

The Lower Member (including all undivided Hartshorne north of the Coal-Split Line) represents the initial phase of deltaic sedimentation. The Lower Hartshorne Coal (and the undivided Hartshorne Coal north of the coal-split line) represents either widespread delta abandonment or an unrelated flooding event during a subsequent sea level rise. The Upper Member represents a second phase of deltaic deposition (Houseknecht et al, 1983). The Upper Hartshorne delta appears to have prograded into shallower water. Deltaic facies within the Upper Hartshorne are more poorly developed and thinner than in the Lower Hartshorne Member. There is no strong evidence for the presence of a major prodelta package within the Upper Hartshorne.

In Arkansas, the Hartshorne Formation consists of a single member, that is believed to be correlative with the Lower Hartshorne Member of the study area. In the eastern part of the Arkoma Basin in Arkansas, the Hartshorne Formation is composed of three channel sandstone bodies that merge in western Arkansas (Housknecht, 1983). These are interpreted to be fluvial and deltaic distributary channels. They are as much as

120 feet thick and 3 to 9 miles in width. Matteo (1983) explains that local differential subsidence of mud/shale below and adjacent to the active distributary created a cycle of continuous sand deposition and subsidence that resulted in the development of these thick distributary channels. They are separated by strata that are interpreted to to be the result of deposition in extensive interdistributary bays. As the Hartshorne extends into the Oklahoma side of the Arkoma Basin, it becomes two linear sandstone trends that are thinner and less widely distributed than the three to the east. As the channel sands decrease in width, the interdistributary bays increase in area. This trend continues into the western side of the Arkoma, where the interdistributary deposits are more widespread than the channel sandstones. Houseknecht et al (1983) also noted that the prodelta facies in the western Arkoma Basin is similar to that in the eastern portion of the basin, but that delta front facies are thin or absent. Within this deltaic model all sandstone bodies that exhibited characteristics of a fluvial nature were considered to be distributary channels deposits of the delta plain facies. Houseknecht et al (1983), Matteo (1981), and Fields (1987) interpret the Upper Hartshorne distributary channels as being spatially distributed directly on top of and adjacent to distributary channels of the Lower Hartshorne Member.

A second model proposed is that of a deltaic system with an entrenched distributary or fluvial system (Figures 11 and 12). This model is a modification of the purely deltaic model of Houseknecht et al (1983) and is proposed to account for the relationship of the thin deltaic sediments and the abnormally thick linear sandstone bodies or trends that had been classified as distributary channels. This model is proposed with the idea that tectonic uplift within the active Arkoma Basin caused the distributary channel to erode into the older deltaic sediments.

Andrews (1998) redefined the Hartshorne depositional model within a sequence stratigraphic framework (Figures 13 and 14). This third model suggests that a drop in sea level and the formation of an incised valley and correlative unconformity or sequence boundary, punctuated each of the two primary delta cycles. This phase was followed by a rise in sea level and flooding, the extent of which is important when considering the formation of the Hartshorne coals. The overall system of deposition remained same and contained two phases of delta progradation. The primary difference between the older model of Houseknecht et al (1983) and the Andrews (1998) model was the inclusion of an incised valley and subsequent valley fill in the latter model. The multiple incised valleys are believed by Andrews (1998) to have formed after each Hartshorne delta progradation represented by the Upper and Lower Hartshorne Members. Andrews (1998) redefined the thick distributary channel sands of Houseknecht et al (1983) as being incised valley channel sands that were deposited as a result of a major regressive event. The implications of this are twofold: 1) it would suggest a relative drop in sea level after each phase of delta deposition, and 2) sediment transported through the incised valley would be deposited elsewhere, thus implying that a significant downdip accumulation of sediment occurred if the sea level fall was sufficient enough to allow for sediment bypass (Andrews, 1998). Andrews (1998) describes the thick sandstone bodies as being "falling stage deposits" of an incised valley system, and suggests that the basic model of incised valley fill architecture does not apply, as the transition upward from fluvial to estuarine

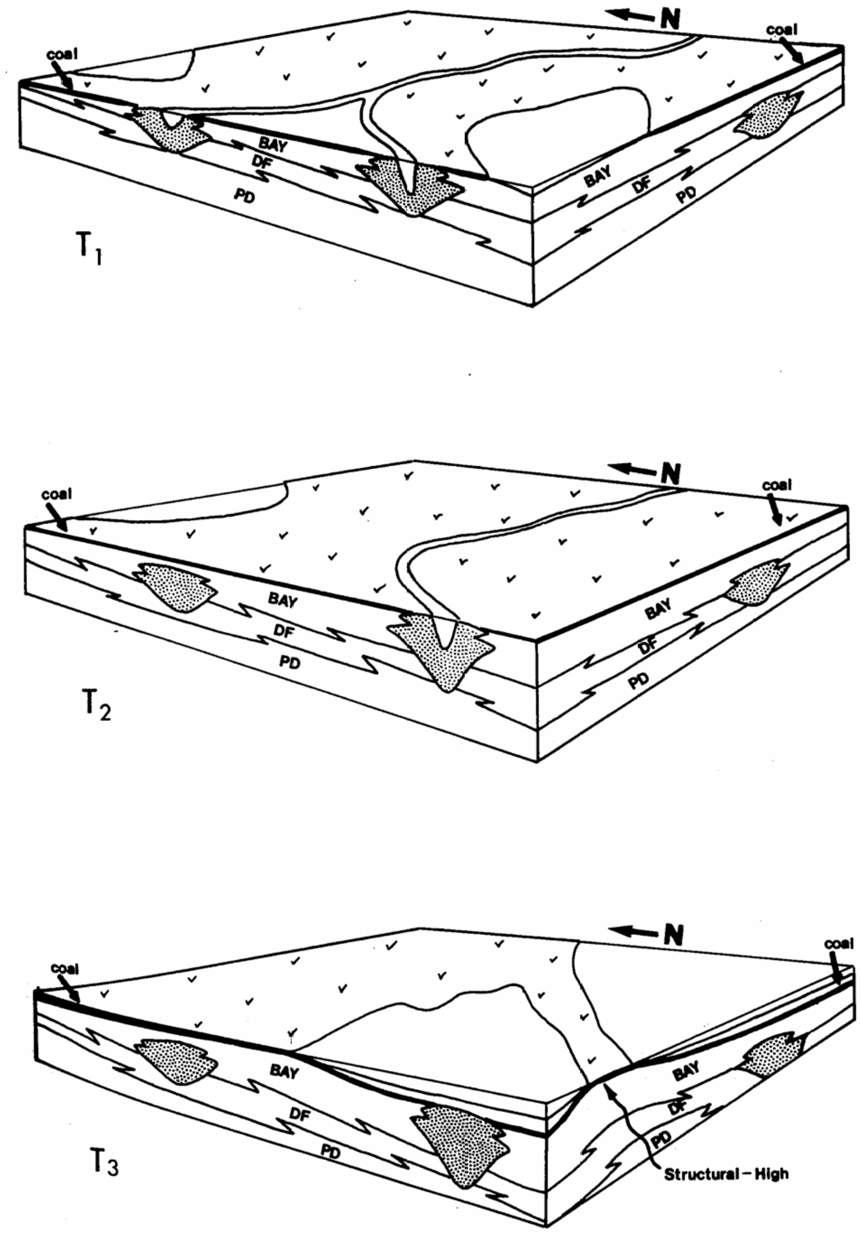


Figure 9: Deltaic Model, Lower Hartshorne deposition (from Matteo, 1983)

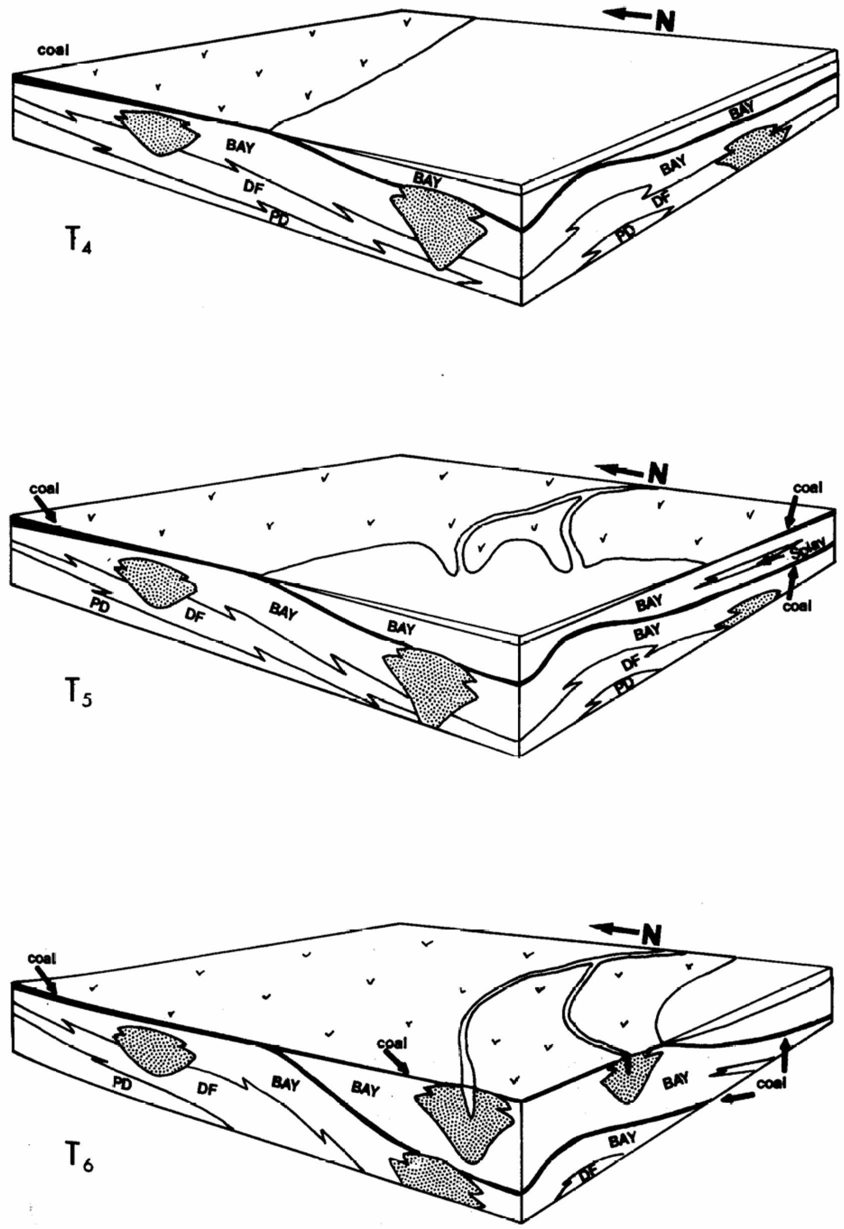


Figure 10: Deltaic Model, Upper Hartshorne deposition (from Matteo, 1983)

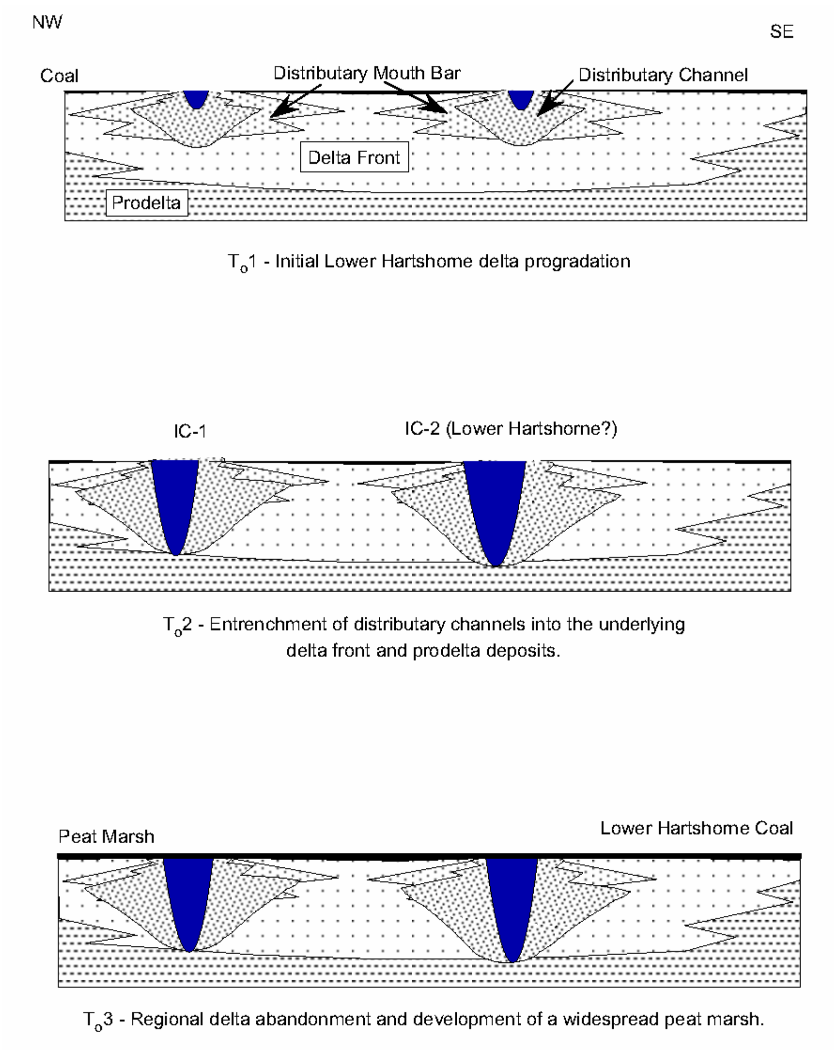
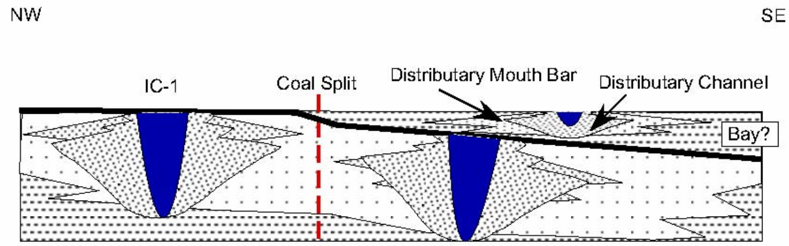
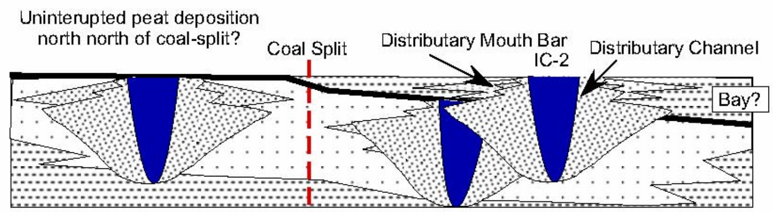


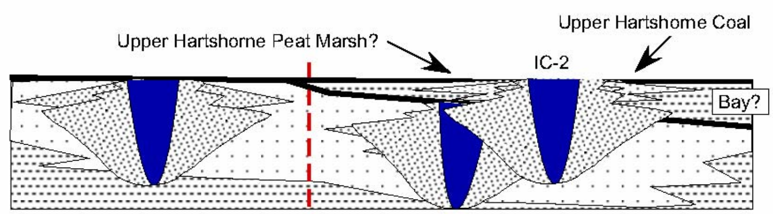
Figure 11: Lower Hartshorne delta cycle (Entrenched Distributary Model) illustrating distributary entrenchment as the origin of the thick sandstone trends (IC-1 and IC-2)



T_o4 - Coal-Split: Differential Subsidence to the Southeast. Thin Upper Hartshome Delta progrades into new accomodation space

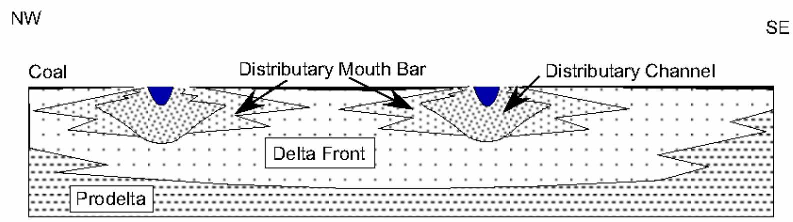


T_o5 - Upper Hartshome distributary channels become entrenched. The entrenched entrenched distributaries erode into underlying delta front and prodelta deposits, as well as Lower Hartshome deposits.

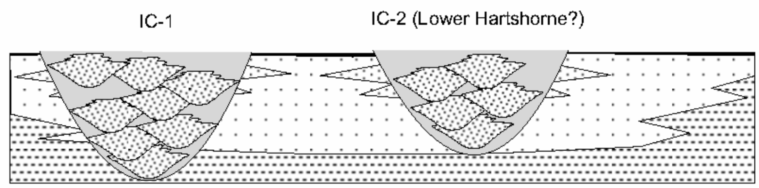


T_o6 - Widespread delta abandonment and development of Upper Hartshorne peat marshsystem.

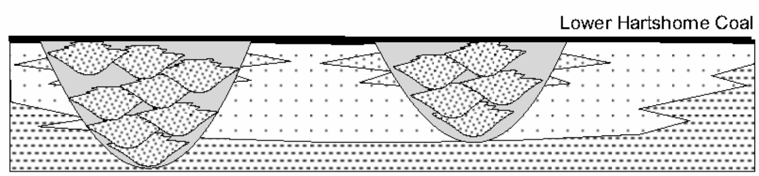
Figure 12: Upper Hartshorne delta cycle (Entrenched Distributary Model)) illustrating distributary entrenchment as the origin of the thick sandstone trends (IC-1 and IC-2)



T1 - Initial Lower Hartshornedelta progradation



T2 - Lower Hartshorne Incised Valley/Channel development. Andrews (1998) interprets the valley fill as falling stage deposits with some marine deposition.



T3 - Marine transgression and flooding and development of a coastal? peat marsh system, possible hiatus between Lower Hartshorne Coal and Lower Hartshorne sandstones and shales.

Figure 13: Lower Hartshorne depositional model with incised valley development.

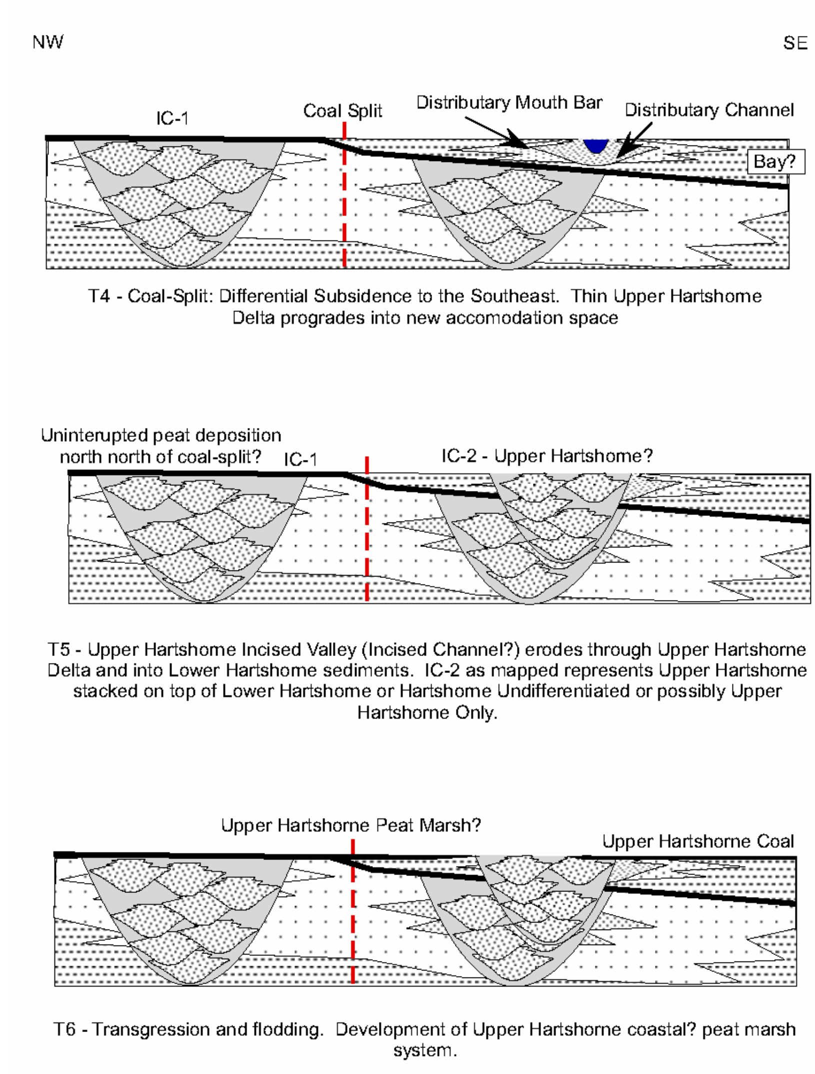


Figure 14: Upper Hartshorne depositional model with incised valley development.

deposition during valley flooding did not occur. Andrews (1998) model indicates the presence of downdip delta front deposition. In this model, the extensive coalbeds of both the Lower and Upper Hartshorne Members formed during the subsequent marine transgression, which would be similar to the coal formation during delta destruction (Matteo, 1981). It is also suggested that the coals may have formed concurrently with incised valley filling (Andrews, 1998). This would imply that the coal forming peat was deposited in a raised mire system, but would not explain the presence of coal directly above the incised valley fill deposits.

The widespread coal above the incised valley fill could result from a rise in sea level as rising base level would cause a rise in the ground water table; possibly creating a poorly drained peat marsh along the interfluves and even on top of the channel sandstones (Shanley and McCabe, 1994). The rise in sea level would create accommodation space, reducing the delivery of clastic sediment to the area to minimal amounts and allowing for the deposition of low ash peat that would form economical coal beds. The formation of peat marshes represents a relatively stable period within the Arkoma Basin (Suneson, 1998).

Suneson (1998) reported that Hendricks et al (1936) documented plant fossils and brackish to freshwater invertebrate fossils contained within the shale overlying the Lower Hartshorne coal in the eastern part of the Arkoma Basin. This was interpreted to represent lacustrine deposition. Hendricks et al (1936) also reported the presence of marine beds in the western part of the Arkoma Basin that were interpreted to have been deposited at the same time as the lacustrine deposits to the east (Suneson, 1998).

Paleocurrent analysis using various types of sedimentary structures including cross-bedding, ripples marks, and flow casts has been done by various workers including McDaniel (1968) and Matteo (1981). These paleocurrent analyses indicated a dominant northeasterly to southwesterly flow direction. The primary sediment source was to the northeast, probably the Ozark Uplift. Housknecht et al (1983) suggested that an even more distal northeastern source contributed some sediment and bypassed the Illinois Basin.

Each model is summarized as follows:

Deltaic Model

1. Lower Hartshorne delta progradation, peat deposited within interdistributary bays and above abandoned delta lobes.
2. Lower Hartshorne delta abandonment, possible widespread peat marsh development.
3. Differential subsidence, development of accommodation space in south part of basin.
4. Upper Hartshorne delta progradation, peat deposited within interdistributary bays and above abandoned delta lobes.
5. Delta abandonment. Possible widespread peat marsh development.

Entrenched Distributary Model

1. (T_O1) Progradation of the Lower Hartshorne Delta System

2. (T_O2) Small sea level fall or tectonic tilting event that caused distributary channels to incise their course, but no major basinward shift of facies. Distributaries became entrenched.
3. (T_O3) Regional delta abandonment or small sea level rise. Development of widespread peat marsh (Lower Hartshorne Coal)
4. (T_O4) Differential subsidence between the north and south parts of the Arkoma Basin. Possibly caused by tectonic activity. Progradation of Upper Hartshorne delta system south of the coal-split line.
5. (T_O5) Small sea level fall or tectonic tilting event that caused Upper Hartshorne distributary channel entrenchment into underlying delta front and prodelta deposits, as well as Lower Hartshorne deposits.
6. (T_O5) Delta abandonment or small sea level rise and flooding. Development of the Upper Hartshorne peat marsh.

Incised Valley Model

1. (T1) Lower Hartshorne delta progradation
2. (T2) Fall is sea level and formation of Lower Hartshorne incised valley/channel system. Possible development of sequence boundary.
3. (T3) Rise in sea level and development of regional peat swamp/marsh, resulting in the deposition of the peat precursor to the Lower Hartshorne Coal. The development of the coal underclay (palsosol) indicates a significant depositonal hiatus.

4. (T4) Differential subsidence occurred within the Arkoma Basin, creating new accommodation space in the southern part of the basin for the progradation of the Upper Hartshorne delta system.
5. (T5) Fall in sea level and subsequent development of an incised valley/channel system and possible sequence bounding unconformity.
6. (T6) Rise in sea level and development of widespread peat marsh and deposition of peat precursor to Upper Hartshorne Coal.

Deltaic Facies of the Hartshorne Delta System

Prodelta

The uppermost part of the Atoka and the lowermost part of the Hartshorne Formation (below the lowermost sandstone) are believed to represent the prodelta facies of the Hartshorne delta system. The prodelta is composed of dark gray shale and abundant fossils and fossil debris. Although the uppermost part of the Atoka Formation is considered to be predominantly marine and representative of the prodelta part of the Hartshorne delta system, Donica (1978) reported that there were thin coalbeds present in the upper Atoka in LeFlore County, Oklahoma (Suneson, 1998). Oakes (1977) also reported coal within the Atoka in Muskogee County, Oklahoma (Suneson, 1998). This would indicate that there may have been some non-marine deposition within the uppermost Atoka, possibly concurrent with marine deposition. In the western part of the Arkoma Basin, the Hartshorne is believed to conformably overlie the Atoka Formation. However, there are instances where an unconformable relationship apparently exists between the Hartshorne and Atoka. This unconformable relationship is the result of the erosion by Hartshorne channels (possible incised valleys) through the delta front and into the Atoka prodelta deposits.

Delta Front

The Hartshorne delta fringe, recognized by Houseknecht et al (1983) as the distal-bar, represents the transition from proximal prodelta deposition to delta front deposition.

Delta front, or marine deposits, of the Hartshorne Formation are typically very fine to fine grained, and often exhibit an apparent upward increase in grain size on wireline logs (Figure 3). Delta fringe or distal delta front deposits are typically highly indurated with silica cement (Houseknecht et al, 1983; Andrews, 1998) and are low porosity and permeability. Within the study area, sandstone interpreted to be distal delta front has lower porosity. The lower portion of the delta fringe is composed of laminated and shaly siltstone and sandstone. The upper part is lenticular and flaser bedded, ripple cross-bedded, siltstone and sandstone (Figure 15) (Houseknecht et al, 1983). The base is transitional with the underlying prodelta facies. The delta front sandstone contains horizontal burrows (Figure 16).

The proximal delta front is represented by the distributary mouth bar subfacies and may grade laterally into the distributary channel facies, making it difficult to distinguish between the two.

Figure 15: Laminated shaly siltstone and sandstone of the distal delta front. The gamma ray profile on an electric log would have a very "dirty" or shaley response with a ragged deflection from the shale baseline.

Figure 16: Example of horizontal burrows found at the base of a thick (3 foot) sandstone within the upper delta front deposits.

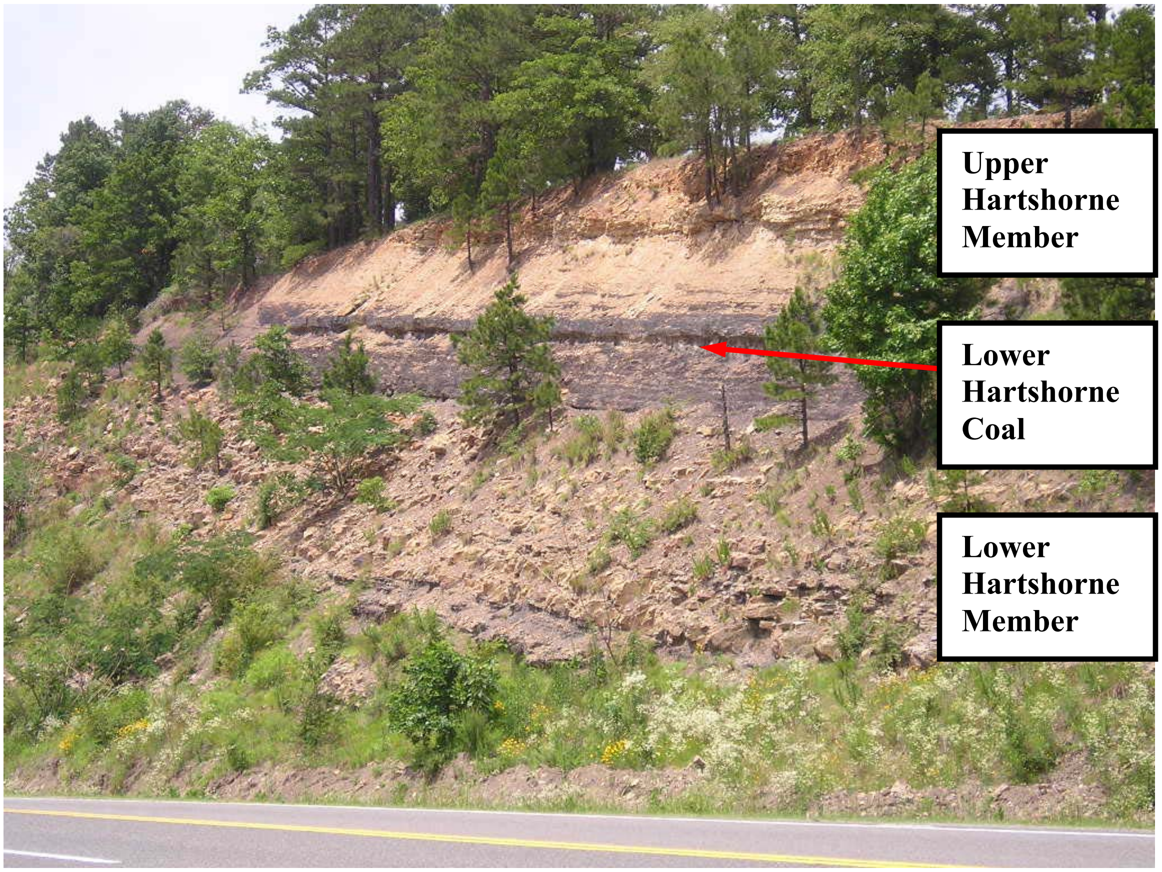


Figure 17: Roadcut south of Heavener, Oklahoma. Exposure includes the Lower Hartshorne Coal, as well as both the Lower and Upper Hartshorne Members.

Delta Plain

In the Hartshorne delta system, the distributary channels appear to bifurcate, creating an anastomosing channel system. This is a common theme in many shallow water deltas and the result of the development of immature levees and subsequent multiple crevassing. As the delta progrades and successive channels erode earlier ones, the characteristics of distributary channels become less deltaic and more fluvial.

Incised Valley Fill/Entrenched Distributary Channels

Valley fill deposits are an important facies within the Hartshorne, since their interpretation implies an additional depositional model. Reinterpretation of the Hartshorne by Andrews (1998) suggests that thick (80-200 feet) sandstone bodies are a result of falling stage deposition within an incised valley system. These sandstones were previously interpreted to be very thick distributary channel deposits by Matteo (1981), Houseknecht et al (1983), and Fields (1987).

Subsurface work by Andrews (1998) and this study suggest that these thick sandstones are genetically unrelated to the deltaic deposits into which they erode. In most cases incised valleys appear to erode through the delta plain and delta front facies and into the prodelta facies in the uppermost Atoka. The incision was likely the result of a decline in sea level. This scenario implies that the boundary between the incised valley fill and the underlying Hartshorne delta deposits represents an unconformity and sequence boundary. Consequently, the Hartshorne may be composed of two sequences, not simply two progradational deltaic cycles.

Hartshorne Coal

Peat, the sedimentary precursor to coal, is deposited in a wide variety of depositional environments. These include, but are not limited to, locations proximal to clastic deposition such as interdistributary bays, floodplains adjacent to river systems, back barrier lagoons and marshes. More often, significant peat deposition occurs away from clastic deposition and results in higher quality (low ash, low sulfur) coal (McCabe, 1987). Fisk and McCabe (1987) suggest that interdistributary bays, such as those found within the Mississippi Delta, are poor locations for economically important peat deposition because of the high ash content, which measures up to fifty-five percent. They also suggest that leaching during early diagenesis could lower the ash content. Ash content of Hartshorne coal beds ranges from three to fifteen percent (Suneson, 1998). Suneson (1998) also reported average sulfur content for the Hartshorne coals of 0.5 to 4.2 percent. The Lower Hartshorne Coal and Upper Hartshorne Coal have similar ash contents, but the lower coal contains less sulfur than the upper coal (Suneson, 1998 and Friedman, 1974).

In the northern part of the Arkoma Basin, the Hartshorne Coal is represented by a single laterally extensive coal bed, which is considered to be top of the Hartshorne Formation. To the south, this coal bed appears to split into two mappable coal beds (Figure 5). This coal-split has resulted in the division of the Hartshorne into two members, Upper Hartshorne and Lower Hartshorne. The two coals, which have been termed the Upper Hartshorne Coal and Lower Hartshorne Coal, represent the top of each of these members. This coal-split can be seen in subsurface logs (Wells #9, 10, and 11 on Cross-Section F-F', Plate 24) and the trend of the coal-split line can be traced (Plate 16). The genesis of the coal-split is believed to be a result of regional differential subsidence within the Arkoma Basin. The Lower Hartshorne Coal is well exposed in a roadcut south of Heavener, Oklahoma (Figure 17)

The differential subsidence model suggests that during or after the initial Lower Hartshorne delta cycle, the southern part of the Arkoma Basin subsided, while the northern part of the basin remained relatively stable. This subsidence created a shallow basin into which the second (Upper) Hartshorne delta prograded. Matteo (1983) suggested that during Upper Hartshorne time, the peat marsh north of the coal-split line remained active and that the upper part of the undivided Hartshorne Coal in the north formed during the Upper Hartshorne, and is chronostratigraphically equivalent. The single coalbed north of the coal split is consistently thicker (4-8 feet) than either of the individual coals (1-6 feet) south of the coal-split. Rieke and Kirr (1984) reported that the "undivided" Hartshorne Coal north of the coal-split contains a persistent black shale parting that is approximately 1 inch thick. This shale may indicate a break between deposition of Lower and Upper Hartshorne peats. A "bony" coal layer (possibly the equivalent of the black shale parting) has been identified within the Hartshorne Coal north of the coal split and may represent a break in peat deposition during the transition from Lower to Upper Hartshorne. Hamilton and Tadros (1994) reported that bone coals form as a result of excessively wet periods of time within the peat marsh. During this wet period pH of the swamp waters increases, resulting in enhanced bacterial decay of the peat and release of mineral matter to the marsh (Hamilton and Tadros, 1994). Rieke and Kirr (1984) also reported that the Lower Hartshorne Coal is underlain by a thin underclay layer. Houseknecht et al (1983) also reported that the marsh-swamp facies of the Hartshorne contained a "rooted mudstone." This mudstones or underclay as is described as being 0 to 40 cm thick and containing "abundant root traces and macerated plant debris." It is not known if this is the same underclay that Cecil et al (2003) reported as a paleosol. If this underclay is indeed a paleosol, it may indicate a significant hiatus between the deltaic and/or incised valley fill phase and a later peat deposition phase. This hiatus could be very important to interpreting the Hartshorne within a sequence stratigraphic framework. Shanley and McCabe (1994), in referencing Coleman (1966) and Tye and Kosters (1986) imply that a rise in base level, such as a transgressive event, would result in a rise in the groundwater table. This would create poorly drained areas (swamps or mires) around the valley margins (Shanley and McCabe, 1994), and on the interfluves between incised valleys.

It is generally accepted that the Lower Hartshorne Member identified south of the coal-split line is equivalent to the undivided Hartshorne located to the north of the line. The Upper Hartshorne Member is only present south of the coal split line, except for one instance where it is reported north of the coal-split line by Andrews (1998). Localized coal stringers are associated with some thick, amalgamated channel sandstone complexes. These likely formed from peat deposited within abandoned meanders or other limited bogs associated with the channels. Fields (1987) identified a thin coal seam in the thick sandstone that was cored in the Hunt-Garrett #1 (Section 34-T.6N.-R.13E).

The Lower Hartshorne Coal is laterally extensive, suggesting that suggesting that the peat was deposited during a widespread delta abandonment phase or widespread marine incursion at the end of Lower Hartshorne deposition. The Lower Hartshorne Coal (Hartshorne Coal north of the coal-split) overlies the Lower Hartshorne interval throughout the basin and thins or is absent only in localized areas.

Both the Lower and Upper Hartshorne Coals are now grouped with and assumed to be genetically related to their underlying sandstone and shale intervals. Each coal is interpreted by Housknecht et al (1983), Matteo (1981), and Andrews (1998) to represent the final phase of its respective depositional cycles. There is a school of thought that would suggest that the Hartshorne Coals represent the beginning of a cyclothem (Cecil et al, 2003). A thin “underclay” layer below the coal would suggest a prolonged exposure and development of a paleosol. The Desmoinesian Croweburg Coal of eastern Kansas is interpreted to unconformably overly a paleosol (Cecil et al, 2003). Cohen et al (1987) suggests that modern back-barrier salt marshes and lagoons are inadequate locations for the deposition of economically viable coal forming peats due to the proximity to active clastic deposition. Sohen et al (1987) suggests that peat deposited within this environment would form “thin lenses of high sulfur, high ash” coal. Cohen et al (1987) and McCabe (1987) both describe the Okefenokee Swamp, located far inland from the current coastline, as a location active deposition of high quality peat (that if preserved, could later form economic coal seams) that overlies Pleistocene age beach ridges and lagoonal salt marshes. They both suggest that this subtle unconformity would, if buried and preserved, would be difficult to distinguish in the rock record and the coal would probably be interpreted to be formed within the barrier bar depositional system within back barrier lagoons and marshes. McCabe (1987) suggested “In some case, the overlying strata may be more genetically related to a coal than underlying strata.” A more intensive examination of the genetic relationship of the Hartshorne coals and the adjacent siliclastic deposits is highly recommended. Figures 18 and 19 show the relationship of the coal and the underlying underclay. These photographs were taken at a roadcut located 1.5 miles south of Heavener, Oklahoma on State Highway 59.

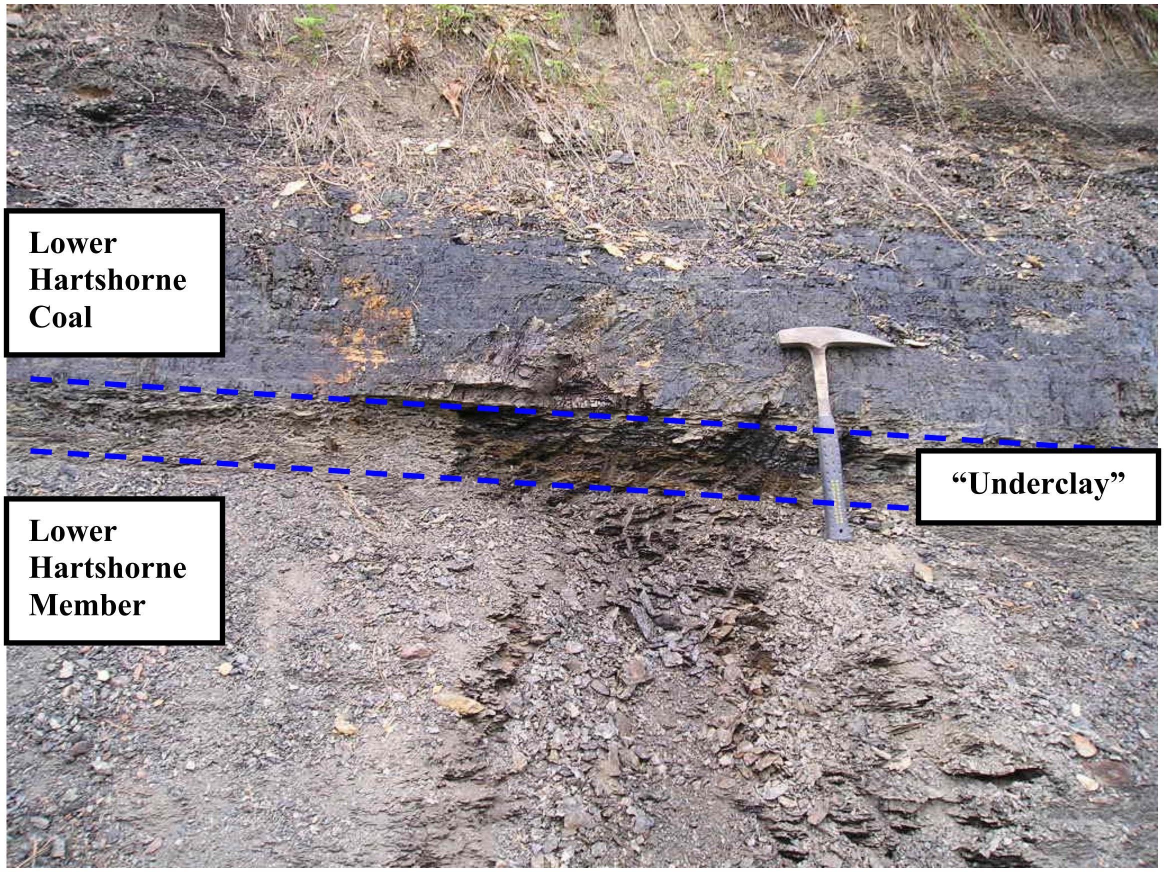


Figure 18: Relationship of Lower Hartshorne Coal to the subjacent thin underclay that shows some evidence of paleosol development. Heavener roadcut, 1.5 miles south of Heavener, Oklahoma.

Figure 19: Close up photograph of the Lower Hartshorne Coal underclay. Note yellow mottling, indicative of root traces and evidence for paleosol development.

Discussion of the Hartshorne Depositional Model as Applied to the Study Area

Within the study area, the Hartshorne Formation is composed of sandstone, shale and coal that formed from sediments deposited within a fluvial-dominated deltaic system during what are interpreted as multiple phases of progradation, entrenchment, and abandonment. Thick shale of the uppermost Atoka and lowermost Hartshorne are believed to represent the prodelta facies. Delta front facies, including distributary mouth bar and bar crest subfacies, are present within the study area, but are not as widespread as other facies (Plate). Delta plain facies are the most abundant within the study area and include distributary channel, interdistributary bay, and crevasse splay subfacies. The overall sandstone geometry and facies distribution of the Hartshorne within the study area was determined using two gross sandstone isopach maps (Plate 3 and 4) and multiple cross-sections (Plates 18 thru 26). The most important feature; one that is most telling about the history of the Hartshorne delta system, is the coal-split that occurs within the Hartshorne Formation. As indicated in the section on stratigraphy, the coal-split line defines the boundary where the Hartshorne Formation can be divided into the Upper and Lower Hartshorne Members. The Lower Hartshorne Coal represents the top of the Lower Member south of the coal-split line, whereas the Upper Hartshorne Coal represents the top of the Upper Member and top of the Hartshorne Formation south of the coal-split line. Within the study area, the split between the Upper Hartshorne and Lower Hartshorne Members is easily mapped as a northeast-southwest trending line (Plate 16). The coal-split is illustrated in Cross-Section H-H' (Plate 26). Northwest of this line only the Lower Hartshorne Member is present and the Hartshorne Coal is undivided.

Southeast of the coal-split line, both members are present and can be mapped separately, except where there is thick fluvial succession or incised valley fill sandstones. The overall Hartshorne interval thickens from the north-northwest to the south-southeast, as do the overlying McAlester Formation and underlying Atoka Formation. This is a result of the basin geometry and increased subsidence to the south. The differential subsidence that occurred between the areas north and south of the coal-split line may have been structurally induced, as normal faulting is common and influence sediment thickness in the Atokan Series (Zachry and Sutherland, 1984).

Within the study area, there are two thick sandstone bodies that trend from the northeast to the southwest. These sandstone bodies are composed of a thick succession of fluvial deposits that were first interpreted by earlier workers as distributary channel facies of the delta system (Housknecht et al, 1983). Andrews (1998) reinterpreted these thick sandstones as falling stage fluvial deposits of an incised valley system that formed as a result of a drop in sea level. Based on mapping and cross-section work, fieldwork, and past core studies it is apparent that these thick sandstone bodies represent a significant change in the depositional system. It is possible for distributary channels to entrench very deeply into the underlying sediment, even into the prodelta mud. This is often not a result of eustatic drop in sea level, but rather a local or regional change in stream discharge, often a result of tectonic uplift or climatic changes (Schumm and Ethridge, 1994; Zaitlin et al, 1994). The northern incised valley, or entrenched distributary channel, (Incised Channel, IC-1) is generally accepted to be Lower Hartshorne only, as it is north of the coal-split line. The southern incised valley, or entrenched distributary channel (Incised Channel, IC-2) is generally thought to be composed of Lower Hartshorne overlain by Upper Hartshorne. The division of this interval was based on a shale bed that separates the "Upper Hartshorne Sandstone" from the underlying "Lower Hartshorne Sandstone." In this study, the southern incised valley/entrenched channel (IC-2) was mapped as Hartshorne undifferentiated.

The Lower Hartshorne Member contains prodelta, delta front, and delta plain facies, as well as a possible entrenched distributary or incised valley-fill facies. It is considerably thicker than the Upper Hartshorne Member. It ranges from approximately 60 feet thick to more than 200 feet thick. The Upper Hartshorne Member only reaches approximately 60 feet of total interval thickness within the study area. This occurs in the southern area, away from the coal split line. It appears that the only recognizable deltaic facies within the Upper Hartshorne is delta plain facies, which consists of shale that contains thin (2-4 foot thick) sandstone lenses. As stated before, the upper part of the southern incised valley fill/entrenched channel deposit (IC-2, mapped as Hartshorne Undifferentiated) may be Upper Hartshorne distributary channel facies or incised valley fill facies. The accommodation space created by the subsidence of the Lower Hartshorne Delta did not create the depth required for deposition of a complete delta succession.

Matteo (1981), Houseknecht at al (1983), Suneson (1998), and Andrews (1998) interpreted the Lower and Upper Members as two distinct deltaic cycles, punctuated by marine flooding and delta destruction. They suggest that peat formation occurred at the end of Lower Hartshorne deposition, as marine waters drowned the former delta during the transgressive phase. Peat deposition may have continued north of the coal-split throughout Upper Hartshorne deposition.

Lower Hartshorne Member

The Lower Hartshorne Member is interpreted to be correlative to the undivided Hartshorne that lies to the north of the coal split line. At some point, differential subsidence created a topographic low into which the Upper Hartshorne delta complex is thought to have prograded. The Lower Hartshorne Member is the thickest, more widespread, and complex of the two. The Lower Hartshorne Member represents the initial delta depositional cycle, during which there seems to have been several cycles of deltaic sedimentation. As the result of lobe switching and localized subsidence, proximal delta front and delta plain deposits overlie more distal facies. Consequently, the electrofacies patterns indicate that distal facies grade upward to proximal facies. The Lower Hartshorne Member thickens from northwest to southeast toward the Arkoma depocenter. The strike of the trend of sediment thickening and the coal-split parallel the strike of the major structural features within the Arkoma Basin.

Prodelta

The uppermost part of the Atoka Series represents distal prodelta deposition and is composed primarily of shale. Within the northeastern part of the study there is a locally occurring sandstone in the uppermost Atoka, that is believed to be the Gilcrease Sandstone of economic usage. The contact between the Hartshorne and the Atoka appears to be conformable in the study area and is not easily discernable. In the northwestern part of the study area, the contact is represented by a shift in the resistivity that is evident on wireline logs. This marker is mappable throughout most of the study area, but becomes hard to identify in the southern area, where thick channel sands were deposited.

The proximal prodelta/distal delta front transition is most likely represented by the lowermost portion of the Lower Hartshorne Member and comprises what others have termed the transitional facies. It represents a time during delta evolution when increasing amounts of coarser silt and very fine-grained sand was introduced into the prodelta subsystem as the delta prograded. The prodelta facies is not represented on the facies map (Plate 17).

Delta Front

The proximal prodelta deposits grade upward into the distal delta front deposits, which are indicated on wireline logs by an increasing thickness and frequency of sandstone. The delta front facies can be seen in well log 3 in Cross-Section B-B' (Plate 20) and in most wells in the attached cross-sections as the transitional zone between the prodelta shale of the uppermost Atoka Formation and lowermost Hartshorne Formation. Sand content increases upward as the delta progrades. As progradation continued, proximal delta front sediments accumulated on those of the distal delta front. Matteo (1981), Houseknecht et al (1983), and Andrews (1998) have stated that the delta front of the Lower Hartshorne Delta is difficult to identify and may be thin to not present within the study area. The proximal delta front is represented by a very distinct coarsening upward signature on the gamma ray curve. It is typically 20 to 30 feet thick, and may be mistaken for crevasse splay deposits. This is not unusual, as the process of crevassing along a distributary channel is part of the delta building process and crevasse splays may become new delta lobes. Differentiation between delta front and distributary mouth bar facies is made more difficult as higher frequency sea level changes are imprinted upon the larger delta progradation. This can be seen as a shallowing upward cycle, followed by a deepening upward one, which is succeeded by another shallowing upward cycle. This pattern is evident in outcrop (Figure 20) as well as in electric log profiles (well log #5, Cross-Section C-C', Plate 15). These cycles seem to increase in number and thickness in the southern part of the study area where the overall section is thicker. Well log #11 in Cross-Section C-C' is an example of multiple cycles within the Lower Hartshorne. Log signature indicates delta front and distributary mouth bar electrofacies as well as channel facies.

Distributary Mouth Bar and Bar Fringe

The distributary or channel-mouth bar electrofacies is recognized by a blocky to slightly upward coarsening profile on the gamma-ray curve. The distributary mouth bar is adjacent and subjacent to the distributary channel deposits, as show on the facies map (Plate 17) and in various cross-sections. The channel-mouth bar represents the transition from channel to delta front, and is deposited immediately headward of the channel as the delta progrades. In some cases, it becomes difficult to distinguish between channel and channel-mouth bar electrofacies. Well log #2 in Cross-Section E-E' (Plate 23) is a good example of what is interpreted to be distributary mouth bar facies that is overlain by a Type-1 channel. In well log #2 in Cross-Section B-B' (Plate 20) the sandstone has been interpreted to be channel-mouth bar, but could represent the margin of a Type-1 Channel.

In well log #1 in Cross-Section F-F' (Plate 24) the distributary mouth bar appears to be overlain by interdistributary bay and crevasse splay deposits of the delta plain.

Delta Plain

Within the western part of the Arkoma, including this study area, the delta plain is composed of widespread interdistributary bays crosscut by thin, bifurcating distributary channels. These bays are typically muddy, except where overbank deposits and crevasse splays spilled out into the delta plain. The distributary bay facies is not the most common facies interpreted for wells that penetrated the Hartshorne Formation, but it is widespread and present between the narrow trends of the channel/bar/delta front, as well as superposed on abandoned distributary and crevasse splay/delta front deposits.

Distributary Channel Sandstones

The interpretation of distributary channel facies is problematic. Within the study area, three different types of channels are identified. The first two are defined as distributary channels primarily on the basis of their relationship to other deltaic facies. The third type was originally defined by Matteo (1981) and Houseknecht (1983) as distributary channels, but were redefined by Andrews (1998) as incised valley fill or entrenched channel deposits. Based on the gross sandstone isopach map and cross-sections, this third channel type appears to be unrelated to the deltaic facies. Deposits interpreted to be distributary channels are divided into two categories: i) Type-1 Distributary Channels, and ii) Type-2 Distributary Channels (Figure 21). Type-1 distributary channels tend to be located near the top of the Lower Hartshorne interval and are 3 to 15 feet thick. Type-1 channels appear to be closely related to sandstones that are

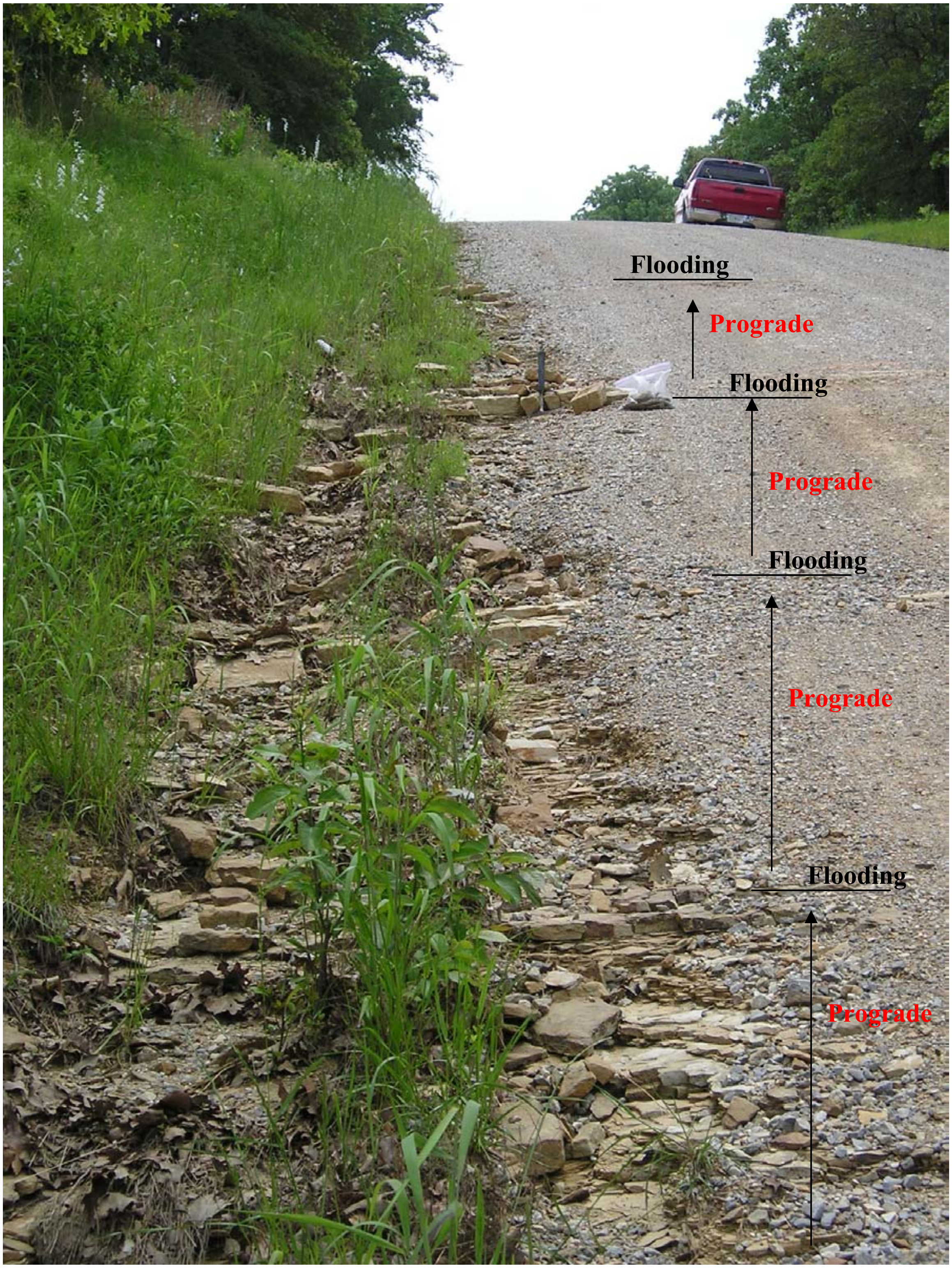


Figure 20: Example of multiple high-frequency sequences within the delta front to distributary mouth bar facies of the Hartshorne delta system. The cycles are actually about the same thickness as they increase in distance away from the camera up the hill.

interpreted to be distributary mouth bar deposits. Well logs 4 and 5 on Cross-section A-A' (Plate 13) are examples of Type-1 distributary channel deposits. They have a blocky to fining upward profile on the gamma ray curve. Type-1 distributary channels can be difficult to distinguish from the channel mouth bar and may represent the bar crest portion of the distributary mouth bar, and despite their apparent fining upward log pattern. Type-2 distributary channels are easily identified because they appear to erode through Type-1 channels and distributary mouth bar deposits and into the delta front.

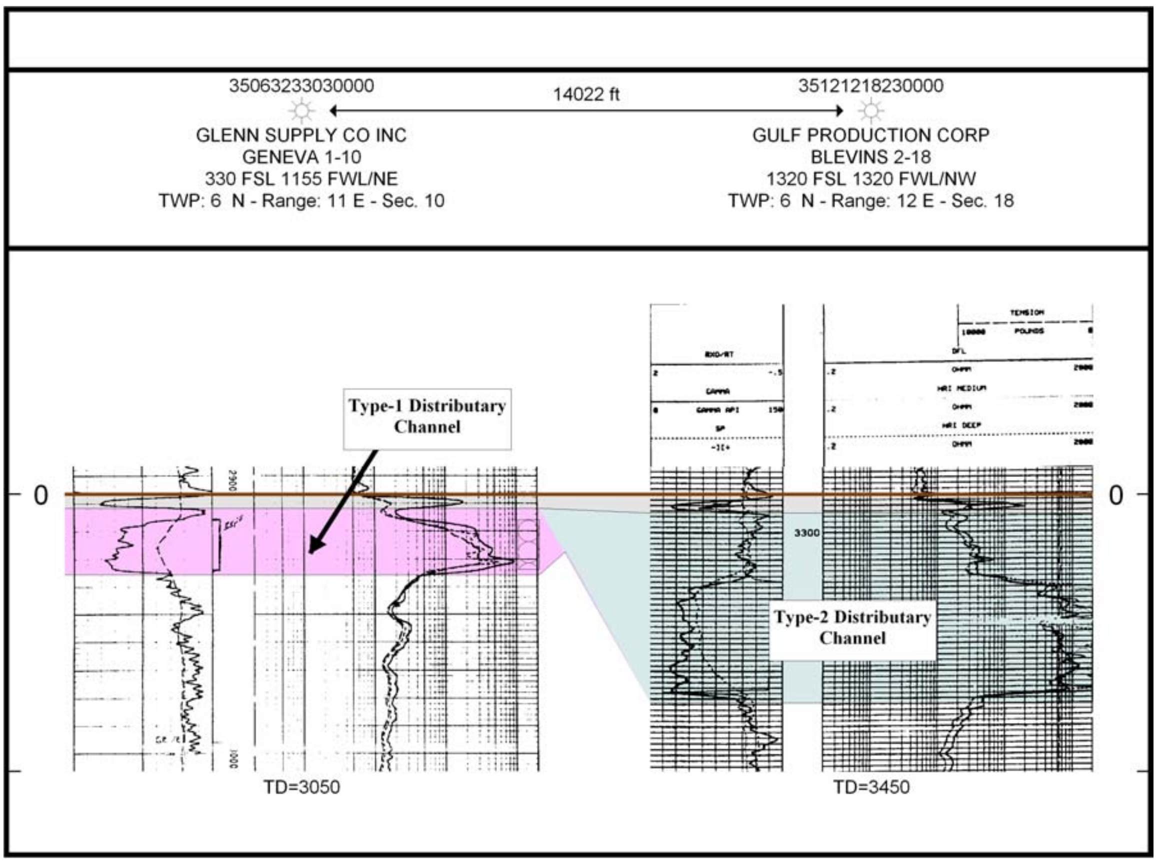


Figure 21: Example of Type-1 and Type-2 Distributary Channels.

This entrenchment of the Type-2 distributary channel may represent the initial erosion associated with an incised valley/entrenched channel system. A second interpretation could be that the Type-2 distributary channel deposits are older than the Type-1 distributary channel deposits, based on their stratigraphic position relative to each other. Type-2 channels sandstones have a blocky to fining-upward profile on the gamma ray profile, but are thicker than Type-1. Type-2 channel sandstones always exhibit a very sharp and probably erosional base. Type-1 channel sandstones may have a sharp base, but are often directly underlain by coarsening upward sandstone that is interpreted to be the distributary mouth bar facies. Type-2 distributary channels are from 20 to 50 feet thick and always overlain by abandonment phase deposits or bay fill deposits with possible crevasse splay sandstones. Well log 7 in Cross-Section B-B' (Plate 14) is a very good example of a blocky Type-2 distributary channel deposits overlain by bay fill deposits, including possible crevasse splay sandstones. This well, the Davis Operating Company Donna #1-16, is located in South Pine Hollow field and has produced significant quantities of gas. Well log 2 in Cross-Section C-C' is another example of what has been interpreted to be a Type-2 channel deposit, as evidenced by the sharp base and fining-upward gamma-ray profile. This well, the Unit Petroleum Company Duncan #1, is more than 10 miles north of the Donna #1-16. The overall interval is thinner in the northern part of the study area and the channel sandstone evident in Duncan #1 is thinner than the one in the Donna #1-16. Well log 4 in Cross-Section F-F' is interpreted to contain channel margin deposits of a Type-2 channel. The entrenchment evident in this location may represent the initial onset of the development of the entrenched channel or incised valley system.

Crevasse Splay

Crevasse splay deposits are not easily recognized and may be mistaken for proximal delta front facies. Distinguishing crevasse splay deposits from proximal delta front (not distributary mouth bar or bar crest) relies on establishing the relationship of the sandstone in question to interpreted distributary channel and distributary mouth bar facies in offset wells. Crevasse splays are an important factor in delta lobe switching, as the splay itself is an incipient delta lobe that may develop further and lead to the flooding and destruction of the former active lobe (Galloway and Hobday, 1997). Wireline logs were closely scrutinized to establish sandstone body geometry. Geometry was integrated with distribution to identify depositional environments. As a result, crevasse splay and channel margin deposits were grouped as a subfacies of the delta plain facies. Crevasse splays occur within bay fill deposits overlying abandoned distributary channels, as is seen in well log 7 in Cross-Section B-B' (plate 14).

Lower Hartshorne Coal

The Lower Hartshorne Coal is present throughout the study area except where it was eroded by the southern incised valley/entrenched channel (IC-2). The Lower Hartshorne Coal is considered the equivalent of the Hartshorne Coal where there is no division between the Lower and Upper Hartshorne Members. It has been suggested that Hartshorne Coal deposition north of the coal split line continued, uninterrupted from Lower Hartshorne time into Upper Hartshorne time (Andrews, 1998; Matteo, 1981).

Because the Lower Hartshorne Coal is so widespread and found above the IC-1, it is likely that the peat did not form until after the transgression that followed incision.

Upper Hartshorne Member

The Upper Hartshorne Member is only present in the southern part of the study area (southeast of the coal-split line) and little or no sandstone is present within it. The Upper Hartshorne Member is believed to represent a second phase of delta progradation that followed the destructive phase of the Lower Hartshorne Delta System. The accommodation space created by the differential subsidence following deposition of the Lower Hartshorne was relatively limited compared to that which was present prior to Lower Hartshorne deposition. The Upper Hartshorne Member thickens to the southeast away from the coal-split, and the hingeline is represented by the regional trend of the Hartshorne Coal-Split. Within the study area, the Upper Hartshorne is mostly shale and believed to represent deposition within an interdistributary bay. There are very thin, 1 to 4 feet thick, siltstone or sandstone beds within the Upper Hartshorne Member, that may represent crevasse splay deposits. These sandstones seldom meet the "clean" sandstone cut-off of 50% that was used for gross sandstone mapping.

Prodelta

There is no strong evidence that supports the interpretation of prodelta deposits within the study area. Very thin prodelta may be present and not distinguishable from what are interpreted to be interdistributary bay deposits. Suneson (1998), in a field trip guide containing numerous measured sections south and east of the study area, presented evidence for the presence of definitive prodelta deposition. Suneson (1998) reported marine shale at the base of the Upper Hartshorne Member, directly above the Lower Hartshorne Coal.

Delta Front

Delta front facies are rarely identified within the Upper Hartshorne in the western part of the Arkoma Basin. Houseknecht et al (1983) identified underdeveloped delta front deposits in the eastern part of the basin. In the Deer Creek #1 well located in Sec 24-T.5N.-R.13E., the Upper Hartshorne Member reaches its greatest thickness and shows some evidence of a coarsening upward electric-log profile as this coarsening-upward interval capped by a shale, which is succeeded by a 3 feet thick sandstone, more shale, and finally the Upper Hartshorne Coal. This is the best example of a log profile within the study area that could be interpreted as the Upper Hartshorne delta front electrofacies

Delta Plain

The Upper Hartshorne Member contains sedimentary features and log profiles that suggest it is likely composed primarily of delta plain deposits. There is no evidence for Upper Hartshorne distributary channel deposits.

Incised Valley Fill/Entrenched Distributary Channel Complexes

The Lower Hartshorne and Hartshorne Undifferentiated Gross Sandstone Isopach Maps (Plates 6 and 7) indicate the presence of two thick sandstone trends that are oriented in a northeast to southwest. These are termed IC-1 (north) and IC-2 (south). These thick sandstones were first interpreted by Houseknecht et al (1983) as thick distributary channel sandstones that were part of the original Hartshorne delta system. Andrews (1998) modified the interpretation to include sequence stratigraphic concepts. This recent work resulted in the interpretation of these sandstone trends as incised valley fills that are separate from the delta system and the resulted of a major regressive event (Andrews, 1998). According to this model, incision occurred at the end of each of the Hartshorne deltaic cycles (represented by the Lower and Upper Hartshorne Members). A lowering in sea level resulted in the erosion of older deltaic sediments, and formation of incised valleys or entrenched channels. Andrews (1998) suggests that the sandstone within these valleys represents falling stage deposition.

The northern sandstone body, IC-1, is located north of the coal-split line, and by definition is Lower Hartshorne. Well logs 3 and 4 on Cross-Section C-C' illustrate the relationship between the incised valleys/entrenched channel complex of the IC-1 trend with adjacent Hartshorne deltaic facies in well logs 2 and 5 (Plate 15). This same illustration can be seen in Cross-Section E-E' (Plate 17). A gross sandstone map of the Lower Hartshorne clearly defines the IC-1 incised valley/entrenched channel trend (Plate #3). IC-1 is always capped by the (Lower) Hartshorne Coal; in places the coal sits directly above the sandstone. In other areas there is a shale break between the sandstone and the coal, indicating that at some point this channel or valley was abandoned. The second thick channel sandstone trend, IC-2, is located south of the coal-split line. Previous workers have divided this channel into Upper and Lower Hartshorne. This separation was based on a shale marker within the channel fill that is not easily identified. Well logs 6 and 7 in Cross-Section C-C' and well logs 7 and 8 in Cross-Section F-F' are representative of sandstone within the IC-2 trend and its relationship to adjacent facies of the Hartshorne delta system. The division of the southern IC-2 sandstone may have been based on the presence of a thin coal bed within the channel fill that was assumed to be the Lower Hartshorne Coal. The coal within the channel fill does not directly correlate to either the Lower or Upper Hartshorne Coals. IC-2 is mapped as Hartshorne Undifferentiated, but the author acknowledges that it may contain Lower and Upper Hartshorne deposits.

It is clear from relationships evident on the cross-sections and sandstone maps that the IC-1 and IC-2 trends eroded through the primary deltaic deposits. The gross sandstone isopach map of the Lower Hartshorne Member confirms that both the northern (IC-1) and southern (IC-2) thick sandstone trends eroded older delta deposits, including Type-2 distributary channel deposits, which themselves may have eroded or entrenched into the delta plain. In Cross-Section G-G' (Plate 19), the Type-2 distributary channel is traceable on either side of the northern IC-1 trend. The two wireline logs on the left of cross-section are located northwest of IC-1, the two wireline logs on the right are located southeast of IC-1, and between IC-1 and IC-2. It stands to reason that incision would occur along the course of an active channel system. As incision occurred, the distributary channel system became entrenched and developed a very linear trend as the channel was no longer allowed to migrate laterally, nor develop crevasse splay lobes; two processes that helped generate the anastomising channel pattern in the Lower Hartshorne Delta system.

Fields (1987) described core from the Hunt Garrett #1 (Section 34-T.6N.-R.13E.), which is located in South Pine Hollow Field. Two core intervals were taken, 3555 to 3561 feet and 3561 to 3601 feet. The overall core condition was poor. Fields (1987) interpreted this to be Upper Hartshorne distributary channel sandstone, stacked on top of Lower Hartshorne distributary sandstone. Neither the upper or lower contacts were cored. The location of the well is within the mapped IC-2 trend (Plate 5), which was mapped as Hartshorne Undifferentiated. The cored sandstone contains a variety of sedimentary structures including small scale trough cross-bedding, planar bedding, and contorted bedding (Field, 1987). The overall grain size is fine with a two-foot interval of very fine-grained sandstone at the base of the core (Fields, 1987). The sandstone contains black carbonaceous debris and plant fossils, which Fields (1987) suggests indicates that the Upper Hartshorne distributary channel cut through interdistributary bay deposits of the Lower Hartshorne. All cross-bedding indicates unidirectional flow and there was no evidence for marine deposition, although there was a thin coal bed reported in the lower part of the section. A thin coal bed near the base of the may be remnant of the Lower Hartshorne coal if IC-2 sandstone trend represents both Hartshorne Members, or it could simply be a coal stringer representing a short term phase of channel abandonment phase. No evidence was presented by Fields (1987) to suggest that IC-2 trend is an incised valley fill deposit.

Local Structure

To help evaluate the control of gas production two structure maps were constructed. The first defined the structural attitude of the top of the Lower Hartshorne Coal. The second structure map was constructed on the base of a hot shale marker above the Lower Hartshorne Coal. Several prominent structural features that have been mapped and noted by previous workers can be detected in the study area (Figure 22). This map shows that the Tonkawa Syncline and McAlester Anticline are two prominent structural features. Both have a general northeast to southwest trend and plunge. The contour patterns indicate a northeast to southwest structural trend, which coincides with the structural elements presented by Fields (1987). One fault was definitively identified in the southeastern part of the study area. Well control for structural interpretation was limited. Many wells that penetrated deeper than the Hartshorne did not contain wireline log measurements across the Hartshorne interval.

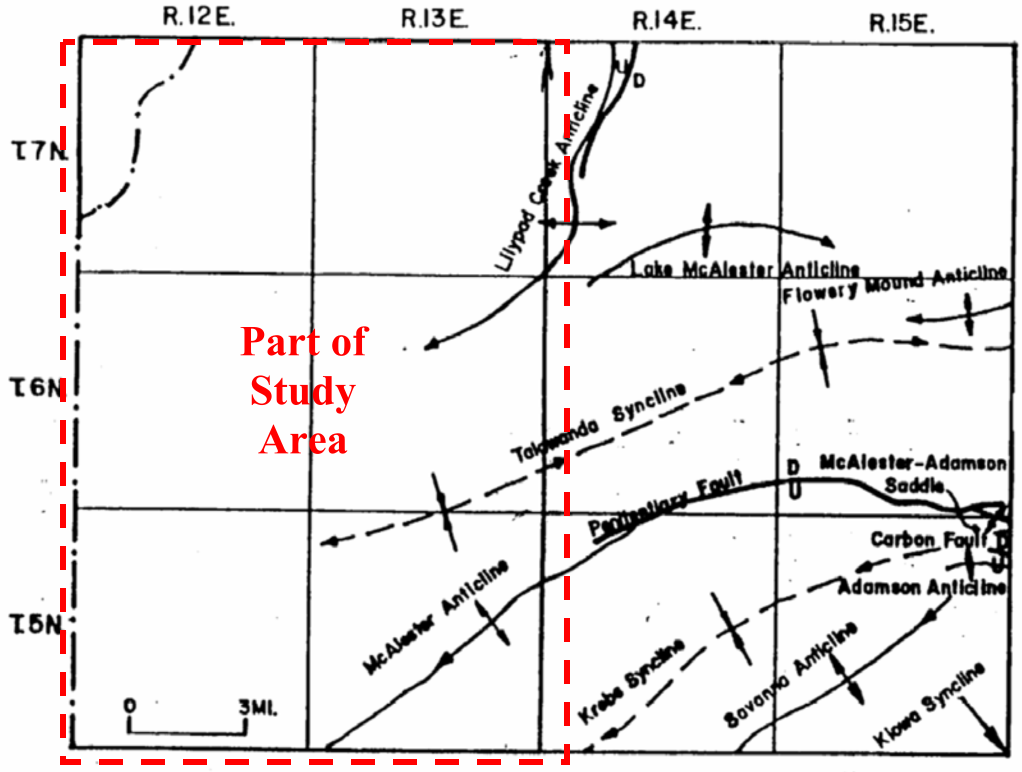


Figure 22: Map showing local structures that trend into the study area (from Fields, 1987).

CHAPTER IV

PETROLEUM GEOLOGY

Regional Overview

Delta systems are prolific habitats of petroleum throughout the world, and the Hartshorne delta in the Arkoma Basin is no exception. The study area is in a gas producing province and natural gas production from the Hartshorne Formation, including coalbed methane production, in the Arkoma Basin in Oklahoma is estimated to be 1.07 tcf (trillion cubic feet). Production data could not be quality checked and may include gas from other reservoirs that is commingled Hartshorne production. Within the study area the Hartshorne (including commingled production) has produced in excess of 167 bcf (billion cubic feet) from 259 wells, or an average of 0.836 bcf per well. This is economically important considering that the average depth of the producing Hartshorne reservoir is only 3000 feet. The current daily production from the study area is 93 mmcfd (million cubic feet per day) from 202 active wells, or an average of 460 mcfd.

Volumetric Methodology

Volumetric calculations were performed to determine the recoverable original gas in place (recoverable OGIP) for each field. The volume of the reservoir was measured using the Net Pay Isopach Map for the Lower Hartshorne and Hartshorne Undifferentiated (Plates 9 and 11) using a porosity cut-off of 8% and a Sw (water saturation) cut-off of 40%. Areas within each contour interval were measured and subtracted from the area of the next lowest contour interval (Figure 23). The net pay value used for each volumetric calculation was the average between that contour interval and the next highest. For example, an average reservoir thickness of 12.5 feet (net pay) was used to calculate the volumetric parameters for the reservoir within the 10 feet contour interval. Similarly, 7.5 feet of net pay was used for the average thickness of pay for the reservoir within the 5 feet contour interval after the area of the 10 feet contour interval was subtracted from the area of the 5 feet contour interval (based on a 5 feet contour interval). The basic equation used in the calculation of Recoverable OGIP is:

$$\frac{\mathbf{(43.56 \times \Phi \times (1\text{-}Sw) \times A \times (Net\ Pay) \times Pi \times Tsc \times Rf)}}{\mathbf{(Zi \times Pa \times T)}}$$

43,560 is the amount of cubic feet per acre (43.56 will result in Mcf/Acre)
Φ - Porosity
Sw – Water Saturation
Net Pay – (Feet) – Porosity >8% and Sw <40%
Pi – Initial Reservoir Pressure
Psc – Standard Conditions or Atmospheric Pressure
T – Reservoir Temperature in Rankin (460 + degrees F)
Tsc – Surface Temperature in Rankin (460 + degrees F)
Zi – Gas Compressibility at initial conditions
Rf – Recovery Factor

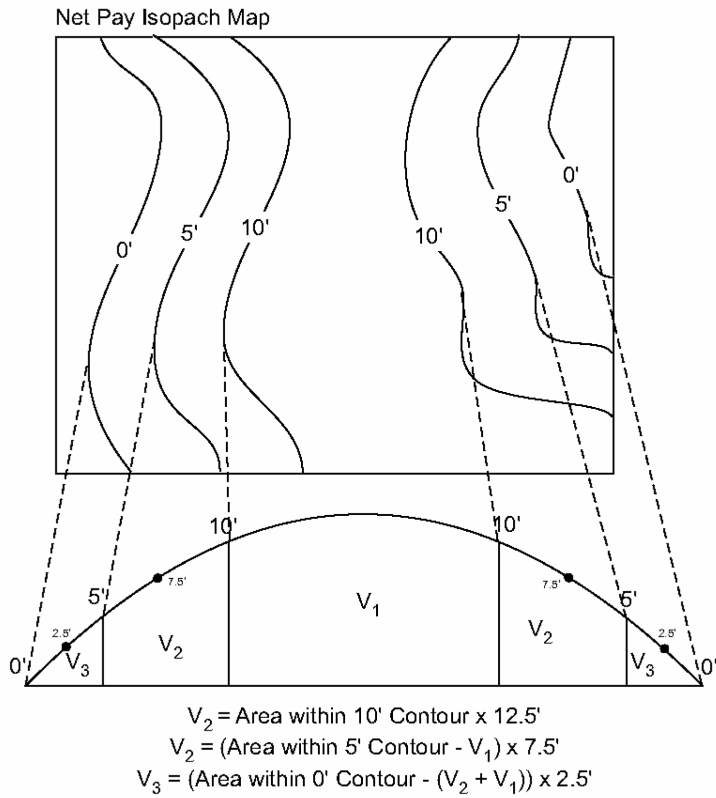


Figure 23: Diagram illustrating method used to determine reservoir volume.

Conventional Hartshorne Play

Four primary gas plays are identified within the study area. They include the (1) Distributary Channel, (2) Channel Mouth Bar, (3) Incised Valley Fill/Entrenched Channel, and (4) Coalbed Methane. All are defined primarily by their stratigraphic control (facies change or pinch-out of sandstone into adjacent shale). Gas is also produced from secondary or marginal plays. Secondary gas plays in the area include channel margin, bar fringe, delta front, and crevasse splay. Production from these facies is limited and economic potential is low. The production volumes that are reported from Hartshorne wells may include production from other reservoirs. As a result, there is some inaccuracy in the production values reported for the Hartshorne. In instances where production is commingled and initial test rates are provided, the reader can assess the contribution from the Hartshorne. Most wells cited in this study mostly produce only from the Hartshorne Formation. There are also instances where production from the Hartshorne Sandstone is commingled with production from the Hartshorne Coal.

The Incised Valley Fill/Entrenched Channel Play has provided the most prolific or highest volume wells. The average cumulative production from this play within the study area is 1.9 bcf (based on 60 wells). The northern IC-1 has produced from 21 wells, with an cumulative production of just over 1 bcf per well. The IC-1 contains a gas-water contact in the updip end of the channel that limits the reservoir volume (see the section below on Reams NW Field). On the downdip end of the channel, the Stuart Southwest Field also appears to be limited by a water leg. Both of these fields produce gas where the valley fill sandstone crosses a structural high. The southern IC-2 has produced over 93 bcf from 39 wells, or an average of 2.4 bcf per well. These wells are all contained within the Pine Hollow South Field, which also produces from the other Hartshorne Facies.

The distributary channel facies is the second best play within the study area. The Type-1 channel facies averages 0.63 bcf per well, based on 11 wells. This production may be closely tied to production from the Distributary Mouth Bar deposits that the channel sandstones appear to overly. The Type-2 Channel Facies Play has produced an average of 0.42 bcf from 43 wells. This production comes from sandstones that are classified as channel margin facies.

The average production per well from the distributary mouth bar facies is 0.29 Bcf. This volume may be slightly overstated as a result of commingling with the Booch

Sandstone in the Scipio Northwest and Lamar East Fields. Excluding dry holes, the range of cumulative production values is from 2 mmcf to over 2 bcf per well.

The Delta Front Facies within the study area has produced an average of .15 Bcf per well. The delta front facies may also be referred to as crevasse splay deposits.

Deposits classified as channel margin have produced an average of 0.21 Bcf from 37 wells.

Coalbed Methane

The Hartshorne coals are exploited within the Arkoma Basin. Rieke and Kirr (1985) estimated the gas content of the Hartshorne Coals to range from 73 to 570 cubic feet/ton. The high range for Hartshorne Coal gas content is significantly greater than that of the Booch Coals (200 to 211 cubic feet/ton) and McAlestar Coal (131 cubic feet/ton) (Rieke and Kirr, 1985). Coals located in the eastern part of the Arkoma Basin have a higher gas content than those in the western part of the basin (Rieke and Kirr, 1984).

Several wells in the study area produce gas from Hartshorne coal seams. Most are commingled with production from the underlying Lower Hartshorne sandstone. One example of a coalbed gas well is the Ott #2-22 located in Section 22-T.5N.-R. 12E. This well is completed solely in the Lower Hartshorne Coal.

To date, no horizontal wells have been drilled for coalbed methane within the study area. There is, however, significant activity east of the study area in Latimer and Haskell Counties, Oklahoma. There is potential for the application of horizontal drilling technology to exploit the Hartshorne Coal. Further work should be done; including a regional study of the distribution of ash and sulfur content of the Hartshorne coals.

Detailed microstratigraphic work on the Hartshorne coals should be done to determine the type of vegetation that was present within the mires and swamps during the Hartshorne time.

Gas Field Summaries

Cabannis NW Field

The Cabannis NW Field, which was described in Andrews (1998), is located in Sections 12 and 13 of T.6N. , R.11E. and Sections 7-9, 15-21, and 29 of T.6N., R.12E. (Figure 24). The field has produced in excess of 7.29 bcf (as of November 2003) from 21 wells. Drilling in the Cabannis NW Field began in 1979. The first well that produced from the Hartshorne was the Blevins #1-18 (Section 18-T.6N.-R.12E.), which was completed in September 1974 for an initial gas rate of 62 Mcfd, and has subsequently made 0.19 Bcf. The well produced from what is interpreted to be a Type-2 distributary channel sandstone.

The primary gas-producing reservoirs are Type-2 distributary channel sandstones of the delta plain facies and the distributary mouth bar and bar crest of the delta front facies. Gas is also produced from channel margin and bar fringe deposits. There is also production directly from the Lower Hartshorne Coal and cases where the coal gas is completed along with the sandstone and the production is commingled. The wells in the field are shallow, averaging about 3400 feet deep, and have an average cumulative production of 300 mmcf.

Structural control appears to be of minimum importance, the primary trapping mechanism is a change in lithofacies, as sandstone terminates against adjacent interdistributary bay and delta front shale. No gas-water contact is present in the field. Net pay values (based on a minimum of 8% porosity and a maximum of 40% water

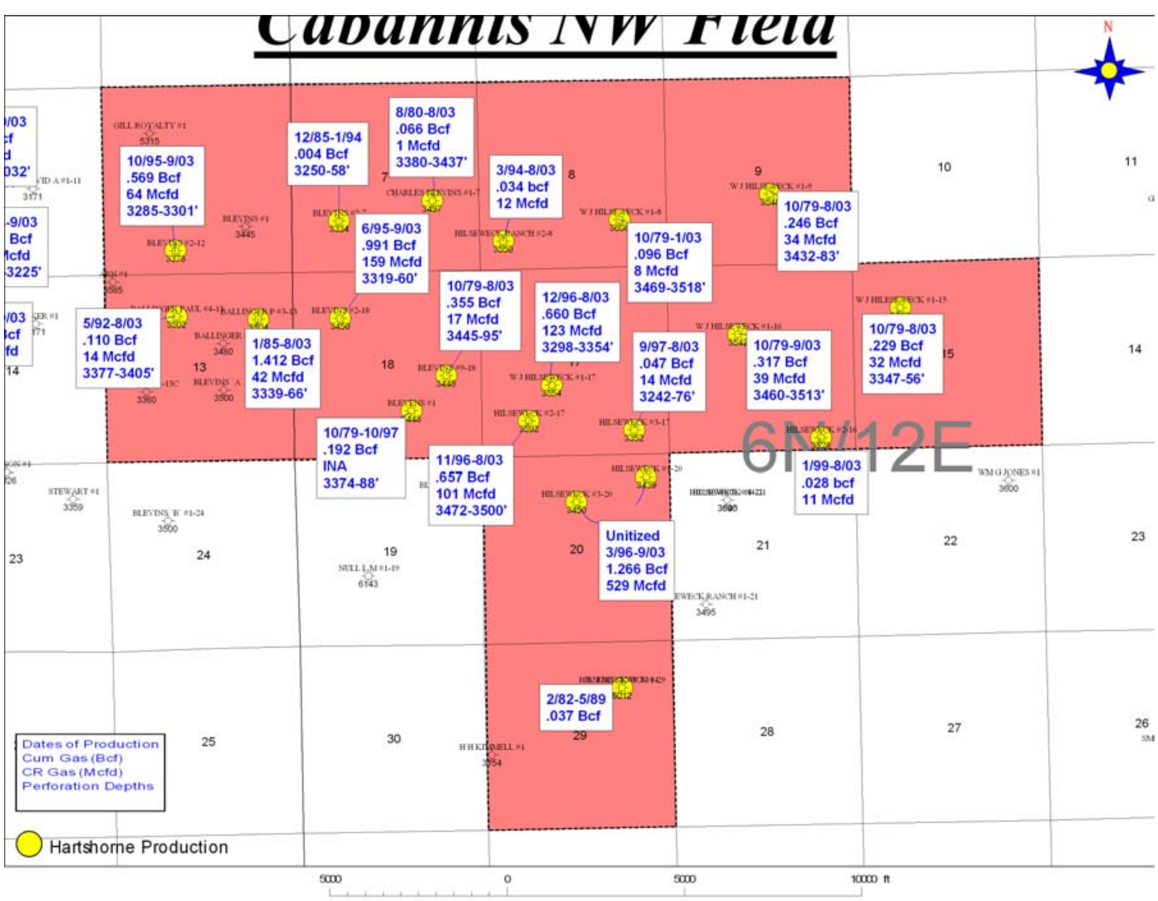


Figure 24: Hartshorne Production Map for Cabannis NW Field, Pittsburg County, Oklahoma.

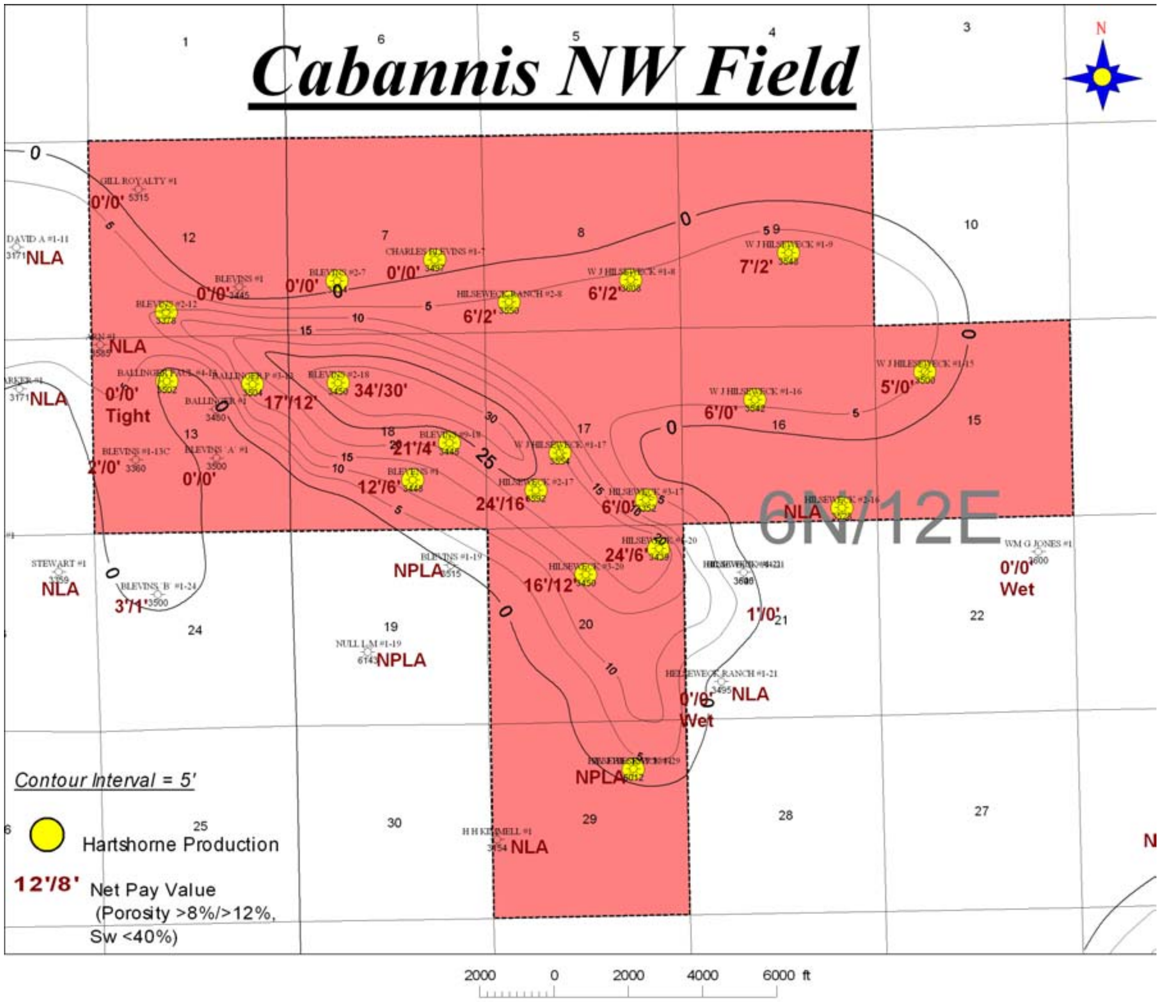


Figure 25: Lower Hartshorne Net Pay Isopach for Cabannis NW Field, Pittsburg County, Oklahoma (Countour Interval = 5 feet).

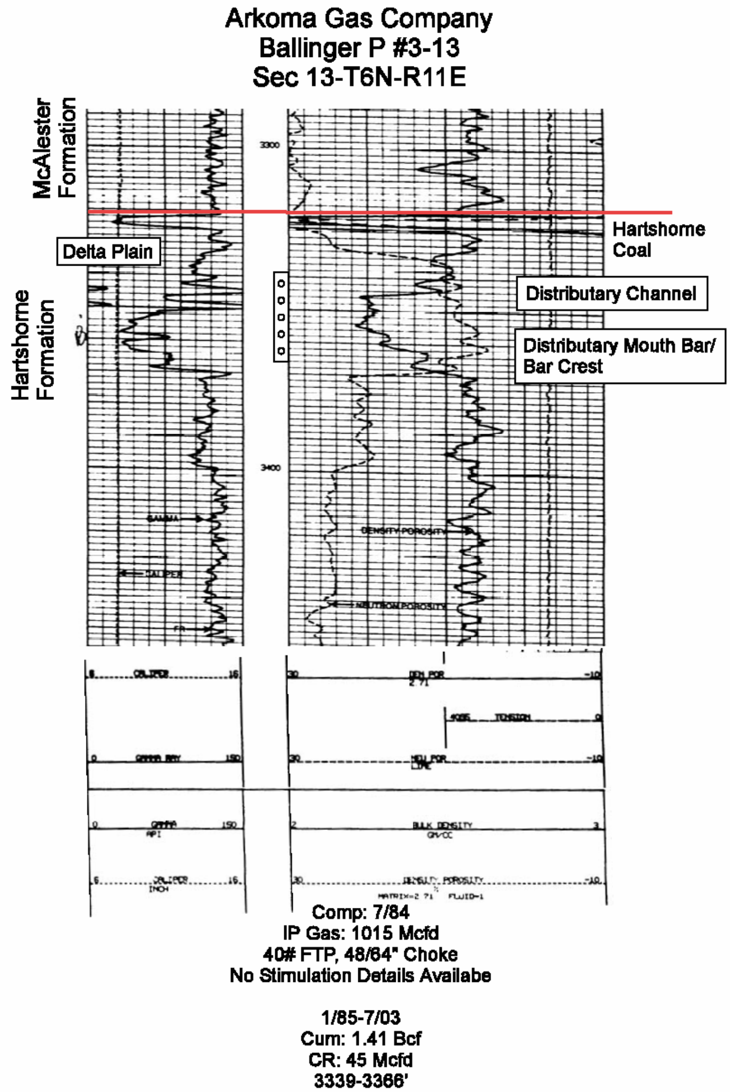


Figure 26: Example of productive distributary mouth bar/type-1 distributary channel succession, Cabannis NW Field, Pittsburg County, Oklahoma.

saturation) are as much as 34 feet within the main channel facies (Figure 25). Total gross sandstone thickness ranges from less than 10 feet to 42 feet.

The highest volume well in the field is the Ballinger 3-13 (Section 13-T.6N.-R.11E.) (Figure 26). The Ballinger #3-13 has produced 1.4 bcf since January 1985, and is currently producing 45 mcfd. The Ballinger #3-13 produces from what is interpreted to be distributary mouth bar subfacies of the delta front. The gamma ray curve through the Hartshorne interval exhibits slight overall coarsening upward character. The Ballinger P #3-13 contains 17 feet of net pay with greater than 8% porosity and less than 40% water saturation. Average porosity and water saturation are 14% and 12% respectively, based on a 0.04 ohm-m water resistivity (Rw), with 150 ohm-m resistivity as measured by the deep resistivity curve.

The Blevins #2-18 (Section 18-T.6N.-R.11E.) is another example of higher volume production from a Type-2 distributary channel sandstone (Figure 27). This well was completed in September 1994 with an initial gas rate of 527 mcfd. The well produced from June 1995 to July 2003 and reached a cumulative gas production of 0.98 bcf. The sandstone calculates 34 feet of net pay with a minimum of 8% porosity and a maximum of 40% water saturation. The average porosity is 14%. The water saturation calculates extremely low, 7%, using the 0.04 ohm-m Rw (formation water resistivity).
Production from distributary channel deposits also occurs 5 miles to the southeast, in T.5N.-R.12E in South Pine Hollow Field. Here, production is from what is interpreted to be a remnant segment of the same distributary complex as the distributary channel reservoir in the Cabannis NW Field. This segmented distributary channel play lies

between the two incised valley fill/entrenched channel trends, IC-1 and IC-2, which have eroded through deposits associated with the Lower Hartshorne delta.

Andrews (1998) discussed the production statistics and characteristics of the Cabannis NW Field. He reported an original gas in place (OGIP) of 8.181 Bcf, based on a gross sandstone map, with a reservoir size of 4224 acres (greater than 5 feet gross

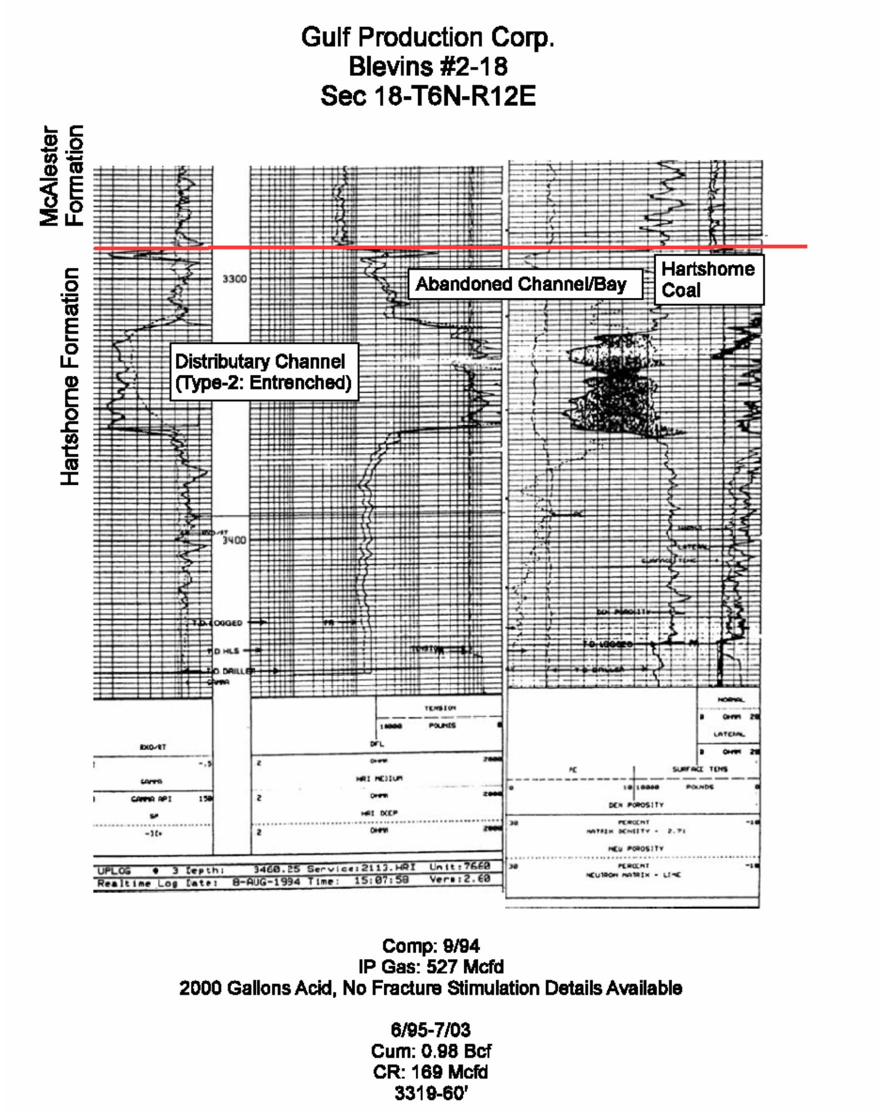


Figure 27: Exmple of a productive type-2 distributary channel sandstone, Cabannis NW Field, Pittsburg County, Oklahoma.

sandstone), an average porosity of 8%, average gross thickness of 16 feet, average Sw of 20%, reservoir temperature of 110 to 115 degrees Fahrenheit, and a initial reservoir pressure of 630 psi (pounds per square inch). Andrews (1998) reported a total field production of 3.553 Bcf, or a 43% recovery. Using Net Pay (based on 8% porosity and 40% Sw cut-offs) volumetrics were calculated for the field. An average porosity and water saturation of 12% and 25%, respectively, were used. The area within each contour interval was measured and adjusted for the area within larger contour lines. Based on the same reservoir parameters (630 psi, 110-115 degrees Fahrenheit, and gas density of .64) a recoverable OGIP (for the area greater than 5 feet net pay) was calculated to be 6.97 bcf., with an OGIP of 7.24. The field has produced 7.29 Bcf as of July, 2003, and is currently producing at a rate of 680 Mcfd from 16 active wells. At least one of the wells in the field is a commingled Hartshorne and Booch producer. It is the Hilseweck #1-29 (Section 29-T.6N.-R.12E.), which only produced 36 mmcf from February 1982 thru May 1989 and is currently inactive. Two wells, the Hilseweck #1-20 (Section 20-T.6N.-R.12E.) and Hilseweck #3-20 (Section 20-T.6N.-R.12E.) comprise a unit that has produced 1.23 bcf. As Andrews (1998) noted, some wells produce gas directly from the coal, and the reservoir potential of the channel margin shales and thinbedded sandstones, which fall outside of mapped net pay, are unknown. Thin-bedded sandstone is difficult to measure with the resolution of most wireline logging tools, and may appear very shaly, which results in pessimistic reservoir calculations. Several wells that produce contain a calculated 0 feet of net pay. Figure 28 is a picture from a Hartshorne Formation outcropping located in Sections 17 and 18 T.1S.-R.10E. The picture illustrates the shaly sandstone and interbedded sandstone and shale of the delta front facies. Suneson (1998)

Figure 28: Picture from an outcropping of the Hartshorne Formation, Sections 17 and 18-T.1S.-R.10E. The picture illustrates the shaly sandstone and interbedded sandstone and shale of the Hartshorne Formation. Suneson (1998) interpreted this section to be possible upper distributary mouth bar facies. Rock hammer is 12 inches long.

described this section in a field trip guide as possibly being upper distributary mouth bar.

Potential for infill drilling appears to be limited, although a southwest offset to the Hilseweck #3-20 (Section 20-T.6N.-R.11E.) is one possibility. The average thickness of the Lower Hartshorne Coal is 4 feet, but does reach thicknesses of 5-6 feet within the field. Just to the northeast of the field the coal is 7 feet thick. The minimum thickness needed for horizontal wells in the coal is 4 feet, thus opening the field for possible horizontal Coalbed Methane (CBM) production. Table I contains a summary of volumetric parameters for the calculations for the Cabannis NW Field.

Table I: Volumetric reservoir summary for the Hartshorne Formation, Cabannis NW Field, Pittsburg County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	25%	4484	1480	0.61	0.58	115	630	25	0.64	96%	158
5	7.50	12%	25%	3004	1614	1.99	1.91	115	630	25	0.64	96%	158
10	12.50	12%	25%	1390	537	1.10	1.06	115	630	25	0.64	96%	158
15	17.50	12%	25%	853	302	0.87	0.83	115	630	25	0.64	96%	158
20	22.50	12%	25%	551	423	1.56	1.50	115	630	25	0.64	96%	158
25	27.50	12%	25%	238	128	0.58	0.56	115	630	25	0.64	96%	158
30	30.00	12%	25%	110	110	0.54	0.52	115	630	25	0.64	96%	158
					Total	***7.24***	***6.97***						

Field Production:	7.29 BCF
Recoverable OGIP:	6.97 BCF
Reserves Recovered:	**105%**

Hill Top Field

The Hill Top Field is located in the southwest corner of the study area (Plate #1). The field was discovered in 1975. The discovery well, the Pace #1 (Section 18-T.5N.-

R.11E.), only produced 21 mmcf over three years. A production map for the field is presented in Figure 29, as well as Plate 2. Only 20 wells have been drilled in the field. Fifteen have a combined production of 4.6 bcf, or an average of 309 mmcf per well. Five were abandoned before production, either for lack of gas production (dry) or mechanical problems within the wellbore. Presently there are 11 active wells with an average daily rate of 33 mcfd per well.

The primary reservoir facies include distributary mouth bar and bar fringe of the delta front. The highest volume well in the field is the Travis P #1-L (Section 21-T.5N.-R.11E.) which has produced over 600 mmcf since June 1991. It appears to produce from distributary mouth bar or delta front deposits. The Travis P #1 contains 11 feet of net pay using the 8% porosity and 40% water saturation cut-offs. The average porosity and water saturation (using 0.04 ohms) are 12% and 19% respectively. The Southern Resources Vernon 1-29 (29-T.5N.-R.11E.) produces from distributary mouth bar or bar fringe, as evidenced from the very slight upward-coarsening gamma ray signature (Figure 30). The Vernon #1-29 contains 8 feet of net pay (porosity >8%, Sw<40%), but contains no net pay using the 12% porosity cut-off. The average porosity and water saturation are 9% and 33% respectively. The well has produced 0.10 Bcf since May 1990.

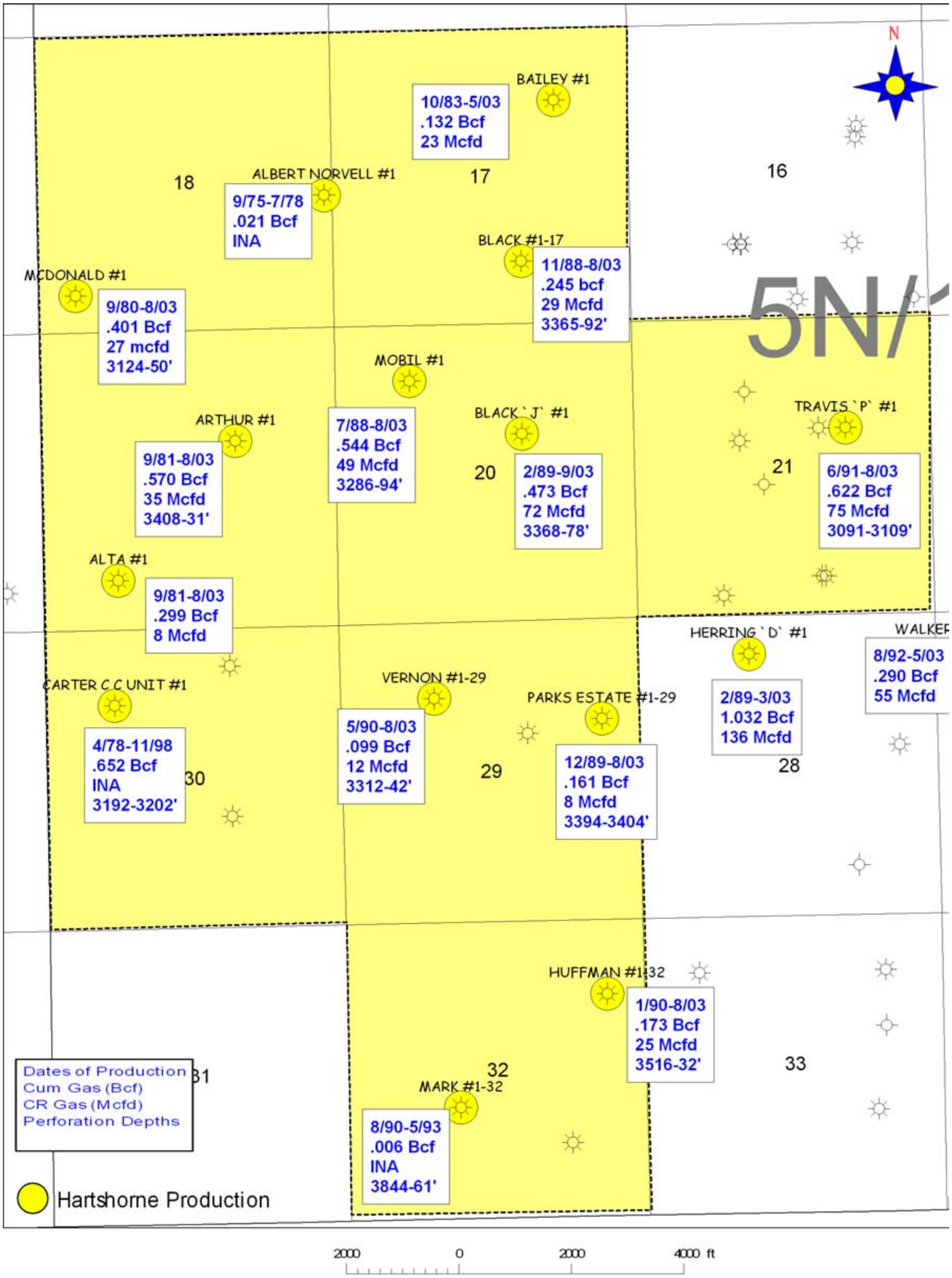


Figure 29: Hartshorne production map for Hill Top Field, Pittsburg County, Oklahoma.

The Mobil #1-20 (Section 20-T.5N.-R.11E.) is an example of a well that may be producing from the distributary mouth bar subfacies of the delta front facies (Figure 31). The Mobil #1-20, which was completed in September 1987, produced 0.54 bcf from July 1988 to July 2003. Initial production was 1400 mcfd, with a flowing tubing pressure of 240 psi on a 48/64 inch choke. Initial shut-in tubing pressure was 620 psi. No stimulation details were available. Average Hartshorne sandstone porosity in the Mobil #1-20 is 12% and average Sw is 20%. The Mobil #1-20 contains 8 feet of net pay using the 8% porosity and 40% Sw cut-offs. The well contains 6 feet of net pay using 12% porosity cut-off and 40% Sw cut-offs.

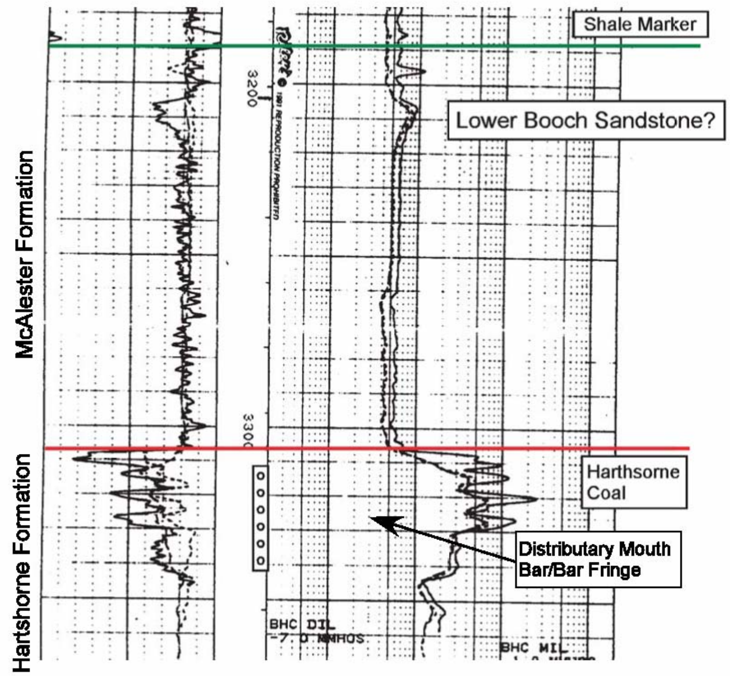
Using the reservoir parameters of 720 psi original formation pressure, 110-115 degrees Fahrenheit formation temperature, and a recovery factor of 96% and 168 mcf/acre-foot, of recoverable original gas in place (OGIP) was calculated from the net pay isopach map. An abandonment pressure of 25 psi was used. The recoverable OGIP was calculated to be 7.45 bcf from a net pay reservoir of 5930 acres greater than 0'. Volumetric calculations were done following the method described in the methodology. The percentage of the produced recoverable reserves to date is 62%, but as mentioned before this does not account for gas produced from the coal, or thin bedded bar fringe and bay deposits. It should be noted that, as seen on Plate 5, the Hill Top Field shares the same reservoir as the Stuart Southwest Field. A volumetric summary for the Hartshorne Formation is given in Table II.

Table II: Volumetric reservoir summary for the Hartshorne Formation, Hill Top Field, Hughes County Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	20%	5930	2000	1.01	0.98	115	630	25	0.64	96%	168
5	7.50	12%	20%	3930	2494	3.78	3.66	115	630	25	0.64	96%	168
10	12.50	12%	20%	1436	1436	2.90	2.81	115	630	25	0.64	96%	168
					Total	***7.69***	***7.45***						

Field Production:	4.60
Recoverable OGIP:	7.45
Reserves Recovered:	62%

Southern Resources
Vernon #1-29
Sec 29-T5N-R11E

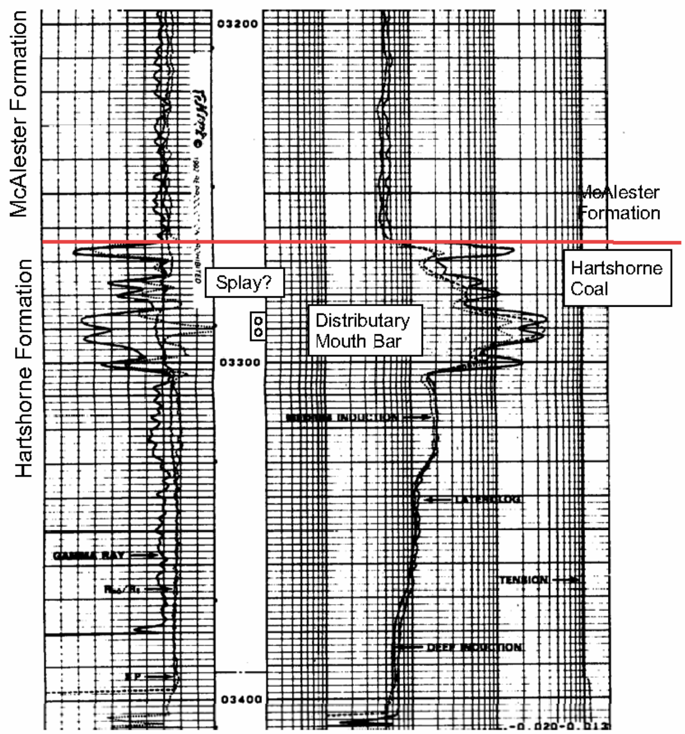


Comp: 5/90
IP Gas: 82 Mcfd
IP Water: 2 BWD
20# FTP, 20/64" Choke, 570# SITP
3000 Gallons Acid, Unkown Fracture Stimulation

5/90-7/03
Cum: 0.10 Bcf
CR: 14 Mcfd
3312-42'

Figure 30: Example of production from possible distributary mouth bar/bar fringe or possible crevasse splay deposits, Hill Top Field, Hughes County, Oklahoma.

Southern Resources
Mobil #1-20
Sec 20-T5N-R11E



Comp: 9/87
IP Gas: 1400 Mcfd
IP Water: 0 BWD
240# FTP, 48/64" Choke
620# SITP
No Stimulation Details Available

7/88-7/03
Cum: 0.54 Bcf
CR: 54 Mcfd
3286-94'

Figure 31: Example of productive distributary mouth bar sandstone in Hill Top Field, Hughes County, Oklahoma.

Hill Top North Field

The Hill Top North Field is located 2 miles north of the Hill Top Field and contains 4 producing wells (Figure 32). Figure 33 is a gross sandstone isopach map for Hill Top North Field. Cumulative production for the field is 478 mmcf, of which 345 mmcf comes from the Lindley #1-30 (Section 30-T.6N.-R.11E.), and includes production from the Middle Booch Sandstone. The Lindley #1-30 (Figure 34), which was completed in June 1987, was the discovery well in the Hill Top North Field. The initial production rate from the Hartshorne was 162 mcfd, whereas the initial rate from the Middle Booch was 483 mcfd, which would suggest that the majority of the production comes from the Booch.

The completion of the Hartshorne in the Lindley #1-30 included 1000 gallons of acid, type unknown, 15,550 gallons of fluid, type unknown, and 25,900 pounds of sand. Initial flowing tubing pressure was 110 psi on a 16/64 inch choke. The primary productive facies within the Hill Top North Field include thin distributary mouth bar/ bar fringe subfacies of the delta front (Plate 17). The Roland #1-20 (Sec 20-T.6N.-R.11E.) produces from distributary mouth bar/Type-1 distributary channel. (Figure 35). The Little #1-19 (Figure 36) is an example of production from thin distributary mouth bar facies.

Volumetrics (Table III) were run to determine the recoverable OGIP using a reservoir temperature of 110 degrees Fahrenheit, initial pressure of 630 psi, and abandonment pressure of 25 psi. The reservoir area was 832 acres, which included all of the area within the 0 feet net pay contour (minimum porosity of 8% and maximum water saturation of 40%). The calculated recoverable OGIP was 0.51 Bcf, at a recovery factor of 96.32% of OGIP and 135.81 mcf/acre-foot (Table III). The total recovery to date is 78%, and the field is currently producing 59 mcfd from 3 wells, for an average of 19.6 mcfd per well. Again, this does not take into account coal gas production or pessimistic net pay and reservoir calculations due to shaly sand and thin interbedded sandstone and shale.

Table III: Volumetric reservoir summary for the Hartshorne Formation, Hill Top North Field, Hughes County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	20%	832	319	0.14	0.13	115	630	25	0.64	96%	168
5	6.00	12%	20%	513	513	0.54	0.52	115	630	25	0.64	96%	168
					Total	***0.68***	***0.65***						
Field Production:				0.51									
Recoverable OGIP:				0.65									
Reserves Recovered:				78%									

Horntown SE Field

This field is composed of a single producing well, the Anderson #1 (Sec 17-T.7N.-R.11E.), that produced 0.29 bcf from April 1985 through October 2002, and is currently producing at a rate of 10 mcfd (Figure 37). Production appears to come from the Type-1 distributary channel facies or distributary mouth bar delta front (Figure 38).

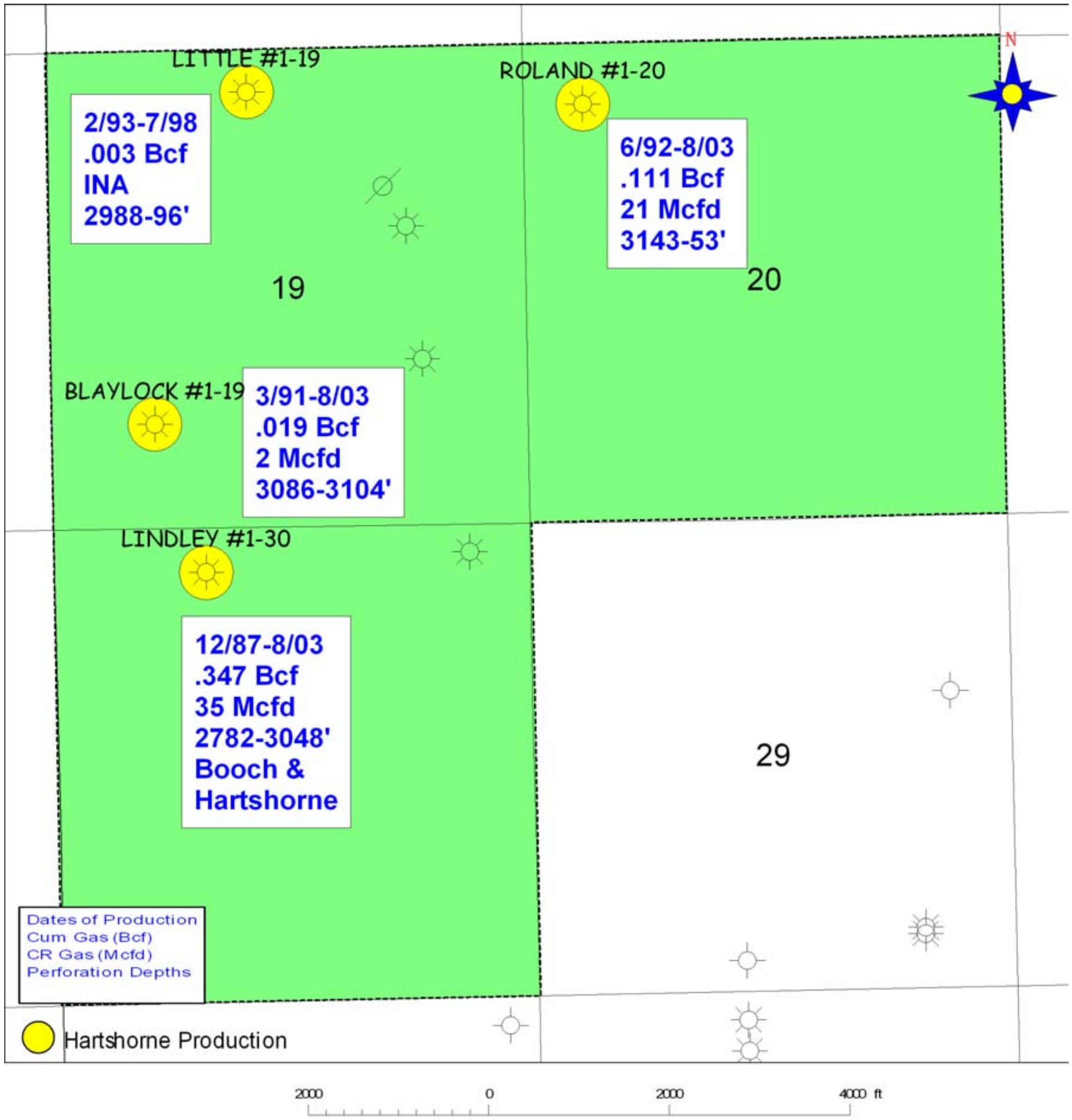


Figure 32: Hartshorne production map, Hill Top North Field, Hughes County, Oklahoma.

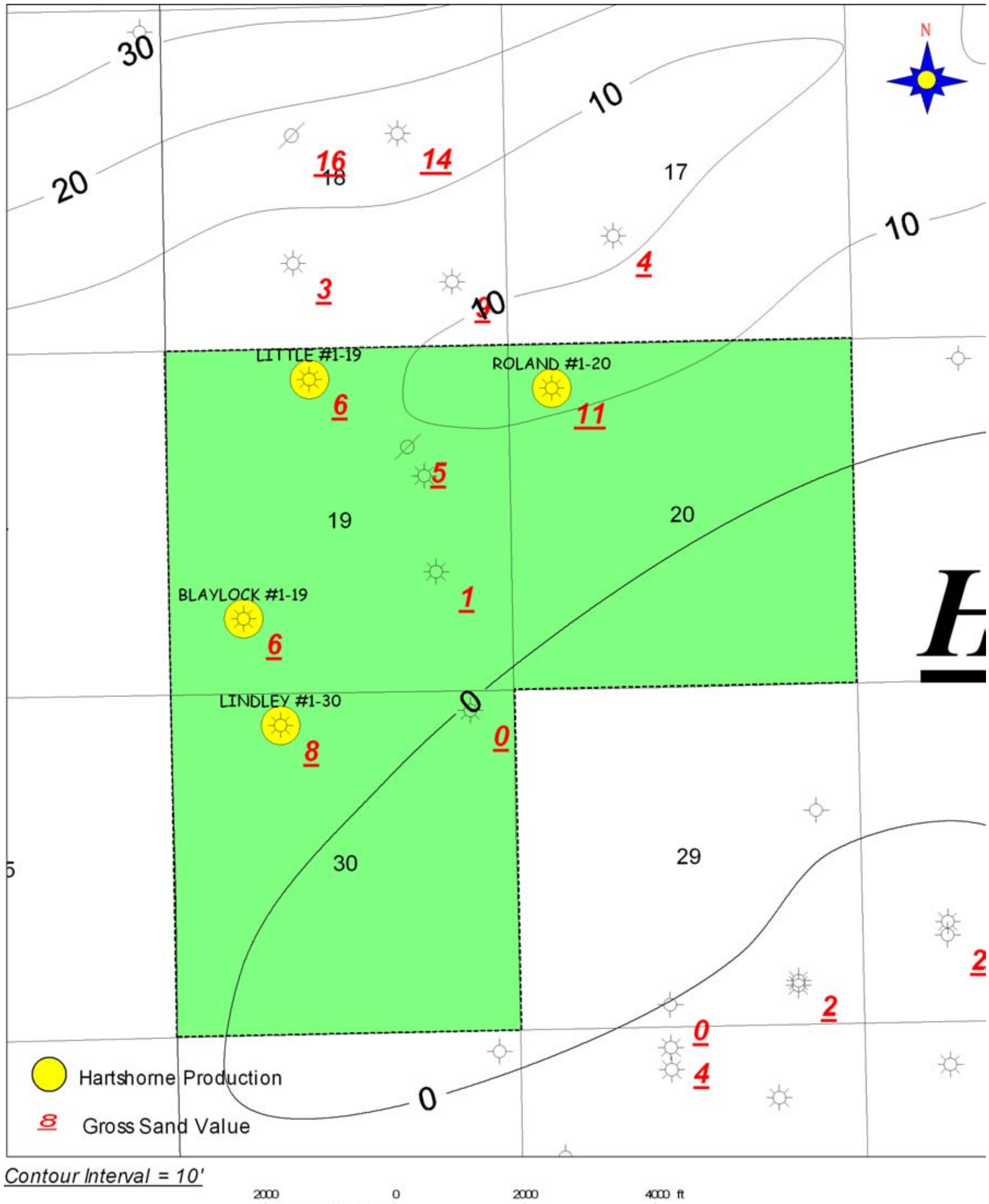


Figure 33: Lower Hartshorne gross sandstone isopach map.

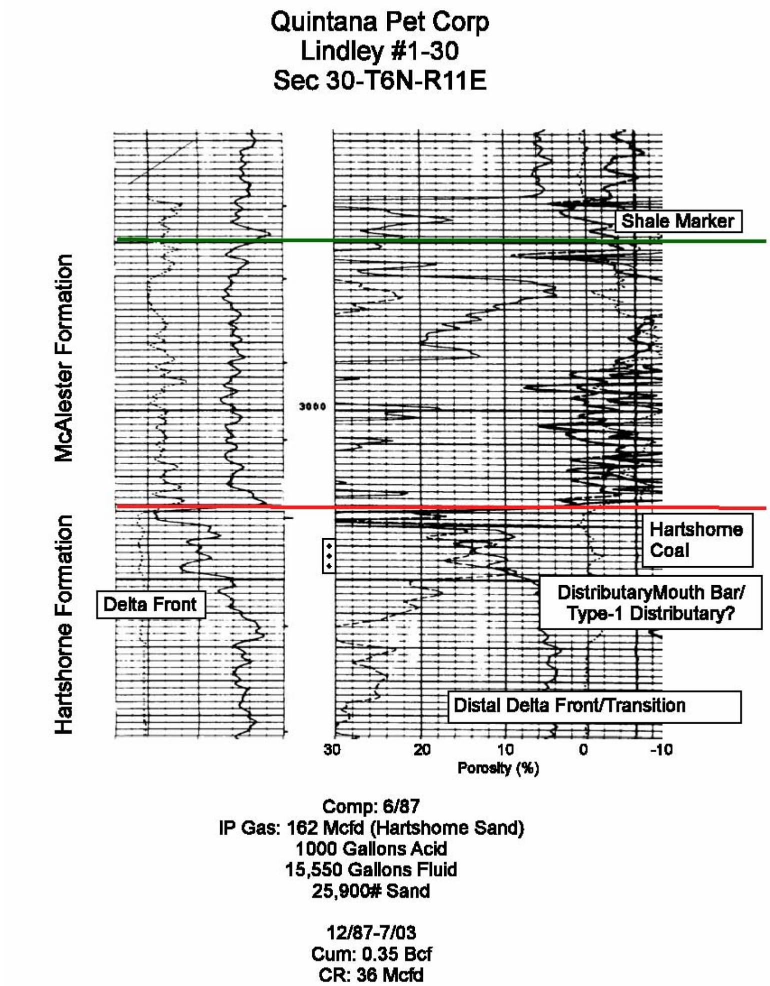


Figure 34: Example of production from distributary mouth bar/delta front and Type-1 distributary channel facies.

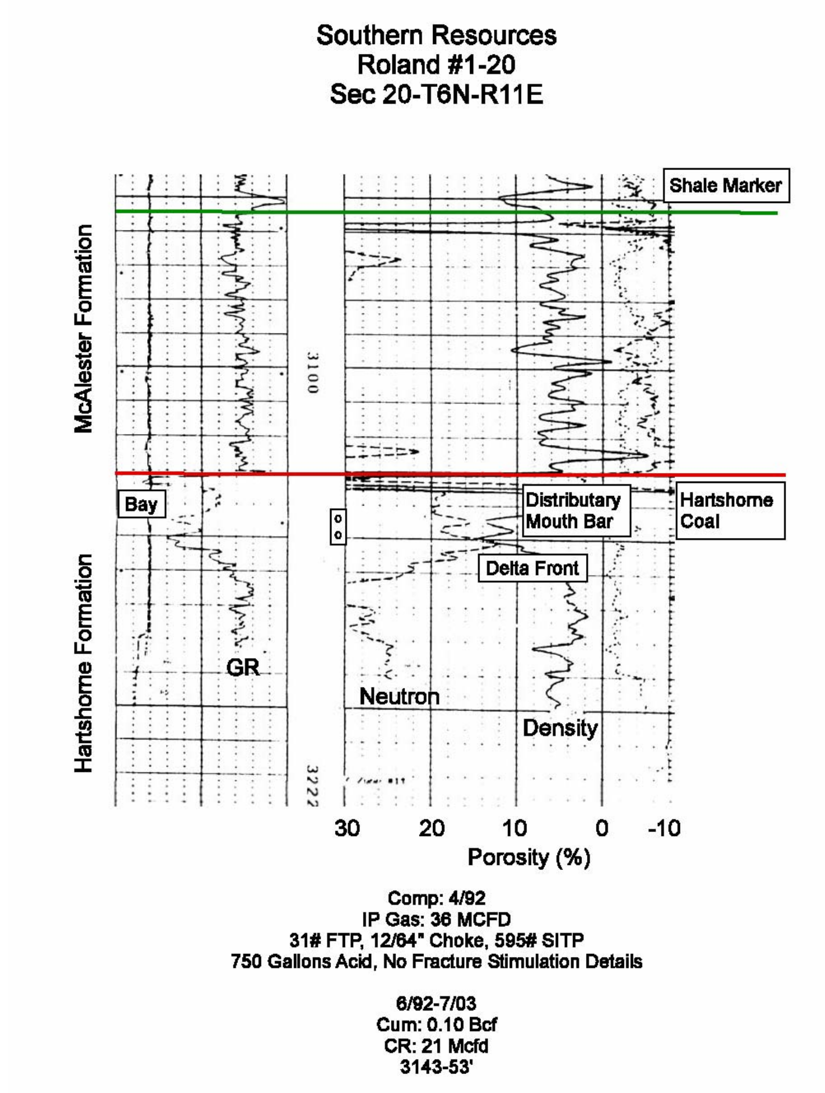


Figure 35: Example of production from distributary mouth bar/bar fringe deposits, Hill Top North Field, Pittsburg County, Oklahoma.

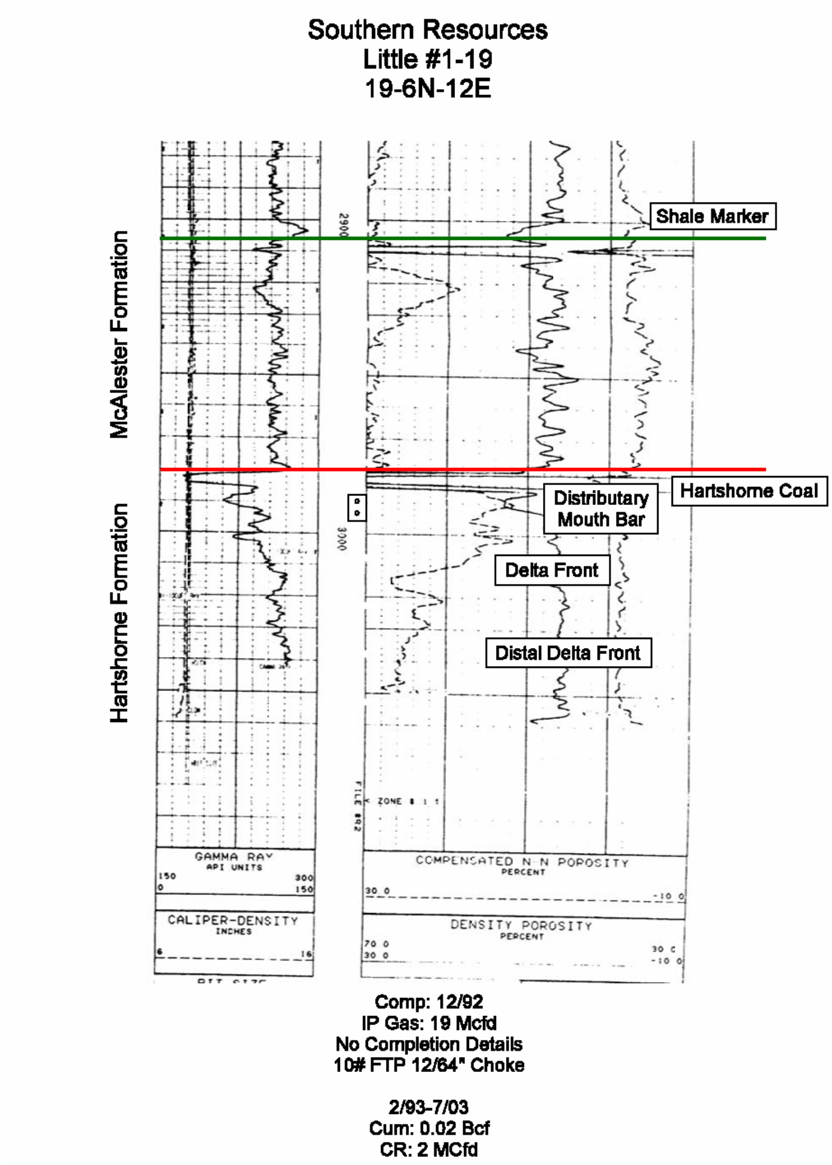


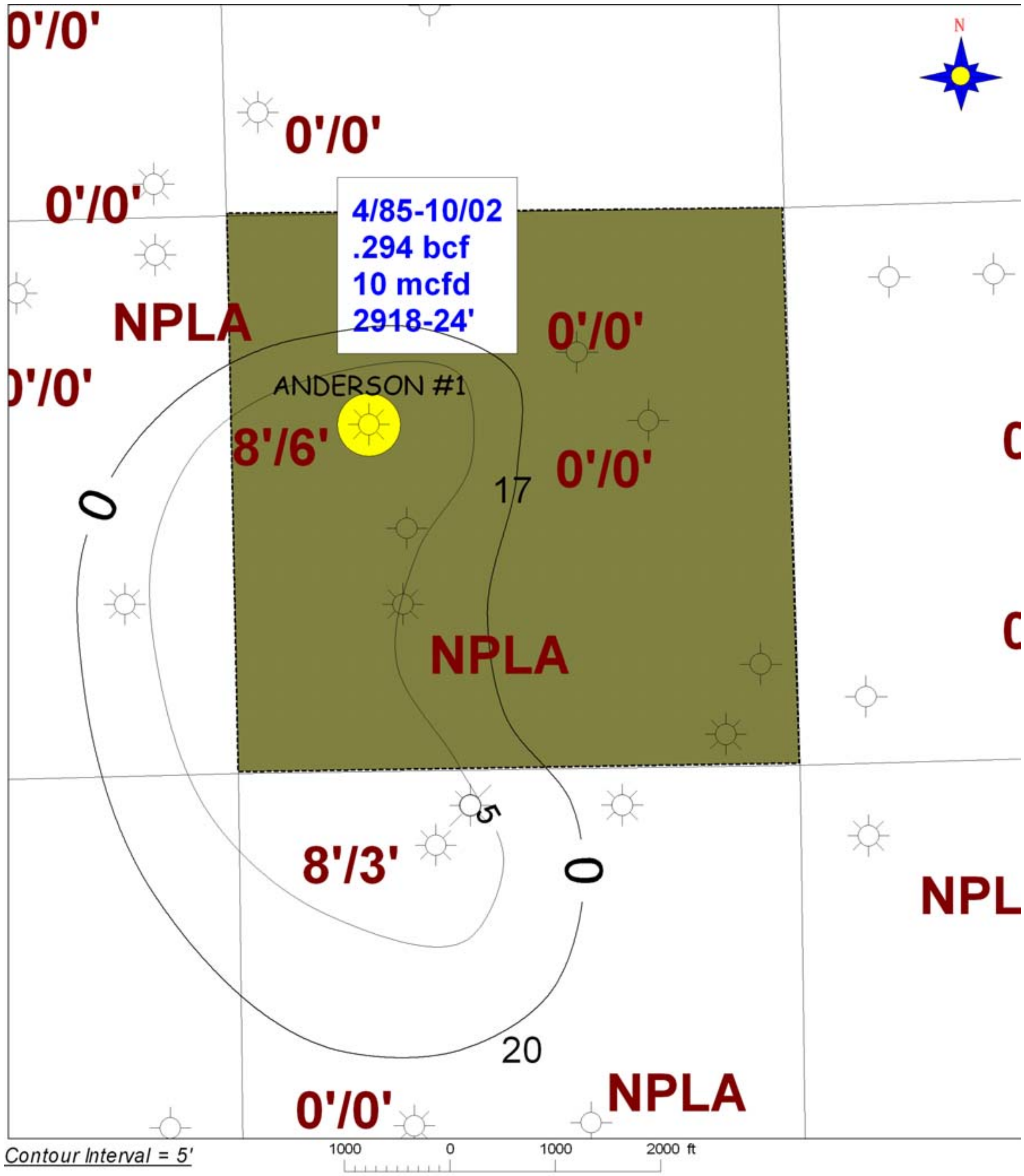
Figure 36: Example of production from distributary mouth bar/delta front sandstone, Hill Top North Field, Hughes County, Oklahoma.

The Anderson #1 penetrated a relatively small reservoir (Plate 5). The sandstone calculates 8 feet of net pay (minimum porosity of 8%, maximum water saturation of 40%) (Figure 37). The average porosity is 15%, average water saturation (Sw) is 24%, with a 0.04 Rw (formation water resistivity). Based on an initial reservoir pressure of 751 psi (from the initial well head shut-in pressure test), and an abandonment pressure of 25 psi, the Anderson #1 has drained and an approximate area of 173 acres. Based on the same parameters, but with 6 feet of net pay based on a minimum porosity of 12%, the Anderson #1 has drained an area of 230 acres. The overall area of the net pay (at least 8% porosity and no more than 40% Sw) within the 5 feet contour interval is 292 acres. The reservoir calculates to have 0.49 Bcf recoverable OGIP, meaning the Anderson has only produced 58% of the reserves in place. At the current rate of production, the likelihood of producing all of the reserves is low, and the need for a replacement well should be evaluated. There appears to be little structural control on production. Table IV contains the volumetric data for the Horntown SE Field.

Table IV: Volumetric reservoir summary for the Hartshorne Formation, Horntown SE Field, Hughes County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	20%	832	319	0.14	0.13	115	630	25	0.64	96%	168
5	6.00	12%	20%	513	513	0.54	0.52	115	630	25	0.64	96%	168
					Total	***0.68***	***0.65***						

Field Production:	0.51
Recoverable OGIP:	0.65
Reserves Recovered:	78%



Hartshorne Production

8'/3' Net Pay Value (Porosity >8%/>12%, Sw <40%)

Figure 37: Lower Hartshorne net pay isopach map, Horntown SE Field, Hughes, County, Oklahoma.

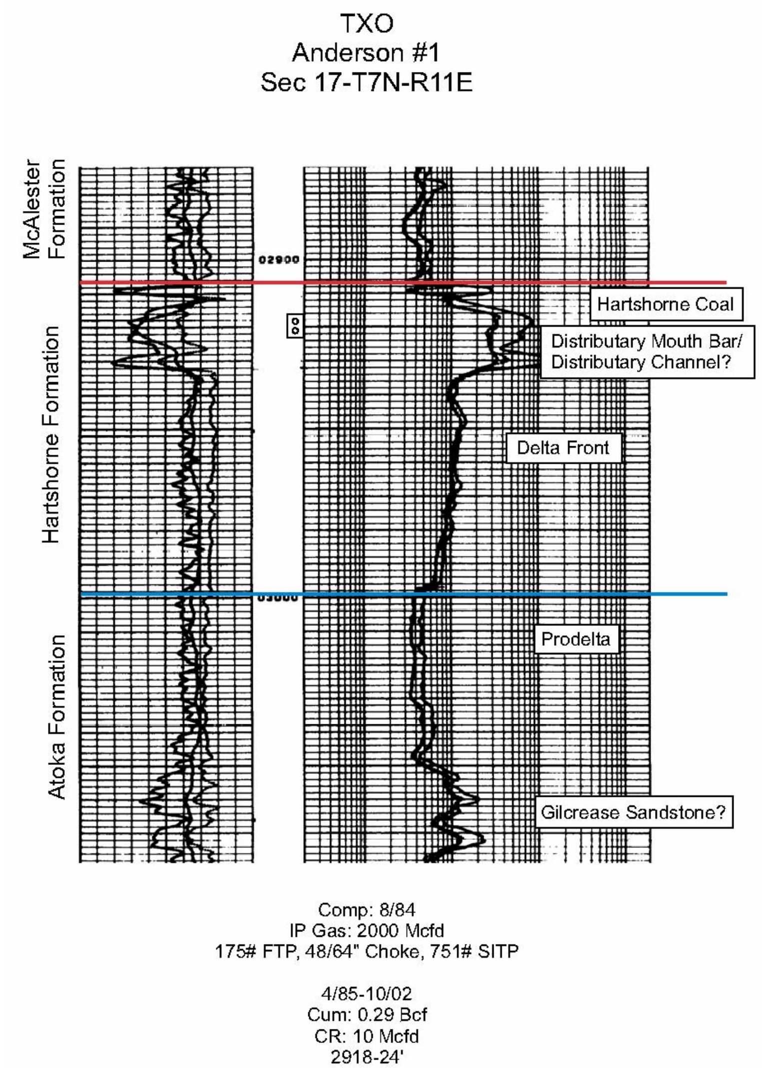


Figure 38: Example of productive Type-1 distributary channel facies, Horntown SE Field, Hughes County, Oklahoma.

Lamar East Field

Lamar Field is located in the northern part of the study area and overlaps with the Scipio Field (Figure 39). Total cumulative gas production from the field is 6.7 bcf from 11 wells. More than 2/3 the production comes from two wells. The Sarkey Unit #1 (Section 7-T.7N.-R.12E.) and the Klene #1 (Section 1-T.7N.-R.11E.) have each produced over 2.0 bcf. These wells appear to produce from distributary mouth bar and distributary channel deposits. The Jay Petroleum Inc. White 13 #1 (Section 13-T.7N.-R.12.E.) is a good example of production from a Type-2 distributary channel, which appears to have eroded through the mouth bar deposits and into the underlying delta front (Figure 40). The classic fining upward log signature is present, indicating abandonment, and reservoir quality sandstone is limited to the base of the channel-fill sandstone. The White 13 #1 has produced 0.24 bcf from June 1985 through July 2003 and currently produces 14 mcfd.

The Sarkey Unit #1, which was the discovery well in the Lamar East Field in 1961, is still active. The primary reservoir facies in this well and the field are distributary mouth bar and distributary channel sandstones, as seen on the gross sandstone isopach and facies maps (Plate 3 and 17).

Volumetrics (Table V) were calculated based on the net pay isopach of the Lower Hartshorne/Hartshorne undivided reservoir. The parameters that were used were 675 psi initial pressure and 110 degrees Fahrenheit reservoir temperature, based on reported well tests, and a 25 psi abandonment pressure. The recoverable OGIP (original gas in place) calculates to only be 4.3 bcf. However, the field has produced 6.7 bcf, and continues to produce at a rate of 208 mcfd from 8 wells. The production reported from the Klene #1 is 2.3 bcf, but the initial gas flow rate from the Hartshorne Formation was 6 mcfd. The well was completed in 1959, reportedly in the sandstone within the interval from 2350 to 2360 feet. The well was drilled to a depth of 3414 feet and encountered other producing reservoirs, including the Booch above the Hartshorne and the Gilcrease Sandstone of the Atoka Formation. The mapped net pay for the well (no porosity log was available) is 12.5 feet, and the reservoir parameters are estimated to be 12% porosity and 20% Sw, based on offset wells. Based on these variables the well has drained more than 1000 acres, which, though possible, brings into some doubt the reliability of the reported production when coupled with the calculated volumetric reserve of the field. The discrepancy between the cumulative field production and the calculated recoverable OGIP is troublesome. Some of the difference can be attributed to thin-bedded or shaly sandstone that is not counted as pay, as well as coal gas, that do not account for a 2+ bcf difference. Part of the reservoir is shared with the Scipio Northwest Field, but the access to the Lamar East Field side of the reservoir is limited to a narrow net pay corridor defined by the deposition trend of channel and channel mouth bar sandstone. There is also an area of unknown net pay due to the lack of available porosity logs. This area in the northeast part of the field, contains only one producing well, but may extend the reservoir and account for the discrepancy in the reserve calculations.

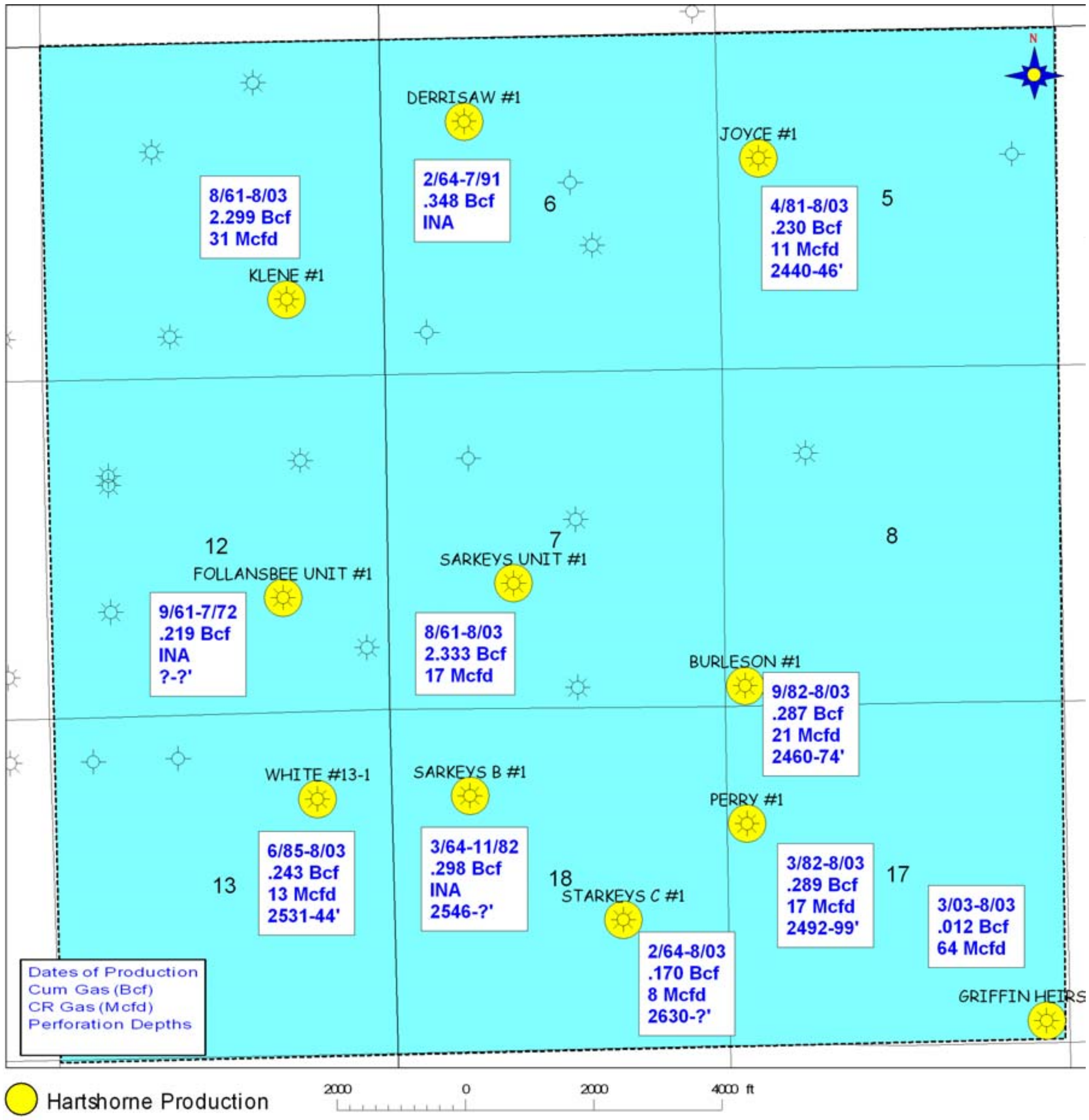


Figure 39: Hartshorne Production Map, Lamar East Field.

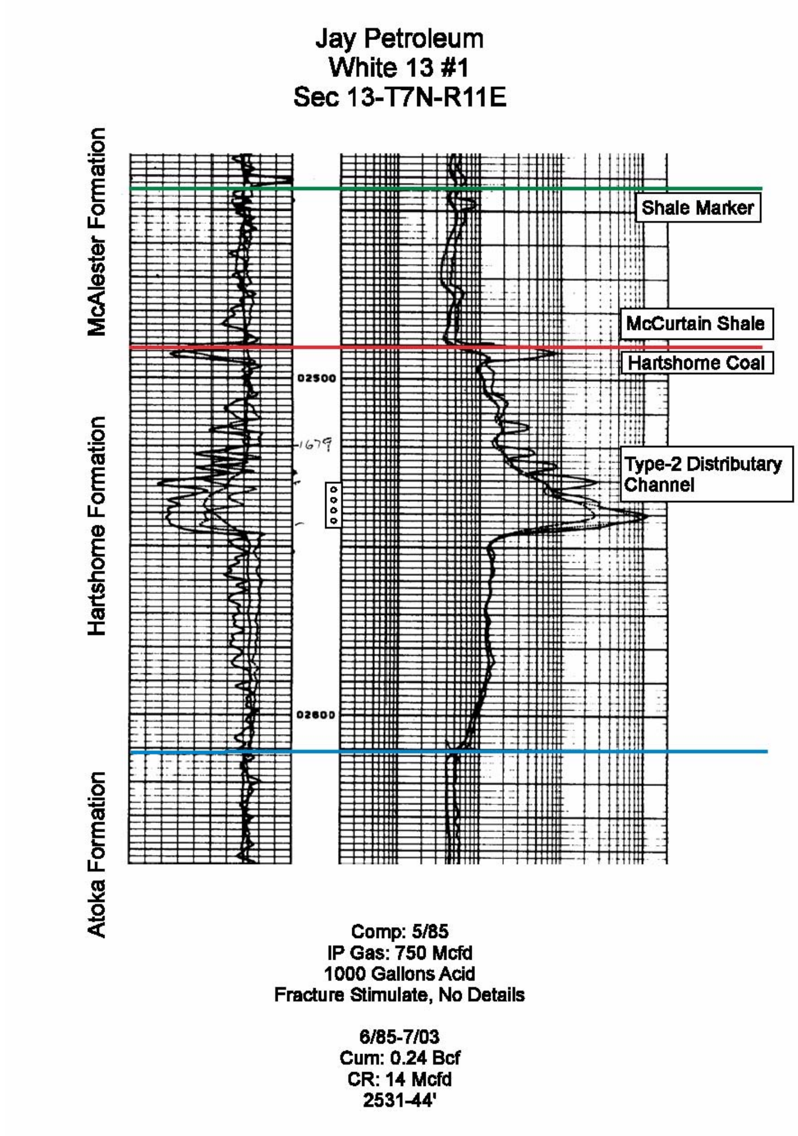


Figure 40: Example of production from a Type-2 distributary channel sandstone, Lamar East Field, Hughes County, Oklahoma.

Table V: Volumetric reservoir summary for the Hartshorne Formation, Lamar East Field, Pittsburg and Hughes Counties, Oklahoma

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	20%	3350	997	0.48	0.46	110	675	25	0.64	96%	184
5	7.50	12%	20%	2353	1144	1.64	1.58	110	675	25	0.64	96%	184
10	12.50	12%	20%	1209	854	2.01	1.94	110	675	25	0.64	96%	184
15	16.00	12%	20%	355	355	1.08	1.05	110	675	25	0.64	96%	184
					Total	*5.21*	*5.03*						

Field Production:	6.70
Recoverable OGIP:	5.03
Reserves Recovered:	133%

Reams Northwest

Reams Northwest Field is located in the northeast part of the study area. It has produced 8.8 bcf from 14 wells, for an average of 0.64 bcf per well (Figure 41). The highest cumulative volume well has produced 2.7 bcf. The average depth of the Hartshorne is 2600 feet. There are 12 active wells in the field with an average daily rate of 68 mcfd per well.

The first well, which was the the State #1-35 (Section 35-T.7N.-R.13E.) was drilled in 1980 and cumulated 0.6 bcf from October 1980 to April 1987. The State #1-35 produced from the upper part of IC-1. This thick sandstone had a gas-water contact at 2648’ (-1941 feet subsea) (Figure 42). After the State #1-35 quit producing, the State #2-35 was drilled and completed in the Lower Hartshorne Formation in 1986. It has produced over 1.0 bcf from perforations in the upper part of the IC-1, above a gas-water contact at 2620 feet (-1917 feet subsea).

The State #2-35 is 24 feet structurally higher than the State #1-35. Production in the field is structurally controlled (Figure 43). The structure map indicates that the production in the IC-1 facies follows a small anticlinal nose (Plates 13 and 14). The Lower Hartshorne Net Pay map illustrates the development of pay within the sandstone as it drapes over the structure (Figure 44; Plates 9 and 10). The combination of the distribution of quality reservoir and structural attitude is responsible for gas accumulation.

Several wells in the field appear to have been completed in the channel margin of the IC-1 or the thin overbank sands of the interdistributary bay facies. These wells, located in Section 25-T.7N.-R.13E., are believed to produce primarily from Booch Sandstone, but were commingled with the Hartshorne sandstone.

Volumetrics for the Reams Northwest field were calculated using 630 psi initial reservoir pressure (based on reported tests), 25 psi of abandonment pressure, and 115 degrees Fahrenheit reservoir temperature. The average porosity and Sw are 15% and 25% respectively. The area within each net pay contour interval was measured and the internal area of the contour interval greater than each contour was subtracted. The recoverable OGIP was then calculated with a 96.32% recovery factor (based on the reservoir temperature and pressure, as well as the gas gravity of 0.64). The recoverable OGIP for the Reams Northwest Field is 13.75 bcf from a net reservoir area of 3100 acres (above the 0' contour interval). The field has produced 64% of the recoverable reserves, and continues to produce at a rate of 667 mcfd.

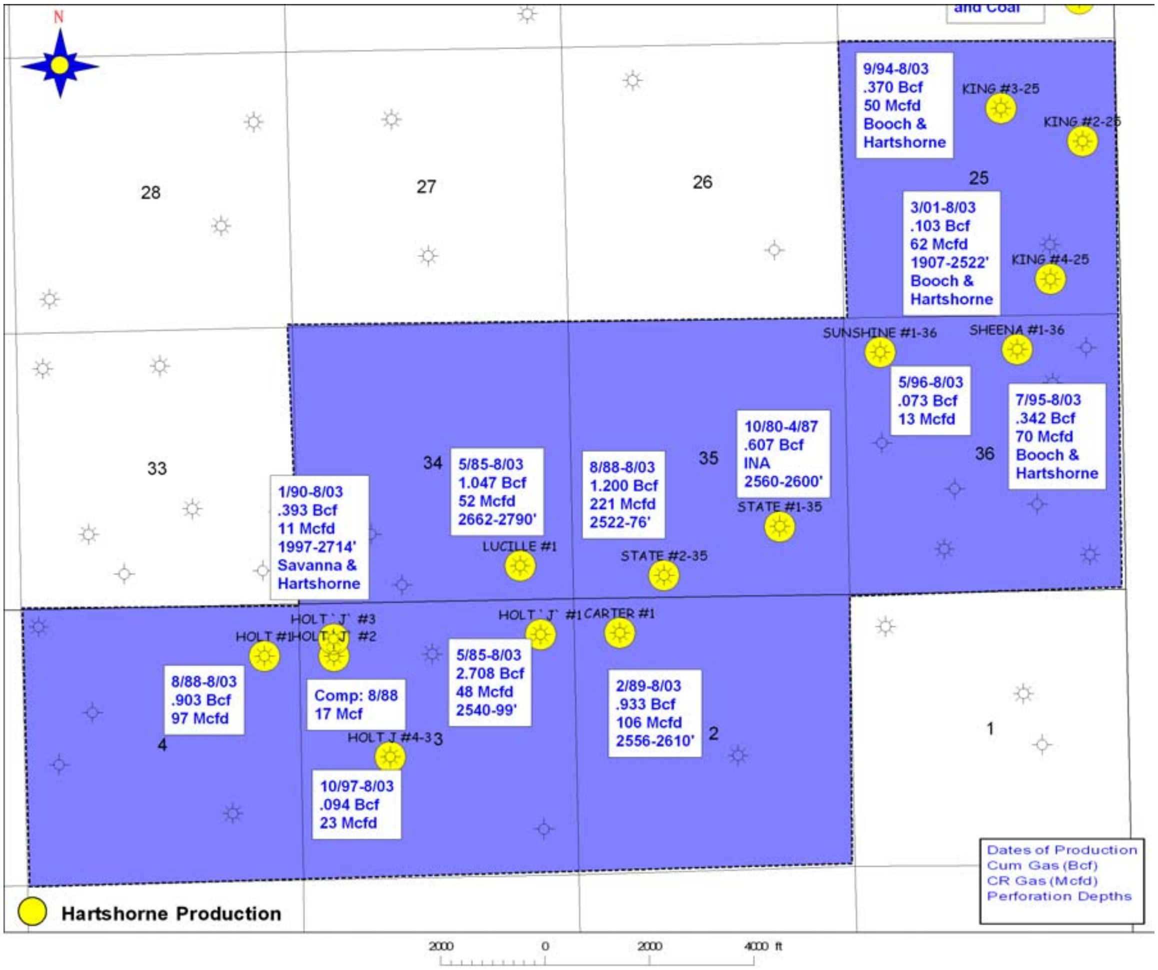


Figure 41: Hartshorne production map, Reams NW Field, Pittsburg County, Oklahoma.

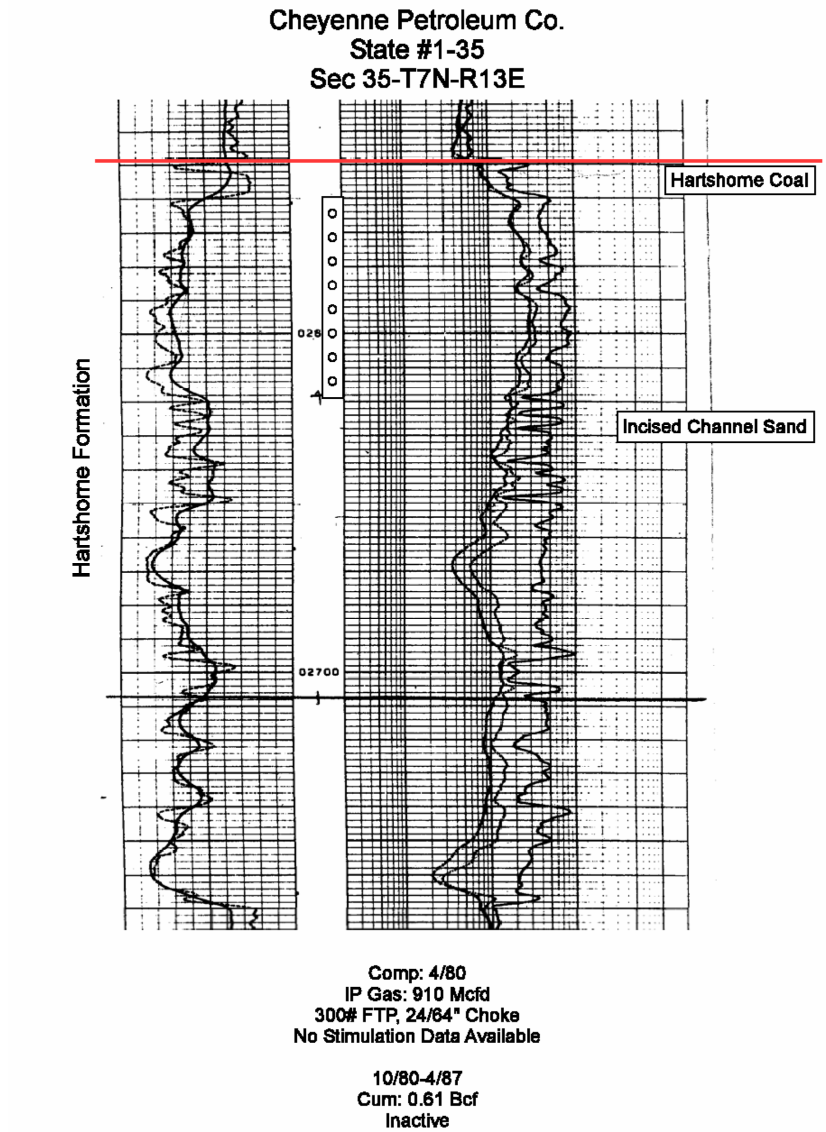


Figure 42: Example of production from the IC-1 entrenched channel/incised valley fill facies, Reams NW Field, Hughes County, Oklahoma.

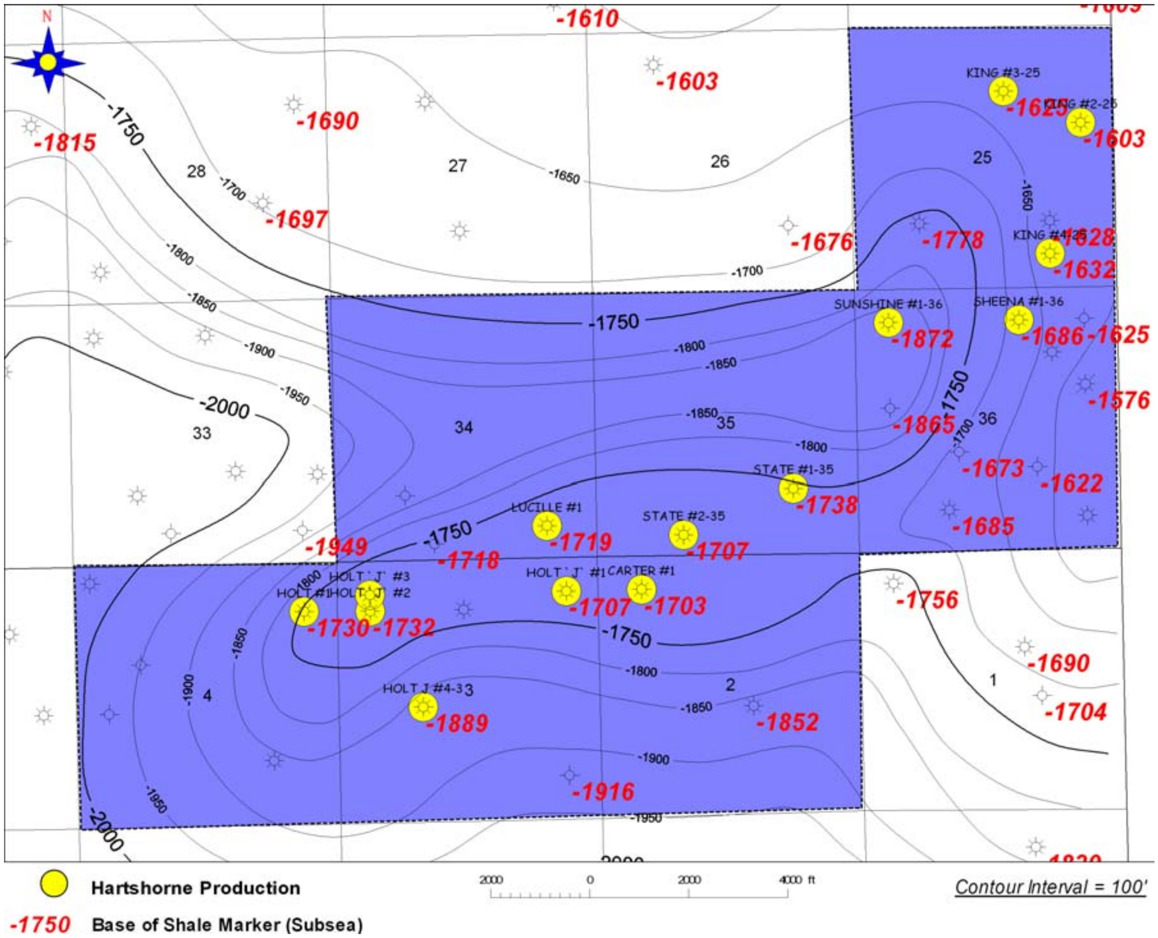


Figure 43: Structure map: Base of "Hot Shale" marker, Reams NW Field.

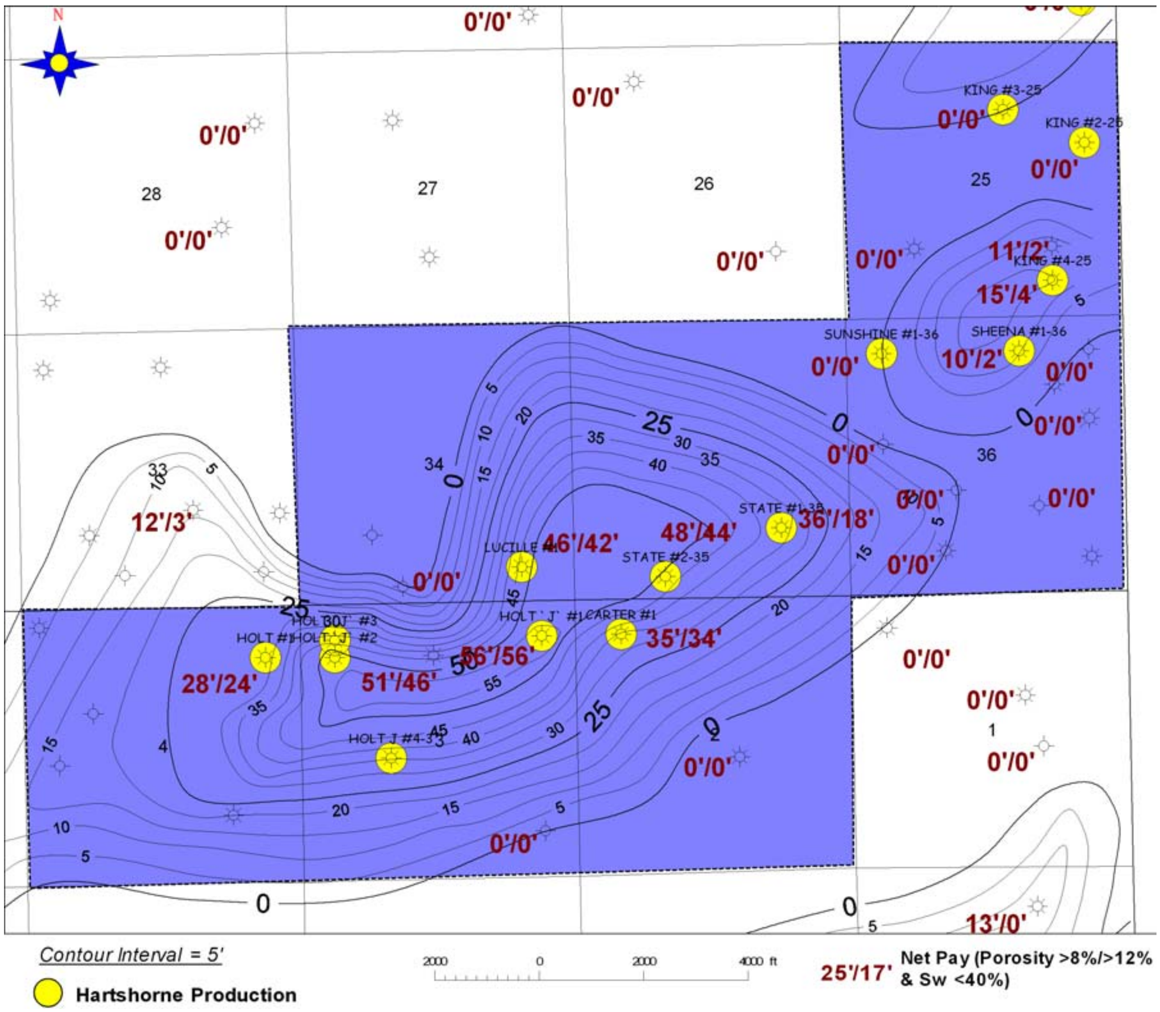


Figure 44: Net pay isopach map, Reams NW Field.

Table VI: Volumetric reservoir summary for the Hartshorne Formation, Reams NW Field, Hughes County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	5.00	15%	25%	3100	950	0.97	0.94	115	630	25	0.64	96%	159
10	15.00	15%	25%	2150	747	2.30	2.21	115	630	25	0.64	96%	159
20	25.00	15%	25%	1403	564	2.89	2.78	115	630	25	0.64	96%	159
30	35.00	15%	25%	839	309	2.22	2.14	115	630	25	0.64	96%	159
40	45.00	15%	25%	530	287	2.65	2.55	115	630	25	0.64	96%	159
50	50.00	15%	25%	243	243	3.25	3.13	115	630	25	0.64	96%	159
					Total	*14.28*	*13.75*						
				Field Production:	8.80								
				Recoverable OGIP:	13.75								
				Reserves Recovered:	64%								

Scipio Northwest Field

The Scipio Northwest Field is located in the northern part of the study area and is composed of the Scipio Field, West Scipio Field, East Scipio Field, and NW Scipio Field. The field has produced over 6.0 Bcf from 38 wells, an average of 0.16 Bcf per well. The field was discovered in 1963 by the drilling of the Broadstreet #1 (Section 22-T.7N.-R.12E.) which subsequently produced 0.69 bcf from 2/63 to 8/69 from commingled Hartshorne and Booch reservoirs. Commingling production makes it difficult to gauge the true productivity of the Hartshorne reservoir. The average depth of the Hartshorne Formation within Scipio Northwest Field is about 2550’ (-1650’ subsea).

The primary reservoir facies within the Scipio Northwest Field include distributary mouth bar and distributary channel. Some wells were completed in channel margin and bar fringe deposits on the edge of the main sandstone trend.

The Broadstreet #1, (22-T.7N.-R.11E.) is a good example of production from the distributary channel facies of the delta plain (Figure 45). The channel is stratigraphically lower than some delta front deposits seen in offset well, though the channel filling sandstone is likely younger. This is the result of channel erosion and entrenchment in older sediments. The well was completed in November 1962. The initial gas production rate from the Hartshorne reservoir was 3500 mcfd, flowing after a 5000 gallon, 3000# fracture stimulation. Shut-in tubing pressure was 820 psi. The reservoir characteristics of the Hartshorne sandstone in the Broadstreet #1 are unknown, as a porosity log was not available. The strong deflection of the SP curve on the induction log indicates that the sandstone is clean and likely has good porosity and permeability. The initial gas rate from the Booch Formation was 3000 mcfd. Allocation of production solely based on the initial gas rate suggests that the cumulative production from each of the producing formations is relatively equal at 0.34 bcf.

Based of the gross sandstone and net pay isopach maps (Plate 5) the distributary channel sandstone and distributary mouth bar sandstone in the Scipio Northwest Field are less extensive than in other fields. Where thicker gross sandstone is developed on the southeast side of the field, it appears to be wet and nonproductive.

The Million #1-27 (Section 27-T.7N.-R.11E.) is an example of production from distributary mouth bar of the delta front, or crevasse splay sandstones within the interdistributary bay facies (Figure 46). The Million #1-27 only produced 2000 Mcf from January 1983 through March 1985, demonstrating the poor reservoir quality of delta front sandstones. These

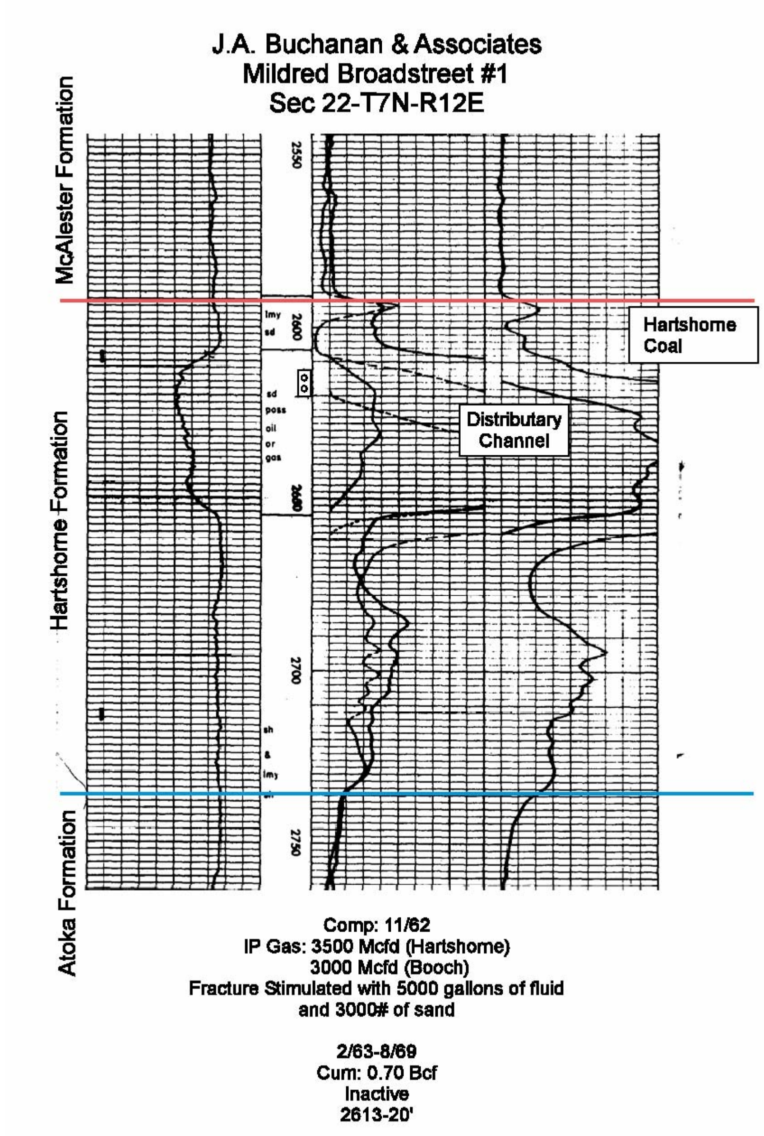


Figure 45: Example of gas production from what is interpreted to be distributary channel sandstone, Scipio NW Field, Hughes County, Oklahoma.

sandstones are thin and clay rich, and as a result have low porosity and permeability. The Million #1-27 was completed in May 1982 with an initial gas rate was 25 Mcfd from Hartshorne and 25 Mcfd from the Booch. Both reservoirs were fracture stimulated, but no details are available.

The Tag Team Resources LLC Michael #2-22 (Section 22-T.7N.-R.11E.) is a well that illustrates production from what is interpreted to be distributary mouth bar/bar fringe facies (Figure 47). The well has produced 0.12 bcf from 8 feet of net pay, that has an average porosity of 12% and calculated water saturation of 22%. The well was completed in April 2001 with an initial gas production rate of 297 mcfd through a 10/64" choke with a flowing tubing pressure (FTP) of 335 psi. The well was acidized with 500 gallons and fracture stimulated with 17,892 gallons of an unknown fluid and an unknown amount of sand-based propant. Initial shut-in pressure was 480 psi.

Volumetrics for the Scipio Northwest Field were calculated using the net pay isopach map based on the porosity and Sw cut-offs of 10% and 30%, respectively. The reservoir parameters were 675 psi initial pressure, 25 psi abandonment pressure, and 110° formation temperature. The recoverable OGIP was calculated to be 8.57 bcf, indicating the field has produced approximately 70% of its reserves.

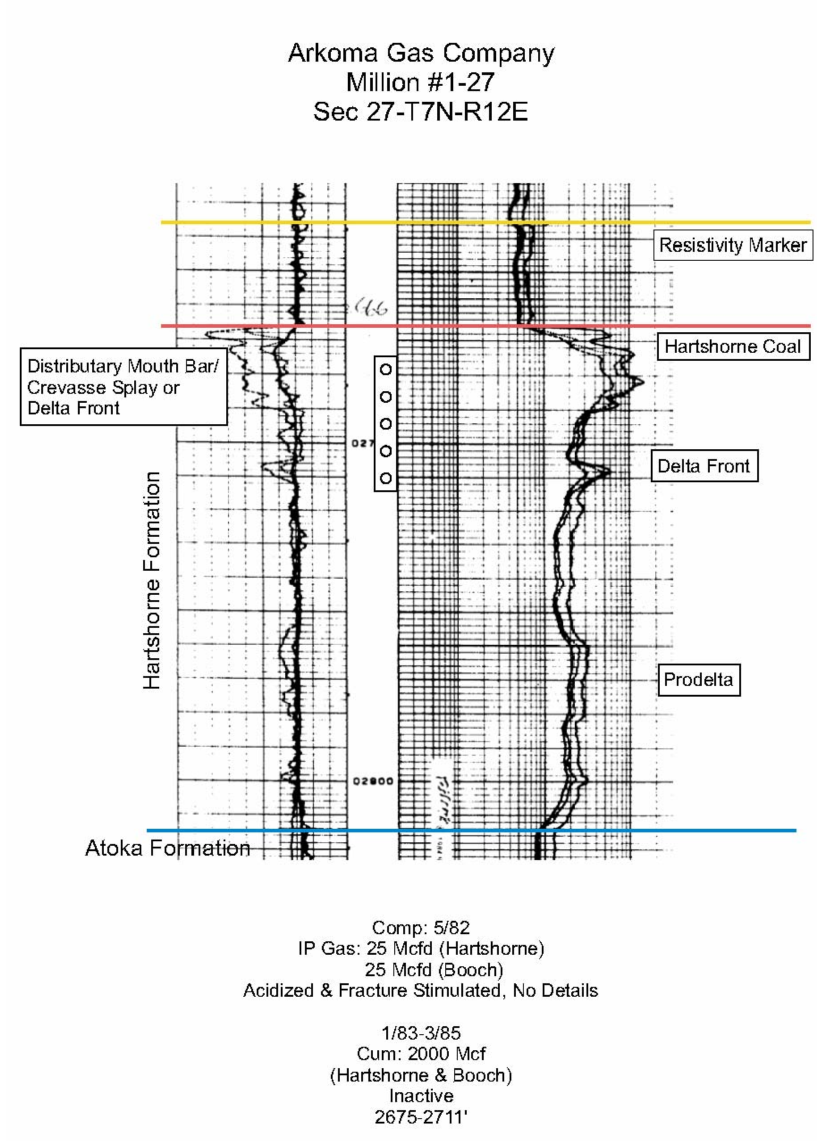


Figure 46: Example of production from possible distributary mouth bar/delta front facies, Scipio NW Field, Hughes County, Oklahoma.

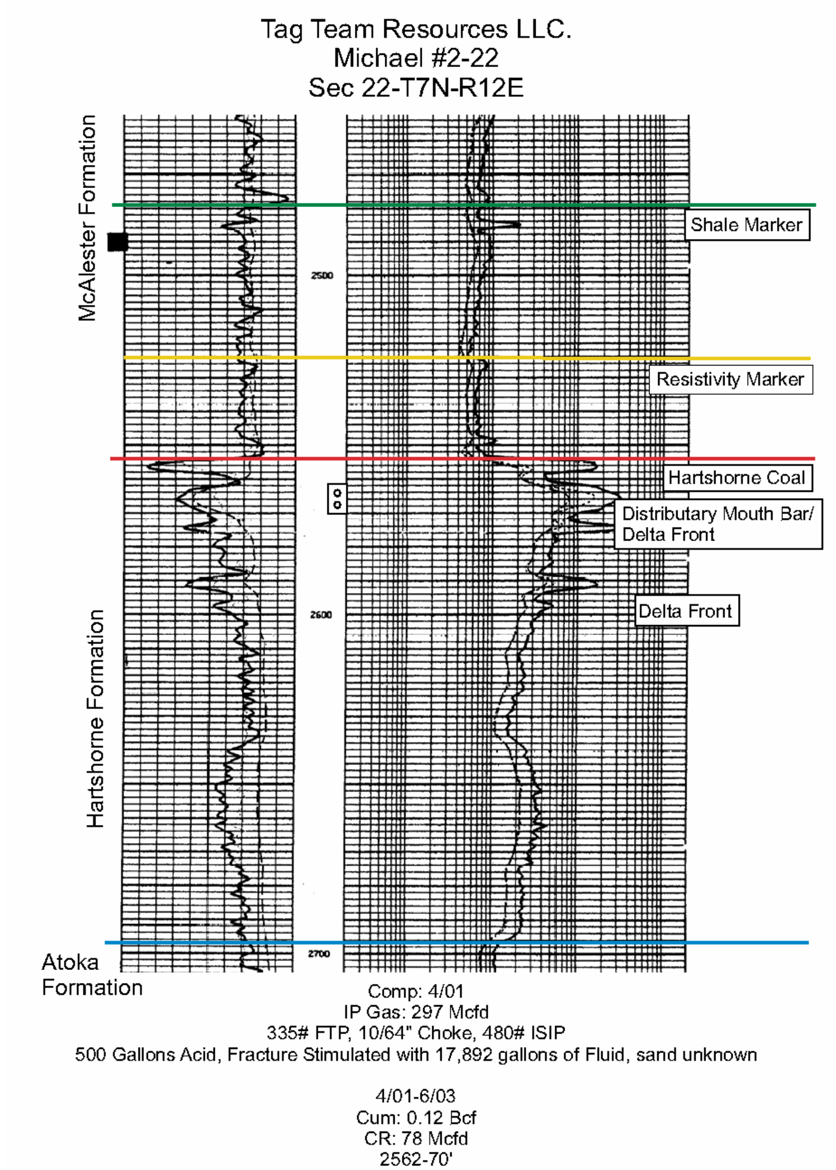


Figure 47: Example of production from fringe deposits of the distributary mouth bar facies. An alternate interpretation is that this is an example of crevasse splay deposits.

Table VII: Volumetric reservoir summary for the Hartshorne Formation, Scipio NW Field, Pittsburg and Hughes Counties, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	10%	30%	7968	4776	1.54	1.48	115	630	25	0.64	96%	159
5	7.50	10%	30%	5304	3192	3.09	2.98	115	630	25	0.64	96%	159
10	12.50	10%	30%	2473	2112	3.41	3.28	115	630	25	0.64	96%	159
15	17.50	10%	30%	361	230	0.52	0.50	115	630	25	0.64	96%	159
20	20.00	10%	30%	131	287	0.34	0.33	115	630	25	0.64	96%	159
					Total	***8.89***	***8.57***						

Field Production:	6.00
Recoverable OGIP:	8.57
Reserves Recovered:	70%

Shady Grove Field

The Shady Grove Field is composed of the Shady Grove South and Shady Grove Southwest Fields. The field is located in west-central part of the study area (T.6N.-R.11E.) (Plate 1). Cumulative production is 6.7 bcf from 18 wells, for an average of 0.37 bcf per well. The first reported production was in 1964; 3 wells remain active.

The Shady Grove Field represents the westward extension of the Cabannis NW Field. The primary reservoir facies are distributary mouth bar subfacies of the delta front facies and distributary channel subfacies of the delta plain facies.

The well with the largest volume of gas production is the Hill #1-11 (Sec 11-T.6N.-R.11E.) which has produced just over 1.0 bcf from the distributary mouth bar subfacies (Figure 48). The Hill #1-11 contains 11 feet of net pay (minimum porosity of 8% and maximum water saturation of 40%), with an average of 18% porosity. The well was completed in September 1994, and is currently producing at a rate of 183 mcfd. The top of the Hartshorne sandstone (Lower Hartshorne or Hartshorne Undivided) producing zone is 3213 feet measured depth (-2399 feet subsea); top of the Hartshorne Coal is 3189 feet measured depth (-2375 feet subsea). The Hill #1-11 was fracture stimulated with 12,474 gallons of fluid (type unknown) and 11,500 pounds of sand. It was treated with 300 gallons of acid prior to the fracture stimulation. The Hill #1-11 had an initial gas rate of 361 mcfd, flowing on a 12/64 inch choke with 450 psi of flowing tubing pressure (FTP). Shut-in tubing pressure built to 620 psi. Structurally the Hill #1-11 is low compared to wells in the field to the west, and is possibly separated from them by a fault. The overall structure of the field is a northwest-southeast trending synclinal nose (Plates 3 and 4).

The Glenn Supply Co. Inc. Geneva #1-10 (Figure 48) and Glenn Supply Co. Inc. Black #3 (Figure 49) are located in Section 10-T.6N.-R.11E. Both are interpreted to be producing from Type-1 distributary channel subfacies of the delta plain facies. An alternate interpretation is distributary mouthbar/bar crest subfacies of the delta front. The Geneva #1-10 (Figure 48 and Well #4, Cross-Section A-A', Plate 13) produced 0.26 bcf from July 1995 thru July 2003. It contains 16 feet of net pay (minimum porosity of 8% and maximum water saturation of 40%) with an average porosity of 18%. The Black #3 produced 0.47 Bcf (November 1995 thru July 2003) from 18 feet of net pay (porosity

>8%, Sw < 40%). Average porosity in the Black #3 is 20% and the calculated water saturation (Sw) is 8%. The calculated Sw seems anomalously low, which may be explained by an Rw that is higher than 0.04 ohm-m. The Black #3 had an initial flow rate rate of 115 mcfd with 295# flowing tubing pressure on a 18/64" choke. Shut-in tubing pressure was only 500#, which may indicate partial reservoir depletion. Figure 50 is a net pay isopach map.

In Section 7-T.6N.-R.11E., the Victor Pryot Boyd #2 produces from what is interpreted to be delta front or possibly crevasse splay deposits (Well #1 on Cross-Section E-E', Plate 15). The well has only produced 80 mmcf and is currently making 5 mcfd.

Volumetrics were calculated for the Shady Grove Field, which is a direct offset to the Cabannis NW Field and may share reserves. The OGIP that was calculated for the Shady Grove Field was 9.01 bcf, with a recovery factor of 96%. The recoverable OGIP is 8.68 bcf, for a 77% recovery to date. This does not take into consideration coal gas, gas from shaly sands outside the mapped net pay isopach, or commingled gas from other non-Hartshorne reservoirs.

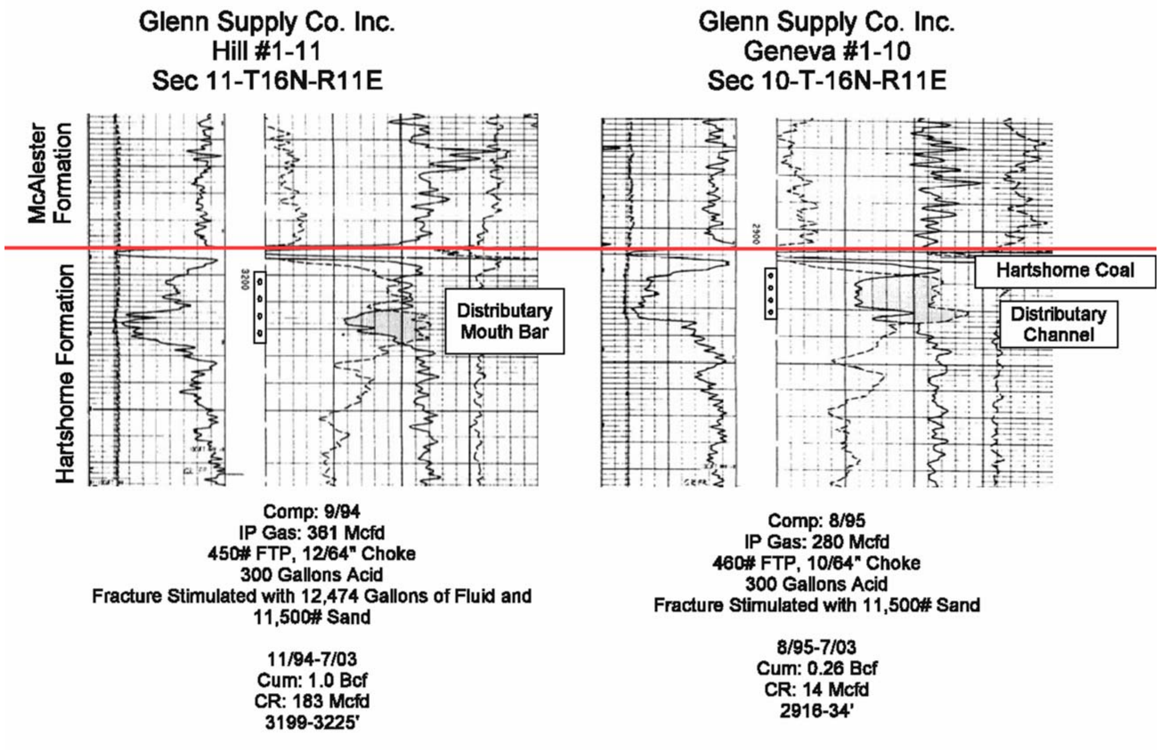


Figure 48: Examples of production from distributary mouth bar (left) and Type-1 distributary channel sandstones within the Shady Grove South Field, Pittsburg County, Oklahoma.

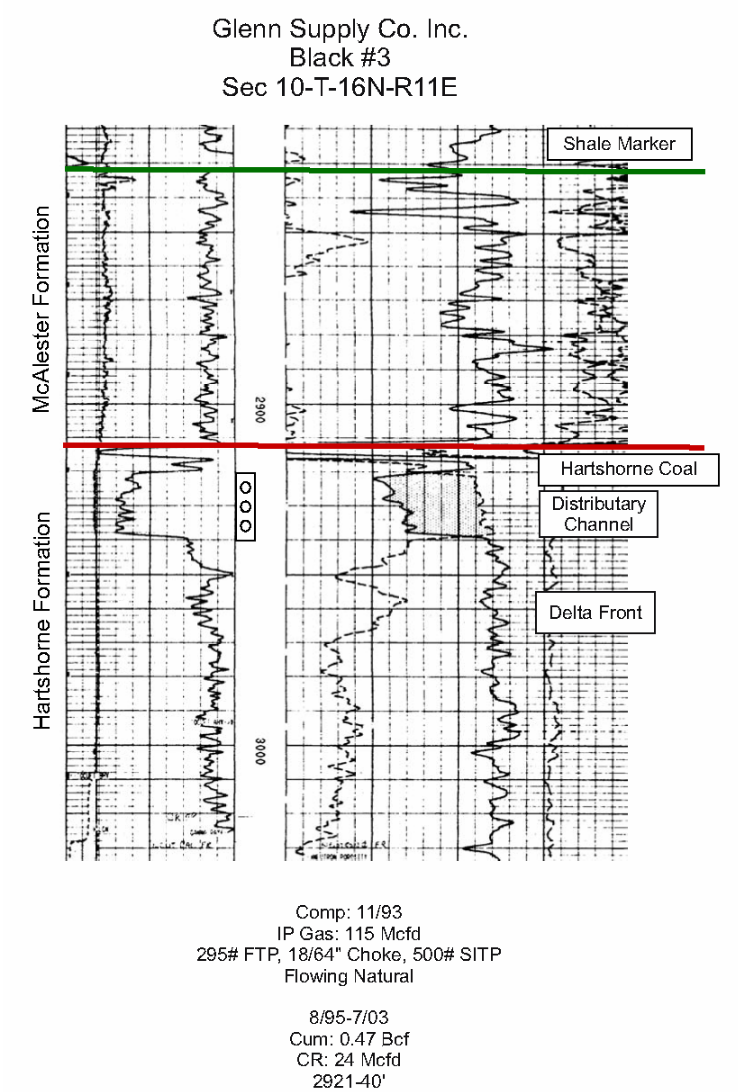


Figure 49: Example of production from the Type-1 distributary channel facies, Shady Grove South Field, Pittsburg County, Oklahoma.

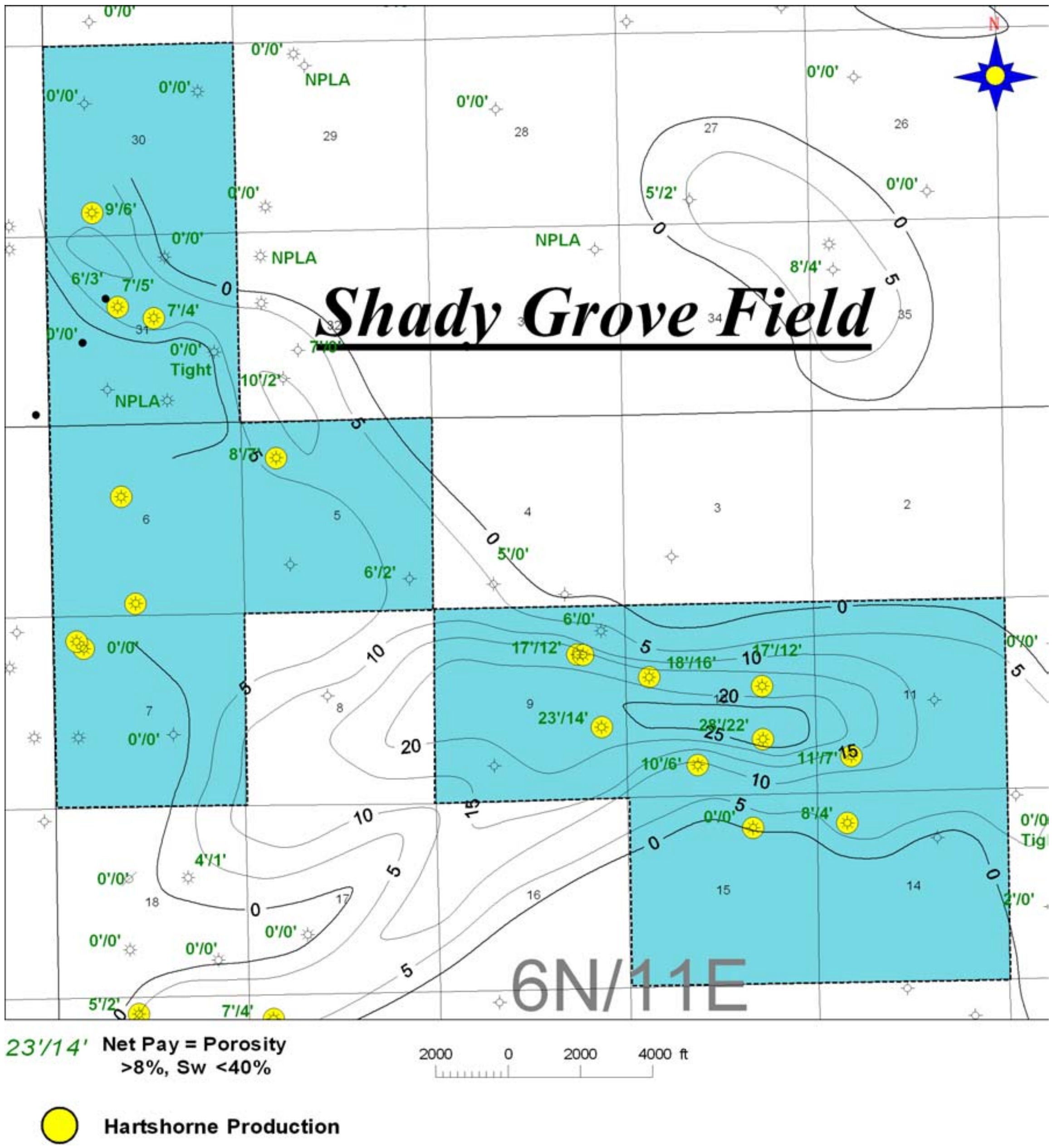


Figure 50: Net pay isopach map, Shady Grove Field.

Table VIII: Volumetric reservoir summary for the Hartshorne Formation, Shady Grove Field, Pittsburg County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	20%	6048	2348	1.03	0.99	115	630	25	0.64	96%	159
5	7.50	12%	20%	3700	1763	2.31	2.23	115	630	25	0.64	96%	159
10	12.50	12%	20%	1937	875	1.91	1.84	115	630	25	0.64	96%	159
15	17.50	12%	20%	1062	535	1.58	1.58	115	630	25	0.64	96%	159
20	22.50	12%	20%	527	432	1.70	1.64	115	630	25	0.64	96%	159
25	25.00	12%	20%	95	95	0.42	0.40	115	630	25	0.64	96%	159
					Total	***8.95***	***8.68***						

Field Production:	6.81
Recoverable OGIP:	8.68
Reserves Recovered:	78%

South Pine Hollow Field

South Pine Hollow Field is the largest field in both area and production volume. Located in the southern part of the study area (Townships 5 and 6 North and Ranges 12 and 13 East); the field has produced over 112 bcf from 121 wells. Most gas production is from the thick sandstone of IC-1 and IC-2. Average production per well is over 900 mmcf, whereas production for individual wells ranges from less than 2 mmcf to more than 11 bcf.

The primary reservoir for the field is the IC-2 sandstone trend, or incised valley fill/entrenched distributary channel facies. Secondary reservoir facies include distributary channel, channel margin, and delta front. South Pine Hollow Field is located in the most depositionally complex part of the study area and difficult to interpret. The South Pine Hollow Field is bordered on the north by the northeast-southwest trending IC-1 channel and incised by the IC-2 channel. The IC-2 sandstone can be a great as 180 feet thick and very gas productive The incised channel sandstone IC-2, which has been mapped as Hartshorne Undifferentiated, accounts for more than 2/3 of the production in the field. The amount of modification of the original sediments resulting from incision of both channels, as well as the reworking that may have occurred during the subsequent transgression is difficult to access.

Some wells have penetrated the Type-2 distributary channel facies. The Davis Operating Co. Ott #2-22 (Section 22-T.5N.-R.12E.) is a prime example of the distributary channel facies (Figure 51). The Ott #2-22 is also an example of a well that produces from the Hartshorne Coal. The well was completed in the coal with an initial production rate of 30 mcfd in 1999. The well has cumulated 50 mmcf and currently producing 31 mcfd. The production rate has remained relatively stable over the past four years, which is typical for vertical coal wells. Another well that penetrated the Type-2 distributary channel facies is the Davis Operating Co. Donna #1-16 (Section 16-T.5N.-R.12E.), which produced 0.43 bcf from the Lower Hartshorne from September 2000 through August 2003 (Figure 52). The well was completed and flowed gas at a rate of 561 mcfd and currently produces 177 mcfd. The reservoir was fracture stimulated with 35,646 gallons of fluid and 56,240 pounds of sand. The Virgil #1-22 (Section 22-T.5N.-R.12E.) is an example of production from delta front or bar fringe facies (Figure 53).

Remnants of older distributary channel, channel margin/splay, and distributary mouth bar facies are evident within the field, but the interpretation of the original deposition framework is difficult due to possible subaerial exposure and erosion during sea level fall, as well as sediment reworking during the subsequent sea level rise.

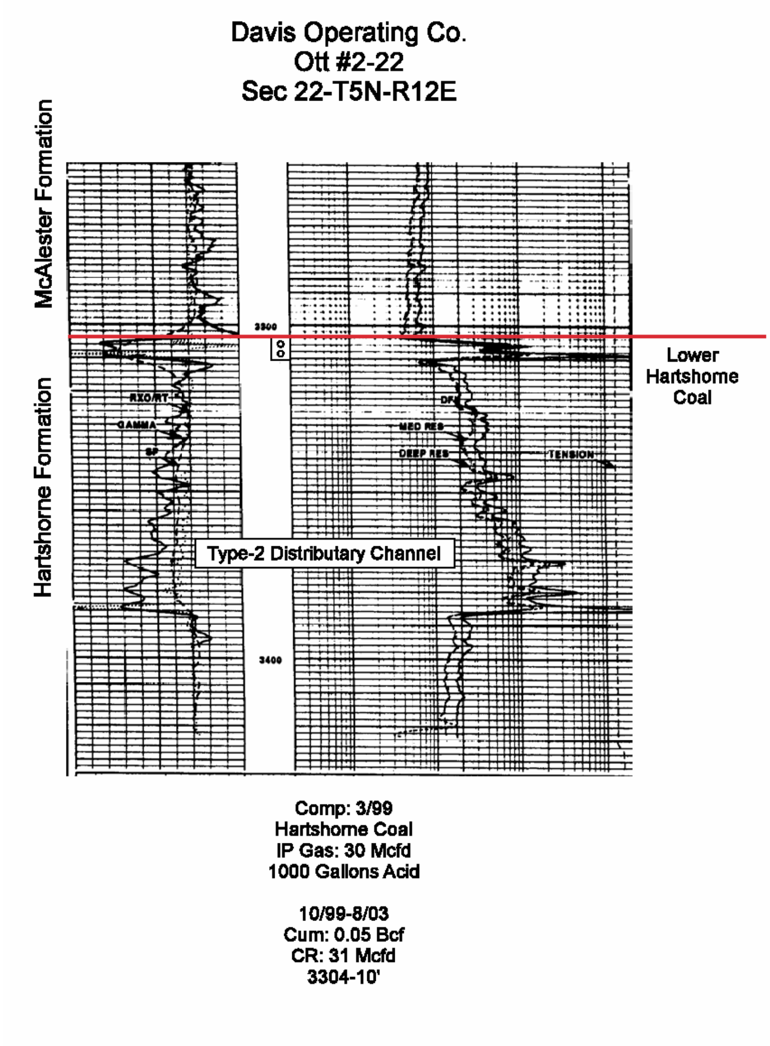


Figure 51: Example of a well that penetrated a Type-2 distributary channel sandstone. Production in this well is from the Lower Hartshorne Coal. South Pine Hollow Field, Hughes County, Oklahoma.

Production in some wells is from multiple facies. The Mustang Fuel Corporation Semeski #1-3, located in Section 3-T.5N.-R.12E., is perforated in what has been interpreted to be distributary mouth bar and possible crevasse splay facies (Well #6 on Cross-Section B-B', Plate 20). The Lower Hartshorne Coal was also perforated in the Semeski #1-3. The well produced 0.22 bcf from October 2000 to September 2003 and has a current gas production rate of 139 mcfd.

Volumetric calculations (Table IX) for the South Pine Hollow Field were calculated using a reservoir temperature used was 115 degrees Fahrenheit, and initial reservoir pressure and abandonment pressure of 650 psi and 25 psi respectively. The volumetric calculations for the South Pine Hollow Field were done in two parts. The first set of calculations was for the Lower Hartshorne, without the south incised channel (IC-2). The second set of calculations was for the southern incised channel, IC-2, mapped as Hartshorne Undifferentiated.

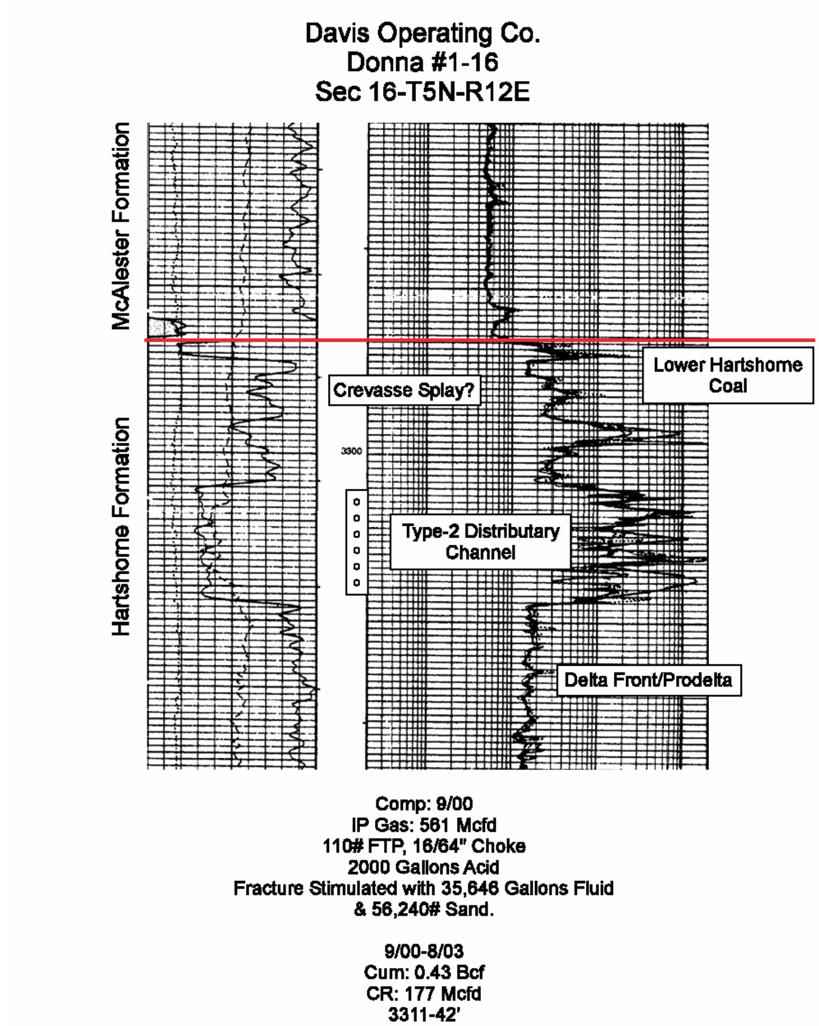


Figure 52: Example of production from the Type-2 distributary channel facies within the South Pine Hollow Field, Hughes County, Oklahoma.

Reserve calculations for the Lower Hartshorne (without the IC-2 Channel) were based on average porosity and Sw of 10% and 25%, respectively. The total recoverable OGIP was calculated to 47.31 bcf using a recovery factor of 96.2% or 132 mcf/acre-foot. Presently, that part of the field has produced 19.11 bcf, a 40% recovery.

Hartshorne Undifferentiated (IC-2) calculations were based on an average porosity of 12% and a calculated Sw of 20%. The total recoverable OGIP was 91.96 bcf using a 96% recovery factor or 174 mcf/acre-foot. The IC-2 part of the field has cumulated 93.94 bcf, or a 102% total recovery to date.

Communication between the IC-2 reservoir and the Lower Hartshorne outside of the incised channel (IC-2) may explain why the total recovery for the IC-2 reservoir exceeds 100%. Some production contribution may be from coalbed gas, as well as from commingled reservoirs. The total estimated recoverable OGIP for the combined Hartshorne reservoir is 139.27 bcf, based on a 96% recovery factor at an average of 155 mcf/Acre-Foot. Total recovery to date, is approximately 80% of the reserves in the field. As a result of higher average porosity and lower water saturation values, the recovery factor was similar for both reservoirs. Volumetric summaries for each can be found in Appendix E.

Stuart Southwest Field

The Stuart Southwest Field is located in the southwest part of the study area and is composed of just 7 wells (Figure 54). The field has produced over 12 bcf of gas, with the majority coming from just 2 wells. The Woodfork #1 (Sec 26-T.5N.-R.11E.) and the

Lackey #1 (Sec 27-T.5N.-R.11E.) have produced 5.4 bcf and 4.2 bcf, respectively, combining for

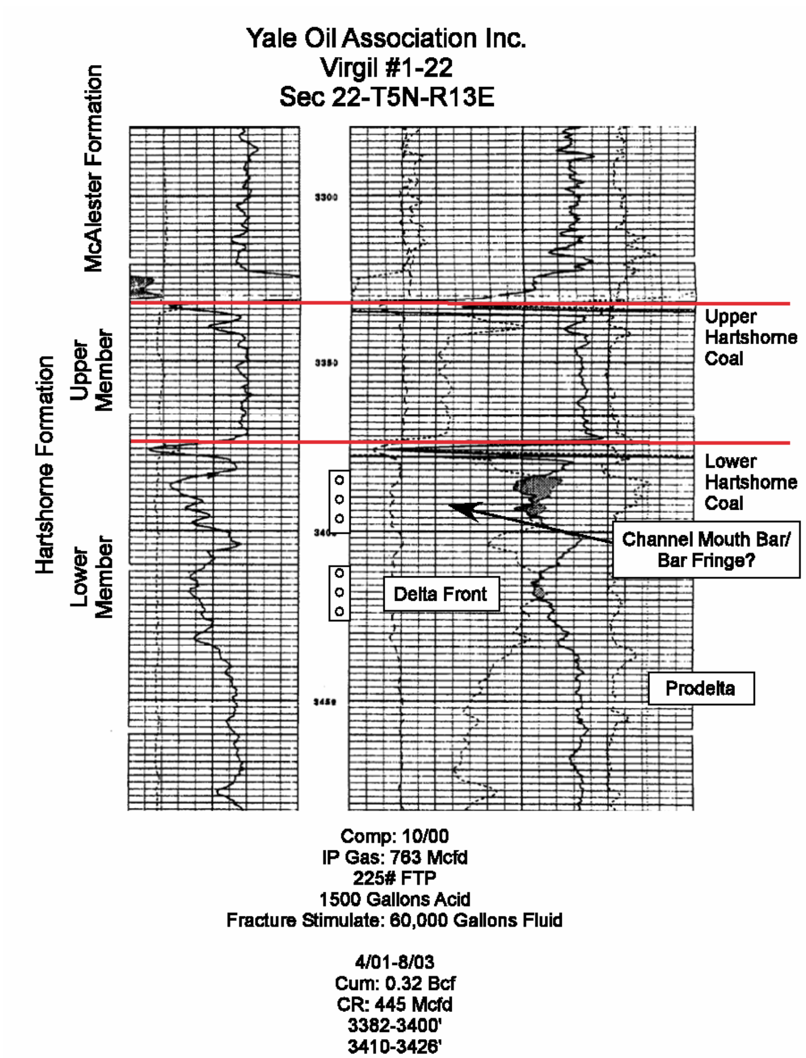


Figure 53: Example of production from distributary mouth bar/bar fringe or possible delta front facies within the South Pine Hollow Field, Hughes County, Oklahoma. Note the presence of both the Upper and Lower Hartshorne Members. Upper Hartshorne is bay facies.

Table IX: Volumetric reservoir summary for the Hartshorne Formation, South Pine Hollow Field, Pittsburg County, Oklahoma.

Lower Hartshorne													
Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	10%	25%	27268	2843	1.00	0.97	115	630	25	0.64	96%	136
5	7.50	10%	25%	24425	9108	9.65	9.31	115	630	25	0.64	96%	136
10	12.50	10%	25%	15317	6228	11.01	10.61	115	630	25	0.64	96%	136
15	17.50	10%	25%	9089	4991	12.35	11.90	115	630	25	0.64	96%	136
20	22.50	10%	25%	4098	2552	8.12	7.82	115	650	25	0.64	96%	136
25	27.50	10%	25%	1546	837	3.25	3.13	115	650	25	0.64	96%	136
30	32.50	10%	25%	709	204	0.94	0.90	115	650	25	0.64	96%	136
35	37.50	10%	25%	505	253	1.34	1.29	115	650	25	0.64	96%	136
40	40.00	10%	25%	252	252	1.43	1.38	115	650	25	0.64	96%	136
					Total	***49.08***	***47.31***					96%	

Field Production:	19.11
Recoverable OGIP:	47.31
Reserves Recovered:	40%

Incised Channel (IC-2) - Hartshorne Undifferentiated													
Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	12.50	12%	20%	12800	3857	8.70	8.40	115	630	25	0.64	96%	174
25	37.50	12%	20%	8943	4197	28.47	27.46	115	630	25	0.64	96%	174
50	62.50	12%	20%	4746	2742	31.01	29.90	115	630	25	0.64	96%	174
75	75.00	12%	20%	2004	2004	27.19	26.20	115	630	25	0.64	96%	174
					Total	***95.37***	***91.96***					96%	

Field Production:	93.94
Recoverable OGIP:	91.96
Reserves Recovered:	102%

Field Totals		
Total Field Production:	112.00	BCF
Recoverable OGIP:	139.27	BCF
Reserves Recovered:	80%	

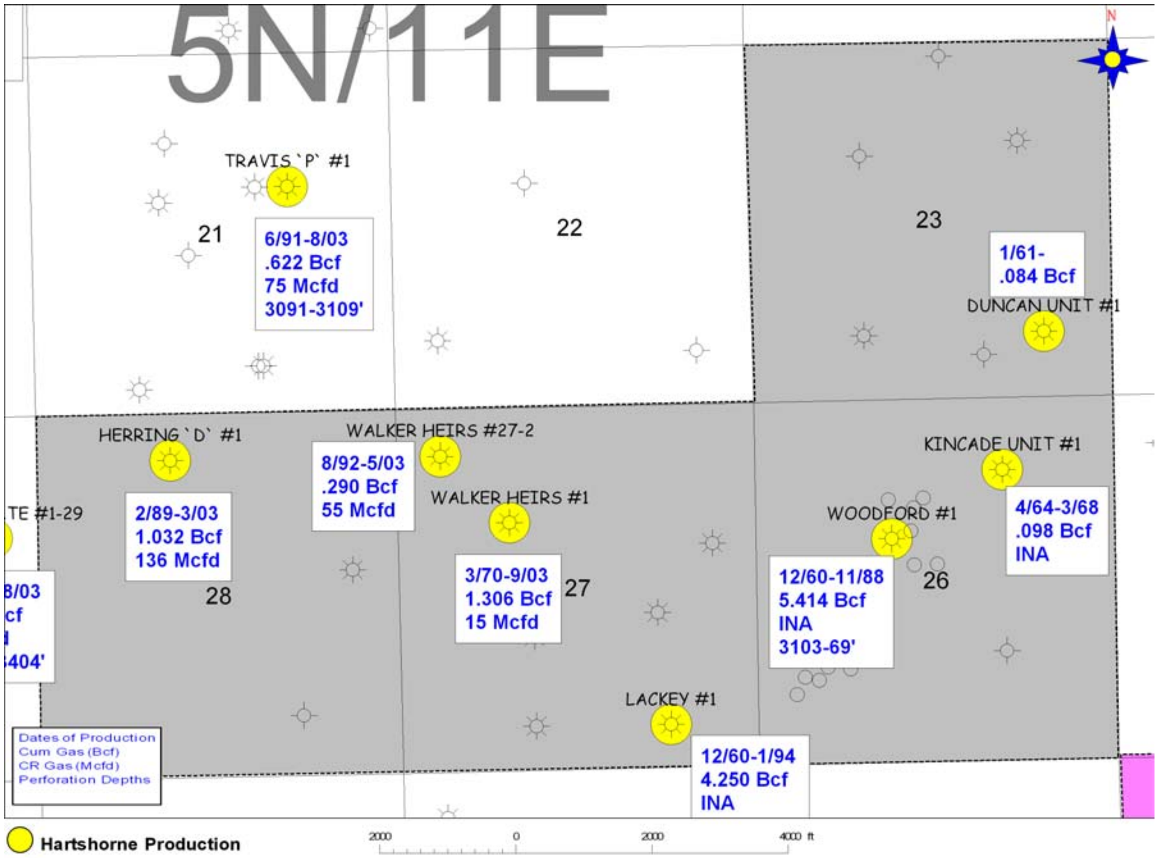


Figure 54: Hartshorne production map, Stuart SW Field, Hughes County, Oklahoma.

more than half of the field's production. Both of these wells produce from the Incised Channel Facies (IC-1) of the Lower Hartshorne. No porosity logs were available for either of these wells, which make reserve calculations difficult and may explain the discrepancy between calculated recoverable reserves and field production. Both wells are located on a small structural closure (Plates 3 and 4), and may be separated from other reservoir sandstones within the field. Another well that produced gas from incised channel facies is the Bell Oil & Gas Company Duncan Unit #1 (Sec 23-T.5N.-R.11E.). This well was completed in 1960, and produced 80 mmcf from perforations in the uppermost part of the sandstone and the Hartshorne Coal. Most of the Hartshorne section in this well is low resistivity and appears water bearing (Figure 55). The Duncan Unit #1 is about 80 feet structurally low to the Woodfork #1 and Lackey #1, demonstrating the strong structural component of production within the incised channel sandstone reservoir (Figure 56).

Several wells have produced from distributary mouth bar and distributary channel deposits that are found at the edge of the incised channel complex. These wells are the Herring D #1 (Section 28-T.5N.-R.11E.) and the Walker Heirs #1 (Section 27-T5N-R11E), have produced over 1.0 Bcf. Based on electrofacies interpretation, the Herring D #1 (Figure 57) produces from distributary mouth bar/bar fringe subfacies of the delta front facies, as well as overlying channel margin subfacies of the delta plain. The delta front exhibits a coarsening upward profile on the gamma ray curve, which is topped by a subtle fining upward signature that is interpreted as channel margin facies.

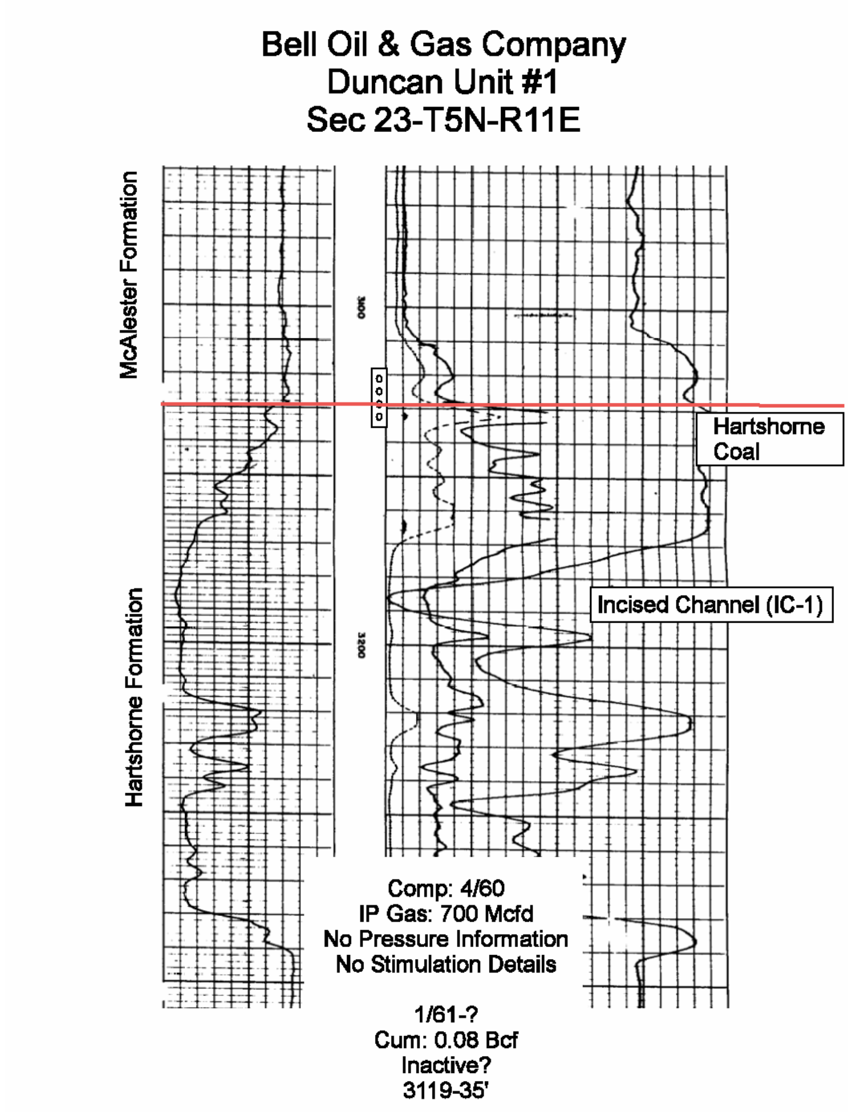


Figure 55: Example of a well that penetrated IC-1 incised channel/incised valley fill facies in Stuart SW Field, Pittsburg County, Oklahoma. Production appears to come primarily from the Hartshorne Coal.

Volumetric calculations were used to establish gas reserves for the field. These calculations were based on an initial formation pressure of 820 psi, which was reported on initial well pressure tests. The abandonment pressure was 25 psi, and the formation temperature used was 115 degrees F. Volumetric calculations for Stuart SW Field were done in two parts. The first set of calculations was for the Lower Hartshorne sandstone that is part of the initial delta system. The second set of calculations are for the Lower Hartshorne incised channel (IC-1).

For the first set of calculations are based on an average porosity and Sw values of 10% and 30%, respectively. The recoverable OGIP was calculated at 1.77 Bcf. The Hartshorne reservoir within this part of the field has produced 2.2 Bcf, or more than 100% of the calculated recoverable OGIP. Some of the discrepancy may be attributed to downhole commingling with other reservoirs, thin-bedded sandstone that does not calculate as pay, or coalbed gas. The second set of calculations used an average porosity of 15% and an average calculated Sw of 30%. The porosity values for the Woodfork #1 and Lackey #1 are unknown, but are likely 15%. The Sw is estimated at 25-30% based on the Reams Northeast Field analog, which produces updip in the IC-1. To account for the discrepancy, a rough calculation of reserves was conducted using the gross sand isopach. An area was chosen that represents the reservoir encountered by the Woodfork #1 and the Lackey #1. The Lacky #1 contains 50 feet of gross Lower Harthsorne (IC-1) sand and the Woodfork #1 contains 105 feet of gross sand. The entire Lower Hartshorne sandstone appears to be productive based on the induction log resistivity, so a base net pay of 50 feet was used in the volumetric calculations. The result was a recoverable.

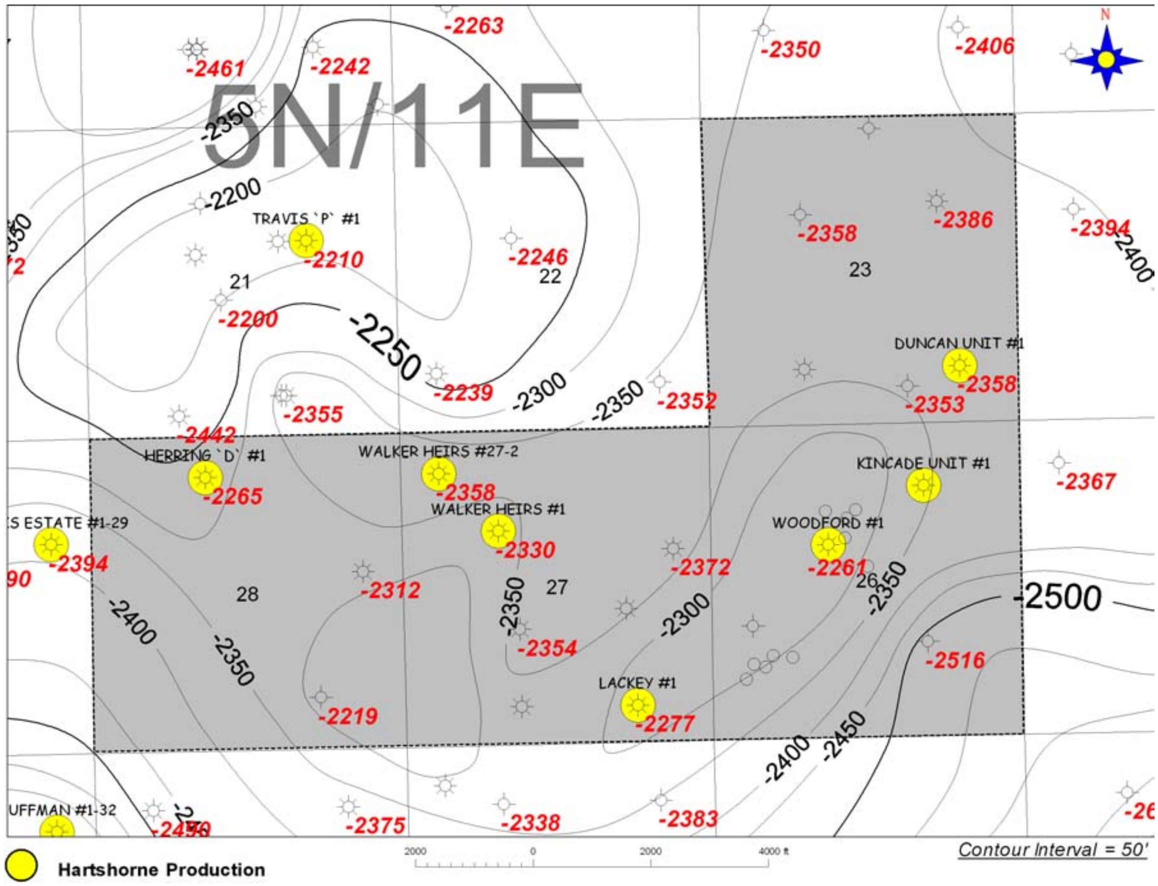


Figure 56: Structure map: Top of Lower Hartshorne Coal, Stuart SW Field.

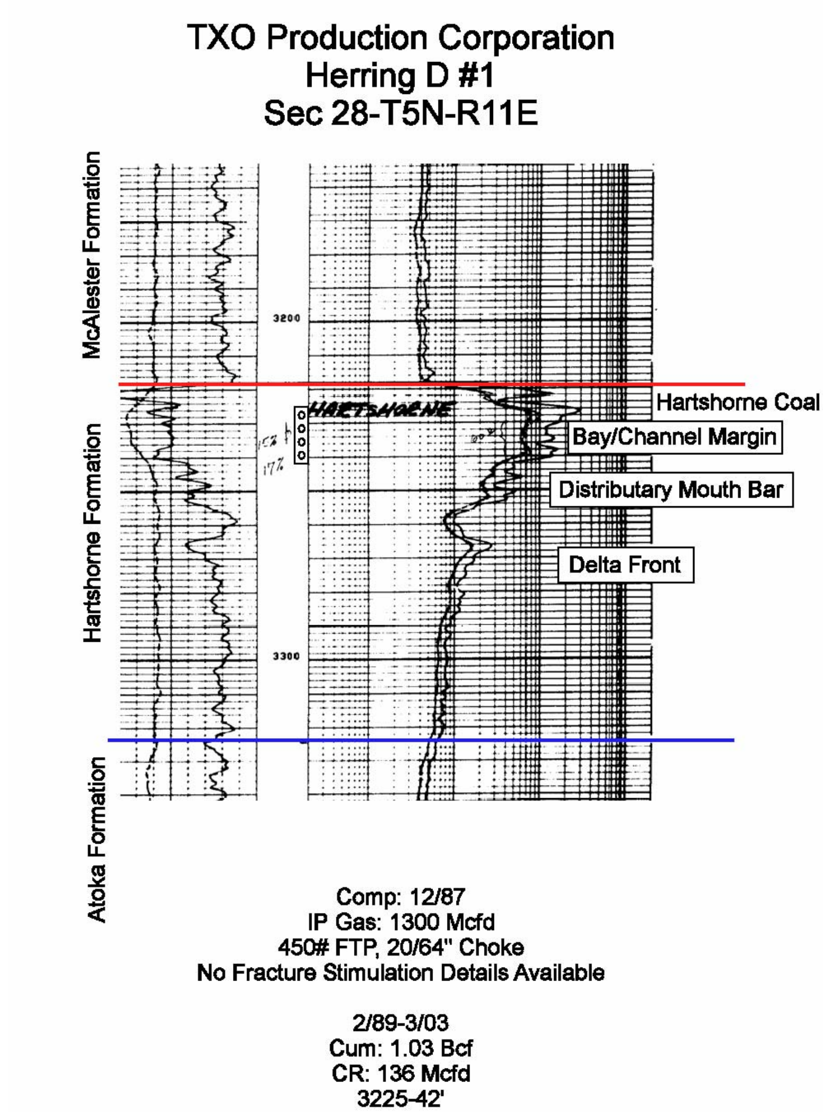


Figure 57: Example of production from the distributary mouth bar/channel margin succession within the Stuart SW Field, Pittsburg County, Oklahoma.

OGIP of 15.07 Bcf The Lackey #1, Woodfork #1, and two other wells have produced 9.8 Bcf from this reservoir, for a total recovery of 65%

The final reserve value of 16.78 Bcf recoverable OGIP, when divided into the field production, indicates that field production is only 72% of the recoverable OGIP. There is more inherent error in these calculations than in the previous field summaries, as no porosity logs were available for the two primary wells in the main producing trend and net pay was estimated. This data is summarized in Table X.

Table X: Volumetric reservoir summary for the Hartshorne Formation, Stuart SW Field, Hughes County, Oklahoma.

Incised Channel - IC-1													
Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
50	50.00	15%	30%	1218	1218	15.50	15.01	115	820	25	0.64	97%	247
					Total	***15.50***	***15.01***						

Lower Hartshorne Deltaic Deposits													
Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	10%	30%	1347	494	0.58	0.55	115	820	25	0.64	97%	165
5	7.50	10%	30%	853	466	0.59	0.58	115	820	25	0.64	97%	165
10	10.00	10%	30%	387	387	0.66	0.64	115	820	25	0.64	97%	165
					Total	***1.82***	***1.77***						

Field Totals		
Field Production:	12.00	BCF
Recoverable OGIP:	16.78	BCF
Reserves Recovered:	72%	

Ulan Field

The Ulan Field is located in the northeast part of the study area and contains three wells. Total cumulative production is 0.66 bcf. The first well in the field was the Ward #2-13 (Section 13-T.7N.-R.13E.), which produced 0.16 Bcf from January 1993 thru July 2003 (Figure 58). The Ward #2-13 is a vertical Hartshorne Coal producer. The coal in the Ward #2-13 is about 5 feet thick. Only one of the wells, the Brower Oil & Gas Hill #1-24 is located within mapped net pay (Plate 5). The Hill #1-24 has produced 0.30 bcf from the Lower Hartshorne sand, Lower Hartshorne Coal, and Booch sandstones. The initial well production tests reported gas flow rates of 300 mcfd from the Booch and 200 mcfd from the Hartshorne sandstone and coal.

Volumetric calculations for the Ulan East Field can be seen in Table XI. One well produces from the Hartshorne Sandstone within the mapped net pay and it is commingled with another reservoir. Production within the field primarily comes from channel margin deposits that do calculate net pay and from the Hartshorne Coal. Judging by the production from the part of the Ulan East Field within the study area, the only economically promising development would be horizontal coalbed drilling.

Calvin Southeast & Greasy Creek Fields

The Calvin Southeast Field contains one well, the Murexco Petroleum Inc. Lyons #1-6, located in Section 6-T.5N.-R.11E.. No log was available for this well. Based on the gross sandstone thickness map (Plate 2) the well appears to have produced from delta front sandstones within the Hartshorne. The well had an initial rate of 201 mcfd on a ½

Table XI: Volumetric reservoir summary for the Hartshorne Formation, Ulan East Field, Pittsburg County, Oklahoma.

Contour Interval	Avg. Net Pay	Avg. Porosity	Avg. Sw	Area (Acres)	Adjusted Area (Acres)	OGIP (BCF)	Recoverable OGIP (BCF)	Formation Temp (Degrees F)	Initial Formation Pressure (psi)	Abandonment Pressure (psi)	Gas Density	Recovery Factor	Mcf/Acre-Foot
0	2.50	12%	25%	369	176	0.61	0.58	110	630	25	0.64	96%	158
5	5.00	12%	25%	193	193	1.99	1.91	110	630	25	0.64	96%	158
					Total	***2.59***	***2.50***						

Field Production:	7.29
Recoverable OGIP:	6.97
Reserves Recovered:	**105%**

inch choke with 25 psi of flowing tubing pressure. The well produced 46 mmcf from June 1984 thru August 2003, and is currently producing at a rate of 3 mcfd.

The Greasy Creek Field is a one well field located in Section 6-T.7N.-R.11E.. The sole well, Glenco Turner #5, produced 42 mmcf from commingled Hartshorne and Booch reservoirs between May 1986 thru June 2003. The well had an initial production rate of 30 mcfd on a 16/64" choke with 101 psi of flowing tubing pressure and well is currently producing 14 mcfd. The well appears to produce from the channel mouth bar-fringe/channel margin facies.

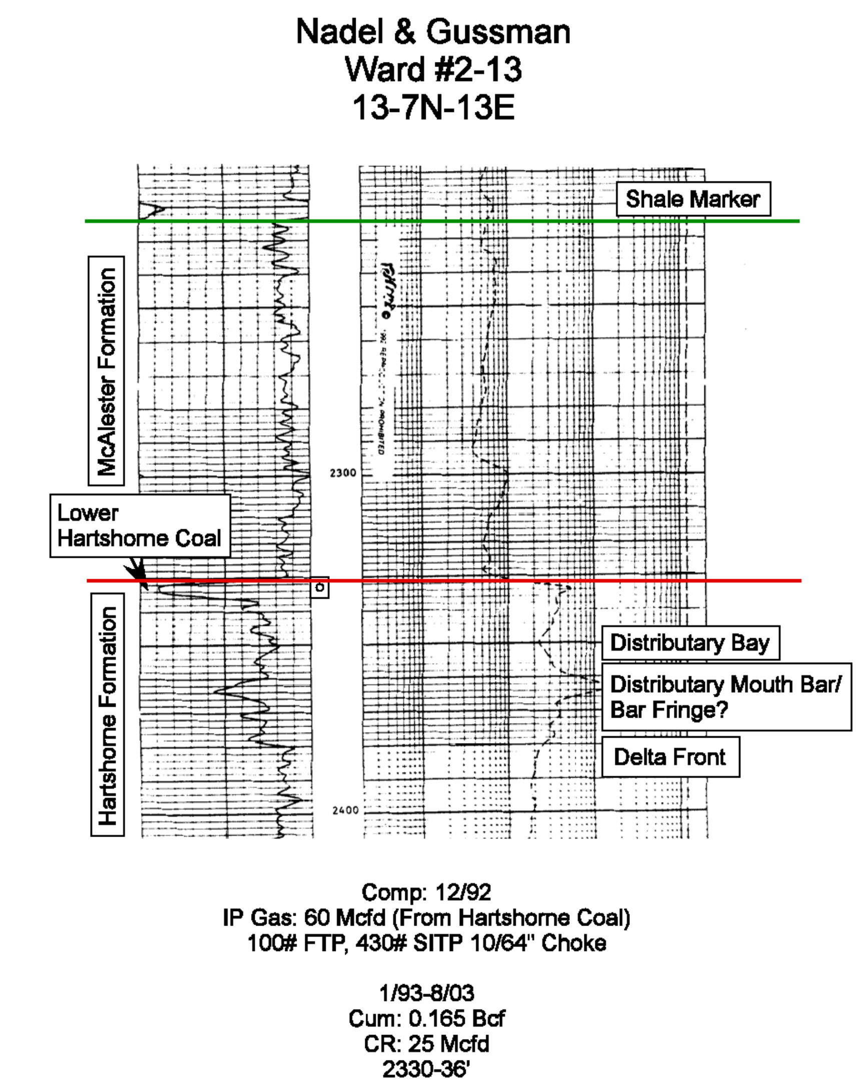


Figure 58: Example of a well that encountered the delta front/distributary mouth bar/distributary bay succession within the Ulan Field, Pittsburg County, Oklahoma. Note that production in this well comes from the Hartshorne Coal.

Coalbed Methane Production

Coalbed methane is an interesting play, in that the coal acts as source, reservoir, and trap for the gas. Initially, coalbed gas was produced the same way as sandstone and carbonate gas reservoirs through conventional vertical well completions that often involved multiple coal seams. With the advent of horizontal drilling technologies, the viability of drilling for coalbed methane has been increased greatly. Coalbed methane is now one of the most active gas plays in the Midcontinent, Rocky Mountain, and Appalachian Regions of the United States.

The Arkoma Basin of Oklahoma and Arkansas has seen a dramatic increase in coalbed methane exploitation using vertical and horizontal drilling and completion methods. The Hartshorne Coal is one of the most sought after coal seams within this play. Gas production from the Hartshorne in vertical or conventional wellbores is often commingled with gas production from the underlying Hartshorne Sandstone, or other reservoirs. Vertical coalbed methane wells, typically produce at a low rates for long periods of time.

Within the study area, there are a number of wells that have produced directly from the coal, either independently or commingled with production from the underlying Hartshorne sandstone. The Ott #2-22 (Section 22-T.5N.-R.12E.) is an example of a well that was completed solely in the Hartshorne Coal (Figure 51). The well was completed in January 2000 and had an initial production rate of 30 mcfd. No water was reported, but most coal wells initially produce high volumes of water. The well has produced for almost four years and has cumulated 0.05 bcf of gas. It exhibits no apparent decline in production rate, and is producing 31 Mcfd. This is typical production for many vertical coal wells that do not produce at high initial flow rates, but instead produce small volumes at a sustained rate for long periods of time.

Hydrocarbon Production Potential

The Hartshorne sandstone reservoir in this area is considered a mature play, but it continues to generate drilling activity. The key to the future development is a thorough understanding of the depletion patterns and identifying potential infill locations within known reservoirs. The shallow depth of the Hartshorne makes drilling for partially depleted reservoirs a viable economic option at present gas prices.

Coalbed Methane Play

Coalbed completions have been a viable option for gas production within the Pennsylvanian section of Oklahoma, Arkansas, and Kansas for many years. Gas production rates from coal seams completed in vertical wellbores is usually relatively small, but these wells produce for periods of time with small rates of decline. With the advent of horizontal drilling technology an entirely new play has emerged with wells that produce at higher sustained rates. The Hartshorne Coal of the Arkoma Basin is frequently drilled using horizontal drilling technology. The minimum coal thickness needed is 4 feet. Logging-while-drilling (LWD) technology is utilized to assist the driller in keeping the bit in the coal seam.

There is sufficiently thick coal within the study area to allow for drilling of horizontal coalbed wells. However the coal does thin to as little as 0-1 foot thick in some areas. The thickest coal occurs where the Upper and Lower Hartshorne Coals are undifferentiated or where they begin to ‘split.’ At this point, the two coal seams appear become a single coal seam, but may be separated by a layer of bony coal (Fields, 1987).

According to recent Oklahoma Corporation Commission records, several sections within the study area are proposed for horizontal coalbed methane well spacing and unit designation for the Hartshorne Coal.

CHAPTER V

SUMMARY

Depositional Models

The Hartshorne Formation is a complex depositional system that is not completely understood. The Hartshorne has been interpreted as a multicyclic, high-constructional lobate delta system, based on various deltaic facies interpreted in outcrops and the subsurface. These facies include prodelta, delta front (distal delta front and distributary mouth bar), and delta plain (distributary channel, interdistributary bay, and crevasse splay). The upper part of the underlying Atoka Formation is believed to represent the transition from marine to deltaic sedimentation and represents initial prodelta sedimentation. Thick sandstone bodies are interpreted as distributary channel deposits in the deltaic model.

Recent work that integrated the concept of sequence stratigraphy into the earlier work reinterprets the very thick (80-250 feet) sandstone bodies as incised valley fill deposits. Within the study area, there are two such sandstone trends, IC-1 and IC-2. All models agree that the Hartshorne Formation was deposited in two primary cycles, each punctuated by widespread and fundamental changes in the depositional system. The first cycle includes the Lower Hartshorne Member south of the coal-split line and Hartshorne Formation Undivided north of the coal-split line. During this first cycle, the Lower Hartshorne delta system prograded out into the basin. This system was punctuated by a basin-wide delta abandonment and subsidence that resulted in a large-scale coastal peat marsh system that capped the abandoned delta system. The sequence stratigraphic model suggests that a major regressive followed delta formation and a large incised valley was eroded and subsequently filled. This interpretation also suggests that peat was deposited within widespread coastal marshes as sea level rose. All models indicate that following Lower Hartshorne deposition, structurally induced differential subsidence occurred in the southern part of the area. This created accommodation space that allowed for the deposition of the Upper Hartshorne Member as a shallow delta system, which is presently capped by the Upper Hartshorne Coal. The hinge line of this differential subsidence coincides with the coal-split line and trends southwest to northeast, subparallel to major structural features within the basin. North of this coal-split line only the Lower Hartshorne Member (Hartshorne Undivided) and the Lower Hartshorne Coal are present. The sequence stratigraphic model recognizes another drop in sea level (lowstand) and incision episode within the Upper Hartshorne that occurred prior to deposition of the peat. This valley eroded through the Lower Hartshorne Coal and into the Lower Hartshorne Sandstone. It is believed that peat deposition continued uninterrupted north of the caol-split. This means that the undivided coal north of the coal split line contains both Lower and Upper Hartshorne Coal equivalents. A thin black shale or bony coal layer has been recognized within the undivided coal. This bony coal layer may represent a change in peat deposition that is the boundary between the Lower and Upper Hartshorne cycles.

Evidence Supporting Depositional Model

There is insufficient evidence to completely endorse or reject the proposed depositional models, where differences center around the origin of the thick valley fills. There is evidence concerning sand and peat deposition that should be considered in evaluating. This evidence is outlined below:

1) The thick valleys or entrenched channels were eroded through local and regional markers.

2) Thick valley fills contain what appear to be fluvial and estuarine or shallow marine deposits, but there electrofacies were not cored. The type of fill within the valleys is key to determining their origin.

3) Distribution pattern for older deltaic distributaries and thick valley fills are quite different, suggesting separate depositional systems.

4) Production data indicate the delta and thick valley fills can have separate fluid types and are not a common reservoir. This suggests the two are unrelated.

5) The Hartshorne coals are widespread and continuous except where they are eroded by younger valley forming processes or they thin or are absent over the top of the thicker channel fills. This latter case suggests the valleys formed topographic highs as a result of differential compaction.

6) The thickness and lithologic characteristics of the Hartshorne Coals indicate that saltwater marshes in interdistributary bays are not viable depositional models for the Hartshorne peat. Hartshorne coal is relatively low ash and vertically continuous. Peat that form in saltwater marshes in interdistributary settings tend to contain siliclastic material that causes them to be interbedded/interlaminated

with other sediments and result in high ash content. This would make the later coal seams uneconomical.

7) The Hartshorne Peat was likely deposited in a marsh or mire that was distal to active silicastic deposition. This setting may be similar to the setting of the modern Okefenokee and Snuggedy marshes in southern Georgia, U.S.A.

8) The underclay/paleosol below the Lower Hartshorne Coal indicate it may represent a significant period of exposure and possible sequence boundary.

Table 5: Summary of Evidnece for Channel Deposition

DEPOSITIONAL ENVIRONMENTS			
	Deltaic Depostion	**Entrenched Meander**	**Incised Valley**
Drainage Patterns	Anastomising distributary channels	Linear	Linear
Channel Thickness	0-50'	80-250'	80-250'
Elctrofacies Relationships and Distribution	Normal facies distribution (prodelta, delta front, mouth bar, channel, and bay.	Cross-cutting relationship to adjacent sediments	Cross-cutting relationship to adjacent sediments
		Stacked channels sandstone with possible marine influence	Stacked channels with possible marine influence
Coal	Coal that formed from peats deposited within the interdistributary bays (proximal to active siliclastic sedimentation) is often has high ash content, and numerous clastic breaks (sandstone and siltsone partings) representing overbank deposition.	Thick, laterally continuous, except were where eroded by younger processes	Thick, laterally continuous, except were where eroded by younger processes
		Low ash and low sulfur - distal or unrelated to clastic deposition	Low ash and low sulfur - distal or unrelated to clastic deposition
		Underclay/paleosol - exposure and possible hiatus (sequence boundary)	Underclay/paleosol - exposure and possible hiatus (sequence boundary)
	Coal would be thin and uneconomical	Economical Coal	Economical Coal

Conclusions

The following conclusions were formulated from this study:

1) Interpreting the stratigraphy and depositional history of the Hartshorne Formation is hindered by the scarcity of relevant core data.

2) The Hartshorne contains two deltaic systems that are identified by their respective coals.

3) The presence of underclay and paleosol beneath the coal indicates a hiatus and possible genetic separation from the underlying lithologies.

4) The difference in the trends, fluid types, and thickness of the deltaic distributary channels and the thick valley fills/entrenched distributary channels favor the idea that these were deposited by unrelated processes.

5) Characteristics of the coals favor their origin as peat deposited in frewshwater swamps that are removed from siliclastic deposition and not in settings associated with saltwater marsh or distributary channels.

6) Highest gas recoveries in the Hartshorne Formation are from the thick valley fill sandstones that often contain a water leg that is not identifiable in older adjacent deltaic sandstones that have been cut through.

7) Hartshorne coalbed methane has considerable potential in the study area, especially in the areas of thick coal development.

8) Additional drilling for conventional Hartshorne Sandstone reservoir is a viable option when volumetric calculations predict remaining reserves.

9) Additional high-resolution stratigraphy is necessary to establish the sequence boundaries and general sequence stratigraphy and depositional history of the Hartshorne Formation.

10) Microstratigraphy of the Hartshorne Coals, together with geochemical studies, should be undertaken to establish the paleoenvironmental setting of the peat.

11) Integrated electrofacies, outcrop, and core data support a Hartshorne depositional model that contains delta cycles that are separated by en episode of relative sea level fall that resulted in deep distributary entrenchment or valley incision. Subsequent to valley filling, widespread peat marshes formed within the area in response to a relative rise in sea level. As a result, Hartshorne coals may be more genetically related to overlying strata than underlying strata.

12) The summary of general depositional setting and history is shown in Figures 59-64.

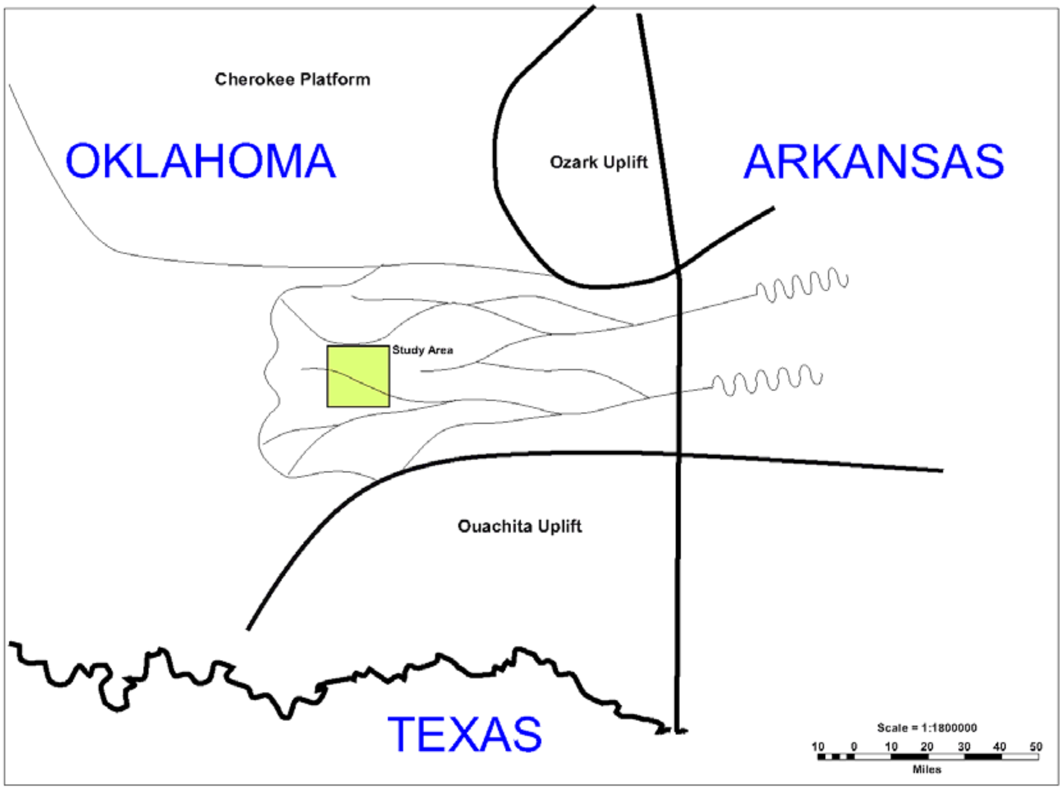


Figure 59: T-1 - Lower Hartshorne delta progradation.

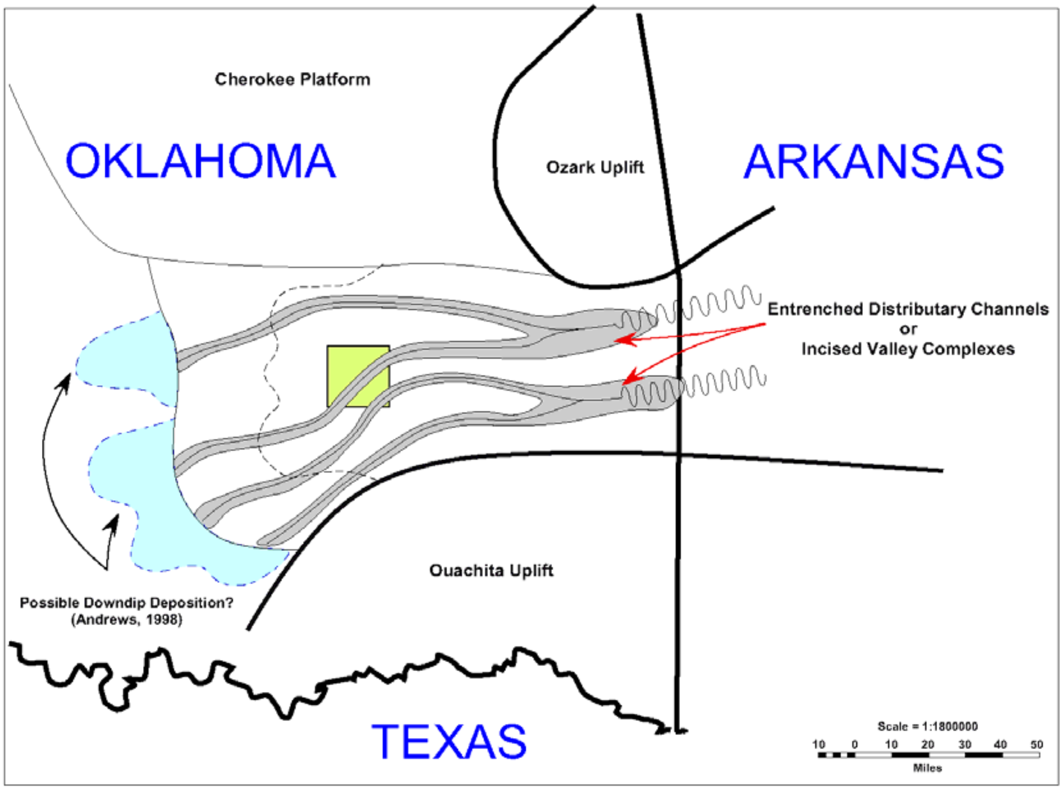


Figure 60: T-2 - Lower Hartshorne incised valley/channel development.

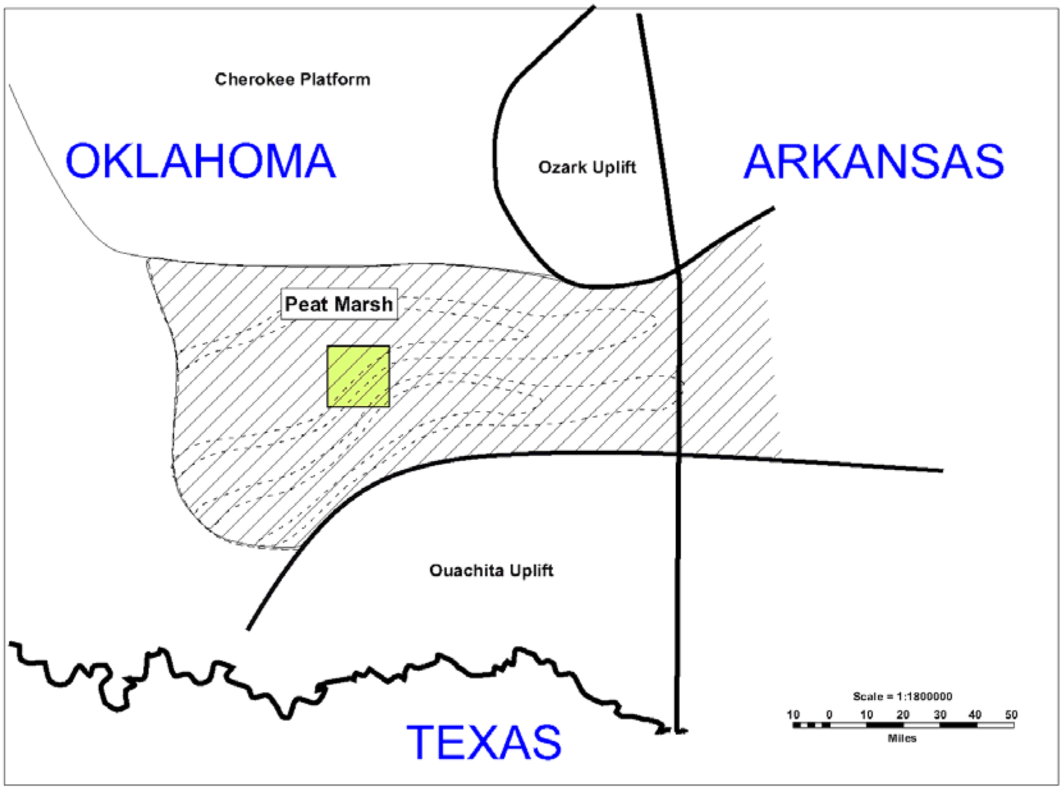


Figure 61: T-3 - Development of widespread peat marsh, with possible unconformity between peat deposits and underlying Lower Hartshorne clastic deposits.

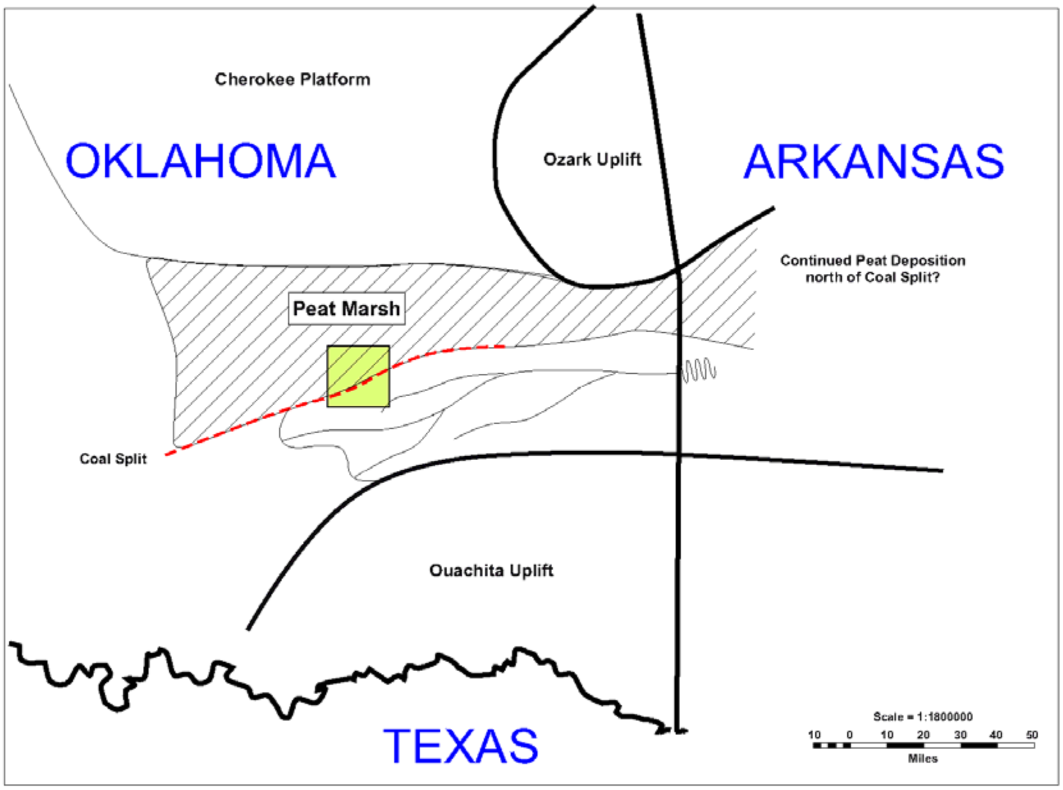


Figure 62: T-4 - Differential subsidence and Upper Hartshorne delta progradation.

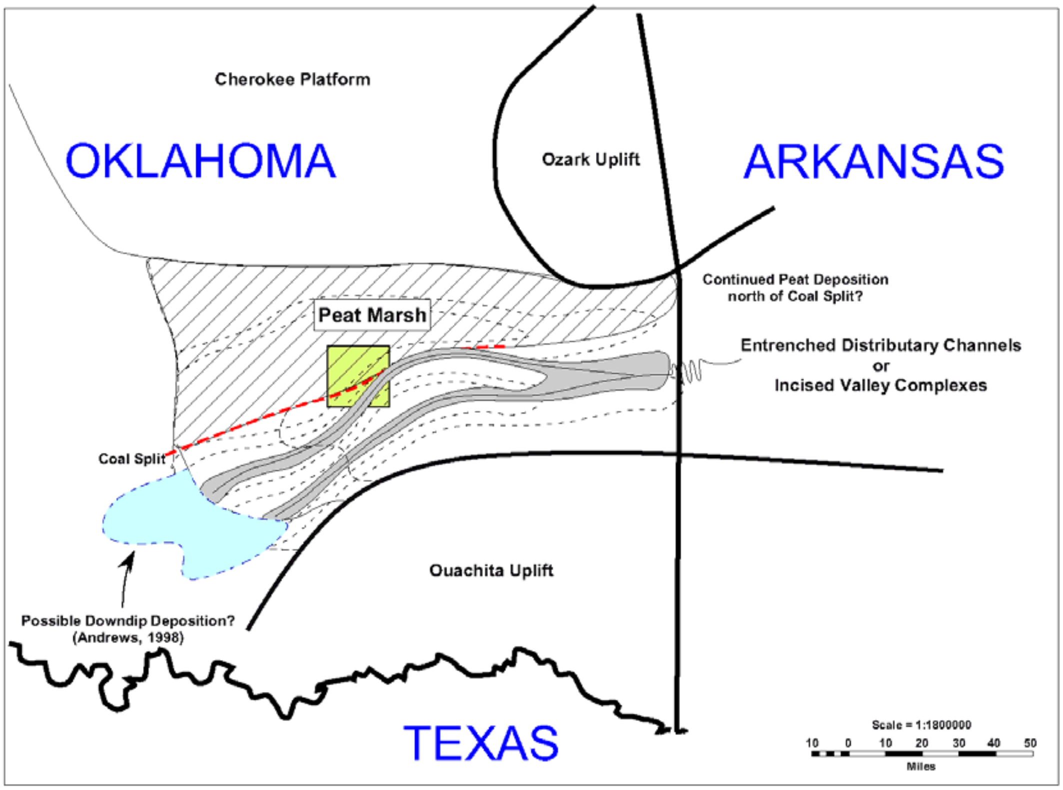


Figure 63: T-5 - Development of incised valley/channel system following Upper Hartshorne delta system.

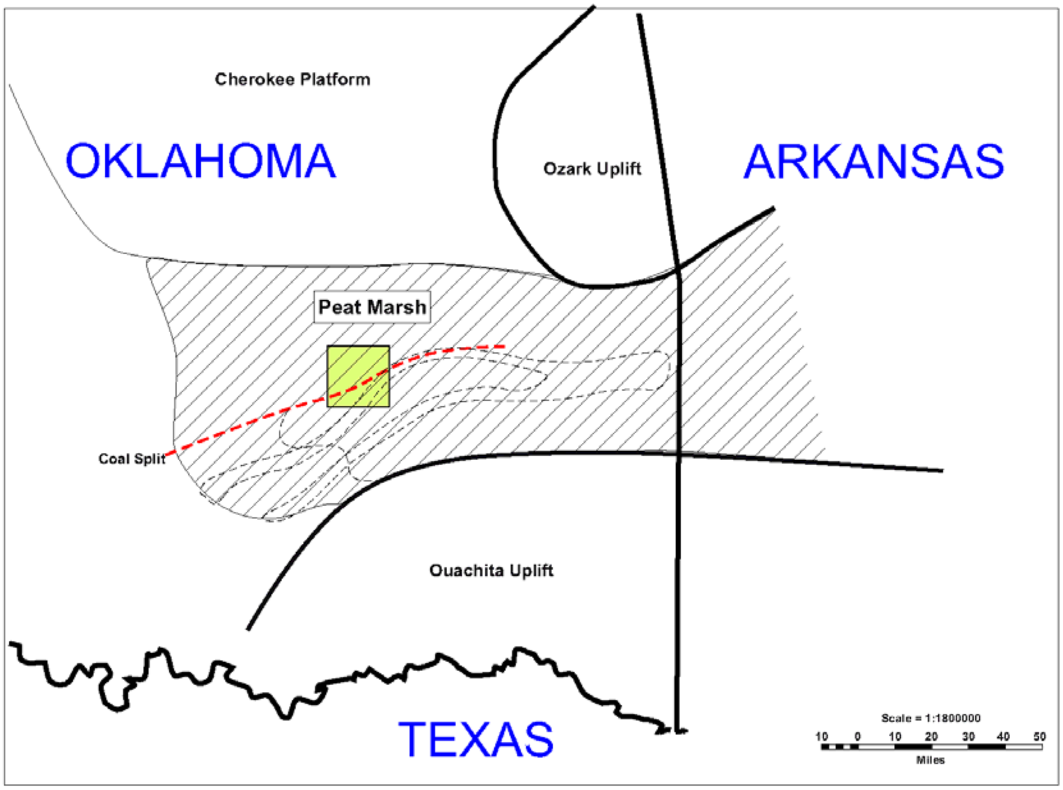


Figure 64: T-6 - Development of widespread peat marsh overlying (possibly unconformably) Upper Hartshorne clastic deposits.

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APPENDIXES

<u>Appendix A</u>: Hartshorne Gas Production Data, With Facies Interpretation.

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
LYONS	1-6	6-5N-11E	HARTSHORNE	CALVIN SOUTHEAST	46,254	3	1984/06	2003/08	DF	
BLACK	1-17	17-5N-11E	HARTSHORNE	HILL TOP	245,241	29	1988/11	2003/08	DMB	
BAILEY	1	17-5N-11E	HARTSHORNE	HILL TOP	131,633	23	1983/10	2003/05	DF	
MCDONALD	1	18-5N-11E	HARTSHORNE	HILL TOP	401,182	27	1980/09	2003/08	DF	
PACE	1	18-5N-11E	HARTSHORNE	HILL TOP	21,377	0	1975/09	1978/07		
ARTHUR #1	1	19-5N-11E	HARTSHORNE	HILL TOP	569,869	35	1981/09	2003/08	DMB	
ALTA #1	1	19-5N-11E	HARTSHORNE	HILL TOP	299,093	8	1981/09	2003/08	DMB	
MOBIL #1	1	20-5N-11E	HARTSHORNE	HILL TOP	544,250	49	1988/07	2003/08	DMB	
BLACK J	1	20-5N-11E	HARTSHORNE	HILL TOP	472,784	72	1989/02	2003/09	DMB	
TRAVIS P	1L	21-5N-11E	HARTSHORNE	HILL TOP	621,903	75	1991/06	2003/01	DMB	C-1
DUNCAN	1	23-5N-11E	HARTSHORNE	STUART SOUTHWEST	83,900	0	1961/01		IC-1	
WOODFORK	1	26-5N-11E	HARTSHORNE	STUART SOUTHWEST	5,413,737	0	1960/12	1988/11	IC-1	
KINCADE	1	26-5N-11E	HARTSHORNE	STUART SOUTHWEST	97,600	0	1964/04	1968/03	IC-1	
LACKEY C S 2 NE	1	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	4,249,974	0	1960/12	1994/01	IC-1	
WALKER HEIRS	1	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	1,306,286	15	1970/03	2003/09	IC-1	
WALKER HEIRS 27-2	27-2	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	290,973	55	1992/08	2003/05	IC-1	
HERRING D	1-C	28-5N-11E	HARTSHORNE / JEFFERSON	STUART SOUTHWEST	1,032,069	136	1989/02	2003/03	IC-1	
VERNON	1-29	29-5N-11E	HARTSHORNE	HILL TOP	98,612	12	1990/05	2003/08	DF	
VERNON PARK ESTATE	1-29	29-5N-11E	HARTSHORNE	HILL TOP	160,930	8	1989/12	2003/08	DF	
PLP CARTER	PLP2	30-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	652,029	0	1978/04	1998/11		
CARTER C C	1	30-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	251,921	0	1978/05	1980/12	DF	BF
HUFFMAN	1-32	32-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	173,087	25	1990/01	2003/08	DMB	
MARK	1-32	32-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	5,954	0	1990/08	1993/05	DF	
SHIRLEY#1	1	36-5N-11E	HARTSHORNE	PINE HOLLOW SOUTH	87,827	8	1986/04	2003/06	DF	CM
MARBET LLC		1-5N-12E	HARTSHORNE	REAMS NORTHWEST	199,182	150	2000/04	2003/03	DF	DMB
SHERRILL	1	2-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	166,008	73	1997/01	2003/08	DF	DMB
SHERRILL	3-2	2-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	71,385	77	2001/05	2003/08	DF	DMB
SEMESKI	1-3	3-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	217,786	139	2000/10	2003/09	CM	DF
EVERETT 1	1	3-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	279,023	62	1991/01	2003/08	CM	DF

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
ROSE	1-4	4-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	110,079	61	2001/02	2003/08	CM	DF
LOFTIS	1	8-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	3,787	0	2000/08	2000/10	IC-1	
BETHEL	3	9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	154,148	59	2000/05	2003/08	C-2	CM
BETHAL	2-9	9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	118,352	30	1999/05	2003/08	C-2	
BLEVINS		9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	40,085	82	2002/05	2003/08	C-2	
COOPER	1	10-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	778,565	140	1996/08	2003/08	C-2	CM
CRAWFORD	1	10-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	152,357	38	2001/02	2003/08	C-2	CM
WATKINS #1	1	10-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	532,012	152	1984/02	2003/08	C-2	CM
WILLARD	1-10	10-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	722,003	110	1999/02	2003/08	C-2	
MARVIN	3	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	495,062	225	1999/10	2003/06	CM	DMB
MARVIN	4	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	26,210	0	1999/12	2000/02	CM	DMB
MARVIN	5	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,227	0	2001/03	2001/03	CM	DMB
MARVIN	6	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	2,387	42	2003/02	2003/03	CM	DMB
MARBET	17	12-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	254,191	152	2000/01	2003/03	DF	CM
JEFFERSON	1	12-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	258,557	61	1996/08	2003/03	DMB	DF
FIELD HEIR	1	13-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	3,255,168	24	1965/08	2003/09	IC-2	
WAGEMAN	1	14-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	109,498	55	1997/02	2003/08	CM	DF
JUDY	1	15-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	6,009	200	2003/07	2003/07	DF	CM
WILCOX	1-15	15-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	378,555	56	2001/02	2003/08	C-2	
TRACEY	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	53,744	67	2002/06	2003/08	C-2	CM
DONNA	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	434,511	177	2000/09	2003/08	C-2	
GOODE#1	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	456,606	6	1985/01	2003/08	C-2	CM
ADAMS J W	1-16	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	243,096	20	1998/07	2003/08	C-2	
JOHNNY	1-16	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	716,366	147	1999/05	2003/08	C-2	CM

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
ISENHOWER	1-17	17-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	463,477	148	1999/09	2003/08	C-2	
KRISTY LEE	1-17	17-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	33,779	17	2000/07	2003/08	C-2	CM
BROOKS	1-18	18-5N-12E	HARTSHORNE / SENORA	PINE HOLLOW SOUTH	16,675	0	1984/03	1996/11	IC-1	
HARRISON	1-18	18-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	281,510	157	1999/10	2003/08	IC-1	
VANDEVEER	1	19-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	517,653	126	1975/04	2003/09	CM	DF
VANDEVEER	2-19	19-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	2,347	78	2003/09	2003/09	CM	DF
WESTLAKE HEIRS	1-20	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	177,031	26	1987/05	2003/08	C-2	
TIM	2-20	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	10,003	15	2002/08	2003/08	CM	C-2
BLACK	1	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,572	0	1980/12	1982/07	DF	DMB
GARRETT A	1	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	637,888	29	1966/04	2003/08	DF	CM
GARRETT	1-A	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	178,807	0	1966/04		CM	DF
JENNIFER	1-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	45,011	52	2001/12	2003/08	DF	CM
GARRETT	2-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	16,077	0	1999/09	2000/10	CM	DF
JENNIFER	2-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	17,529	17	2002/02	2003/08	CM	DF
GARRETT	3-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	82,910	49	2000/07	2003/08	CM	DF
GARRETT	4-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	81,325	119	2001/10	2003/08	CM	DF
MORAN S	1	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	888,828	82	1965/08	2003/08	C-2	
OTT	2	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	52,983	32	1999/10	2003/08	C-2	
ELLIS G W	1B	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	115,101	82	2001/11	2003/08	CM	
OTT	4-22	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	123,980	19	2000/12	2003/08	CM	DF
DELILAH	1	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,693,279	137	1985/10	2003/09	IC-2	
LOFTIS	2	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	4,239,153	0	1968/10	1985/09	IC-2	

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
LOFTIS AUSTIN E	1	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	892,201	87	1985/10	2003/09	IC-2	
LOFTIS & DELILAH		23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,216,608	0	1985/10	1992/11	IC-2	
MORRIS OSSIE	1	24-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	11,017,443	276	1965/08	2003/09	IC-2	
MORRIS O	3-24	24-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	46,175	38	2000/11	2003/09	IC-2	
DEPOT	1	25-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	260,615	46	1990/11	2003/09	IC-2	
WORKING EE	1	25-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	8,166,885	180	1965/08	2003/09	IC-2	
DAVIS	1	26-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	7,660,105	175	1965/10	2003/09	IC-2	
BLACK	3-28	28-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	429,743	80	1993/08	2003/06	C-2	CM
HALL	1	29-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	519,302	43	1981/07	2003/09	C-2	CM
ROGERS	1-30	30-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	746,296	41	1978/06	2003/08	C-2	
LOFTIS	1-30	30-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,068,855	122	1986/10	2003/08	C-2	
HALL	1	31-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	428,728	19	1981/12	2003/08	C-2	
HALL	1	32-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	470,147	0	1966/11	2000/10	C-2	
MCDONALD SUSAN	1	35-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	8,044,198	78	1965/08	2003/09	IC-2	
USA #36	1	36-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	864,986	0	1966/03	1983/11	IC-2	
THOMPSON	1	1-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	304,160	32	1984/10	2003/08	C-2	CM
WATKINS	1	2-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	793,928	37	1975/09	2003/09	IC-2	
FOOD SE SW NW	1	3-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,258,446	40	1965/08	2003/09	IC-2	
FOOD	2-3	3-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	345,576	59	1995/02	2003/09	IC-2	
GIBSON WINNIE	2-4	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	77,738	20	1999/08	2003/08	IC-2	
GIBSON WINNIE	1	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	948,223	164	1990/06	2003/09	IC-2	
LINDSAY GIBSON NE SW	1	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	3,730,939	0	1965/07	1990/04	IC-2	
THORNTON SE NW SE	1	5-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,508,564	34	1965/08	2003/09	IC-2	

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
STIPE	1-6	6-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	83,798	0	1999/12	2002/07	DF	CM
REYNOLDS	1	7-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,161,911	96	1979/07	2003/09	IC-2	
FIRESTON	1	7-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	678,818	0	1966/04	1977/04	IC-2	
BUSE SW NE	1	8-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	6,868,237	113	1965/08	2003/09	IC-2	
WALLACE W C NE SW NW	1&2	9-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,700,574	56	1965/07	2003/08	IC-2	
WINNIE	1	10-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	101,532	13	1988/08	2003/08	CM	DF
GIBSON	10-1	10-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	123,071	17	1985/01	2003/08	DF	CM
WATKINS	1	11-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	545,907	63	1980/11	2003/08	C-2	CM
WATKINS	1	12-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	520,858	66	1984/10	2003/08	C-2	
HOPKINS	1	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	295,379	46	1981/09	2003/08	C-2	CM
JUANITA	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	40,369	26	2000/09	2003/08	CM	DF
GLENNIE	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	126,153	58	2000/04	2003/08	CM	DF
SANDRA	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	122,939	55	2000/04	2003/08	CM	DF
MARBET LLC	31	14-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	77,214	108	2001/05	2003/07	C-2	
RAMSEY	1	14-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	19,129	0	1983/09	1985/12	C-2	CM
RAMSEY	1-14	14-5N-13E	HARTSHORNE ZONE	PINE HOLLOW SOUTH	9,631	0	1983/02	1983/08	C-2	
MARBET LLC 37	37	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	57,461	93	2001/10	2003/08	C-2	
EGGLESTON	1-15	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	674,126	29	1984/12	2003/08	C-2	
EGGLESTON UNIT 1-A	1A	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	286,095	35	1994/07	2003/07	C-2	
ROCK WP	1	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	32,358	0	1965/08	1989/07	IC-2	
ROCK W P C NW NW	2	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	4,245,468	0	1968/10	2003/02	IC-2	
ROCK W P	3-17	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,170	1	2002/02	2002/10	IC-2	
BRUCE ROBBINS UNIT	1	18-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	6,535,822	128	1965/08	2003/09	IC-2	

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
UNIV OF TULSA	1	19-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	3,516,263	0	1970/04	1998/11	IC-2	
GRETA	1-21	21-5N-13E	HARTSHORNE	POSTLE	13,725	101	2002/12	2003/03	DF	
CRAWLEY	1-21	21-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	215,157	342	2001/07	2003/08	C-2	DMB
VIRGIL	1-22	22-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	226,545	446	2001/04	2003/01	CM	DMB
MARBETT LLC	32	23-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	17,246	19	2001/10	2003/03	CM	DMB
NELL MARY	4	24-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	9,546	83	2003/05	2003/08	CM	DMB
DEER CREEK	1-24	24-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	73,422	0	1985/05	1989/10	C-2	
ECKLES	1-5	5-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	85,551	13	1999/09	2003/09	DMB	C-1
TRUMBO	1	6-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	597,243	4	1964/01	2003/07	DF	DMB
STEPHENS	1	6-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	525,239	0	1964/01	2003/07	DF	
BOYD	1	7-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	737,652	9	1964/01	2003/08	DF	
BOYD	2	7-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	85,110	6	1987/10	2003/08	DF	
BLACK #2	2	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	96,090	5	1993/06	2003/06	DMB	DF
BLACK #4	4	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	456,763	17	1993/11	2003/09	C-1	DMB
WARREN	1	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	77,348	0	1969/09	1972/01	C-1	DMB
BLACK #3	3	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	467,630	22	1993/11	2003/09	DMB	
GENEVA	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	262,228	15	1995/07	2003/09	DMB	DF
GAYLER #1-10	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	852,326	69	1994/11	2003/09	C-1	DMB
MC DONALD #1-10	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	132,555	0	1994/11	1999/07	C-1	DMB
HILL #1-11	1-11	11-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	1,028,357	206	1994/11	2003/09	C-1	DMB
BLEVINS	2-12	12-6N-11E	HARTSHORNE	CABANISS NORTHWEST	569,027	64	1995/10	2003/09	C-1	
BALLINGER	3-13	13-6N-11E	HARTSHORNE	CABANISS NORTHWEST	1,412,822	42	1985/01	2003/08	DMB	C-1
PAUL BALLINGER 4-13	4-13	13-6N-11E	HARTSHORNE	CABANISS NORTHWEST	109,744	14	1992/05	2003/08	DMB	DF
HILL	4-14	14-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	124,168	23	1995/06	2003/09	DF	DMB

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
HILL	2-15	15-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	4,004	0	1995/06	1996/06	DF	DMB
LITTLE	1	19-6N-11E	HARTSHORNE	HILL TOP NORTH	2,857	0	1993/02	1998/07	DMB	C-1
BLAYLOCK 1-19	1-19	19-6N-11E	HARTSHORNE	HILL TOP NORTH	19,043	2	1991/03	2003/08	DF	
ROLAND	1	20-6N-11E	HARTSHORNE	HILL TOP NORTH	101,522	21	1992/06	2003/08	DMB	C-1
ROLAND 1-20	1-20	20-6N-11E	HARTSHORNE	HILL TOP NORTH	9,809	0	1992/04	1992/11	DMB	C-1
LINDLEY	1-30C	30-6N-11E	HARTSHORNE / BOOCH	HILL TOP NORTH	346,832	35	1987/12	2003/08	DF	CM
BLEVINS	1-7	7-6N-12E	HARTSHORNE	CABANISS NORTHWEST	66,117	1	1980/08	2003/08	CM	DF
BLEVINS	2-7	7-6N-12E	HARTSHORNE	CABANISS NORTHWEST	4,030	0	1985/12	1994/01	CM	DF
HILSEWECK W J	1-8	8-6N-12E	HARTSHORNE	CABANISS NORTHWEST	95,547	8	1979/10	2003/01	CM	DF
HILSEWECK RANCH	2-8	8-6N-12E	HARTSHORNE	CABANISS NORTHWEST	34,419	12	1994/03	2003/08	CM	DF
HILSEWECK W J	1-9	9-6N-12E	HARTSHORNE	CABANISS NORTHWEST	246,534	34	1979/10	2003/08	CM	DF
HILSEWECK W J	1-15	15-6N-12E	HARTSHORNE	CABANISS NORTHWEST	229,313	32	1979/10	2003/08	CM	DF
HILSEWECK W J	1-16	16-6N-12E	HARTSHORNE	CABANISS NORTHWEST	317,359	39	1979/10	2003/08	CM	DF
HILSENECK	2-16	16-6N-12E	HARTSHORNE	CABANISS NORTHWEST	27,972	11	1999/01	2003/08	CM	DF
HILSEWECK W J	1-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	355,224	17	1979/10	2003/08	C-2	DMB
HILSEWECK	2-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	657,365	101	1996/11	2003/08	C-2	
HILSWECK	3-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	46,551	14	1997/09	2003/08	DMB	
BLIVENS	1-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	191,738	0	1979/10	1997/10	CM	DMB
BLEVINS	2-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	990,511	159	1995/06	2003/09	C-2	
BLEVINS	9-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	660,508	123	1996/12	2003/08	C-2	
HILSEWECK	1&3	20-6N-12E	HARTSHORNE	CABANISS NORTHWEST	1,266,867	529	1996/03	2003/09	C-2	
JONES	2-25	25-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	7,264	30	2003/02	2003/08	DF	BAY
HILSEWICK	1-29	29-6N-12E	HARTSHORNE	CABANISS NORTHWEST	9,311	0	1981/06	1989/06	CM	DF
HILSEWECK	1-29A	29-6N-12E	HARTSHORNE	CABANISS NORTHWEST	36,728	0	1982/02	1989/05	CM	DF

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
HARTSFIELD	1-35	35-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	46,203	68	2002/02	2003/08	DF	
HARTSFIELD	1-36A	36-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	128,207	151	2002/02	2003/08	DF	
CARTER 1-2	1-2	2-6N-13E	HARTSHORNE	REAMS NORTHWEST	933,438	106	1989/02	2003/08	IC-1	
HOLT	J2-3	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	17	0	1988/08	1988/08	IC-1	
HOLT J	4-3	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	94,298	23	1997/10	2003/08	IC-1	
HOLT J	1	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	2,708,284	48	1985/05	2003/08	IC-1	
HOLT	3J	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	393,172	11	1990/01	2003/08	IC-1	
HOLT	1-4T	4-6N-13E	HARTSHORNE	REAMS NORTHWEST	902,526	97	1988/08	2003/08	IC-1	
WHATS IF	1-11	11-6N-13E	HARTSHORNE	ULAN SOUTH	42	1	2003/07	2003/07	DF	
LEO	1-25	25-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	207,738	22	1988/09	2003/07	IC-2	
BLEVINS	1	25-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,135,398	49	1968/05	2003/09	IC-2	
GRAY	1	26-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	842,707	118	1978/07	2003/09	IC-2	
GLEESE	1-27	27-6N-13E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	64,130	9	1989/07	2003/08	DF	
GLEESE	1-28	28-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	58,494	10	1990/02	2003/08	DF	
FRANCES 1-29	1-11	29-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	75,528	33	1992/09	2003/08	DF	DMB
MCCARTY	3-32	32-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	305,371	175	1999/11	2003/08	IC-2	
GLEESE J	1	33-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	674,747	19	1965/08	2003/08	IC-2	
GLEESE	2-33	33-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	180,921	62	1998/02	2003/08	IC-2	
HUNT-GARRETT NW SE SW	1	34-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	4,041,853	123	1965/08	2003/09	IC-2	
DOMINIC NE NW SW	1	35-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,744,814	83	1965/07	2003/09	IC-2	
DOMINIC	2-35	35-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	149,749	31	1993/12	2003/09	IC-2	
LEFLORE SE SW NW	1	36-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	831,922	0	1965/07	1979/02	IC-2	
LEFLORE	1-36	36-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	59,148	10	1997/02	2003/08	IC-2	
KLENE UN	1	1-7N-11E	HARTSHORNE	LAMAR EAST	2,299,313	31	1961/08	2003/08	DMB	C-1
TURNER	5	6-7N-11E	HARTSHORNE / BOOCH	GREASY CREEK	42,702	14	1986/05	2003/06	DF	CM

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
FOLLANSBE	1	12-7N-11E	HARTSHORNE	LAMAR EAST	218,512	0	1961/09	1972/07	CM	DMB
WHITE	13-1	13-7N-11E	HARTSHORNE	LAMAR EAST	242,776	13	1985/06	2003/08	C-2	
ANDERSON#1	1	17-7N-11E	HARTSHORNE	HORNTOWN SOUTHEAST	293,933	10	1985/04	2002/10	DMB	
JACKSON	1	30-7N-11E	HARTSHORNE	SHADY GROVE SOUTH	419,823	0	1986/04	1992/01	DMB	
BE	1	31-7N-11E	HARTSHORNE	SHADY GROVE SOUTH	719,276	5	1985/01	2003/08	DMB	
KAMPERMAN	1	31-7N-11E	HARTSHORNE	SHADY GROVE WEST	137,116	14	1989/02	2003/08	DMB	DF
JOYCE	1	5-7N-12E	HARTSHORNE	LAMAR EAST	230,132	11	1981/04	2003/08	DF	CM
DERRISAW	1	6-7N-12E	HARTSHORNE	LAMAR EAST	347,958	0	1964/02	1991/07	DF	BAY
SARKEY	1	7-7N-12E	HARTSHORNE	LAMAR EAST	2,333,208	17	1961/08	2003/08	C-1	DMB
BURLESON	1	8-7N-12E	HARTSHORNE	LAMAR EAST	287,131	21	1982/09	2003/08	C-1	DMB
SARKEYS	1	14-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	557,943	17	1963/05	2003/08	C-1	DMB
MAD MAX	1-14	14-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	51,994	29	2000/07	2003/08	DF	BF
TOM	1-14	14-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	54,194	55	2001/01	2003/08	DF	BF
MYERS	1	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	426,770	12	1963/11	2003/08	DF	BF
MYERS	1	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	54,156	0	1964/01	1970/05	DF	BF
KLEINKE	2	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	467,401	0	1963/08	1970/05	C-1	DMB
GILCREASE	2	16-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	259,338	0	1963/08	1986/07	DMB	
PERRY	1	17-7N-12E	HARTSHORNE	LAMAR EAST	289,538	17	1982/03	2003/08	DMB	C-1
GRIFFIN HEIRS	1-17	17-7N-12E	HARTSHORNE	LAMAR EAST	12,152	64	2003/03	2003/08	DMB	C-1
SARKEYS	1B	18-7N-12E	HARTSHORNE	LAMAR EAST	298,179	0	1964/03	1982/11	DMB	C-1
SARKEYS	1C	18-7N-12E	HARTSHORNE	LAMAR EAST	169,548	8	1964/02	2003/08	DMB	C-1
GILCREASE #1 #2	1	21-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	318,949	0	1964/12	1997/06	DMB	DF
FALCON CLUB	1-21	21-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	108,581	64	2000/08	2003/08	DF	
KERN	1-21	21-7N-12E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	10,195	10	2001/08	2003/08	DF	
FALCON CLUB	2-21	21-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	136,167	56	2001/01	2003/08	DF	DMB
FALCON CLUB	3-21	21-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	146,922	123	2001/01	2003/08	DMB	DF
CLARKE	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	86,270	0	1964/12	1987/05	DMB	DF
CLARK	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	78,590	0	1964/12		DMB	DF

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
BRADSTREET	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	696,861	0	1963/02	1969/08	C-2	C-1
JONATHAN	1-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	31,129	12	2000/09	2003/08	DMB	DF
MELISSA	2-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	48,110	14	2000/12	2003/08	DF	DMB
MICHAEL	2-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	124,116	67	2001/04	2003/08	DMB	DF
SOUSEA	1	24-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	53,703	0	1968/07		DF	BF
MYERS-HOLT	1	24-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	92,080	12	1981/12	2003/08	DF	BF
ROSS	1-24	24-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	14,240	0	2001/08	2003/06	DF	
STIPE	1-27	27-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	178,169	49	1997/09	2003/08	DF	DMB
MILLION	1-27	27-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	2,078	0	1983/01	1985/03	DF	DMB
STIPE	2-27	27-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	102,786	145	2001/07	2003/08	DF	DMB
STIPE	3-27	27-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	67,332	65	2001/10	2003/08	DF	DMB
STIPE	1-28	28-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	437,796	93	1996/10	2003/08	DMB	DF
MYERS	1-28	28-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	77,827	0	1980/08	1988/02	DF	DMB
STIPE	2-28	28-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	119,611	40	1997/09	2003/08	DMB	DF
W J HILSEWECK	1-29	29-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	142,605	24	1988/01	2003/08	DF	BAY
PUCKETT	1-32	32-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	57,410	0	1982/12	1996/11	DMB	
PUCKETT	2-32	32-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	23,495	10	1995/06	2003/08	DF	
DOSS	1-33	33-7N-12E	HARTSHORNE / BOOCH	CABANISS NORTHWEST	42,806	0	1982/12	1997/01	DMB	
OTHEL	1	1-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	27,389	21	1998/11	2003/07	DF	BAY
HERMAN	1-12	12-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	19,271	16	2000/12	2003/07	DMB	C-1
WARD	1	13-7N-13E	HARTSHORNE	ULAN EAST	204,197	39	1994/03	2003/08	DMB	C-1
WARD	2-13	13-7N-13E	HARTSHORNE	ULAN EAST	164,754	25	1993/01	2003/08	DMB	C-1
DUNCAN #1	1	13-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	208,699	31	1995/12	2003/08	C-1	DMB
MOONEYHAM	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	489,300	18	1994/07	2003/06	DMB	DF

Well Name	Well #	Location	Formation	Field Name	Cumulative Gas (Mcf)	Current Production Rate (Mcfd)	First Production Date	Last Production Date	Facies	Secondary Facies
ROCKEY	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	88,122	0	1994/07	1999/11	DMB	DF
MOONEYHAM #1-18	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	163,419	18	1994/02	2003/08	DMB	DF
HOOTERS	1-18	18-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	19,936	45	2002/06	2003/08	DMB	DF
HILL #1-24	1-24	24-7N-13E	HARTSHORNE / BOOCH	ULAN EAST	299,375	12	1993/10	2003/08	DF	
KING	3-25	25-7N-13E	HARTSHORNE / BOOCH	REAMS NORTHWEST	369,985	50	1994/09	2003/08	DF	
KING	4-25	25-7N-13E	HARTSHORNE / BOOCH	REAMS NORTHWEST	103,446	62	2001/03	2003/08	DF	
LUCILLE	1-34	34-7N-13E	HARTSHORNE	REAMS NORTHWEST	1,046,508	52	1985/05	2003/08	IC-1	
STATE	1-35	35-7N-13E	HARTSHORNE	REAMS NORTHWEST	607,018	0	1980/10	1987/04	IC-1	
STATE	2-35	35-7N-13E	HARTSHORNE	REAMS NORTHWEST	1,200,399	221	1988/08	2003/08	IC-1	
SUNSHINE	1-36	36-7N-13E	HARTSHORNE	REAMS NORTHWEST	73,470	13	1996/05	2003/08	IC-1	
SHEENA #1-36	1-36	36-7N-13E	HARTSHORNE	REAMS NORTHWEST	342,580	70	1995/07	2003/08	IC-1	

<u>Appendix B</u>: Hartshorne Production Sorted By Field

Operator	Well	Well Num	Location	Formation	Cumulative Gas Production (Mcf)	Gas Production_Latest Month (Mcf)	Active Number of Wells	Current Gas Production RateRate (Mcfd)	First Prod Date	Last Prod Date
CABANISS NORTHWEST FIELD										
ARKOMA GAS CO	BALLINGER	3-13	13-6N-11E	HARTSHORNE	1,412,822	1250	1	42	1985/01	2003/08
ARKOMA GAS CO	BLEVINS	1-7	7-6N-12E	HARTSHORNE	66,117	37	1	1	1980/08	2003/08
ARKOMA GAS CO	BLEVINS	2-7	7-6N-12E	HARTSHORNE	4,030			0	1985/12	1994/01
XAE CORPORATION	BLEVINS	2-12	12-6N-11E	HARTSHORNE	569,027	1915	1	64	1995/10	2003/09
GULF PROD. CORP.	BLEVINS	2-18	18-6N-12E	HARTSHORNE	990,511	4770	1	159	1995/06	2003/09
GULF PROD. CORP.	BLEVINS	9-18	18-6N-12E	HARTSHORNE	660,508	3699	1	123	1996/12	2003/08
ARKOMA GAS CO	BLIVENS	1-18	18-6N-12E	HARTSHORNE	191,738			0	1979/10	1997/10
ARKOMA GAS CO	HILSENECK	2-16	16-6N-12E	HARTSHORNE	27,972	337	1	11	1999/01	2003/08
ARKOMA GAS CO	HILSEWECK	2-17	17-6N-12E	HARTSHORNE	657,365	3023	1	101	1996/11	2003/08
GULF PROD. CORP.	HILSEWECK	1&3	20-6N-12E	HARTSHORNE	1,266,867	15870	1	529	1996/03	2003/09
ARKOMA GAS CO	HILSEWECK	1-29A	29-6N-12E	HARTSHORNE	36,728			0	1982/02	1989/05
ARKOMA GAS CO	HILSEWECK RANCH	2-8	8-6N-12E	HARTSHORNE	34,419	352	1	12	1994/03	2003/08
ARKOMA GAS CO	HILSEWECK W J	1-8	8-6N-12E	HARTSHORNE	95,547	231	1	8	1979/10	2003/01
ARKOMA GAS CO	HILSEWECK W J	1-9	9-6N-12E	HARTSHORNE	246,534	1018	1	34	1979/10	2003/08
ARKOMA GAS CO	HILSEWECK W J	1-15	15-6N-12E	HARTSHORNE	229,313	957	1	32	1979/10	2003/08
ARKOMA GAS CO	HILSEWECK W J	1-16	16-6N-12E	HARTSHORNE	317,359	1171	1	39	1979/10	2003/08
ARKOMA GAS CO	HILSEWECK W J	1-17	17-6N-12E	HARTSHORNE	355,224	514	1	17	1979/10	2003/08
ARKOMA GAS CO	HILSEWICK	1-29	29-6N-12E	HARTSHORNE	9,311			0	1981/06	1989/06
ARKOMA GAS CO	HILSWECK	3-17	17-6N-12E	HARTSHORNE	46,551	412	1	14	1997/09	2003/08
ARKOMA GAS CO	PAUL BALLINGER 4-13	4-13	13-6N-11E	HARTSHORNE	109,744	427	1	14	1992/05	2003/08
					7,327,687	**35,983**	**16**	**1,199**		
CALVIN SOUTHEAST FIELD										
PA ENERGY	LYONS	1-6	6-5N-11E	HARTSHORNE	46,254	76	1	3	1984/06	2003/08
					46,254	**76**	**1**	**3**		
GREASY CREEK FIELD										
LOFTIS BOB L	TURNER	5	6-7N-11E	HARTSHORNE / BOOCH	42,702	408	1	14	1986/05	2003/06
					42,702	**408**	**1**	**14**		
HILL TOP FIELD										
DIAMOND HARRY H INC.	ALTA #1	1	19-5N-11E	HARTSHORNE	299,093	246	1	8	1981/09	2003/08
DIAMOND HARRY H INC.	ARTHUR #1	1	19-5N-11E	HARTSHORNE	569,869	1040	1	35	1981/09	2003/08
T K DRILLING CORPORATION	BAILEY	1	17-5N-11E	HARTSHORNE	131,633	691	1	23	1983/10	2003/05
SOUTHERN RESOURCES	BLACK	1-17	17-5N-11E	HARTSHORNE	245,241	881	1	29	1988/11	2003/08
T K DRILLING CORPORATION	BLACK J	1	20-5N-11E	HARTSHORNE	472,784	2165	1	72	1989/02	2003/09
TENNECO OIL COMPANY	CARTER C C	1	30-5N-11E	HARTSHORNE	251,921			0	1978/05	1980/12
SOUTHERN RESOURCES	HUFFMAN	1-32	32-5N-11E	HARTSHORNE	173,087	735	1	25	1990/01	2003/08
SOUTHERN RESOURCES	MARK	1-32	32-5N-11E	HARTSHORNE	5,954			0	1990/08	1993/05
BONNELL FRANK A	MCDONALD	1	18-5N-11E	HARTSHORNE	401,182	808	1	27	1980/09	2003/08
DIAMOND HARRY H INC.	MOBIL #1	1	20-5N-11E	HARTSHORNE	544,250	1464	1	49	1988/07	2003/08
T K DRILLING CORPORATION	PACE	1	18-5N-11E	HARTSHORNE	21,377			0	1975/09	1978/07
T K DRILLING CORPORATION	PLP CARTER	PLP2	30-5N-11E	HARTSHORNE	652,029			0	1978/04	1998/11
MARBET LLC	TRAVIS P	1L	21-5N-11E	HARTSHORNE	621,903	2252	1	75	1991/06	2003/01
SOUTHERN RESOURCES	VERNON	1-29	29-5N-11E	HARTSHORNE	98,612	361	1	12	1990/05	2003/08
SOUTHERN RESOURCES	VERNON PARK ESTATE	1-29	29-5N-11E	HARTSHORNE	160,930	230	1	8	1989/12	2003/08
					4,649,865	**10,873**	**11**	**362**		
HILL TOP NORTH FIELD										
SOUTHERN RESOURCES	BLAYLOCK 1-19	1-19	19-6N-11E	HARTSHORNE	19,043	56	1	2	1991/03	2003/08
SOUTHERN RESOURCES	LINDLEY	1-30C	30-6N-11E	HARTSHORNE / BOOCH	346,832	1042	1	35	1987/12	2003/08
SOUTHERN RESOURCES	LITTLE	1	19-6N-11E	HARTSHORNE	2,857			0	1993/02	1998/07
SOUTHERN RESOURCES	ROLAND	1	20-6N-11E	HARTSHORNE	101,522	616	1	21	1992/06	2003/08
SOUTHERN RESOURCES	ROLAND 1-20	1-20	20-6N-11E	HARTSHORNE	9,809			0	1992/04	1992/11
					480,063	**1,714**	**3**	**57**		
HORNTOWN SOUTHEAST FIELD										
SWADLEY R W & J	ANDERSON#1	1	17-7N-11E	HARTSHORNE	293,933	303	1	10	1985/04	2002/10
					293,933	**303**	**1**	**10**		
LAMAR EAST FIELD										
JAY PET. INC.	BURLESON	1	8-7N-12E	HARTSHORNE	287,131	622	1	21	1982/09	2003/08
JAY PET. INC.	DERRISAW	1	6-7N-12E	HARTSHORNE	347,958			0	1964/02	1991/07
JAY PET. INC.	FOLLANSBE	1	12-7N-11E	HARTSHORNE	218,512			0	1961/09	1972/07
TILFORD PINSON EXPL.	GRIFFIN HEIRS	1-17	17-7N-12E	HARTSHORNE	12,152	1919	1	64	2003/03	2003/08

Operator	Well	Well Num	Location	Formation	Cumulative Gas Production (Mcf)	Gas Production_Latest Month (Mcf)	Active Number of Wells	Current Gas Production RateRate (Mcfd)	First Prod Date	Last Prod Date
JAY PET. INC.	JOYCE	1	5-7N-12E	HARTSHORNE	230,132	317	1	11	1981/04	2003/08
JAY PET. INC.	KLENE UN	1	1-7N-11E	HARTSHORNE	2,299,313	925	1	31	1961/08	2003/08
JAY PET. INC.	PERRY	1	17-7N-12E	HARTSHORNE	289,538	499	1	17	1982/03	2003/08
JAY PET. INC.	SARKEY	1	7-7N-12E	HARTSHORNE	2,333,208	513	1	17	1961/08	2003/08
JAY PET. INC.	SARKEYS	1B	18-7N-12E	HARTSHORNE	298,179			0	1964/03	1982/11
JAY PET. INC.	SARKEYS	1C	18-7N-12E	HARTSHORNE	169,548	233	1	8	1964/02	2003/08
JAY PET. INC.	WHITE	13-1	13-7N-11E	HARTSHORNE	242,776	376	1	13	1985/06	2003/08
					6,728,447	**5,404**	**8**	**180**		
				PINE HOLLOW SOUTH FIELD						
DAVIS OPER. CO	ADAMS J W	1-16	16-5N-12E	HARTSHORNE	243,096	613	1	20	1998/07	2003/08
DAVIS OPER. CO	BETHAL	2-9	9-5N-12E	HARTSHORNE	118,352	885	1	30	1999/05	2003/08
DAVIS OPER. CO	BETHEL	3	9-5N-12E	HARTSHORNE	154,148	1758	1	59	2000/05	2003/08
ROCKWELL DRLG CO.	BLACK	1	20-5N-12E	HARTSHORNE	1,572			0	1980/12	1982/07
BRAVO	BLACK	3-28	28-5N-12E	HARTSHORNE / BOOCH	429,743	2404	1	80	1993/08	2003/06
WYTEX PROD.	BLEVINS	1	25-6N-13E	HARTSHORNE	1,135,398	1471	1	49	1968/05	2003/09
DAVIS OPER. CO	BLEVINS		9-5N-12E	HARTSHORNE	40,085	2466	1	82	2002/05	2003/08
DAVIS OPER. CO	BROOKS	1-18	18-5N-12E	HARTSHORNE / SENORA	16,675			0	1984/03	1996/11
XTO	BRUCE ROBBINS UNIT	1	18-5N-13E	HARTSHORNE	6,535,822	3839	1	128	1965/08	2003/09
XTO	BUSE SW NE	1	8-5N-13E	HARTSHORNE	6,868,237	3375	1	113	1965/08	2003/09
DAVIS OPER. CO	COOPER	1	10-5N-12E	HARTSHORNE / BOOCH	778,565	4195	1	140	1996/08	2003/08
DAVIS OPER. CO	CRAWFORD	1	10-5N-12E	HARTSHORNE / BOOCH	152,357	1144	1	38	2001/02	2003/08
YALE OIL ASSOC.	CRAWLEY	1-21	21-5N-13E	HARTSHORNE	215,157	10262	1	342	2001/07	2003/08
XTO	DAVIS	1	26-5N-12E	HARTSHORNE	7,660,105	5263	1	175	1965/10	2003/09
TUCKER RON & COMPANY	DEER CREEK	1-24	24-5N-13E	HARTSHORNE	73,422			0	1985/05	1989/10
SAMSON	DELILAH	1	23-5N-12E	HARTSHORNE	1,693,279	4098	1	137	1985/10	2003/09
CHESAPEAKE	DEPOT	1	25-5N-12E	HARTSHORNE	260,615	1386	1	46	1990/11	2003/09
GM PROP. & INVEST. INC.	DOMINIC	2-35	35-6N-13E	HARTSHORNE	149,749	923	1	31	1993/12	2003/09
CHESAPEAKE	DOMINIC NE NW SW	1	35-6N-13E	HARTSHORNE	2,744,814	2493	1	83	1965/07	2003/09
DAVIS OPER. CO	DONNA	1	16-5N-12E	HARTSHORNE	434,511	5313	1	177	2000/09	2003/08
TUCKER RON & COMPANY	EGGLESTON	1-15	15-5N-13E	HARTSHORNE	674,126	872	1	29	1984/12	2003/08
WHEELER ENERGY	EGGLESTON UNIT 1-A	1A	15-5N-13E	HARTSHORNE	286,095	1056	1	35	1994/07	2003/07
DAVIS OPER. CO	ELLIS G W	1B	22-5N-12E	HARTSHORNE	115,101	2469	1	82	2001/11	2003/08
STOVER COMPANY	EVERETT 1	1	3-5N-12E	HARTSHORNE	279,023	1868	1	62	1991/01	2003/08
XTO	FIELD HEIR	1	13-5N-12E	HARTSHORNE	3,255,168	721	1	24	1965/08	2003/09
UNOCAL	FIRESTON	1	7-5N-13E	HARTSHORNE	678,818			0	1966/04	1977/04
GM PROP. & INVEST. INC.	FOOD	2-3	3-5N-13E	HARTSHORNE	345,576	1759	1	59	1995/02	2003/09
CHESAPEAKE	FOOD SE SW NW	1	3-5N-13E	HARTSHORNE	2,258,446	1199	1	40	1965/08	2003/09
DAVIS OPER. CO	FRANCES 1-29	1-11	29-6N-13E	HARTSHORNE	75,528	987	1	33	1992/09	2003/08
TAG TEAM RESOURCES LLC	GARRETT	2-21	21-5N-12E	HARTSHORNE	16,077			0	1999/09	2000/10
TAG TEAM RESOURCES LLC	GARRETT	3-21	21-5N-12E	HARTSHORNE	82,910	1479	1	49	2000/07	2003/08
TAG TEAM RESOURCES LLC	GARRETT	4-21	21-5N-12E	HARTSHORNE	81,325	3576	1	119	2001/10	2003/08
SKELLY OIL COMPANY	GARRETT	1-A	21-5N-12E	HARTSHORNE	178,807			0	1966/04	
ELLS H A JR ET AL	GARRETT A	1	21-5N-12E	HARTSHORNE	637,888	862	1	29	1966/04	2003/08
YALE OIL ASSOC.	GIBSON	10-1	10-5N-13E	HARTSHORNE	123,071	502	1	17	1985/01	2003/08
CHESAPEAKE	GIBSON WINNIE	1	4-5N-13E	HARTSHORNE	948,223	4931	1	164	1990/06	2003/09
BROWER O&G CO	GIBSON WINNIE	2-4	4-5N-13E	HARTSHORNE	77,738	587	1	20	1999/08	2003/08
BROWER O&G CO	GLEESE	2-33	33-6N-13E	HARTSHORNE	180,921	1870	1	62	1998/02	2003/08
DAVIS OPER. CO	GLEESE	28-محرم	28-6N-13E	HARTSHORNE	58,494	299	1	10	1990/02	2003/08
DAVIS OPER. CO	GLEESE	1-27	27-6N-13E	HARTSHORNE / BOOCH	64,130	272	1	9	1989/07	2003/08
BROWER O&G CO	GLEESE J	1	33-6N-13E	HARTSHORNE	674,747	563	1	19	1965/08	2003/08
TAG TEAM RESOURCES LLC	GLENNIE	1-13	13-5N-13E	HARTSHORNE	126,153	1753	1	58	2000/04	2003/08
DAVIS OPER. CO	GOODE#1	1	16-5N-12E	HARTSHORNE	456,606	179	1	6	1985/01	2003/08
CHESAPEAKE	GRAY	1	26-6N-13E	HARTSHORNE	842,707	3539	1	118	1978/07	2003/09
YALE OIL ASSOC.	GRETA	1-21	21-5N-13E	HARTSHORNE	13,725	3043	1	101	2002/12	2003/03
XTO	HALL	1	29-5N-12E	HARTSHORNE / BOOCH	519,302	1304	1	43	1981/07	2003/09
DAVIS OPER. CO	HALL	1	31-5N-12E	HARTSHORNE	428,728	568	1	19	1981/12	2003/08
TENNECO OIL COMPANY	HALL	1	32-5N-12E	HARTSHORNE	470,147			0	1966/11	2000/10
GLB EXPL. INC	HARRISON	1-18	18-5N-12E	HARTSHORNE	281,510	4701	1	157	1999/10	2003/08
TILFORD PINSON EXPL.	HARTSFIELD	1-35	35-6N-12E	HARTSHORNE	46,203	2053	1	68	2002/02	2003/08
TILFORD PINSON EXPL.	HARTSFIELD	1-36A	36-6N-12E	HARTSHORNE	128,207	4533	1	151	2002/02	2003/08
TAG TEAM RESOURCES LLC	HOPKINS	1	13-5N-13E	HARTSHORNE	295,379	1373	1	46	1981/09	2003/08
CHESAPEAKE	HUNT-GARRETT NW SE SW	1	34-6N-13E	HARTSHORNE	4,041,853	3691	1	123	1965/08	2003/09
DAVIS OPER. CO	ISENHOWER	1-17	17-5N-12E	HARTSHORNE	463,477	4427	1	148	1999/09	2003/08
WIMBERLY JAMES A	JEFFERSON	1	12-5N-12E	HARTSHORNE	258,557	1836	1	61	1996/08	2003/03
TAG TEAM RESOURCES LLC	JENNIFER	1-21	21-5N-12E	HARTSHORNE	45,011	1560	1	52	2001/12	2003/08
TAG TEAM RESOURCES LLC	JENNIFER	2-21	21-5N-12E	HARTSHORNE	17,529	515	1	17	2002/02	2003/08

Operator	Well	Well Num	Location	Formation	Cumulative Gas Production (Mcf)	Gas Production_Latest Month (Mcf)	Active Number of Wells	Current Gas Production RateRate (Mcfd)	First Prod Date	Last Prod Date
TAG TEAM RESOURCES LLC	JOHNNY	1-16	16-5N-12E	HARTSHORNE	716,366	4413	1	147	1999/05	2003/08
TILFORD PINSON EXPL.	JONES	2-25	25-6N-12E	HARTSHORNE	7,264	902	1	30	2003/02	2003/08
TAG TEAM RESOURCES LLC	JUANITA	1-13	13-5N-13E	HARTSHORNE	40,369	771	1	26	2000/09	2003/08
DAVIS OPER. CO	JUDY	1	15-5N-12E	HARTSHORNE	6,009	6009	1	200	2003/07	2003/07
TAG TEAM RESOURCES LLC	KRISTY LEE	1-17	17-5N-12E	HARTSHORNE	33,779	516	1	17	2000/07	2003/08
BROWER O&G CO	LEFLORE	1-36	36-6N-13E	HARTSHORNE	59,148	290	1	10	1997/02	2003/08
BROWER O&G CO	LEFLORE SE SW NW	1	36-6N-13E	HARTSHORNE	831,922			0	1965/07	1979/02
T K DRILLING CORPORATION	LEO	1-25	25-6N-13E	HARTSHORNE	207,738	664	1	22	1988/09	2003/07
CHESAPEAKE	LINDSAY GIBSON NE SW	1	4-5N-13E	HARTSHORNE	3,730,939			0	1965/07	1990/04
DAVIS OPER. CO	LOFTIS	1	8-5N-12E	HARTSHORNE	3,787			0	2000/08	2000/10
SAMSON	LOFTIS	2	23-5N-12E	HARTSHORNE				0		
SAMSON	LOFTIS	2	23-5N-12E	HARTSHORNE	4,239,153			0	1968/10	1985/09
SAMSON	LOFTIS & DELILAH		23-5N-12E	HARTSHORNE	1,216,608			0	1985/10	1992/11
SAMSON	LOFTIS AUSTIN E	E1	23-5N-12E	HARTSHORNE	892,201	2596	1	87	1985/10	2003/09
DAVIS OPER. CO	LOFTIS#1-30	1-30	30-5N-12E	HARTSHORNE	1,068,855	3654	1	122	1986/10	2003/08
MARBET LLC	MARBET LLC		1-5N-12E	HARTSHORNE	199,182	4508	1	150	2000/04	2003/03
SJM INCORPORATED	MARBET	17	12-5N-12E	HARTSHORNE	254,191	4562	1	152	2000/01	2003/03
MARBET LLC	MARBET LLC	31	14-5N-13E	HARTSHORNE	77,214	3232	1	108	2001/05	2003/07
MARBET LLC	MARBET LLC 37	37	15-5N-13E	HARTSHORNE	57,461	2787	1	93	2001/10	2003/08
MARBET LLC	MARBETT LLC	32	23-5N-13E	HARTSHORNE	17,246	571	1	19	2001/10	2003/03
MARBET LLC	MARVIN	3	11-5N-12E	HARTSHORNE	495,062	6749	1	225	1999/10	2003/06
MARBET LLC	MARVIN	4	11-5N-12E	HARTSHORNE	26,210			0	1999/12	2000/02
MARBET LLC	MARVIN	5	11-5N-12E	HARTSHORNE	1,227			0	2001/03	2001/03
MARBET LLC	MARVIN	6	11-5N-12E	HARTSHORNE	2,387	1245	1	42	2003/02	2003/03
DAVIS OPER. CO	MCCARTY	3-32	32-6N-13E	HARTSHORNE	305,371	5247	1	175	1999/11	2003/08
XTO	MCDONALD SUSAN	1	35-5N-12E	HARTSHORNE	8,044,198	2352	1	78	1965/08	2003/09
DAVIS OPER. CO	MORAN S	1	22-5N-12E	HARTSHORNE	888,828	2469	1	82	1965/08	2003/08
XTO	MORRIS O	3-24	24-5N-12E	HARTSHORNE	46,175	1139	1	38	2000/11	2003/09
XTO	MORRIS OSSIE	1	24-5N-12E	HARTSHORNE	11,017,443	8293	1	276	1965/08	2003/09
TAG TEAM RESOURCES LLC	NELL MARY	4	24-5N-13E	HARTSHORNE	9,546	2475	1	83	2003/05	2003/08
DAVIS OPER. CO	OTT	2	22-5N-12E	HARTSHORNE	52,983	955	1	32	1999/10	2003/08
TAG TEAM RESOURCES LLC	OTT	4-22	22-5N-12E	HARTSHORNE	123,980	570	1	19	2000/12	2003/08
TEXAS EMPIRE EXPL.	RAMSEY	1	14-5N-13E	HARTSHORNE	19,129			0	1983/09	1985/12
TEXAS EMPIRE EXPL.	RAMSEY	1-14	14-5N-13E	HARTSHORNE ZONE	9,631			0	1983/02	1983/08
TREPCO PROD.	REYNOLDS	1	7-5N-13E	HARTSHORNE	2,161,911	2893	1	96	1979/07	2003/09
XTO	ROCK W P	3-17	17-5N-13E	HARTSHORNE	1,170	18	1	1	2002/02	2002/10
XTO	ROCK W P C NW NW	2	17-5N-13E	HARTSHORNE	4,245,468	9	1	0	1968/10	2003/02
XTO	ROCK WP	1	17-5N-13E	HARTSHORNE	32,358			0	1965/08	1989/07
DAVIS OPER. CO	ROGERS 1-30	1-30	30-5N-12E	HARTSHORNE	746,296	1236	1	41	1978/06	2003/08
MUSTANG FUEL CORP.	ROSE	1-4	4-5N-12E	HARTSHORNE	110,079	1816	1	61	2001/02	2003/08
TAG TEAM RESOURCES LLC	SANDRA	1-13	13-5N-13E	HARTSHORNE	122,939	1647	1	55	2000/04	2003/08
MUSTANG FUEL CORP.	SEMESKI	1-3	3-5N-12E	HARTSHORNE	217,786	4158	1	139	2000/10	2003/09
STOVER COMPANY	SHERRILL	1	2-5N-12E	HARTSHORNE	166,008	2180	1	73	1997/01	2003/08
TILFORD PINSON EXPL.	SHERRILL	3-2	2-5N-12E	HARTSHORNE / BOOCH	71,385	2314	1	77	2001/05	2003/08
DAVIS OPER. CO	SHIRLEY#1	1	36-5N-11E	HARTSHORNE	87,827	233		8	1986/04	2003/06
DAVIS OPER. CO	STIPE	1-6	6-5N-13E	HARTSHORNE	83,798			0	1999/12	2002/07
TUCKER RON & COMPANY	THOMPSON	1	1-5N-13E	HARTSHORNE	304,160	947	1	32	1984/10	2003/08
CHESAPEAKE	THORNTON SE NW SE	1	5-5N-13E	HARTSHORNE	1,508,564	1028	1	34	1965/08	2003/09
DAVIS OPER. CO	TIM	2-20	20-5N-12E	HARTSHORNE	10,003	451	1	15	2002/08	2003/08
DAVIS OPER. CO	TRACEY	1	16-5N-12E	HARTSHORNE	53,744	2012	1	67	2002/06	2003/08
XTO	UNIV OF TULSA	1	19-5N-13E	HARTSHORNE	3,516,263			0	1970/04	1998/11
TENNECO OIL COMPANY	USA #36	1	36-5N-12E	HARTSHORNE	864,986			0	1966/03	1983/11
CHESAPEAKE	VANDEVEER	1	19-5N-12E	HARTSHORNE / BOOCH	517,653	3784	1	126	1975/04	2003/09
CHESAPEAKE	VANDEVEER	2-19	19-5N-12E	HARTSHORNE	2,347	2347	1	78	2003/09	2003/09
YALE OIL ASSOC.	VIRGIL	1-22	22-5N-13E	HARTSHORNE	226,545	13373	1	446	2001/04	2003/01
DAVIS OPER. CO	WAGEMAN	1	14-5N-12E	HARTSHORNE	109,498	1648	1	55	1997/02	2003/08
DAVIS OPER. CO	WALLACE W C NE SW NW	1&2	9-5N-13E	HARTSHORNE	1,700,574	1688	1	56	1965/07	2003/08
COVE PET. CORP.	WATKINS	1	2-5N-13E	HARTSHORNE	793,928	1121	1	37	1975/09	2003/09
TAG TEAM RESOURCES LLC	WATKINS	1	11-5N-13E	HARTSHORNE	545,907	1889	1	63	1980/11	2003/08
TUCKER RON & COMPANY	WATKINS	1	12-5N-13E	HARTSHORNE	520,858	1994	1	66	1984/10	2003/08
DAVIS OPER. CO	WATKINS #1	1	10-5N-12E	HARTSHORNE	532,012	4568	1	152	1984/02	2003/08
DAVIS OPER. CO	WESTLAKE HEIRS	1-20	20-5N-12E	HARTSHORNE	177,031	789	1	26	1987/05	2003/08
DAVIS OPER. CO	WILCOX	1-15	15-5N-12E	HARTSHORNE	378,555	1671	1	56	2001/02	2003/08
DAVIS OPER. CO	WILLARD	1-10	10-5N-12E	HARTSHORNE	722,003	3299	1	110	1999/02	2003/08
YALE OIL ASSOC.	WINNIE	1	10-5N-13E	HARTSHORNE	101,532	394	1	13	1988/08	2003/08
XTO	WORKING EE	1	25-5N-12E	HARTSHORNE	8,166,885	5414	1	180	1965/08	2003/09

Operator	Well	Well Num	Location	Formation	Cumulative Gas Production (Mcf)	Gas Production_Latest Month (Mcf)	Active Number of Wells	Current Gas Production RateRate (Mcfd)	First Prod Date	Last Prod Date
					112,734,683	**118,325**	**44**	**3,944**		
				REAMS NORTHWEST FIELD						
XTO	CARTER 1-2	1-2	2-6N-13E	HARTSHORNE	933,438	3190	1	106	1989/02	2003/08
XTO	HOLT	1-4T	4-6N-13E	HARTSHORNE	902,526	2897	1	97	1988/08	2003/08
XTO	HOLT	3J	3-6N-13E	HARTSHORNE	393,172	340	1	11	1990/01	2003/08
SONAT	HOLT	J2-3	3-6N-13E	HARTSHORNE	17			0	1988/08	1988/08
XTO	HOLT J	1	3-6N-13E	HARTSHORNE	2,708,284	1453	1	48	1985/05	2003/08
TAG TEAM RESOURCES LLC	HOLT J	4-3	3-6N-13E	HARTSHORNE	94,298	679	1	23	1997/10	2003/08
BROWER O&G CO	KING	3-25	25-7N-13E	HARTSHORNE / BOOCH	369,985	1505	1	50	1994/09	2003/08
BROWER O&G CO	KING	4-25	25-7N-13E	HARTSHORNE / BOOCH	103,446	1867	1	62	2001/03	2003/08
XTO	LUCILLE	1-34	34-7N-13E	HARTSHORNE	1,046,508	1561	1	52	1985/05	2003/08
BROWER O&G CO	SHEENA #1-36	1-36	36-7N-13E	HARTSHORNE	342,580	2106	1	70	1995/07	2003/08
BROWER O&G CO	STATE	1-35	35-7N-13E	HARTSHORNE	607,018			0	1980/10	1987/04
BROWER O&G CO	STATE	2-35	35-7N-13E	HARTSHORNE	1,200,399	6628	1	221	1988/08	2003/08
BROWER O&G CO	SUNSHINE	1-36	36-7N-13E	HARTSHORNE	73,470	386	1	13	1996/05	2003/08
					8,775,141	**22,612**	**11**	**754**		
				SCIPIO NORTHWEST FIELD						
TAG TEAM RESOURCES LLC	BRADSTREET	1	22-7N-12E	HARTSHORNE	696,861			0	1963/02	1969/08
GRIMES OTHA H INC.	CLARK	1	22-7N-12E	HARTSHORNE	78,590			0	1964/12	
DEISENROTH CRAIG M	CLARKE	1	22-7N-12E	HARTSHORNE	86,270			0	1964/12	1987/05
ARKOMA GAS CO	DOSS	1-33	33-7N-12E	HARTSHORNE / BOOCH	42,806			0	1982/12	1997/01
UNIT	DUNCAN #1	1	13-7N-13E	HARTSHORNE	208,699	924	1	31	1995/12	2003/08
TILFORD PINSON EXPL.	FALCON CLUB	1-21	21-7N-12E	HARTSHORNE / BOOCH	108,581	1932	1	64	2000/08	2003/08
TILFORD PINSON EXPL.	FALCON CLUB	2-21	21-7N-12E	HARTSHORNE / BOOCH	136,167	1690	1	56	2001/01	2003/08
TILFORD PINSON EXPL.	FALCON CLUB	3-21	21-7N-12E	HARTSHORNE	146,922	3704	1	123	2001/01	2003/08
DEISENROTH CRAIG M	GILCREASE	2	16-7N-12E	HARTSHORNE	259,338			0	1963/08	1986/07
DEISENROTH CRAIG M	GILCREASE #1 #2	1	21-7N-12E	HARTSHORNE	318,949			0	1964/12	1997/06
XAE CORPORATION	HERMAN	1-12	12-7N-13E	HARTSHORNE	19,271	492	1	16	2000/12	2003/07
TAG TEAM RESOURCES LLC	HOOTERS	1-18	18-7N-13E	HARTSHORNE	19,936	1346	1	45	2002/06	2003/08
TAG TEAM RESOURCES LLC	JONATHAN	1-22	22-7N-12E	HARTSHORNE	31,129	356	1	12	2000/09	2003/08
TILFORD PINSON EXPL.	KERN	1-21	21-7N-12E	HARTSHORNE / SAVANNA	10,195	295	1	10	2001/08	2003/08
DEISENROTH CRAIG M	KLEINKE	2	15-7N-12E	HARTSHORNE	467,401			0	1963/08	1970/05
TAG TEAM RESOURCES LLC	MAD MAX	1-14	14-7N-12E	HARTSHORNE / BOOCH	51,994	873	1	29	2000/07	2003/08
TAG TEAM RESOURCES LLC	MELISSA	2-22	22-7N-12E	HARTSHORNE	48,110	414	1	14	2000/12	2003/08
TAG TEAM RESOURCES LLC	MICHAEL	2-22	22-7N-12E	HARTSHORNE	124,116	2011	1	67	2001/04	2003/08
ARKOMA GAS CO	MILLION	1-27	27-7N-12E	HARTSHORNE	2,078			0	1983/01	1985/03
TAG TEAM RESOURCES LLC	MOONEYHAM	1-18	18-7N-13E	HARTSHORNE / SAVANNA	489,300	544	1	18	1994/07	2003/06
TAG TEAM RESOURCES LLC	MOONEYHAM #1-18	1-18	18-7N-13E	HARTSHORNE / SAVANNA	163,419	549	1	18	1994/02	2003/08
DEISENROTH CRAIG M	MYERS	1	15-7N-12E	HARTSHORNE	426,770	358	1	12	1963/11	2003/08
DEISENROTH CRAIG M	MYERS	1	15-7N-12E	HARTSHORNE	54,156			0	1964/01	1970/05
ARKOMA GAS CO	MYERS	1-28	28-7N-12E	HARTSHORNE / BOOCH	77,827			0	1980/08	1988/02
TILFORD PINSON EXPL.	MYERS-HOLT	1	24-7N-12E	HARTSHORNE / BOOCH	92,080	353	1	12	1981/12	2003/08
XAE CORPORATION	OTHEL	1	1-7N-13E	HARTSHORNE	27,389	633	1	21	1998/11	2003/07
ARKOMA GAS CO	PUCKETT	1-32	32-7N-12E	HARTSHORNE	57,410			0	1982/12	1996/11
ARKOMA GAS CO	PUCKETT	2-32	32-7N-12E	HARTSHORNE	23,495	295	1	10	1995/06	2003/08
TAG TEAM RESOURCES LLC	ROCKEY	1-18	18-7N-13E	HARTSHORNE / SAVANNA	88,122			0	1994/07	1999/11
TILFORD PINSON EXPL.	ROSS	1-24	24-7N-12E	HARTSHORNE / BOOCH	14,240	2	1	0	2001/08	2003/06
TAG TEAM RESOURCES LLC	SARKEYS	1	14-7N-12E	HARTSHORNE	557,943	509	1	17	1963/05	2003/08
MYERS C G	SOUSEA	1	24-7N-12E	HARTSHORNE	53,703			0	1968/07	
ARKOMA GAS CO	STIPE	1-27	27-7N-12E	HARTSHORNE / BOOCH	178,169	1455	1	49	1997/09	2003/08
ARKOMA GAS CO	STIPE	1-28	28-7N-12E	HARTSHORNE	437,796	2804	1	93	1996/10	2003/08
ARKOMA GAS CO	STIPE	2-27	27-7N-12E	HARTSHORNE / BOOCH	102,786	4346	1	145	2001/07	2003/08
ARKOMA GAS CO	STIPE	2-28	28-7N-12E	HARTSHORNE / BOOCH	119,611	1202	1	40	1997/09	2003/08
ARKOMA GAS CO	STIPE	3-27	27-7N-12E	HARTSHORNE	67,332	1963	1	65	2001/10	2003/08
TILFORD PINSON EXPL.	TOM	1-14	14-7N-12E	HARTSHORNE	54,194	1644	1	55	2001/01	2003/08
ARKOMA GAS CO	W J HILSEWECK	1-29	29-7N-12E	HARTSHORNE	142,605	713	1	24	1988/01	2003/08
					6,085,760	**31,407**	**26**	**1,047**		

Operator	Well	Well Num	Location	Formation	Cumulative Gas Production (Mcf)	Gas Production_Latest Month (Mcf)	Active Number of Wells	Current Gas Production RateRate (Mcfd)	First Prod Date	Last Prod Date
				SHADY GROVE SOUTH FIELD						
PRYOR VICTOR W JR	BE	1	31-7N-11E	HARTSHORNE	719,276	142	1	5	1985/01	2003/08
GLENN SUPPLY CO.	BLACK #2	2	9-6N-11E	HARTSHORNE	96,090	140	1	5	1993/06	2003/06
GLENN SUPPLY CO.	BLACK #3	3	10-6N-11E	HARTSHORNE	467,630	665	1	22	1993/11	2003/09
GLENN SUPPLY CO.	BLACK #4	4	9-6N-11E	HARTSHORNE	456,763	506	1	17	1993/11	2003/09
PRYOR VICTOR W JR	BOYD	1	7-6N-11E	HARTSHORNE / BOOCH	737,652	271	1	9	1964/01	2003/08
PRYOR VICTOR W JR	BOYD	2	7-6N-11E	HARTSHORNE	85,110	166	1	6	1987/10	2003/08
ROBERSON OIL CO. INC.	ECKLES	1-5	5-6N-11E	HARTSHORNE	85,551	404	1	13	1999/09	2003/09
GLENN SUPPLY CO.	GAYLER #1-10	1-10	10-6N-11E	HARTSHORNE	852,326	2082	1	69	1994/11	2003/09
GLENN SUPPLY CO.	GENEVA	1-10	10-6N-11E	HARTSHORNE	262,228	453	1	15	1995/07	2003/09
GULF PROD. CORP.	HILL	2-15	15-6N-11E	HARTSHORNE	4,004			0	1995/06	1996/06
GULF PROD. CORP.	HILL	4-14	14-6N-11E	HARTSHORNE	124,168	694	1	23	1995/06	2003/09
GLENN SUPPLY CO.	HILL #1-11	1-11	11-6N-11E	HARTSHORNE	1,028,357	6175	1	206	1994/11	2003/09
WILLIAMS REID OPER.	JACKSON	1	30-7N-11E	HARTSHORNE	419,823			0	1986/04	1992/01
SOUTHERN RESOURCES	KAMPERMAN	1	31-7N-11E	HARTSHORNE	137,116	406	1	14	1989/02	2003/08
GLENN SUPPLY CO.	MC DONALD #1-10	1-10	10-6N-11E	HARTSHORNE	132,555			0	1994/11	1999/07
PRYOR VICTOR W JR	STEPHENS	1	6-6N-11E	HARTSHORNE / BOOCH	525,239	1	1	0	1964/01	2003/07
PRYOR VICTOR W JR	TRUMBO	1	6-6N-11E	HARTSHORNE / BOOCH	597,243	116	1	4	1964/01	2003/07
LUBELL OIL COMPANY	WARREN	1	9-6N-11E	HARTSHORNE	77,348			0	1969/09	1972/01
					6,808,479	**12,221**	**14**	**407**		
				STUART SOUTHWEST FIELD						
BELL O&G	DUNCAN	1	23-5N-11E	HARTSHORNE	83,900			0	1961/01	
MARBET LLC	HERRING D	1-C	28-5N-11E	HARTSHORNE / JEFFERSON	1,032,069	4088	1	136	1989/02	2003/03
LUBELL OIL COMPANY	KINCADE	1	26-5N-11E	HARTSHORNE	97,600			0	1964/04	1968/03
CENTRAL OKLA O&G	LACKEY C S 2 NE	1	27-5N-11E	HARTSHORNE	4,249,974			0	1960/12	1994/01
T K DRILLING CORPORATION	WALKER HEIRS	1	27-5N-11E	HARTSHORNE	1,306,286	448	1	15	1970/03	2003/09
T K DRILLING CORPORATION	WALKER HEIRS 27-2	27-2	27-5N-11E	HARTSHORNE	290,973	1647	1	55	1992/08	2003/05
HUTTON GAS OPER.	WOODFORK	1	26-5N-11E	HARTSHORNE	5,413,737			0	1960/12	1988/11
					12,474,539	**6,183**	**3**	**206**		
				ULAN EAST FIELD						
BROWER O&G CO	HILL #1-24	1-24	24-7N-13E	HARTSHORNE / BOOCH	299,375	370	1	12	1993/10	2003/08
NADEL & GUSSMAN	WARD	1	13-7N-13E	HARTSHORNE	204,197	1160	1	39	1994/03	2003/08
NADEL & GUSSMAN	WARD	2-13	13-7N-13E	HARTSHORNE	164,754	735	1	25	1993/01	2003/08
TAG TEAM RESOURCES LLC	WHATS IF	1-11	11-6N-13E	HARTSHORNE	42	42	1	1	2003/07	2003/07
					668,368	**2,307**	**4**	**77**		

Appendix C: Hartshorne Production Sorted By Facies Interpretation

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
BLACK #4	4	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	456,763	17	1993/11	2003/09	C-1	DMB
WARREN	1	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	77,348	0	1969/09	1972/01	C-1	DMB
GAYLER #1-10	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	852,326	69	1994/11	2003/09	C-1	DMB
MC DONALD #1-10	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	132,555	0	1994/11	1999/07	C-1	DMB
HILL #1-11	1-11	11-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	1,028,357	206	1994/11	2003/09	C-1	DMB
BLEVINS	2-12	12-6N-11E	HARTSHORNE	CABANISS NORTHWEST	569,027	64	1995/10	2003/09	C-1	
SARKEY	1	7-7N-12E	HARTSHORNE	LAMAR EAST	2,333,208	17	1961/08	2003/08	C-1	DMB
BURLESON	1	8-7N-12E	HARTSHORNE	LAMAR EAST	287,131	21	1982/09	2003/08	C-1	DMB
ANDERSON#1	1	17-7N-11E	HARTSHORNE	HORNTOWN SOUTHEAST	293,933	10	1985/04	2002/10	DMB	
SARKEYS	1	14-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	557,943	17	1963/05	2003/08	C-1	DMB
KLEINKE	2	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	467,401	0	1963/08	1970/05	C-1	DMB
DUNCAN #1	1	13-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	208,699	31	1995/12	2003/08	C-1	DMB
					7,264,691	660,426				
RAMSEY	1-14	14-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	9,631	0	1983/02	1983/08	C-2	
RAMSEY	1	14-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	19,129	0	1983/09	1985/12	C-2	CM
KRISTY LEE	1-17	17-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	33,779	17	2000/07	2003/08	C-2	CM
BLEVINS		9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	40,085	82	2002/05	2003/08	C-2	
OTT	2	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	52,983	32	1999/10	2003/08	C-2	
TRACEY	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	53,744	67	2002/06	2003/08	C-2	CM
MARBET LLC 37	37	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	57,461	93	2001/10	2003/08	C-2	
DEER CREEK	1-24	24-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	73,422	0	1985/05	1989/10	C-2	
MARBET LLC	31	14-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	77,214	108	2001/05	2003/07	C-2	
BETHAL	2-9	9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	118,352	30	1999/05	2003/08	C-2	
CRAWFORD	1	10-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	152,357	38	2001/02	2003/08	C-2	CM
BETHEL	3	9-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	154,148	59	2000/05	2003/08	C-2	CM
WESTLAKE HEIRS	1-20	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	177,031	26	1987/05	2003/08	C-2	
CRAWLEY	1-21	21-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	215,157	342	2001/07	2003/08	C-2	DMB
WHITE	13-1	13-7N-11E	HARTSHORNE	LAMAR EAST	242,776	13	1985/06	2003/08	C-2	
ADAMS J W	1-16	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	243,096	20	1998/07	2003/08	C-2	
EGGLESTON UNIT 1-A	1A	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	286,095	35	1994/07	2003/07	C-2	
HOPKINS	1	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	295,379	46	1981/09	2003/08	C-2	CM
THOMPSON	1	1-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	304,160	32	1984/10	2003/08	C-2	CM
HILSEWECK W J	1-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	355,224	17	1979/10	2003/08	C-2	DMB
WILCOX	1-15	15-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	378,555	56	2001/02	2003/08	C-2	
HALL	1	31-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	428,728	19	1981/12	2003/08	C-2	
BLACK	3-28	28-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	429,743	80	1993/08	2003/06	C-2	CM
DONNA	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	434,511	177	2000/09	2003/08	C-2	
GOODE#1	1	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	456,606	6	1985/01	2003/08	C-2	CM

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
ISENHOWER	1-17	17-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	463,477	148	1999/09	2003/08	C-2	
HALL	1	32-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	470,147	0	1966/11	2000/10	C-2	
HALL	1	29-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	519,302	43	1981/07	2003/09	C-2	CM
WATKINS	1	12-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	520,858	66	1984/10	2003/08	C-2	
WATKINS #1	1	10-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	532,012	152	1984/02	2003/08	C-2	CM
WATKINS	1	11-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	545,907	63	1980/11	2003/08	C-2	CM
HILSEWECK	2-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	657,365	101	1996/11	2003/08	C-2	
BLEVINS	9-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	660,508	123	1996/12	2003/08	C-2	
EGGLESTON	1-15	15-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	674,126	29	1984/12	2003/08	C-2	
BRADSTREET	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	696,861	0	1963/02	1969/08	C-2	C-1
JOHNNY	1-16	16-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	716,366	147	1999/05	2003/08	C-2	CM
WILLARD	1-10	10-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	722,003	110	1999/02	2003/08	C-2	
ROGERS	1-30	30-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	746,296	41	1978/06	2003/08	C-2	
COOPER	1	10-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	778,565	140	1996/08	2003/08	C-2	CM
MORAN S	1	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	888,828	82	1965/08	2003/08	C-2	
BLEVINS	2-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	990,511	159	1995/06	2003/09	C-2	
LOFTIS	1-30	30-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,068,855	122	1986/10	2003/08	C-2	
HILSEWECK	1&3	20-6N-12E	HARTSHORNE	CABANISS NORTHWEST	1,266,867	529	1996/03	2003/09	C-2	
					18,008,220	418,796				
SEMESKI	1-3	3-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	217,786	139	2000/10	2003/09	CM	DF
EVERETT 1	1	3-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	279,023	62	1991/01	2003/08	CM	DF
ROSE	1-4	4-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	110,079	61	2001/02	2003/08	CM	DF
MARVIN	3	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	495,062	225	1999/10	2003/06	CM	DMB
MARVIN	4	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	26,210	0	1999/12	2000/02	CM	DMB
MARVIN	5	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,227	0	2001/03	2001/03	CM	DMB
MARVIN	6	11-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	2,387	42	2003/02	2003/03	CM	DMB
WAGEMAN	1	14-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	109,498	55	1997/02	2003/08	CM	DF
VANDEVEER	1	19-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	517,653	126	1975/04	2003/09	CM	DF
VANDEVEER	2-19	19-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	2,347	78	2003/09	2003/09	CM	DF
TIM	2-20	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	10,003	15	2002/08	2003/08	CM	C-2
GARRETT	1-A	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	178,807	0	1966/04		CM	DF
GARRETT	2-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	16,077	0	1999/09	2000/10	CM	DF
JENNIFER	2-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	17,529	17	2002/02	2003/08	CM	DF
GARRETT	3-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	82,910	49	2000/07	2003/08	CM	DF
GARRETT	4-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	81,325	119	2001/10	2003/08	CM	DF
ELLIS G W	1B	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	115,101	82	2001/11	2003/08	CM	

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
OTT	4-22	22-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	123,980	19	2000/12	2003/08	CM	DF
WINNIE	1	10-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	101,532	13	1988/08	2003/08	CM	DF
JUANITA	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	40,369	26	2000/09	2003/08	CM	DF
GLENNIE	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	126,153	58	2000/04	2003/08	CM	DF
SANDRA	1-13	13-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	122,939	55	2000/04	2003/08	CM	DF
VIRGIL	1-22	22-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	226,545	446	2001/04	2003/01	CM	DMB
MARBETT LLC	32	23-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	17,246	19	2001/10	2003/03	CM	DMB
NELL MARY	4	24-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	9,546	83	2003/05	2003/08	CM	DMB
BLEVINS	1-7	7-6N-12E	HARTSHORNE	CABANISS NORTHWEST	66,117	1	1980/08	2003/08	CM	DF
BLEVINS	2-7	7-6N-12E	HARTSHORNE	CABANISS NORTHWEST	4,030	0	1985/12	1994/01	CM	DF
HILSEWECK W J	1-8	8-6N-12E	HARTSHORNE	CABANISS NORTHWEST	95,547	8	1979/10	2003/01	CM	DF
HILSEWECK RANCH	2-8	8-6N-12E	HARTSHORNE	CABANISS NORTHWEST	34,419	12	1994/03	2003/08	CM	DF
HILSEWECK W J	1-9	9-6N-12E	HARTSHORNE	CABANISS NORTHWEST	246,534	34	1979/10	2003/08	CM	DF
HILSEWECK W J	1-15	15-6N-12E	HARTSHORNE	CABANISS NORTHWEST	229,313	32	1979/10	2003/08	CM	DF
HILSEWECK W J	1-16	16-6N-12E	HARTSHORNE	CABANISS NORTHWEST	317,359	39	1979/10	2003/08	CM	DF
HILSENECK	2-16	16-6N-12E	HARTSHORNE	CABANISS NORTHWEST	27,972	11	1999/01	2003/08	CM	DF
BLIVENS	1-18	18-6N-12E	HARTSHORNE	CABANISS NORTHWEST	191,738	0	1979/10	1997/10	CM	DMB
HILSEWICK	1-29	29-6N-12E	HARTSHORNE	CABANISS NORTHWEST	9,311	0	1981/06	1989/06	CM	DF
HILSEWECK	1-29A	29-6N-12E	HARTSHORNE	CABANISS NORTHWEST	36,728	0	1982/02	1989/05	CM	DF
FOLLANSBE	1	12-7N-11E	HARTSHORNE	LAMAR EAST	218,512	0	1961/09	1972/07	CM	DMB
					4,508,914	121,863				
LYONS	1-6	6-5N-11E	HARTSHORNE	CALVIN SOUTHEAST	46,254	3	1984/06	2003/08	DF	
BAILEY	1	17-5N-11E	HARTSHORNE	HILL TOP	131,633	23	1983/10	2003/05	DF	
MCDONALD	1	18-5N-11E	HARTSHORNE	HILL TOP	401,182	27	1980/09	2003/08	DF	
VERNON	1-29	29-5N-11E	HARTSHORNE	HILL TOP	98,612	12	1990/05	2003/08	DF	
VERNON PARK ESTATE	1-29	29-5N-11E	HARTSHORNE	HILL TOP	160,930	8	1989/12	2003/08	DF	
CARTER C C	1	30-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	251,921	0	1978/05	1980/12	DF	BF
MARK	1-32	32-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	5,954	0	1990/08	1993/05	DF	
SHIRLEY#1	1	36-5N-11E	HARTSHORNE	PINE HOLLOW SOUTH	87,827	8	1986/04	2003/06	DF	CM
MARBET LLC		1-5N-12E	HARTSHORNE	REAMS NORTHWEST	199,182	150	2000/04	2003/03	DF	DMB
SHERRILL	1	2-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	166,008	73	1997/01	2003/08	DF	DMB
SHERRILL	3-2	2-5N-12E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	71,385	77	2001/05	2003/08	DF	DMB
MARBET	17	12-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	254,191	152	2000/01	2003/03	DF	CM
JUDY	1	15-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	6,009	200	2003/07	2003/07	DF	CM
BLACK	1	20-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,572	0	1980/12	1982/07	DF	DMB
GARRETT A	1	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	637,888	29	1966/04	2003/08	DF	CM
JENNIFER	1-21	21-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	45,011	52	2001/12	2003/08	DF	CM
STIPE	1-6	6-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	83,798	0	1999/12	2002/07	DF	CM
GIBSON	10-1	10-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	123,071	17	1985/01	2003/08	DF	CM

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
GRETA	1-21	21-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	13,725	101	2002/12	2003/03	DF	
TRUMBO	1	6-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	597,243	4	1964/01	2003/07	DF	DMB
STEPHENS	1	6-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	525,239	0	1964/01	2003/07	DF	
BOYD	1	7-6N-11E	HARTSHORNE / BOOCH	SHADY GROVE SOUTH	737,652	9	1964/01	2003/08	DF	
BOYD	2	7-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	85,110	6	1987/10	2003/08	DF	
HILL	4-14	14-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	124,168	23	1995/06	2003/09	DF	DMB
HILL	2-15	15-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	4,004	0	1995/06	1996/06	DF	DMB
BLAYLOCK 1-19	1-19	19-6N-11E	HARTSHORNE	HILL TOP NORTH	19,043	2	1991/03	2003/08	DF	
LINDLEY	1-30C	30-6N-11E	HARTSHORNE / BOOCH	HILL TOP NORTH	346,832	35	1987/12	2003/08	DF	CM
JONES	2-25	25-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	7,264	30	2003/02	2003/08	DF	BAY
HARTSFIELD	1-35	35-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	46,203	68	2002/02	2003/08	DF	
HARTSFIELD	1-36A	36-6N-12E	HARTSHORNE	PINE HOLLOW SOUTH	128,207	151	2002/02	2003/08	DF	
WHATS IF	1-11	11-6N-13E	HARTSHORNE	ULAN SOUTH	42	1	2003/07	2003/07	DF	
GLEESE	1-27	27-6N-13E	HARTSHORNE / BOOCH	PINE HOLLOW SOUTH	64,130	9	1989/07	2003/08	DF	
GLEESE	1-28	28-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	58,494	10	1990/02	2003/08	DF	
FRANCES 1-29	1-11	29-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	75,528	33	1992/09	2003/08	DF	DMB
TURNER	5	6-7N-11E	HARTSHORNE / BOOCH	GREASY CREEK	42,702	14	1986/05	2003/06	DF	CM
JOYCE	1	5-7N-12E	HARTSHORNE	LAMAR EAST	230,132	11	1981/04	2003/08	DF	CM
DERRISAW	1	6-7N-12E	HARTSHORNE	LAMAR EAST	347,958	0	1964/02	1991/07	DF	BAY
MAD MAX	1-14	14-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	51,994	29	2000/07	2003/08	DF	BF
TOM	1-14	14-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	54,194	55	2001/01	2003/08	DF	BF
MYERS	1	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	426,770	12	1963/11	2003/08	DF	BF
MYERS	1	15-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	54,156	0	1964/01	1970/05	DF	BF
FALCON CLUB	1-21	21-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	108,581	64	2000/08	2003/08	DF	
KERN	1-21	21-7N-12E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	10,195	10	2001/08	2003/08	DF	
FALCON CLUB	2-21	21-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	136,167	56	2001/01	2003/08	DF	DMB
MELISSA	2-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	48,110	14	2000/12	2003/08	DF	DMB
SOUSEA	1	24-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	53,703	0	1968/07		DF	BF
MYERS-HOLT	1	24-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	92,080	12	1981/12	2003/08	DF	BF
ROSS	1-24	24-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	14,240	0	2001/08	2003/06	DF	
STIPE	1-27	27-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	178,169	49	1997/09	2003/08	DF	DMB
MILLION	1-27	27-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	2,078	0	1983/01	1985/03	DF	DMB
STIPE	2-27	27-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	102,786	145	2001/07	2003/08	DF	DMB
STIPE	3-27	27-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	67,332	65	2001/10	2003/08	DF	DMB
MYERS	1-28	28-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	77,827	0	1980/08	1988/02	DF	DMB
W J HILSEWECK	1-29	29-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	142,605	24	1988/01	2003/08	DF	BAY
PUCKETT	2-32	32-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	23,495	10	1995/06	2003/08	DF	
OTHEL	1	1-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	27,389	21	1998/11	2003/07	DF	BAY

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
HILL #1-24	1-24	24-7N-13E	HARTSHORNE / BOOCH	ULAN EAST	299,375	12	1993/10	2003/08	DF	
KING	3-25	25-7N-13E	HARTSHORNE / BOOCH	REAMS NORTHWEST	369,985	50	1994/09	2003/08	DF	
KING	4-25	25-7N-13E	HARTSHORNE / BOOCH	REAMS NORTHWEST	103,446	62	2001/03	2003/08	DF	
					8,670,781	146,962				
BLACK	1-17	17-5N-11E	HARTSHORNE	HILL TOP	245,241	29	1988/11	2003/08	DMB	
ARTHUR #1	1	19-5N-11E	HARTSHORNE	HILL TOP	569,869	35	1981/09	2003/08	DMB	
ALTA #1	1	19-5N-11E	HARTSHORNE	HILL TOP	299,093	8	1981/09	2003/08	DMB	
MOBIL #1	1	20-5N-11E	HARTSHORNE	HILL TOP	544,250	49	1988/07	2003/08	DMB	
BLACK J	1	20-5N-11E	HARTSHORNE	HILL TOP	472,784	72	1989/02	2003/09	DMB	
TRAVIS P	1L	21-5N-11E	HARTSHORNE	HILL TOP	621,903	75	1991/06	2003/01	DMB	C-1
HUFFMAN	1-32	32-5N-11E	HARTSHORNE	HILL TOP SOUTHWEST	173,087	25	1990/01	2003/08	DMB	
JEFFERSON	1	12-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	258,557	61	1996/08	2003/03	DMB	DF
ECKLES	1-5	5-6N-11E	HARTSHORNE	SHADY GROVE SOUTH	85,551	13	1999/09	2003/09	DMB	C-1
BLACK #2	2	9-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	96,090	5	1993/06	2003/06	DMB	DF
BLACK #3	3	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	467,630	22	1993/11	2003/09	DMB	
GENEVA	1-10	10-6N-11E	HARTSHORNE	SHADY GROVE SOUTHWEST	262,228	15	1995/07	2003/09	DMB	DF
BALLINGER	3-13	13-6N-11E	HARTSHORNE	CABANISS NORTHWEST	1,412,822	42	1985/01	2003/08	DMB	C-1
PAUL BALLINGER 4-13	4-13	13-6N-11E	HARTSHORNE	CABANISS NORTHWEST	109,744	14	1992/05	2003/08	DMB	DF
LITTLE	1	19-6N-11E	HARTSHORNE	HILL TOP NORTH	2,857	0	1993/02	1998/07	DMB	C-1
ROLAND	1	20-6N-11E	HARTSHORNE	HILL TOP NORTH	101,522	21	1992/06	2003/08	DMB	C-1
ROLAND 1-20	1-20	20-6N-11E	HARTSHORNE	HILL TOP NORTH	9,809	0	1992/04	1992/11	DMB	C-1
HILSWECK	3-17	17-6N-12E	HARTSHORNE	CABANISS NORTHWEST	46,551	14	1997/09	2003/08	DMB	
KLENE UN	1	1-7N-11E	HARTSHORNE	LAMAR EAST	2,299,313	31	1961/08	2003/08	DMB	C-1
JACKSON	1	30-7N-11E	HARTSHORNE	SHADY GROVE SOUTH	419,823	0	1986/04	1992/01	DMB	
BE	1	31-7N-11E	HARTSHORNE	SHADY GROVE SOUTH	719,276	5	1985/01	2003/08	DMB	
KAMPERMAN	1	31-7N-11E	HARTSHORNE	SHADY GROVE WEST	137,116	14	1989/02	2003/08	DMB	DF
GILCREASE	2	16-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	259,338	0	1963/08	1986/07	DMB	
PERRY	1	17-7N-12E	HARTSHORNE	LAMAR EAST	289,538	17	1982/03	2003/08	DMB	C-1
GRIFFIN HEIRS	1-17	17-7N-12E	HARTSHORNE	LAMAR EAST	12,152	64	2003/03	2003/08	DMB	C-1
SARKEYS	1B	18-7N-12E	HARTSHORNE	LAMAR EAST	298,179	0	1964/03	1982/11	DMB	C-1
SARKEYS	1C	18-7N-12E	HARTSHORNE	LAMAR EAST	169,548	8	1964/02	2003/08	DMB	C-1
GILCREASE #1 #2	1	21-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	318,949	0	1964/12	1997/06	DMB	DF
FALCON CLUB	3-21	21-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	146,922	123	2001/01	2003/08	DMB	DF
CLARKE	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	86,270	0	1964/12	1987/05	DMB	DF
CLARK	1	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	78,590	0	1964/12		DMB	DF
JONATHAN	1-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	31,129	12	2000/09	2003/08	DMB	DF
MICHAEL	2-22	22-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	124,116	67	2001/04	2003/08	DMB	DF
STIPE	1-28	28-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	437,796	93	1996/10	2003/08	DMB	DF
STIPE	2-28	28-7N-12E	HARTSHORNE / BOOCH	SCIPIO NORTHWEST	119,611	40	1997/09	2003/08	DMB	DF
PUCKETT	1-32	32-7N-12E	HARTSHORNE	SCIPIO NORTHWEST	57,410	0	1982/12	1996/11	DMB	
DOSS	1-33	33-7N-12E	HARTSHORNE / BOOCH	CABANISS NORTHWEST	42,806	0	1982/12	1997/01	DMB	
HERMAN	1-12	12-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	19,271	16	2000/12	2003/07	DMB	C-1
WARD	1	13-7N-13E	HARTSHORNE	ULAN EAST	204,197	39	1994/03	2003/08	DMB	C-1
WARD	2-13	13-7N-13E	HARTSHORNE	ULAN EAST	164,754	25	1993/01	2003/08	DMB	C-1

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
MOONEYHAM	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	489,300	18	1994/07	2003/06	DMB	DF
ROCKEY	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	88,122	0	1994/07	1999/11	DMB	DF
MOONEYHAM #1-18	1-18	18-7N-13E	HARTSHORNE / SAVANNA	SCIPIO NORTHWEST	163,419	18	1994/02	2003/08	DMB	DF
HOOTERS	1-18	18-7N-13E	HARTSHORNE	SCIPIO NORTHWEST	19,936	45	2002/06	2003/08	DMB	DF
					12,976,469	288,366				
DUNCAN	1	23-5N-11E	HARTSHORNE	STUART SOUTHWEST	83,900	0	1961/01		IC-1	
WOODFORK	1	26-5N-11E	HARTSHORNE	STUART SOUTHWEST	5,413,737	0	1960/12	1988/11	IC-1	
KINCADE	1	26-5N-11E	HARTSHORNE	STUART SOUTHWEST	97,600	0	1964/04	1968/03	IC-1	
LACKEY C S 2 NE	1	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	4,249,974	0	1960/12	1994/01	IC-1	
WALKER HEIRS	1	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	1,306,286	15	1970/03	2003/09	IC-1	
WALKER HEIRS 27-2	27-2	27-5N-11E	HARTSHORNE	STUART SOUTHWEST	290,973	55	1992/08	2003/05	IC-1	
HERRING D	1-C	28-5N-11E	HARTSHORNE / JEFFERSON	STUART SOUTHWEST	1,032,069	136	1989/02	2003/03	IC-1	
LOFTIS	1	8-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	3,787	0	2000/08	2000/10	IC-1	
BROOKS	1-18	18-5N-12E	HARTSHORNE / SENORA	PINE HOLLOW SOUTH	16,675	0	1984/03	1996/11	IC-1	
HARRISON	1-18	18-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	281,510	157	1999/10	2003/08	IC-1	
CARTER 1-2	1-2	2-6N-13E	HARTSHORNE	REAMS NORTHWEST	933,438	106	1989/02	2003/08	IC-1	
HOLT	J2-3	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	17	0	1988/08	1988/08	IC-1	
HOLT J	4-3	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	94,298	23	1997/10	2003/08	IC-1	
HOLT J	1	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	2,708,284	48	1985/05	2003/08	IC-1	
HOLT	3J	3-6N-13E	HARTSHORNE	REAMS NORTHWEST	393,172	11	1990/01	2003/08	IC-1	
HOLT	1-4T	4-6N-13E	HARTSHORNE	REAMS NORTHWEST	902,526	97	1988/08	2003/08	IC-1	
LUCILLE	1-34	34-7N-13E	HARTSHORNE	REAMS NORTHWEST	1,046,508	52	1985/05	2003/08	IC-1	
STATE	1-35	35-7N-13E	HARTSHORNE	REAMS NORTHWEST	607,018	0	1980/10	1987/04	IC-1	
STATE	2-35	35-7N-13E	HARTSHORNE	REAMS NORTHWEST	1,200,399	221	1988/08	2003/08	IC-1	
SUNSHINE	1-36	36-7N-13E	HARTSHORNE	REAMS NORTHWEST	73,470	13	1996/05	2003/08	IC-1	
SHEENA #1-36	1-36	36-7N-13E	HARTSHORNE	REAMS NORTHWEST	342,580	70	1995/07	2003/08	IC-1	
					21,078,221	1,003,725				
FIELD HEIR	1	13-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	3,255,168	24	1965/08	2003/09	IC-2	
DELILAH	1	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,693,279	137	1985/10	2003/09	IC-2	
LOFTIS	2	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	4,239,153	0	1968/10	1985/09	IC-2	
LOFTIS AUSTIN E	1	23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	892,201	87	1985/10	2003/09	IC-2	
LOFTIS & DELILAH		23-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	1,216,608	0	1985/10	1992/11	IC-2	
MORRIS OSSIE	1	24-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	11,017,443	276	1965/08	2003/09	IC-2	
MORRIS O	3-24	24-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	46,175	38	2000/11	2003/09	IC-2	
DEPOT	1	25-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	260,615	46	1990/11	2003/09	IC-2	
WORKING EE	1	25-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	8,166,885	180	1965/08	2003/09	IC-2	

Well	Well Num	Location	Formation	Field Name	Cumulative Gas Production (Mcf)	Current Gas ProductionRate (Mcfd)	First Prod Date	Last Prod Date	Facies	Secondary Facies
DAVIS	1	26-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	7,660,105	175	1965/10	2003/09	IC-2	
MCDONALD SUSAN	1	35-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	8,044,198	78	1965/08	2003/09	IC-2	
USA #36	1	36-5N-12E	HARTSHORNE	PINE HOLLOW SOUTH	864,986	0	1966/03	1983/11	IC-2	
WATKINS	1	2-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	793,928	37	1975/09	2003/09	IC-2	
FOOD SE SW NW	1	3-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,258,446	40	1965/08	2003/09	IC-2	
FOOD	2-3	3-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	345,576	59	1995/02	2003/09	IC-2	
GIBSON WINNIE	2-4	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	77,738	20	1999/08	2003/08	IC-2	
GIBSON WINNIE	1	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	948,223	164	1990/06	2003/09	IC-2	
LINDSAY GIBSON NE SW	1	4-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	3,730,939	0	1965/07	1990/04	IC-2	
THORNTON SE NW SE	1	5-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,508,564	34	1965/08	2003/09	IC-2	
REYNOLDS	1	7-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,161,911	96	1979/07	2003/09	IC-2	
FIRESTON	1	7-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	678,818	0	1966/04	1977/04	IC-2	
BUSE SW NE	1	8-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	6,868,237	113	1965/08	2003/09	IC-2	
WALLACE W C NE SW NW	1&2	9-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,700,574	56	1965/07	2003/08	IC-2	
ROCK WP	1	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	32,358	0	1965/08	1989/07	IC-2	
ROCK W P C NW NW	2	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	4,245,468	0	1968/10	2003/02	IC-2	
ROCK W P	3-17	17-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,170	1	2002/02	2002/10	IC-2	
BRUCE ROBBINS UNIT	1	18-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	6,535,822	128	1965/08	2003/09	IC-2	
UNIV OF TULSA	1	19-5N-13E	HARTSHORNE	PINE HOLLOW SOUTH	3,516,263	0	1970/04	1998/11	IC-2	
LEO	1-25	25-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	207,738	22	1988/09	2003/07	IC-2	
BLEVINS	1	25-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	1,135,398	49	1968/05	2003/09	IC-2	
GRAY	1	26-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	842,707	118	1978/07	2003/09	IC-2	
MCCARTY	3-32	32-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	305,371	175	1999/11	2003/08	IC-2	
GLEESE J	1	33-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	674,747	19	1965/08	2003/08	IC-2	
GLEESE	2-33	33-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	180,921	62	1998/02	2003/08	IC-2	
HUNT-GARRETT NW SE SW	1	34-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	4,041,853	123	1965/08	2003/09	IC-2	
DOMINIC NE NW SW	1	35-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	2,744,814	83	1965/07	2003/09	IC-2	
DOMINIC	2-35	35-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	149,749	31	1993/12	2003/09	IC-2	
LEFLORE SE SW NW	1	36-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	831,922	0	1965/07	1979/02	IC-2	
LEFLORE	1-36	36-6N-13E	HARTSHORNE	PINE HOLLOW SOUTH	59,148	10	1997/02	2003/08	IC-2	
					93,935,219	2,408,595				

Appendix D: Hartshorne Isopach Values

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Wildhorse #1	1-5N-11E	0	0	0	7'/3'	7'/3'	8		8	0								
Oliver #1-3	3-5N-11E	0	0	0	2'/0'	2'/0'	8		8	0								
Cities #1	4-5N-11E	0	0	0	NPLA	NPLA												
Lyons #1-6	6-5N-11E	0	NPLA	NPLA	NPLA	NPLA												
Wirick #1	7-5N-11E	0	0	0	0	0												
S&P 15-7	7-5N-11E	0	0	0	7'/0'	7'/0'	5		5	0								
Bivings #1-9	9-5N-11E	0	0	0	6'/2'	6'/2'	5		5	0								
Newby 1-9	9-5N-11E	0	0	0	5'/1'	5'/1'	8		8	0								
Kenny 1-10	10-5N-11E	0	0	0			6		6	0								
Evans #1	10-5N-11E	0					5		5	0								
Jones #1	12-5N-11E	0	0	0	7'/2'	7'/2'	11		11	0								
Wallace Fargo #1	12-5N-11E	0	0	0	NPLA	0												
Stuart 1-13	13-5N-11E	0	0	0	NPLA	0												
Anderson #1	14-5N-11E	0	0	0	33'/16'	0	31		31	0								
Null 1-14	14-5N-11E	0	0	0	44'/32'	0	46		46	0								
Ellis #1	15-5N-11E	0	0	0	14'/3'	14'/3'												
Ellis #1	16-5N-11E	0	0	0	14'/11'	0	20		20	0								
Pearson #2	16-5N-11E	0	0	0	4'/0	4'/0	1		1	0								
McKoy Heirs #2	16-5N-11E	0	0	0	NPLA	NPLA												
McKoy Heirs #1	16-5N-11E	0	0	0	NPLA	NPLA												
Cathy #1	16-5N-11E	0	0	0	11'/5'	0	25		25	0								
Bailey #1	17-5N-11E	0	0	0	7'/3'	7'/3'	0		0	0								
Artur #1	19-5N-11E	0	0	0	7'/2'	7'/2'	21		21	0								
Black J #1	20-5N-11E	0	0	0	8'/0	8'/0'	10		10	0								
Mobil #1	20-5N-11E	0	0	0	8'/6'	8'/6'	11		11	0								
Patterson #1	21-5N-11E	0	0	0	NPLA	NPLA												
Hickory Hills #1	21-5N-11E	0	0	0			6		6	0								
Hickory Hills A #1	21-5N-11E	0	0	0	6'/1'	6'/1'	9		9	0								
Travis P #1	21-5N-11E	0	0	0	11'/5'	11'/5'	15		15	0								
Berman 1-22	22-5N-11E	0	0	0	12'/8'	0	23		23	0								
Adams N #1	22-5N-11E	0	0	0	6'/2'	6'/2'	14		14	0								
Martin Unit #1	22-5N-11E	0																
Duncan #1-A	23-5N-11E	0	0	0	NPLA	0												
Duncan Unit #1	23-5N-11E	0	0	0	NPLA	0												
Somerville 2-23	23-5N-11E	0	0	0	8'/0'	0	12		12	0								
Somerville #1	23-5N-11E	0	0	0	NPLA	NPLA												
Fern A #1	24-5N-11E	0	0	0	36'/8'	0	30		30	0								
Loftis Unit #1	24-5N-11E	0	0	0	NPLA	0												
Loftis 1-25	25-5N-11E	0	0	0	2'/0'	0	9		9	0								
Loftis #1-25	25-5N-11E	0	0	0	>52'/30'	24'/16'	88		88	0								
Newton 1-25	25-5N-11E	0	0	0	14'/3'	14'/3'	28		28	0								
Loftis #1 "O"	26-5N-11E	0	0	0	NPLA	0												
Woodford #1	26-5N-11E	0	0	0	NPLA	NPLA												
Lackey #1	27-5N-11E	0	0	0	NPLA	NPLA												
Holly B Trimm 1-27	27-5N-11E	0	0	0	7'/2'	7'/2'	7		7	0								
Leon Adams 1-27	27-5N-11E	0	0	0	11'/0'	11'/0'	16		16	0								
Walker Heirs #1	27-5N-11E	0	0	0	NPLA	NPLA												
Walker Heirs 27-2	27-5N-11E	0	0	0	13'/2'	13'/2'	18		18	0								
Herring D-1	28-5N-11E	0	0	0	NPLA	NPLA	13		13	0								
Herring #2	28-5N-11E	0	0	0	6'/0'	6'/0'	17		17	0								
Trimm #1	28-5N-11E	0	0	0	14'/4'	14'/4'	21		21	0								
Wilbanks #1	29-5N-11E	0	0	0	NPLA	NPLA												
Parks Estate 1-29	29-5N-11E	0	0	0	6'/0'	6'/0'												
Vernon 1-29	29-5N-11E	0	0	0	8'/0'	8'/0'	8		8	0								
C.C. Carter #1	30-5N-11E	0	0	0														
Derrick 1-30	30-5N-11E	0	0	0	8'/0'	8'/0'	0		0	0								
Wilbanks 3-30	30-5N-11E	0	0	0	8'/3'	8'/3'	10		10	0								
Huffman 1-32	32-5N-11E	0	0	0	12'/9'	12'/9'	12		12	0								
Mark 1-32	32-5N-11E	0	0	0	NPLA	NPLA												
Norvell 32-1	32-5N-11E	0																
Loftis 33-1	33-5N-11E	0	0	0	6'/0'	6'/0'												
Loftis 1-33 (Formor Op)	33-5N-11E	0	0	0	10'/0'	10'/0'	2		2	0								
Martin 1-33	33-5N-11E	0	0	0	11'/0'	11'/0'	10		10	0								
Lackey B Unit #1	34-5N-11E	0	0	0	NPLA	0												
Lackey Unit #1	34-5N-11E	0	0	0	NPLA	0												
Hall E #1	35-5N-11E	0	0	0	78'/49'	0	132		132	0								
Shirley #1 (Joe D.Davis)	36-5N-11E	0	0	0	10'/2'	10'/2'	24		24	0								

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Shirley #1 (Viking Pet)	36-5N-11E	0	0	0	10'/0'	10'/0'	6		6	0								
Marbet #19	1-5N-12E	0			6'/0'	6'/0'	17		17	0								
Sherrill 3-2	2-5N-12E	0	0	0	8'/2'	8'/2'	10		10	0								
Sherrill #1	2-5N-12E	0																
Semeski 1-3	3-5N-12E	0			26'/3'	26'/3'	18		18	0								
Everett #1	3-5N-12E	0			14'/3'	14'/3'	23		23	0								
Gwinn 1-5	5-5N-12E	0	0	0	10'/2'	10'/2'	8		8	0								
Thelma Lee 1-6	6-5N-12E	0				0	60		60	0								
Bethel #1	9-5N-12E	0			8'/2'	8'/2'	11		11	0								
Bethel #3-9	9-5N-12E	0			16'/0'	16'/0'	31		31	0								
Crawford 1-10	10-5N-12E	0	0	0	8'/6'	8'/6'	19		19	0								
Watkins #1	10-5N-12E	0			12'/4'	12'/4'	21		21	0								
Willard 1-10	10-5N-12E	0			23'/2'	23'/2'	22		22	0								
Cooper #1	10-5N-12E	0					24		24	0								
Marvin #1	11-5N-12E	0	NPLA	NPLA	NPLA	NPLA	8		8	0								
Orr B #1	11-5N-12E	0			0	0	20		20	0								
Marvin #4	11-5N-12E	0					12		12	0								
Marvin #5	11-5N-12E	0			14'/0'	14'/0'	5		5	0								
Watt #1	12-5N-12E		NPLA	NPLA	NPLA	NPLA												
Owen "B" #1	12-5N-12E	21	0	0	14'/4'	14'/4'	37		37	0								
Marbet #17	12-5N-12E	8	0	0	2'/0'	2'/0'	16		16	0								
Mcauley #2-14	14-5N-12E		NPLA	NPLA	NPLA	NPLA	0		0	0								
Valente #1	14-5N-12E		NPLA	NPLA	NPLA	NPLA	0		0	0								
Wageman #1	14-5N-12E	0	0	0	21'/17'	21'/17'	18		18	0								
Wilcox 1-15	15-5N-12E				41'/32'	41'/32'	58		58	0								
Rheinhart #1	15-5N-12E		NPLA	NPLA	NPLA	NPLA				0								
Vaughn #1	15-5N-12E		0	0	6'/0'	6'/0'	8		8	0								
J.W. Adams #1-16	16-5N-12E				35'/21'	35'/21'	38		38	0								
Goode #1	16-5N-12E				14'/4'	14'/4'	15		15	0								
Donna #1-16	16-5N-12E				32'/32'	32'/32'	51		51	0								
Black 1-16	16-5N-12E				0	0	0		0	0								
Kristy Lee 1-17	17-5N-12E				17'/8'	17'/8'	31		31	0								
Brown 1-17	17-5N-12E				23'/0'	23'/0'	0		0	0								
John Black G #1	17-5N-12E				0	0	32		32	0								
Tag Team Brown 1-17	17-5N-12E						27		27	0								
Black #1	20-5N-12E		0	0	4'/0'	4'/0'	7		7	0								
Tim #1-20	20-5N-12E				14'/6'	14'/6'	25		25	0								
Gattet 4-21	21-5N-12E		0	0	6'/2'	6'/2'	10		10	0								
Jennifer 2-21	21-5N-12E		0	0	6'/3'	6'/3'	12		12	0								
Gattett 3-21?	21-5N-12E						16		16	0								
Ott 4-22	22-5N-12E				16'/8'	16'/8'	22		22	0								
Ott 2-22	22-5N-12E				18'/2'	18'/2'	34		34	0								
Loftis #1	23-5N-12E		NPLA	NPLA	NPLA	NPLA												
Ossie Morris #1	24-5N-12E		0	0	NPLA	NPLA	49	74	0	123								
O. Morris 3-24	24-5N-12E		0	0	58'/52'	58'/52'	48	64	0	112		20'/17'	20'/17'	20'/17'				
E.E. Working Unit #1	25-5N-12E		0	0	NPLA	NPLA	39	57	0	96								
Davis Unit #1	26-5N-12E		0	0	NPLA	NPLA	50	75	0	125								
Garrett "A" Unit #1	27-5N-12E		NPLA	NPLA	NPLA	NPLA												
Black A #3	27-5N-12E		NPLA	NPLA	NPLA	NPLA	12		12	0								
Black A #5	27-5N-12E				30'/10'	30'/10'	22		22	0								
A.B. Capp #1	28-5N-12E		NPLA	NPLA	NPLA	NPLA	15		15	0								
Black 3-28	28-5N-12E				18'/8'	18'/8'	32		32	0								
Trimm #1	29-5N-12E				8'/0'	8'/0'	26		26	0								
Hall #1	29-5N-12E				12'/2'	12'/2'	12		12	0								
Rogers 1-30	30-5N-12E				10'/0'	10'/0'	38		38	0								
Hall #1	31-5N-12E		NPLA	NPLA	NPLA	NPLA	31		31	0								
Bennet Hall #1	32-5N-12E		NPLA	NPLA	NPLA	NPLA	29		29	0								
J.W. Hall Unit #1	32-5N-12E		NPLA	NPLA	NPLA	NPLA	4		4	0								
Reed #1	33-5N-12E		0	0	4'/0'	4'/0'	4		4	0								
Trapp #1-33	33-5N-12E				2'/0'	2'/0'	14		14	0								
Trapp Unit #1	33-5N-12E		NPLA	NPLA	NPLA	NPLA	16		16	0								
Apache Paschall #1	34-5N-12E		0	0	NPLA	NPLA	30		30	0								
Wright-Wood Unit #1	34-5N-12E						9		9	0								
Davis Paschall #1	34-5N-12E						16		16	0								
S. McDonald Unit #1	35-5N-12E		0	0	84'/55'	84'/55'	55	37	0	92		34'/22'	50'/33'	50'/33'				
Depot #1	36-5N-12E		0	0	38'/10'	38'/10'	58	38	0	96		20'/6'	18'/4'	18'/4'				
Thompson #1	1-5N-13E	0	0	0	16'/0'	16'/0'	30		30	30								

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Watkins #2	2-5N-13E	0	3'/0'	3'/0'	1'/0'	1'/0'	6		6	6								
Food #2	3-5N-13E	36	0	0	44'/14'	44'/14'	18	56	0	74		34'/14'	10'/0'	10'/0'				
Food Unit #1	3-5N-13E	ngr	0	0	NPLA	NPLA	60	40	0	100								
Peters #1	3-5N-13E						34		0	34								
Gibson-Lindsey Unit #1	4-5N-13E		0	0	NPLA	NPLA	87	43	0	130								
Thornton #1	5-5N-13E		0	0	52'/14'	52'/14'		78	0	78		52'/14'	NDE	NDE				
Stipe #1-6	6-5N-13E	5	1'/0'	0	11'/4'	11'/4'	2		2	0								
Stipe #1	6-5N-13E		0	0	4'/0'	4'/0'	12		12	0								
Reynolds #1	7-5N-13E		0	0	92'/55'	92'/55'	104	48	0	152		28'/17'	64'/38'	64'/38'				
Firestone Unit #1	7-5N-13E		0	0	48'/14'	48'/14'		58	0	58		48'/14'	NDE	NDE				
Buse 1	8-5N-13E		0	0	NPLA	NPLA	8	92	0	100								
W.C. Wallace Unit #1	9-5N-13E		0	0	68'/18'	68'/18'	32	52	0	84		42'/11'	26'/7'	26'/7'				
Wallance #2	9-5N-13E		0	0	48'/6'	48'/6'	49	39	0	88		26'/4'	22'/2'	22'/2'				
Winnie #1	10-5N-13E		0	0	28'/0'	28'/0'	2	26	0	28		26'/0'	2'/0'	2'/0'				
Gibson 1-10	10-5N-13E		0	0	3'/0'	3'/0'	17		17	0								
Grant 1-10	10-5N-13E		0	0	0	0	9		9	0								
Watkins #1	11-5N-13E		2'/0'	2'/0'	20'/0'	20'/0'	41		41	0								
Core Energy Watkins #1	12-5N-13E		0	0	12'/0'	12'/0'	32		32	0								
Watson #1	13-5N-13E		NPLA	NPLA	NPLA	NPLA	65		65	0								
Glennie #1-13	13-5N-13E		0	0	12'/2'	12'/2'	15		15	0								
Field Heirs #1	13-5N-12E	ngr	0	0	NPLA	NPLA	14	51	14	0								
Sandra #1-13	13-5N-13E																	
Ramsey #1	14-5N-13E		0	0	7'/0'	7'/0'	21		21	0								
Marbet #31	14-5N-13E		0	0	2'/0'	2'/0'	21		21	0								
Watkins 114	14-5N-13E		3'/3'	3'/3'	12'/4'	12'/4'	17		17	0								
Mason 1-15	15-5N-13E		NPLA	NPLA	NPLA	NPLA	28		28	0								
Investors Royalty	15-5N-13E		2'/0'	0	14'/3'	14'/3'	44		44	0								
Eggleston 1-15	15-5N-13E		0	0	22'/2	22'/2	21		21	0								
Marbet #37	15-5N-13E		0	0	6'/0'	6'/0'	29		29	0								
L.W. Chandler #1-1	16-5N-13E		0	0	4'/0'	4'/0'	13		13	0								
W.P. Rock #2	17-5N-13E		0	0	56'/15'	56'/15'	65	45	65	110		30'/8'	26'/7'	26'/7'				
W.P. Rock #1	17-5N-13E		0	0	NPLA	NPLA									NGR			
Robbins Unit #1	18-5N-13E		0	0			62	92	0	154								
Hazelwood #1	19-5N-13E						4		4	0								
Crawley #1-21	21-5N-13E		0	0	7'/0'	7'/0'	52		52	0								
Virgil 1-22	22-5N-13E		0	0	8'/0'	8'/0'	21		21	0								
Marbet #25	23-5N-13E		2'/0'	2'/0'	14'/8'	14'/8'												
Marbet #32	23-5N-13E		0	0	13'/2'	13'/2'	19		19	0								
Deer Creek #1	24-5N-13E		1'/0'	1'/0'	24'/10'	24'/10'	38		38	0								
Parks 1	1-6N-10E				4'/3'	4'/3'	6		6	0								
Parks 2	1-6N-10E	0			2'/0'	2'/0'	0		0	0								
Lytal #1	11-6N-10E	0			1'/0'	1'/0'	3		3	0								
Degraffenried #1	12-6N-10E	0					3		3	0								
Cecil Gumm	13-6N-10E	0			6'/0'	6'/0'	11		11	0								
Warren 1	4-6N-11E	0	0	0	5'/0'	5'/0'	8		8	0								
Eckles 1-5	5-6N-11E	0	0	0	8'/7'	8'/7'	9		9	0								
Walter 1-5	5-6N-11E	0	0	0	6'/2'	6'/2'	10		10	0								
Boyd #1	7-6N-11E	0	0	0														
Herrod #1	7-6N-11E	0	0	0			19		19	0								
Boyd 2	7-6N-11E	0	0	0	4'/0'	4'/0'	3		3	0								
Black #2	9-6N-11E	0	0	0	17'/12'	17'/12'	18		18	0								
Black #1	9-6N-11E	0	0	0	6'/0'	6'/0'	4		4	0								
Black 4	9-6N-11E	0	0	0	23'/14'	23'/14'	30		30	0								
Black #3	10-6N-11E	0	0	0	18'/16'	18'/16'	18		18	0								
Gayler 1-10	10-6N-11E	0	0	0	28'/22'	28'/22'	31		31	0								
Geneva 1-10	10-6N-11E	0	0	0	17'/12'	17'/12'	20		20	0								
McDonald 1-10	10-6N-11E	0	0	0	10'/6'	10'/6'	16		16	0								
Hill 1-11	11-6N-11E	0	0	0	11'/7'	11'/7'	22		22	0								
Gill 1	12-6N-11E	0	0	0	NPLA	NPLA	3		3	0								
Blevins 1-12	12-6N-11E	0	0	0	0	0	3		3	0								
Ballinger 1-13	13-6N-11E	0	0	0			13		13	0								
Ballinger 3-13	13-6N-11E	0	0	0	17'/12'	17'/12'	26		26	0								
Ballinger 4-13	13-6N-11E	0	0	0	0	0	14		14	0								
Blevins 1-13-C	13-6N-11E	0	0	0	2'/0'	2'/0'	5		5	0								
Blevins A-1	13-6N-11E	0	0	0	3'/1'	3'/1'	5		5	0								
Parker 1-14	14-6N-11E	0	0	0			10		10	0								
Hill 4-14	14-6N-11E	0	0	0	8'/4'	8'/4'	0		0	0								

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Hill 2-15	15-6N-11E	0	0	0	7'/0'	7'/0'	11		11	0								
Smoker 1-17	17-6N-11E	0			5'/2'	5'/2'	4		4	0								
Aldridge 1-18	18-6N-11E	0	0	0	0	0	3		3	0								
Nail 1-18	18-6N-11E	0	0	0	4'/1'	4'/1'	14		14	0								
Rahhal A-1	18-6N-11E	0			6'/0'	6'/0'	16		16	0								
Smoke 1-18	18-6N-11E	0	0	0	3'/0'	3'/0'	9		9	0								
Ellen 1-19	19-6N-11E	0	0	0	5'/0'	5'/0'	3		3	0								
Blaylock 1-19	19-6N-11E	0	0	0	6'/4'	6'/4'	5		5	0								
Little 1-19	19-6N-11E	0	0	0	5'/2'	5'/2'	6		6	0								
Robertson 1-19	19-6N-11E	0	0	0	NPLA	NPLA	1		1	0								
Roland 1-20	20-6N-11E	0	0	0	7'/4'	7'/4'	11		11	0								
Blevins 'B' 1-24	24-6N-11E	0	0	0	3'/1'	3'/1'	0		0	0								
Smith 1-28	28-6N-11E	0	0	0	8'/0'	8'/0'	0		0	0								
Vernon Smith 1-28	28-6N-11E	0	0	0	2'/0'	2'/0'	2		2	0								
McKee 1-29	29-6N-11E	0	0	0	0	0	2		2	0								
Derrick 1-29	29-6N-11E	0	0	0	0	0	0		0	0								
Lindley 1-30	30-6N-11E	0	0	0	8'/4'	8'/4'	8		8	0								
Lindley 2-30	30-6N-11E	0	0	0	0	0	0		0	0								
McKee 3-32	32-6N-11E	0	0	0	6'/1'	6'/1'	4		4	0								
Richardson 1	33-6N-11E	0																
Blevins 1-7	7-6N-12E	0	0	0	4'/0'	4'/0'	0		0	0								
Hilseweck 1-8	8-6N-12E	0	0	0	7'/2'	7'/2'	6		6	0								
Hilseweck 2-8	8-6N-12E	0	0	0	6'/2'	8'/2'	3		3	0								
Hilseweck 1-9	9-6N-12E	0	0	0	7'/2'	7'/2'	4		4	0								
Garrett 1-11	11-6N-12E	0	0	0	NPLA	NPLA												
Loftis 1-13	13-6N-12E	0	0	0	3'/0'	3'/0'	0		0	0								
Hilseweck 1-15	15-6N-12E	0	0	0	5'/0'	5'/0'	5		5	0								
Hilsewck 1-16	16-6N-12E	0	0	0	6'/0'	6'/0'	4		4	0								
Hilseweck 2-17	17-6N-12E	0	0	0	24'/16'	24'/16'	35		35	0								
Hilseweck 3-17	17-6N-12E	0	0	0	6'/0'	6'/0'	7		7	0								
Blevins 1-18	18-6N-12E	0	0	0	12'/6'	12'/6'	12		12	0								
Blevins 2-18	18-6N-12E	0	0	0	34'/30'	34'/30'	42		42	0								
Blevins 9-18	18-6N-12E	0	0	0	21'/4'	21'/4'	44		44	0								
Blevins 1-19	19-6N-12E	0	0	0	NDE					0								
Hilseweck 1-20	20-6N-12E	0	0	0	24'/6'	24'/6'	41		41	0								
Hilseweck 3-20	20-6N-12E	0			7'/4'		21		21	0								
Hilseweck 5-21	21-6N-12E	0	0	0	2'/0'	2'/0'	1		1	0								
Hilseweck Ranch 1-21	21-6N-12E	0	0	0	24'/17'	0	34		34	0								
William G. Jones #1	22-6N-12E	0	0	0	NPLA	NPLA	95		95	0								
Lubell 1-23	23-6N-12E	0	0	0	28'/12'	0	56		56	0								
Smalley 1	26-6N-12E	0	0	0	NPLA	NPLA	0		0	0								
Hilseweck 1-29	29-6N-12E	0	0	0														
Durant 1-1	1-6N-13E		0	0	NPLA	NPLA	74		74	0								
Ashley 1-1	1-6N-13E	0	0	0	62'/18'	0	102		102	0								
McKay 1-1	1-6N-13E		0	0	17'/4'	17'/4'	35		35	0								
Brown Estate 1-2	2-6N-13E		0	0	57'/28'	0	86		86	0								
Carter 1-2	2-6N-13E	0	0	0	92'/75'	35'/34'	145		145	0								
Jaynelle #1	3-6N-13E		0	0	86'/48'	0	105		105	0								
Holt J #2	3-6N-13E		0	0	92'/82'	51/46'	148		148	0								
Holt J #1	3-6N-13E	0	0	0	122'/114'	56'/56'	174		174	0								
Holt 1-4	4-6N-13E		0	0	46'/43'	28'24'	121		121	0								
Jessie 1-5	5-6N-13E																	
Gillin #1	6-6N-13E						34		34	0								
Capps Day 1-8	8-6N-13E		0	0	73'/44'	0	140		140	0								
Arpoika #1-9	9-6N-13E																	
Banks Estate #1	10-6N-13E		0	0	16'/0'	16'/0'	19		19	0								
Minter #1-10	10-6N-13E		0	0	22'/3'	22'/3'	37		37	0								
Menefee #1	11-6N-13E																	
Minter #2-11	11-6N-13E		0	0	4'/0'	4'/0'	4		4	0								
Warren #1-11	11-6N-13E		0	0	24'/8'	24'/8'	34		34	0								
J.N. Miller #1 (12)	12-6N-13E		0	0	NPLA	NPLA	44		44	0								
J.N. Miller #2-12	12-6N-13E		0	0	7'/2'	7'/2'	2		2	0								
McAlester #1	12-6N-13E		0	0	13'/0'	13'/0'	19		19	0								
Bryant #1	13-6N-13E		0	0	0	0	5		5	0								
Miller "AG" #1	13-6N-13E	0	0	0	18'/0'	18'/0'	32		32	0								
Sittel #1-13	13-6N-13E	0	0	0			37		37	0								
Ashley #1	14-6N-13E	9	0	0	NPLA	NPLA	20		20	0								

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Gaddy 1-15	15-6N-13E																	
Phoebe #2	23-6N-13E		0	0	0	0	2		2	0								
Phoebe #1	23-6N-13E		0	0	5'/0'	5'/0'												
Crawford 1-24	24-6N-13E	0	0	0	24'/5'	24'/5'	12	52	0	64		0						
Powell 1-24	24-6N-13E	8	0	0	11'/3'	11'/3'	17		0	0								
Leo #1	25-6N-13E		0	0	46'/0'	46'/0'	66	36	0	102		22'/0'	24'/0'	24'/0'				
Frank Blevins Unit #1	25-6N-13E		0	0	48'/18'	48'/18'	72	26	0	98		14'/6'	34'/12'	34'/12'				
Gray #1	26-6N-13E		0	0	55'/4'	55'/4'	121	26	0	147		0	72'/23'	72'/23'				
Archer Unit #1	26-6N-13E		0	0	NPLA	NPLA	34	73	0	107								
Gleese 1-27	27-6N-13E		0	0	5'/0'	5'/0'	12		12	0								
Steed 27-1	27-6N-13E		0	0	6'/0'	6'/0'	0	8	0	8		6'/0'	0	0				
Gleese A #1-28	28-6N-13E		0	0	10'/6'	10'/6'	8		8	0								
Francis 1-29 (11?)	29-6N-13E		0	0	19'/6'	19'/6'	11		11	0								
West #2	29-6N-13E																	
Roberts #1	31-6N-13E		0	0	2'/0'	2'/0'	2		2	0								
White #1-31	31-6N-13E		0	0	0	0	6		6	0								
Gleese Unit #1	33-6N-13E		0	0	NPLA	NPLA												
Buddy #1-X	34-6N-13E		0	0	NPLA	NPLA												
Hunt Garret Unit #1	34-6N-13E		0	0	NPLA	NPLA	92	62	0	154								
Dominic Unit #1	35-6N-13E		0	0	NPLA	NPLA	68	92	0	160								
LeFlore #1	36-6N-13E		0	0	NPLA	NPLA		73	0	73								
LeFlore 1-36	36-6N-13E		0	0														
Engleman 1-36	36-6N-13E						8	8	0	16								
Howell #1	36-6N-13E	26					0	24	0	24								
Kleine Unit #1	1-7N-11E	0	0	0	NPLA	NPLA	12		12	0								
Bob #1	1-7N-11E	0	0	0	1'/0'	1'/0'	6		6	0								
Jeremy D #1	1-7N-11E	0	0	0	9'/8'	9'/8'	8		8	0								
West Unit #1	1-7N-11E	0	0	0	NPLA	NPLA	12		12	0								
Eckles Unit 1	2-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Huff 1-2	2-7N-11E	0			0	0	0		0	0								
George #1	2-7N-11E	0			1'/0'	1'/0'	0		0	0								
D. Harris #1	3-7N-11E	0	0	0	NPLA	NPLA	1		1	0								
Cowart #1	3-7N-11E	0					6		6	0								
Nancy Harjo 1	4-7N-11E	0	0	0	NPLA	NPLA	6		6	0								
Sarah #1-4	4-7N-11E	0	0	0	NPLA	NPLA	2		2	0								
Thompson 1	4-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Lee Epps #1	4-7N-11E	0	0	0	NPLA	NPLA	6		6	0								
Turner 1	5-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Turner Ranch 1	5-7N-11E	0			7'/4'	7'/4'	7		7	0								
Oliver 1	6-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
George Turner 2	6-7N-11E	0			5'/1'	5'/1'	8		8	0								
B. Bear 1	6-7N-11E	0	0	0	5'/3'	5'/3'	9		9	0								
Turner 5	6-7N-11E	0			8'/4'	8'/4'	6		6	0								
Lankford 3	7-7N-11E	0			0	0	2		2	0								
Thomas 1	7-7N-11E	0			3'/0'	3'/0'	0		0	0								
Lankford 2	7-7N-11E	0			3'/1'	3'/1'	2		2	0								
Lee 1	7-7N-11E	0	0	0	NPLA	NPLA	1		1	0								
George 7-1	7-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Yaroslaski #1	8-7N-11E	0	0	0	2'/0'	2'/0'	2		2	0								
Turner	8-7N-11E	0			0	0	0		0	0								
Welch 1-8	8-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Lamar Mt. #1	9-7N-11E	0	0	0	NPLA	NPLA	0		0	0								
Baca #1-10	10-7N-11E	0			8'/8'	0	14		14	0								
Freeman 1	11-7N-11E	0	0	0	NPLA	NPLA	5		5	0								
Miller #1	11-7N-11E	0	0	0		0	17		17	0								
Upchurch #1	11-7N-11E	0	0	0	NPLA	0	14		14	0								
Beck #1	12-7N-11E	0			9'/3'	9'/3'	9		9	0								
Follansbee #2	12-7N-11E	0	0	0	17'/17'	17'/17'	17		17	0								
M.B. White #1	13-7N-11E	0	0	0	3'/2'	3'/2'	5		5	0								
White #13-1	13-7N-11E	0	0	0	12'/9'	12'/9'	18		18	0								
Neal #1-14	14-7N-11E	0			6'/0'	6'/0'	9		9	0								
Neal #2	14-7N-11E	0	0	0	8'/4'	8'/4'	6		6	0								
Lamar #15	15-7N-11E	0	0	0	8'/3'	0	8		8	0								
Anderson #1	16-7N-11E	0	0	0	12'/8'	0	14		14	0								
Anderson 1-16	16-7N-11E	0			4'/2'	4'/2'	8		8	0								
Adamas #1	16-7N-11E	0	0	0	7'/0'	7'/0'	13		13	0								
Scruggs #1	16-7N-11E	0	NPLA	NPLA	NPLA	NPLA	6		6	0								

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Anderson "Q" #1	17-7N-11E	0			8'/0'	8'/0'	2		2	0								
Jerry #1	17-7N-11E	0	NPLA	NPLA	NPLA	NPLA	3		3	0								
Anderson No. 1	17-7N-11E	0	0	0	8'/6'	8'/6'	14		14	0								
Anderson 2-17	17-7N-11E	0			7'/0'	7'/0'	11		11	0								
Bolt #1	18-7N-11E	0	NPLA	NPLA	NPLA	NPLA	2		2	0								
Bolt #2	18-7N-11E	0			2'/0'	2'/0'	4		4	0								
Coats 1-18	18-7N-11E	0	NPLA	NPLA	NPLA	0	15		15	0								
Shields #1	18-7N-11E	0	0	0	1'/0'	1'/0'	8		8	0								
Lee #2	18-7N-11E	0	NPLA	NPLA	NPLA	NPLA	2		2	0								
Paula #1	19-7N-11E	0	0	0	6'/1'	6'/1'	6		6	0								
Backus #1	19-7N-11E	0	NPLA	NPLA	NPLA	NPLA	5		5	0								
Anita 1-20	20-7N-11E	0	0	0	5'/0'	5'/0'	17		17	0								
Eckles A-1	20-7N-11E	0	NPLA	NPLA	NPLA	NPLA	5		5	0								
Schilling #1-20	20-7N-11E	0	0	0	8'/3'	8'/3'	10		10	0								
Farris #1	20-7N-11E	0	NPLA	NPLA	NPLA	NPLA	8		8	0								
Factor #1	22-7N-11E	0	NPLA	NPLA	NPLA	NPLA	0		0	0								
Weston 1	23-7N-11E	0	0	0	2'/0'	2'/0'	5		5	0								
Rosa #1	24-7N-11E	0			0	0	6		6	0								
Chapman #1	24-7N-11E	0	0	0	6'/4'	0	3		3	0								
Kamperman 1-24	24-7N-11E	0	NPLA	NPLA	NPLA	NPLA	6		6	0								
Bob #1	25-7N-11E	0	0	0	8'/0'	8'/0'				0								
Chapman 1-26	26-7N-11E	0	0	0	2'/0'	2'/0'	6		6	0								
Eckles 1-26	26-7N-11E	0	0	0	3'/1'	3'/1'	7		7	0								
Kamperman 1-27	27-7N-11E	0	0	0	5'/2'	5'/2'	6		6	0								
Sultan Oil Lott #1-28	28-7N-11E	0	0	0	2'/0'	2'/0'				0								
Eckles #1	29-7N-11E	0			2'/0'	2'/0'	0		0	0								
Kamperman 1-29	29-7N-11E	0	0	0	0	0	4		4	0								
Douglass #1	29-7N-11E	0	NPLA	NPLA	NPLA	NPLA	0		0	0								
Jackson #1	30-7N-11E	0	0	0	9'/6'	9'/6'	15		15	0								
Kamperman 1-30	30-7N-11E	0	0	0	2'/0'	2'/0'	0		0	0								
Thompson 1-30	30-7N-11E	0	0	0	0	0	3		3	0								
Eckles 3-31	31-7N-11E	0			0/0	0/0	3		3	0								
Eckles #1	31-7N-11E	0	0	0	6'/3'	6'/3'	10		10	0								
Kamperman 1	31-7N-11E	0	0	0	7'/4'	7'/4'	2		2	0								
Anita #1	31-7N-11E	0			0'/0'	0'/0'	4		4	0								
Showalter #1	31-7N-11E	0	NPLA	NPLA	NPLA	NPLA				0								
B.E. #1	31-7N-11E	0			7'/5'	7'/5'	8		8	0								
B.E. #2	31-7N-11E	0			0'/0'	0'/0'	2		2	0								
Kamperman 1-32	32-7N-11E	0			10'/2'	10'/2'	12		12	0								
Riley #1	32-7N-11E	0	0	0	NPLA	NPLA				0								
Rogers #1	32-7N-11E	0	0	0	7'/0'	7'/0'	7		7	0								
Charles 1-33	33-7N-11E	0	0	0	NPLA	NPLA	2		2	0								
Benham 1	35-7N-11E	0	0	0	8'/4'	8'/4'	2		2	0								
Lott 1	2-7N-12E	0	0	0	4'/0'	4'/0'	7		7	0								
Patsy 1-3	3-7N-12E	0	0	0	4'/2'	0	3		3	0								
Wagoner #1	4-7N-12E	0	0	0	6'/1'	6'/1'	1		1	0								
Carpenter #1	5-7N-12E	0	0	0	3'/0'	3'/0'	1		1	0								
Shields #1	6-7N-12E	0	0	0	22'/ 20'	0	21		21	0								
Sarkeys #2	7-7N-12E	0	0	0	8'/4'	0				0								
Sanders #2	7-7N-12E	0	0	0	13'/5'	13'/5'	16		16	0								
Sarkey Unit #1	7-7N-12E	0	0	0	NPLA	NPLA	14		14	0								
Sanders #1	7-7N-12E	0	0	0	NPLA	NPLA	14		14	0								
Burleson #1	8-7N-12E	0	0	0	9'/3'	9'/3'	12		12	0								
Cotton-Eckles #1	8-7N-12E	0	0	0	NPLA	NPLA				0								
McAfee 1-12	12-7N-12E	0	0	0	10'/0'	10'/0'	10		10	0								
McAfee 1-13	13-7N-12E	0	0	0	5'/0'	5'/0'				0								
W.C. Ratledge #1	13-7N-12E	0	0	0	NPLA	NPLA	2		2	0								
McAfee #1	13-7N-12E	0	0	0	NPLA	NPLA	4		4	0								
State #1	13-7N-12E	0	0	0	NPLA	0	2		2	0								
Owen #1-14	14-7N-12E	0	0	0	9'/4'	9'/4'	8		8	0								
Sarkeys #1	14-7N-12E	0	0	0	NPLA	NPLA	5		5	0								
Mad Max 1-14	14-7N-12E	0	0	0	6'/3'	6'/3'	10		10	0								
Thunderdome 1-14	14-7N-12E	0	0	0	5'/0'	5'/0'	8		8	0								
Sarkey #1	14-7N-12E	0	0	0	NPLA	NPLA				0								
Theel #1	14-7N-12E	0	0	0	NPLA	NPLA	1		1	0								
Tom 2-14	14-7N-12E	0	0	0	6'/0'	6'/0'	6		6	0								
Owens #1	15-7N-12E	0	0	0	8'/4'	2'/0'	7		7	0								

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Kleinke 4	15-7N-12E	0	0	0	NPLA	NPLA	26		26	0								
Lott 1-15	15-7N-12E	0	0	0	17'/3'	17'/3'	9		9	0								
Kleinke #2	15-7N-12E	0	0	0	NPLA	NPLA	31		31	0								
Myers 1	15-7N-12E	0	0	0	NPLA	0				0								
Hoehne 1-16	16-7N-12E	0	0	0	18'/8'	0	19		19	0								
Addington 1	16-7N-12E	0	0	0	NPLA	NPLA	9		9	0								
Gilcrease 3	16-7N-12E	0	0	0	NPLA	NPLA	28		28	0								
Gilcrease 1	16-7N-12E	0								0								
Perry 1	17-7N-12E	0	0	0	10'/8'	10'/8'	9		9	0								
Sarkeys B-1	18-7N-12E	0	0	0	NPLA	NPLA	0		0	0								
Sarkeys C-1	18-7N-12E	0	0	0	NPLA	NPLA	10		10	0								
Shirley Jean	19-7N-12E	0	0	0	6'/3'	6'/3'	2		2	0								
McCoy 1	20-7N-12E	0	0	0	2'/0'	2'/0'	8		8	0								
Kern 1-21	21-7N-12E	0	0	0	14'/2'	14'/2'	14		14	0								
Falcon Club 1-21	21-7N-12E	0	0	0	4'/0'	4'/0'	8		8	0								
Falcon Club 2-21	21-7N-12E	0	0	0	9'/7'	9'/7'				0								
Falcon Club 3-21	21-7N-12E	0	0	0	13'/5'	13'/5'				0								
Jonathan 1-22	22-7N-12E	0	0	0	8'/4'	8'/4'	15		15	0								
Michael 2-22	22-7N-12E	0	0	0	8'/6'	8'/6'	13		13	0								
Melissa 2-22	22-7N-12E	0	0	0	8'/8'	8'/8'	16		16	0								
Broadstreet 1	22-7N-12E	0	0	0	NPLA	NPLA	23		23	0								
C.G. Myers et al #1	22-7N-12E	0	0	0	NPLA	NPLA	0		0	0								
Jackie Holt 2-23	23-7N-12E	0	0	0	20'/8'	20'/8'	20		20	0								
Upchurch 1	23-7N-12E	0	0	0	NPLA	NPLA	11		11	0								
Mamie Sousea 1	24-7N-12E	0	0	0	NPLA	NPLA				0								
Soused 3	24-7N-12E	0	0	0	NPLA	NPLA				0								
Holt 3-24	24-7N-12E	0	0	0	12'/0'	12'/0'	8		8	0								
Anderson 1-24	24-7N-12E	0	0	0	9'/2'	9'/2'	7		7	0								
Holt 1	24-7N-12E	0	0	0	NPLA	NPLA	8		8	0								
Rabke 1-24	24-7N-12E	0	0	0	15'/4'	15'/4'	14		14	0								
Ross 1-24	24-7N-12E	0	0	0	11'/2'	11'/2'	7		7	0								
Bruno 3-25	25-7N-12E	0	0	0	2'/0'	2'/0'				0								
Whitney Heirs 1-26	26-7N-12E	0	0	0	16'/16'	0	20		20	0								
Million 1-27	27-7N-12E	0	0	0	6'/2'	6'/2'	14		14	0								
Stipe 2-27	27-7N-12E	0	0	0	12'/4'	12'/4'	20		20	0								
Stipe 1-27	27-7N-12E	0	0	0	13'/6'	13'/6'	12		12	0								
Hilseweck A-1-29	29-7N-12E	0	0	0	NPLA	NPLA	2		2	0								
Stipe 1-29	29-7N-12E	0	0	0	1'/0'	1'/0'	5		5	0								
Be Ann Puckett 1-32	32-7N-12E	0	0	0	11'/2'	11'/2'	12		12	0								
Myers B-1	32-7N-12E	0	0	0	NPLA	NPLA	2		2	0								
Puckett 2-32	32-7N-12E	0	0	0	5'/0'	5'/0'	0		0	0								
Stipe 1-33	33-7N-12E	0	0	0	5'/0'	5'/0'	10		10	0								
Doss Royalty 1-33	33-7N-12E	0	0	0	10'/4'	10'/4'	12		12	0								
Gladstein 1-34	34-7N-12E	0	0	0	4'/0'	4'/0'	8		8	0								
Stacy 1	35-7N-12E	0	0	0	0	0				0								
Richison 1	36-7N-12E	0	0	0	NPLA	NPLA	41		41	0								
Casey 1-36	36-7N-12E	0	0	0	18'/14'	0	13		13	0								
Brow 2-2	2-7N-13E	0	0	0	11'/0'	11'/0'	7		7	0								
Vaughan 2-2 B	2-7N-13E	0	0	0	NPLA	NPLA	2		2	0								
Howard 1-3	3-7N-13E	0	0	0	4'/0'	4'/0'	8		8	0								
Lee #1	6-7N-13E	0	0	0	NPLA	0	7		7	0								
Proctor #1	7-7N-13E	0	0	0	NPLA	NPLA	5		5	0								
Watkins 1-7	7-7N-13E	0	0	0	8'/0'	8'/0'	11		11	0								
Reed 1-7	7-7N-13E	0	0	0	10'/2'	10'/2'	11		11	0								
Wade 2-10	10-7N-13E	0	0	0	6'/0'	6'/0'	9		9	0								
Wadley 1-11	11-7N-13E	0	0	0	NPLA	NPLA	10		10	0								
Herman #1-12	12-7N-13E	0	0	0	0	0	43		43	0								
Wadley 1-12	12-7N-13E	0	0	0	NPLA	NPLA				0								
Ward 2-13	13-7N-13E	0	0	0	4'/0'	4'/0'	12		12	0								
Duncan #3	13-7N-13E	0	0	0	7'/2'	7'/2'	3		3	0								
Ward #1-13	13-7N-13E	0	0	0	9'/2'	9'/2'				0								
Duncan #1	13-7N-13E	0					25		25	0								
Graham #3	14-7N-13E	0	0	0	0	0	2		2	0								
Graham #1	14-7N-13E	0	0	0	2'/0	2'/0	4		4	0								
Graham #2	14-7N-13E	0	0	0	5'/2'	5'/2'	6		6	0								
Graham C #2	15-7N-13E	0	0	0	5'/1'	5'/1'				0								
Pearson 1-16	16-7N-13E	0	0	0	NPLA	0	9		9	0								

Well	Location	Gross Sand U HRSR (GR)	Net Sand U HRSR (>8%/>12%)	Net Pay U HRSR (>8%/>12%)	Net Sand L HRSR (>8%/>12%)	Net Pay L HRSR (>8%/>12%)	Gross Sand (LHRSR1)	Gross Sand (UHRSR1)	Gross Sand (LHRSR2)	Gross Sand (HRSR Undiff)	Net Sand U HRSR Inc Val (>8%/>12%)	Net Pay U HRSR Inc Val (>8%/>12%)	Net Sand L HRSR1 (>8%/>12%)	Net Pay L HRSR1 (>8%/>12%)	Net Sand HRSR Undiff (>8%/>12%)	Net Pay HRSR Undiff1 (>8%/>12%)	Net Sand L HRSR2 (>8%/>12%)	Net Pay L HRSR2 (>8%/>12%)
Crandell #1-18	18-7N-13E	0	0	0	7'/2'	7'/2'	10		10	0								
Crandell #1	18-7N-13E	0	0	0	8'/3'	8'/3'	17		17	0								
Mooneyham 1-18	18-7N-13E	0	0	0	12'/3'	12'/3'	15		15	0								
Rockey #2-18	18-7N-13E	0	0	0	14'/7'	14'/7'	21		21	0								
Bush 1-19	19-7N-13E	0	0	0	7'/2'	7'/2'	10		10	0								
Stergios #1-20	20-7N-13E	0	0	0	10'/2'	0	21		21	0								
Graham #1	22-7N-13E	0	0	0	NPLA	NPLA	0		0	0								
Pedersen #2	23-7N-13E	0	0	0	4'/0'	4'/0'	8		8	0								
Pederson #1	23-7N-13E	0	0	0	NPLA	NPLA	11		11	0								
Hitchcock 1-24	24-7N-13E	0	0	0	0	0				0								
Abney 1-24	24-7N-13E	0	0	0	2'/0'	2'/0'	1		1	0								
Abney 3-24	24-7N-13E	0	0	0	NPLA	NPLA				0								
Hill 1-24	24-7N-13E	0	0	0	6'/0'	6'/0'	6		6	0								
Whitehead 1-24	24-7N-13E	0	0	0	6'/0'	6'/0'	14		14	0								
Carver 1-25	25-7N-13E	0	0	0	7'/2'	7'/2'	12		12	0								
King #1	25-7N-13E	0	0	0	12'/2'	12'/2'	11		11	0								
King 2-25	25-7N-13E	0	0	0	0	0	2		2	0								
King 3-25	25-7N-13E	0	0	0	6'/0'	6'/0'	6		6	0								
King 4-25	25-7N-13E	0	0	0	15'/4'	15'/4'	11		11	0								
Frederick #1	26-7N-13E	0	0	0	6'/0'	6'/0'	3		3	0								
Collier 1-26	26-7N-13E	0	0	0	5'/2'	5'/2'	6		6	0								
Holt 1-28	28-7N-13E	0	0	0	7'/0'	7'/0'	12		12	0								
Holt 2-28	28-7N-13E	0	0	0	6'/0'	6'/0'	4		4	0								
Holt 1-29	29-7N-13E	0	0	0	3'/0'	3'/0'	11		11	0								
Walters 1-A	29-7N-13E	0	0	0	NPLA	NPLA	8		8	0								
Elbert 1-30	30-7N-13E	0	0	0	0	0	40		40	0								
Helen 1	33-7N-13E	0	0	0	12'/3'	12'/3'	5		5	0								
Lucille 2-34	34-7N-13E	0	0	0	94'/54'	0				0								
Lucille #1	34-7N-13E	0	0	0	93'/82'	46'/42'	107		107	0								
State 2-35	35-7N-13E	0	0	0	94'/84'	48'/44'	147		147	0								
State 1-35	35-7N-13E	0	0	0	92'/56'	36'/18'	186		186	0								
Madden 1-36	36-7N-13E	0	0	0	98'/86'	22'/12'	117		117	0								
Brite 1-36	36-7N-13E	0	0	0						0								
JWP 1-36	36-7N-13E	0	0	0	78'/42'	0	90		90	0								
Painter #2	36-7N-13E	0	0	0	5'/0'	5'/0'				0								
Sheena 1-36	36-7N-13E	0	0	0	10'/2'	10'/2'	16		16	0								
Sunshine 1-36	36-7N-13E	0	0	0	6'/0'	6'/0'				0								
White AF #1	36-7N-13E	0	0	0	54'/22'	0	100		100	0								
Willie Mae 1-36	36-7N-13E	0	0	0	114'/66'	0	127		127	0								

Appendix E: Formation Tops

Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Wildhorse #1	1-5N-11E	909			3226	-2317	3455	-2546	3184	-2275	3115	-2206
Oliver #1-3	3-5N-11E	879			3032	-2153	3233	-2354	2996	-2117	2930	-2051
Cities #1	4-5N-11E	944			3112	-2168	NDE		3077	-2133	3021	-2077
Lyons #1-6	6-5N-11E	787			3051	-2264	NDE		3014	-2227	2968	-2181
S&P 15-7	7-5N-11E	848			3154	-2306	NDE		3116	-2268	3062	-2214
Wirick #1	7-5N-11E	779			3031	-2252	3205	-2426	2992	-2213	2940	-2161
Bivings #1-9	9-5N-11E	990			3248	-2258	3444	-2454	3211	-2221	3145	-2155
Newby 1-9	9-5N-11E	952			3275	-2323	3461	-2509	3245	-2293	3184	-2232
Evans #1	10-5N-11E				3265	-3265	3478	-3478	3227	-3227	3166	-3166
Kenny 1-10	10-5N-11E	937			3223	-2286	3427	-2490	3184	-2247	3117	-2180
Jones #1	12-5N-11E	735			3181	-2446	NDE			735	3057	-2322
Wallace Fargo #1	12-5N-11E	718			3130	-2412	NDE		3105	-2387	3024	-2306
Stuart 1-13	13-5N-11E	710			3125	-2415	NDE		3100	-2390	3011	-2301
Anderson #1	14-5N-11E	771			3112	-2341	NDE		3075	-2304	2995	-2224
Null 1-14	14-5N-11E	779			3166	-2387	NDE		3132	-2353	3039	-2260
Ellis #1	15-5N-11E	827			3090	-2263	NDE		3052	-2225	2979	-2152
Cathy #1	16-5N-11E	889			3349	-2460	NDE		3313	-2424	3240	-2351
Ellis #1	16-5N-11E	796			3017	-2221	3218	-2422	2984	-2188	2912	-2116
McKoy Heirs #1	16-5N-11E					0		0	3053	-3053	2985	-2985
McKoy Heirs #2	16-5N-11E	764			2982	-2218	3186	-2422	2950	-2186	2875	-2111
Pearson #2	16-5N-11E	895			3160	-2265	3363	-2468	3125	-2230	3060	-2165
Bailey #1	17-5N-11E	1000			3367	-2367	3550	-2550	3330	-2330	3267	-2267
Artur #1	19-5N-11E	972			3394	-2422	NDE		3351	-2379		
Black J #1	20-5N-11E	983			3355	-2372	NDE		3317	-2334	3250	-2267
Mobil #1	20-5N-11E	950			3265	-2315	NDE		3226	-2276	3162	-2212
Hickory Hills #1	21-5N-11E	833			3274	-2441	3445	-2612		833	3172	-2339
Hickory Hills A #1	21-5N-11E	897			3240	-2343	NDE		3182	-2285	3046	-2149
Patterson #1	21-5N-11E	937			3124	-2187	3317	-2380	3087	-2150	3020	-2083
Travis P #1	21-5N-11E	883			3080	-2197	3283	-2400	3044	-2161	2972	-2089
Adams N #1	22-5N-11E	899			3138	-2239	3347	-2448	3106	-2207	3074	-2175
Berman 1-22	22-5N-11E	760			3005	-2245	NDE		2968	-2208	2893	-2133
Martin Unit #1	22-5N-11E	819			3169	-2350	NDE					
Duncan #1-A	23-5N-11E	843			3193	-2350	NDE				3075	-2232
Duncan Unit #1	23-5N-11E	756			3111	-2355	NDE				2988	-2232
Somerville #1	23-5N-11E	732			3090	-2358	3211	-2479	3057	-2325	2975	-2243
Somerville 2-23	23-5N-11E	810			3187	-2377	NDE		3160	-2350	3076	-2266
Fern A #1	24-5N-11E	737			3165	-2428	NDE		3118	-2381	3028	-2291
Loftis Unit #1	24-5N-11E	751			3144	-2393	NDE				3000	-2249
Loftis #1-25	25-5N-11E	751			3245	-2494	3482	-2731	3183	-2432	3102	-2351
Loftis 1-25	25-5N-11E	841			3206	-2365	NDE		3206	-2365	F/O	
Newton 1-25	25-5N-11E	779			3454	-2675	NDE		3412	-2633	3306	-2527
Loftis #1 "O"	26-5N-11E	841			3349	-2508	NDE			841		841
Woodford #1	26-5N-11E	794			3068	-2274	NDE		3035	-2241	2965	-2171
Holly B Trimm 1-27	27-5N-11E	839			3192	-2353	NDE			839	3102	-2263
Lackey #1	27-5N-11E	825			3100	-2275	3327	-2502		825	2995	-2170
Leon Adams 1-27	27-5N-11E	852			3224	-2372	NDE		3196	-2344	3103	-2251
Walker Heirs #1	27-5N-11E	812			3142	-2330	NDE		3101	-2289	3018	-2206
Walker Heirs 27-2	27-5N-11E	863			3220	-2357	3349	-2486	3185	-2322	3112	-2249
Herring #2	28-5N-11E	822			3134	-2312	NDE		3100	-2278	3015	-2193
Herring D-1	28-5N-11E	953			3218	-2265	3418	-2465	3175	-2222	3098	-2145
Trimm #1	28-5N-11E	850			3156	-2306	NDE			850	3034	-2184
Parks Estate 1-29	29-5N-11E	986	3266	-2280	3379	-2393	NDE		3340	-2354	3263	-2277
Vernon 1-29	29-5N-11E	990			3307	-2317	NDE		3264	-2274	3140	-2150
Wilbanks #1	29-5N-11E	946			3327	-2381	3513	-2567	3289	-2343	3220	-2274
C.C. Carter #1	30-5N-11E	950			3184	-2234	3317	-2367		950	3080	-2130
Derrick 1-30	30-5N-11E	927			3191	-2264	NDE		3147	-2220	3084	-2157
Wilbanks 3-30	30-5N-11E	922			3198	-2276	NDE		3152	-2230	3085	-2163
Huffman 1-32	32-5N-11E	893			3502	-2609	NDE		3454	-2561	3373	-2480
Mark 1-32	32-5N-11E	865			3835	-2970	NDE			865	3682	-2817
Norvell 32-1	32-5N-11E	801			3624	-2823	3818	-3017		801		801
Loftis 1-33 (Formor Op)	33-5N-11E	835			3210	-2375	NDE		3160	-2325	3090	-2255
Loftis 33-1	33-5N-11E	892			3363	-2471	3544	-2652	3318	-2426	3246	-2354
Martin 1-33	33-5N-11E	881			3294	-2413	NDE		3256	-2375	3165	-2284
Lackey B Unit #1	34-5N-11E	855			3185	-2330	NDE		3160	-2305	3026	-2171
Lackey Unit #1	34-5N-11E	860			3241	-2381	NDE			860	3095	-2235
Hall E #1	35-5N-11E	898			3392	-2494	NDE			898	3274	-2376
Shirley #1 (Joe D.Davis)	36-5N-11E	806			3717	-2911	NDE		3670	-2864	3554	-2748
Shirley #1 (Viking Pet)	36-5N-11E	790			3417	-2627	NDE		3379	-2589	3278	-2488
Marbet #19	1-5N-12E	799			3370	-2571	3548	-2749	3337	-2538	3229	-2430
Sherrill #1	2-5N-12E	754			3224	-2470	NDE			754		754
Sherrill 3-2	2-5N-12E	789			3253	-2464	NDE		3208	-2419	3117	-2328
Everett #1	3-5N-12E	845			3310	-2465	3465	-2620	3264	-2419	3168	-2323

Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Semeski 1-3	3-5N-12E	862			3243	-2381	3395	-2533	3202	-2340	3109	-2247
Gwinn 1-5	5-5N-12E	727			3208	-2481	3350	-2623	3172	-2445	3104	-2377
Thelma Lee 1-6	6-5N-12E	866			3243	-2377	NDE		3214	-2348	3137	-2271
Bethel #1	9-5N-12E	779	3086	-2307	3211	-2432	NDE		3170	-2391	3027	-2248
Bethel #3-9	9-5N-12E	819			3304	-2485	NDE		3260	-2441	3166	-2347
Cooper #1	10-5N-12E	862	3200	-2338	3338	-2476	NDE			862		862
Crawford 1-10	10-5N-12E	864	3186	-2322	3331	-2467	3484	-2620	3283	-2419	3181	-2317
Watkins #1	10-5N-12E	848			3300	-2452	NDE		3253	-2405	3154	-2306
Willard 1-10	10-5N-12E	824			3269	-2445	NDE		3222	-2398	3123	-2299
Marvin #1	11-5N-12E	786			3370	-2584	3539	-2753	3354	-2568	3220	-2434
Marvin #4	11-5N-12E	815			3332	-2517	NDE			815		815
Marvin #5	11-5N-12E	819			3345	-2526	NDE			819	3197	-2378
Orr B #1	11-5N-12E	845			3308	-2463	3465	-2620	3261	-2416	3166	-2321
Marbet #17	12-5N-12E	778	3258	-2480	3386	-2608	NDE		3359	-2581	3252	-2474
Owen "B" #1	12-5N-12E	786	3266	-2480	3403	-2617	NDE		3372	-2586	3262	-2476
Watt #1	12-5N-12E	727				727	3696	-2969	3434	-2707	3335	-2608
Elliot #1	14-5N-12E	819			3457	-2638	NDE		3394	-2575	3288	-2469
Mcauley #2-14	14-5N-12E	832			3451	-2619	NDE		3400	-2568	3273	-2441
Valente #1	14-5N-12E	843				843	NDE		3410	-2567	3300	-2457
Wageman #1	14-5N-12E	752			3387	-2635	NDE		3358	-2606	3245	-2493
Rheinhart #1	15-5N-12E	791			3293	-2502	NDE		3247	-2456	3135	-2344
Vaughn #1	15-5N-12E	750	3200	-2450	3344	-2594	NDE		3300	-2550	3191	-2441
Wilcox 1-15	15-5N-12E	728			3248	-2520	NDE		3204	-2476	3096	-2368
Black 1-16	16-5N-12E	785			3318	-2533	3463	-2678	3262	-2477	3163	-2378
Donna #1-16	16-5N-12E	776	3120	-2344	3266	-2490	NDE		3217	-2441	3112	-2336
Goode #1	16-5N-12E				3218	-3218	3379	-3379	3169	-3169	3066	-3066
J.W. Adams #1-16	16-5N-12E	708			3209	-2501	NDE		3160	-2452	3058	-2350
Brown 1-17	17-5N-12E	750			3208	-2458	NDE		3220	-2470	3125	-2375
John Black G #1	17-5N-12E	792			3322	-2530	NDE		3278	-2486	3177	-2385
Kristy Lee 1-17	17-5N-12E	753	2947	-2194	3213	-2460	NDE		3177	-2424	3080	-2327
Tag Team Brown 1-17	17-5N-12E	736	3131	-2395	3257	-2521	NDE			736		736
Black #1	20-5N-12E	822			3534	-2712	3660	-2838	3486	-2664	3380	-2558
Tim #1-20	20-5N-12E	789			3398	-2609	NDE		3353	-2564	3248	-2459
Gattet 4-21	21-5N-12E	805			3433	-2628	NDE		3393	-2588	3273	-2468
Gattett 3-21?	21-5N-12E	847			3334	-2487	NDE			847		847
Jennifer 2-21	21-5N-12E	754			3314	-2560	NDE		3275	-2521	3158	-2404
Ott 2-22	22-5N-12E	787			3304	-2517	NDE			787	3164	-2377
Ott 4-22	22-5N-12E	820			3318	-2498	NDE		3278	-2458	3162	-2342
Loftis #1	23-5N-12E	729			3288	-2559	nde		3265	-2536		729
O. Morris 3-24	24-5N-12E	689			3228	-2539	3496	-2807		689	3118	-2429
Ossie Morris #1	24-5N-12E	690			3187	-2497	NDE		3161	-2471		690
E.E. Working Unit #1	25-5N-12E	749			3285	-2536	NDE		3255	-2506	3168	-2419
Davis Unit #1	26-5N-12E	717			3287	-2570	NDE		3262	-2545		717
Black A #3	27-5N-12E	681			3279	-2598	3428	-2747	3230	-2549		681
Black A #5	27-5N-12E	807			3368	-2561	NDE		3333	-2526	3216	-2409
Garrett "A" Unit #1	27-5N-12E	678			3270	-2592	NDE		3228	-2550		678
A.B. Capp #1	28-5N-12E	822			3466	-2644	NDE		3424	-2602	3304	-2482
Black 3-28	28-5N-12E	777			3371	-2594	NDE		3330	-2553	3216	-2439
Hall #1	29-5N-12E	762			3493	-2731	NDE		3448	-2686	3327	-2565
Trimm #1	29-5N-12E				3611	-3611	3889	-3889	3571	-3571	3453	-3453
Rogers 1-30	30-5N-12E	828			3616	-2788	NDE		3575	-2747	3453	-2625
Hall #1	31-5N-12E	807			3710	-2903	3865	-3058	3668	-2861		807
Bennet Hall #1	32-5N-12E	789			3662	-2873	3858	-3069	3625	-2836		789
J.W. Hall Unit #1	32-5N-12E	745			3552	-2807	NDE		3508	-2763		745
Reed #1	33-5N-12E	806			3576	-2770	NDE		3530	-2724	3422	-2616
Trapp #1-33	33-5N-12E	803			3484	-2681	NDE		3442	-2639		803
Trapp Unit #1	33-5N-12E	761			3486	-2725	NDE		3447	-2686	3322	-2561
Apache Paschall #1	34-5N-12E	717			3450	-2733	3703	-2986	3419	-2702		717
Davis Paschall #1	34-5N-12E	855			3573	-2718	NDE			855		855
Wright-Wood Unit #1	34-5N-12E	703			3458	-2755	3622	-2919	3408	-2705	3288	-2585
S. McDonald Unit #1	35-5N-12E	681			3375	-2694	NDE		3348	-2667	3250	-2569
Depot #1	36-5N-12E	737			3485	-2748	3740	-3003	3454	-2717	3368	-2631
Thompson #1	1-5N-13E		3464	-3464	3497	-3497	3658	-3658	3428	-3428	3324	-3324
Watkins #2	2-5N-13E	725	3446	-2721	3479	-2754	3619	-2894	3402	-2677	3298	-2573
Food #2	3-5N-13E	678	3204	-2526	3350	-2672	NDE		3321	-2643	3201	-2523
Food Unit #1	3-5N-13E	655	3203	-2548	3332	-2677	NDE		3305	-2650	3190	-2535
Peters #1	3-5N-13E	658			3200	-2542	NDE					
Gibson-Lindsey Unit #1	4-5N-13E	646	3230	-2584	3342	-2696	NDE		3309	-2663	3213	-2567
Thornton #1	5-5N-13E	761			3510	-2749	NDE					
Thornton #1	5-5N-13E	761			3490	-2729	NDE		3474	-2713	3375	-2614
Stipe #1	6-5N-13E	815			3462	-2647	NDE		3432	-2617	3322	-2507

Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Stipe #1-6	6-5N-13E	788	3422	-2634	3457	-2669	3505	-2717				
Stipe #1-6	6-5N-13E	815	3413	-2598	3492	-2677	NDE		3390	-2575	3276	-2461
Stipe 1-6	6-5N-13E	788				788				788		
Firestone Unit #1	7-5N-13E	777			3434	-2657	NDE		3456	-2679	3368	-2591
Reynolds #1	7-5N-13E	674			3317	-2643	NDE		3297	-2623		
Buse 1	8-5N-13E	836			3495	-2659	NDE		3470	-2634	3375	-2539
W.C. Wallace Unit #1	9-5N-13E	655				655	NDE		3268	-2613	3175	-2520
Wallance #2	9-5N-13E					0		0	3316	-3316	3188	-3188
Gibson 1-10	10-5N-13E	745	3440	-2695	3470	-2725	NDE		3410	-2665	3290	-2545
Grant 1-10	10-5N-13E	805	3546	-2741	3584	-2779	NDE		3502	-2697	3386	-2581
Winnie #1	10-5N-13E	651				651			3297	-2646	3190	-2539
Watkins #1	11-5N-13E	774	3543	-2769	3573	-2799	3811	-3037	3502	-2728	3402	-2628
Core Energy Watkins #1	12-5N-13E	698	2765	-2067	2813	-2115	3050	-2352	2705	-2007	2565	-1867
Field Heirs #1	13-5N-13E	796				796	NDE		3380	-2584	3295	-2499
Glennie #1-13	13-5N-13E	665	2392	-1727	2448	-1783	2635	-1970	F/O? 2311'		F/O?	
Marbet #31	14-5N-13E	681	2727	-2046	2780	-2099	NDE		F/O? 2690'		2596	-1915
Sandra #1-13	13-5N-13E	727				727				727		727
Watson #1	13-5N-13E	666	2523	-1857	2575	-1909			2466	-1800		666
Ramsey #1	14-5N-13E	716	3005	-2289	3051	-2335	3206	-2490	2946	-2230	2778	-2062
Watkins 114	14-5N-13E	757	3398	-2641	3440	-2683	NDE		3350	-2593	3230	-2473
Eggleston 1-15	15-5N-13E	904	3563	-2659	3601	-2697	NDE		3516	-2612		904
Investors Royalty	15-5N-13E	828	3430	-2602	3485	-2657	3744	-2916	3405	-2577	3300	-2472
Marbet #37	15-5N-13E	808	3388	-2580	3435	-2627	NDE		3342	-2534	3233	-2425
Mason 1-15	15-5N-13E	785	3378	-2593	3430	-2645	3655	-2870	3329	-2544	3230	-2445
L.W. Chandler #1-1	16-5N-13E	748	3406	-2658	3456	-2708	NDE		3377	-2629	3289	-2541
W.P. Rock #1	17-5N-13E	744				744		744	3314	-2570		744
W.P. Rock #2	17-5N-13E	659			3276	-2617		659	3250	-2591		659
Robbins Unit #1	18-5N-13E	667				667		667		667	3130	-2463
Hazelwood #1	19-5N-13E	795			3351	-2556	NDE			795		795
Crawley #1-21	21-5N-13E	732	3324	-2592	3364	-2632	NDE		3275	-2543	3160	-2428
Virgil 1-22	22-5N-13E	751	3330	-2579	3374	-2623	3588	-2837	3288	-2537	3167	-2416
Marbet #25	23-5N-13E	715	2909	-2194	2961	-2246	NDE		2848	-2133	2711	-1996
Marbet #32	23-5N-13E	680	2812	-2132	2862	-2182	NDE		2748	-2068		
Deer Creek #1	24-5N-13E	681	2681	-2000	2742	-2061	2932	-2251	2642	-1961		
Parks 1	1-6N-10E				2861	-2861	2970	-2970	2840	-2840	2816	-2816
Parks 2	1-6N-10E				2908	-2908	3009	-3009	2886	-2886	2860	-2860
Lytal #1	11-6N-10E				2849	-2849	2947	-2947	2835	-2835	2800	-2800
Degraffenried #1	12-6N-10E				2758	-2758	2872	-2872	2735	-2735	2708	-2708
Cecil Gumm	13-6N-10E				2998	-2998	3123	-3123	2966	-2966	2936	-2936
Warren 1	4-6N-11E				3000	-3000	NDE		2972	-2972	2935	-2935
Eckles 1-5	5-6N-11E				2856	-2856	2987	-2987	2835	-2835	2804	-2804
Walter 1-5	5-6N-11E				3179	-3179	NDE		3162	-3162	3120	-3120
Boyd #1	7-6N-11E				2751	-2751	2870	-2870	2740	-2740	2700	-2700
Boyd 2	7-6N-11E	747			2727	-1980	NDE		2707	-1960	2674	-1927
Herrod #1	7-6N-11E				2764	-2764	2881	-2881	2740	-2740		0
Black #2	9-6N-11E				2981	-2981	NDE		2949	-2949	2905	-2905
Black #1	9-6N-11E				2947	-2947	NDE		2917	-2917	2872	-2872
Black 4	9-6N-11E				2894	-2894	NDE		2860	-2860	2812	-2812
Warren 1	9-6N-11E				3030	-3030	NDE			0		0
Black #3	10-6N-11E				2912	-2912	NDE		2880	-2880	2832	-2832
Gayler 1-10	10-6N-11E				2991	-2991	NDE		2955	-2955	2906	-2906
Geneva 1-10	10-6N-11E				2907	-2907	NDE	#VALUE!	2877	-2877	2838	-2838
McDonald 1-10	10-6N-11E				2955	-2955	NDE		2917	-2917	2869	-2869
Hill 1-11	11-6N-11E				3191	-3191	NDE		3154	-3154	3106	-3106
Blevins 1-12	12-6N-11E				3191	-3191	3320	-3320	3152	-3152	3096	-3096
Gill 1	12-6N-11E				3111	-3111	3274	-3274	3073	-3073	3022	-3022
Ballinger 1-13	13-6N-11E				3395	-3395	NDE		3353	-3353	3240	-3240
Ballinger 3-13	13-6N-11E				3322	-3322	NDE		3280	-3280	3283	-3283
Ballinger 4-13	13-6N-11E				3366	-3366	NDE		3326	-3326	3274	-3274
Blevins 1-13-C	13-6N-11E				3206	-3206	NDE		3164	-3164	3107	-3107
Blevins A-1	13-6N-11E				3318	-3318	NDE		3273	-3273	3215	-3215
Hill 4-14	14-6N-11E				3145	-3145	NDE		3107	-3107	3057	-3057
Parker 1-14	14-6N-11E	650			3052	-2402	NDE		3012	-2362	2965	-2315
Hill 2-15	15-6N-11E				3150	-3150	NDE		3113	-3113	3062	-3062
Smoker 1-17	17-6N-11E				2984	-2984	3142	-3142	2950	-2950		0
Aldridge 1-18	18-6N-11E				2961	-2961	NDE		2931	-2931	2892	-2892
Nail 1-18	18-6N-11E				2910	-2910	NDE		2877	-2877	2847	-2847
Rahhal A-1	18-6N-11E				2886	-2886	NDE		2854	-2854	2817	-2817
Smoke 1-18	18-6N-11E				2910	-2910	NDE		2876	-2876	2837	-2837
Blaylock 1-19	19-6N-11E				3080	-3080	NDE		3052	-3052	3011	-3011
Ellen 1-19	19-6N-11E				2950	-2950	3098	-3098	2913	-2913	2843	-2843

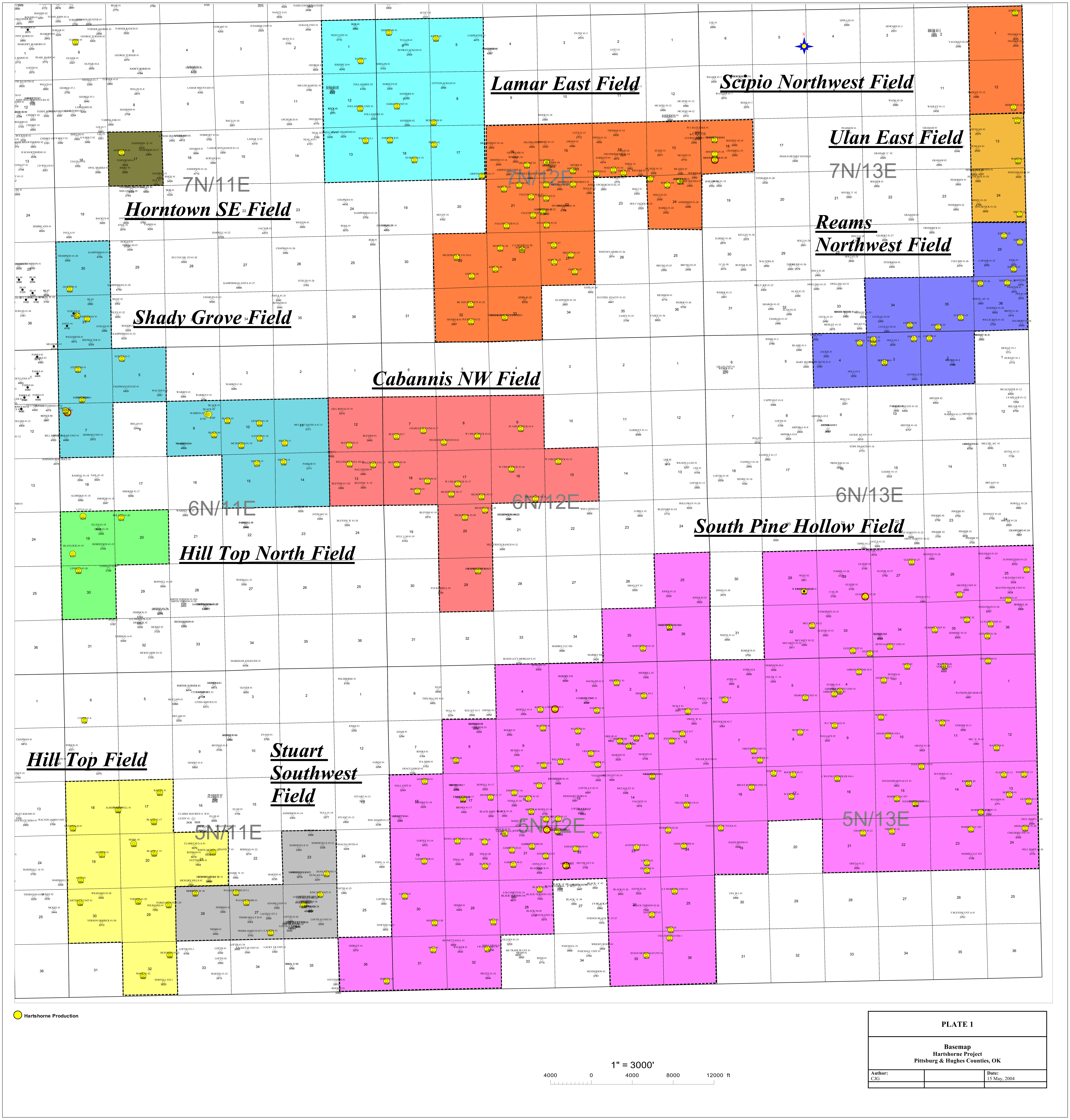
Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Little 1-19	19-6N-11E				2980	-2980	NDE		2947	-2947	2906	-2906
Robertson 1-19	19-6N-11E				3050	-3050	NDE		3013	-3013	2968	-2968
Roland 1-20	20-6N-11E				3131	-3131	NDE		3098	-3098	3054	-3054
Blevins 'B' 1-24	24-6N-11E				3322	-3322	NDE		3278	-3278	3220	-3220
Smith 1-28	28-6N-11E				3050	-3050			3010	-3010	2960	-2960
Smith 1-28	28-6N-11E				3048	-3048	3229	-3229				
Vernon Smith 1-28	28-6N-11E				3011	-3011	NDE		2974	-2974	2917	-2917
Derrick 1-29	29-6N-11E				2982	-2982	3145	-3145	2948	-2948	2898	-2898
McKee 1-29	29-6N-11E				2942	-2942	3113	-3113	2910	-2910	2854	-2854
Lindley 1-30	30-6N-11E				3029	-3029	3194	-3194	2992	-2992	2950	-2950
Lindley 2-30	30-6N-11E				2966	-2966	NDE		2928	-2928	2882	-2882
McKee 3-32	32-6N-11E				3020	-3020	NDE		2985	-2985	2934	-2934
Richardson 1	33-6N-11E				3051	-3051	3225	-3225	3016	-3016		
Blevins 1-7	7-6N-12E	985			3371	-2386	NDE		3330	-2345	3282	-2297
Hilseweck 1-8	8-6N-12E				3454	-3454						
Hilseweck 1-8	8-6N-12E				3456	-3456	NDE		3410	-3410	3345	-3345
Hilseweck 2-8	8-6N-12E				3419	-3419	NDE		3372	-3372	3316	-3316
Hilseweck 1-9	9-6N-12E	1025			3426	-2401	NDE		3380	-2355	3325	-2300
Garrett 1-11	11-6N-12E								3178	-3178	3114	-3114
Loftis 1-13	13-6N-12E				2533	-2533			2490	-2490	F/O?	
Hilseweck 1-15	15-6N-12E						NDE		3298	-3298	3224	-3224
Hilsewck 1-16	16-6N-12E				3436	-3436	3612	-3612	3391	-3391	3333	-3333
Hilseweck 2-17	17-6N-12E		3321	-3321	3422	-3422	NDE		3378	-3378	3316	-3316
Hilseweck 3-17	17-6N-12E				3228	-3228	NDE		3184	-3184	3122	-3122
Blevins 1-18	18-6N-12E				3350	-3350	NDE		3306	-3306	3246	-3246
Blevins 2-18	18-6N-12E				3288	-3288	NDE		3248	-3248	2193	-2193
Blevins 9-18	18-6N-12E				3272	-3272	NDE		3218	-3218	3170	-3170
Blevins 1-19	19-6N-12E				3440	-3440	NDE		3386	-3386	3330	-3330
Hilseweck 1-20	20-6N-12E				3294	-3294	NDE		3253	-3253	3188	-3188
Hilseweck 3-20	20-6N-12E				3286	-3286	NDE			0	3194	-3194
Hilseweck 5-21	21-6N-12E	904			3458	-2554	NDE		3412	-2508	3341	-2437
Hilseweck Ranch 1-21	21-6N-12E	764			3345	-2581	NDE		3312	-2548	3240	-2476
William G. Jones #1	22-6N-12E	886			3416	-2530	3677	-2791	3377	-2491	3304	-2418
Lubell 1-23	23-6N-12E	795			3318	-2523			3278	-2483	3200	-2405
Smalley 1	26-6N-12E				3374	-3374	NDE		3344	-3344	3272	-3272
Hilseweck 1-29	29-6N-12E				3684	-3684			3645	-3645	3568	-3568
Ashley 1-1	1-6N-13E	665	2420	-1755	2519	-1854			2486	-1821	2420	-1755
Durant 1-1	1-6N-13E	670			2470	-1800	NDE		2440	-1770	2376	-1706
McKay 1-1	1-6N-13E	677			2480	-1803				677	2367	-1690
Brown Estate 1-2	2-6N-13E	768			2725	-1957	3004	-2236	2695	-1927	2620	-1852
Carter 1-2	2-6N-13E	711			2544	-1833	2938	-2227	2508	-1797	2439	-1728
Holt J #1	3-6N-13E	722	2431	-1709	2532	-1810	nde		2501	-1779	2429	-1707
Holt J #2	3-6N-13E				2697	-2697	NDE		2675	-2675	2607	-2607
Jaynelle #1	3-6N-13E	982			2983	-2001	3375	-2393	2952	-1970	2882	-1900
Holt 1-4	4-6N-13E	875	2606	-1731	2697	-1822	3051	-2176	2603	-1728	2676	-1801
Jessie 1-5	5-6N-13E	755			2659	-1904	NDE					
Gillin #1	6-6N-13E	734			2729	-1995	NDE					
Capps Day 1-8	8-6N-13E	720			2842	-2122	NDE		2810	-2090	2741	-2021
Arpoika #1-9	9-6N-13E	238	2839	-2601	2937	-2699	NDE					238
Banks Estate #1	10-6N-13E	705			2810	-2105	3057	-2352	2783	-2078	2700	-1995
Minter #1-10	10-6N-13E	694			2961	-2267	3231	-2537	2917	-2223	2828	-2134
Menefee #1	11-6N-13E	674	2659	-1985	2768	-2094	NDE					
Minter #2-11	11-6N-13E	750			2856	-2106	3134	-2384	2826	-2076	2752	-2002
Warren #1-11	11-6N-13E	712			2924	-2212			2884	-2172	2794	-2082
J.N. Miller #1 (12)	12-6N-13E	705	2715	-2010	2715	-2010	3017	-2312	2667	-1962	2581	-1876
J.N. Miller #2-12	12-6N-13E	693	2750	-2057	2750	-2057	3057	-2364	2700	-2007	2609	-1916
McAlester #1	12-6N-13E	697			2764	-2067	2956	-2259	2608	-1911	2520	-1823
Bryant #1	13-6N-13E	730	3197	-2467	3197	-2467	3452	-2722	3140	-2410		
Miller "AG" #1	13-6N-13E	705	2916	-2211	2916	-2211	3232	-2527	2859	-2154	2767	-2062
Sittel #1-13	13-6N-13E	682	2977	-2295	2977	-2295	3295	-2613	2924	-2242	2831	-2149
Ashley #1	14-6N-13E	705	2944	-2239	2944	-2239	3160	-2455	2887	-2182	2789	-2084
Gaddy 1-15	15-6N-13E	686			3202	-2516	3428	-2742				
Phoebe #1	23-6N-13E	673	3448	-2775	3460	-2787			3410	-2737	3298	-2625
Phoebe #2	23-6N-13E		3446	-3446	3446	-3446	3626	-3626	3395	-3395	3283	-3283
Crawford 1-24	24-6N-13E	649			3448	-2799	3650	-3001	3365	-2716	3230	-2581
Powell 1-24	24-6N-13E	631	3114	-2483	3259	-2628	3502	-2871	3209	-2578	3104	-2473
Frank Blevins Unit #1	25-6N-13E	785			3672	-2887	NDE		3640	-2855	3555	-2770
Leo #1	25-6N-13E	618			3705	-3087	3950	-3332			3588	-2970
Archer Unit #1	26-6N-13E	772			3687	-2915	NDE		3655	-2883	3565	-2793
Gray #1	26-6N-13E	750			3665	-2915	NDE		3636	-2886	3543	-2793
Gleese 1-27	27-6N-13E	644	3592	-2948	3595	-2951	3790	-3146	3538	-2894	3429	-2785

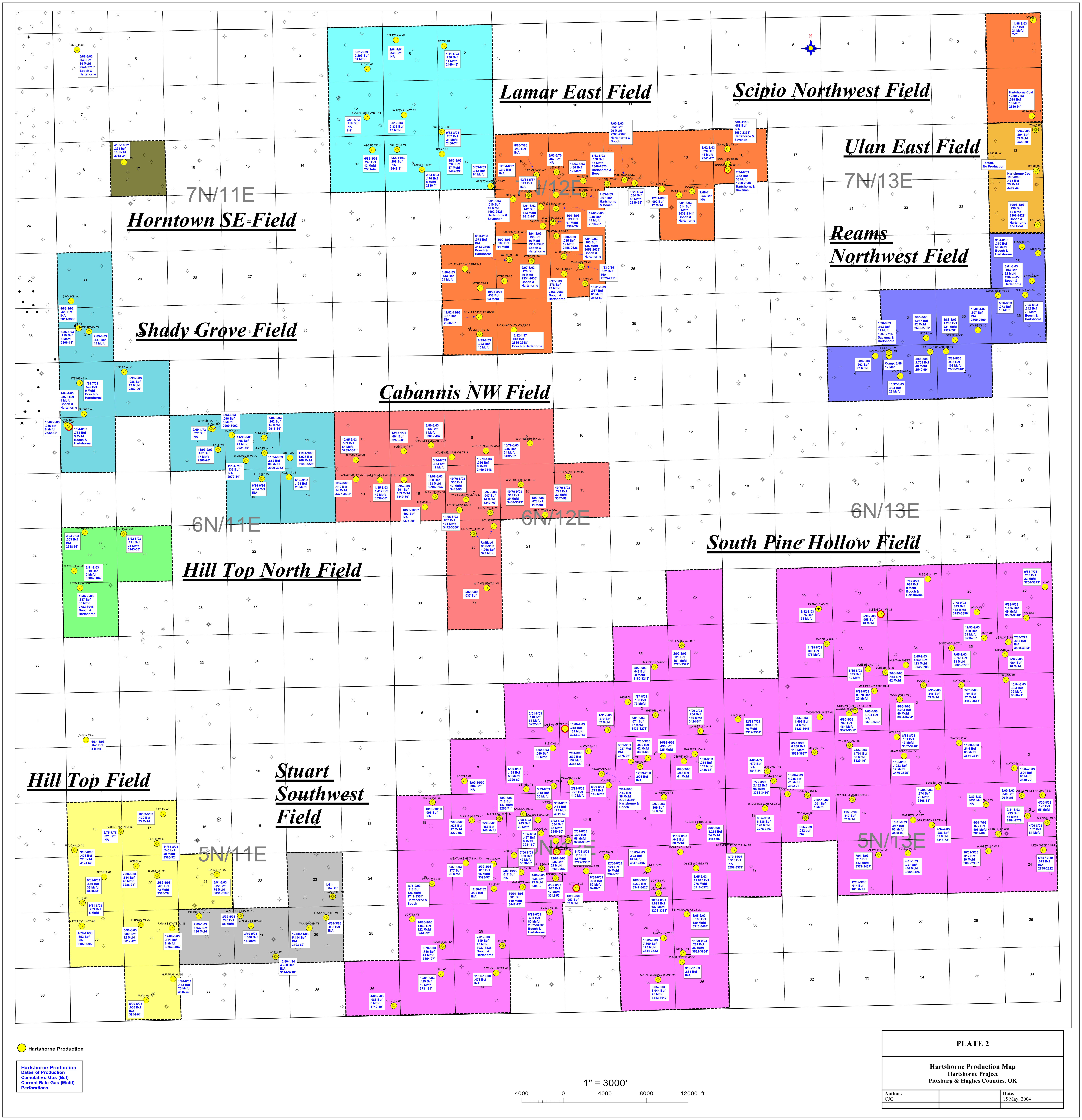
Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Steed 27-1	27-6N-13E	756				756			3648	-2892	3523	-2767
Gleese A #1-28	28-6N-13E	670	3652	-2982	3662	-2992	3820	-3150	3610	-2940	3489	-2819
Francis 1-29 (11?)	29-6N-13E	779			3681	-2902	NDE		2628	-1849	3528	-2749
West #2	29-6N-13E	778			3680	-2902	3885	-3107				
Roberts #1	31-6N-13E	760	3432	-2672	3459	-2699	3663	-2903	3396	-2636	3294	-2534
White #1-31	31-6N-13E	811	3427	-2616	3456	-2645	NDE		3398	-2587	3299	-2488
Gleese Unit #1	33-6N-13E	785			3602	-2817	NDE		3540	-2755	3430	-2645
Buddy #1-X	34-6N-13E	773			3545	-2772					3430	-2657
Hunt Garret Unit #1	34-6N-13E	805			3825	-3020	NDE		3485	-2680		805
Dominic Unit #1	35-6N-13E	802			3588	-2786	NDE		3551	-2749	3460	-2658
Engleman 1-36	36-6N-13E	802			3775	-2973	??			802		802
Howell #1	36-6N-13E	634	3434	-2800	3637	-3003	NDE		F/O? 3598		3427	-2793
LeFlore #1	36-6N-13E	643			3522	-2879	NDE		3482	-2839	3388	-2745
LeFlore 1-36	36-6N-13E	639	3336	-2697	3484	-2845			3455	-2816	3348	-2709
Bob #1	1-7N-11E	741			2365	-1624	2412	-1671	2345	-1604	2318	-1577
Jeremy D #1	1-7N-11E	774			2424	-1650	NDE		2407	-1633	2378	-1604
Kleine Unit #1	1-7N-11E	703			2338	-1635	2445	-1742	2313	-1610	2297	-1594
West Unit #1	1-7N-11E	740			2434	-1694	2531	-1791	2414	-1674		740
Eckles Unit 1	2-7N-11E	761			2409	-1648	2496	-1735	2390	-1629	2370	-1609
George #1	2-7N-11E	717			2458	-1741	2553	-1836	2437	-1720	2410	-1693
Huff 1-2	2-7N-11E	755			2433	-1678	2521	-1766	2415	-1660	2389	-1634
Cowart #1	3-7N-11E	946			2680	-1734	2762	-1816				
D. Harris #1	3-7N-11E	846			2571	-1725	NDE		2556	-1710	2537	-1691
Lee Epps #1	4-7N-11E	720			2396	-1676	NDE		2362	-1642	2298	-1578
Nancy Harjo 1	4-7N-11E	901			2727	-1826	2806	-1905	2698	-1797	2714	-1813
Sarah #1-4	4-7N-11E	932			2862	-1930	2942	-2010	2845	-1913	2822	-1890
Thompson 1	4-7N-11E	836			2863	-2027	2944	-2108	2854	-2018	2885	-2049
Turner 1	5-7N-11E	944			2730	-1786	2806	-1862	2716	-1772	2695	-1751
Turner Ranch 1	5-7N-11E	995			2775	-1780	2852	-1857	2762	-1767	2742	-1747
B. Bear 1	6-7N-11E				2695	-2695	2768	-2768	2682	-2682	2664	-2664
George Turner 2	6-7N-11E	947			2688	-1741	2762	-1815	2674	-1727	2655	-1708
Oliver 1	6-7N-11E	907			2664	-1757	2733	-1826	2650	-1743	F/O	
Turner 5	6-7N-11E	938			2704	-1766	2777	-1839	2690	-1752	2672	-1734
George 7-1	7-7N-11E	937			2719	-1782	2791	-1854	2705	-1768		
Lankford 2	7-7N-11E	884			2729	-1845	2804	-1920	2715	-1831	2694	-1810
Lankford 3	7-7N-11E	906			2696	-1790	2768	-1862	2682	-1776	2662	-1756
Lee 1	7-7N-11E	918			2732	-1814	2812	-1894	2719	-1801	2699	-1781
Thomas 1	7-7N-11E	960			2718	-1758	2790	-1830	2702	-1742	2684	-1724
Turner	8-7N-11E	1027			2800	-1773	NDE		2786	-1759	2767	-1740
Welch 1-8	8-7N-11E	946			2790	-1844	NDE		2774	-1828	2752	-1806
Yaroslaski #1	8-7N-11E	988			2818	-1830	2904	-1916	2806	-1818	2784	-1796
Lamar Mt. #1	9-7N-11E	1000			2860	-1860	2939	-1939	2845	-1845	2830	-1830
Baca #1-10	10-7N-11E	856			2696	-1840	2794	-1938	2680	-1824	2654	-1798
Freeman 1	11-7N-11E	807			2479	-1672	2580	-1773	2462	-1655	2430	-1623
Miller #1	11-7N-11E	753			2474	-1721	2575	-1822	2450	-1697		
Upchurch #1	11-7N-11E	771			2514	-1743	2614	-1843	2490	-1719		
Follansbee #2	12-7N-11E	765			2396	-1631	2507	-1742	2378	-1613	2349	-1584
Beck #1	12-7N-11E	786			2411	-1625	2514	-1728	2394	-1608	2366	-1580
M.B. White #1	13-7N-11E	782			2444	-1662	2552	-1770	2430	-1648	2400	-1618
White #12-1	13-7N-11E	841			2490	-1649	2610	-1769	2472	-1631	2442	-1601
Neal #1-14	14-7N-11E	798			2473	-1675	2582	-1784	2456	-1658	2434	-1636
Neal #2	14-7N-11E	790			2474	-1684	2583	-1793	2457	-1667	2442	-1652
Lamar #15	15-7N-11E	797			2610	-1813	2710	-1913	2594	-1797	2566	-1769
Adamas #1	16-7N-11E	1058			2934	-1876	3029	-1971	2920	-1862	2894	-1836
Anderson #1	16-7N-11E	1012			2926	-1914	3018	-2006	2911	-1899	2888	-1876
Anderson 1-16	16-7N-11E	1074			2918	-1844	3017	-1943	2902	-1828	2878	-1804
Scruggs #1	16-7N-11E	1098			2964	-1866	3068	-1970	2950	-1852		1098
Anderson "Q" #1	17-7N-11E	917			2837	-1920	2928	-2011	2822	-1905	2800	-1883
Anderson 2-17	17-7N-11E	932			2798	-1866	2891	-1959	2783	-1851	2760	-1828
Anderson No. 1	17-7N-11E	1009			2909	-1900	2997	-1988	2894	-1885	2873	-1864
Jerry #1	17-7N-11E				2808	-2808	2898	-2898	2789	-2789	2765	-2765
Bolt #1	18-7N-11E	876			2672	-1796	2748	-1872	2658	-1782	2639	-1763
Bolt #2	18-7N-11E	971			2762	-1791	2840	-1869	2750	-1779	2738	-1767
Coats 1-18	18-7N-11E	898			2761	-1863	2847	-1949	2746	-1848	2726	-1828
Lee #2	18-7N-11E	986			2757	-1771	2841	-1855	2794	-1808		
Shields #1	18-7N-11E	898			2696	-1798	2774	-1876	2683	-1785	2662	-1764
Backus #1	19-7N-11E	864			2800	-1936	2890	-2026	2781	-1917	2761	-1897
Paula #1	19-7N-11E	918			2906	-1988	2993	-2075	2887	-1969	2865	-1947
Anita 1-20	20-7N-11E				2758	-2758	2853	-2853	2740	-2740	2714	-2714
Eckles A-1	20-7N-11E	771			2538	-1767	2636	-1865	2522	-1751	2497	-1726
Farris #1	20-7N-11E	778			2796	-2018	2896	-2118	2778	-2000	2755	-1977

Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Schilling #1-20	20-7N-11E	799			2810	-2011	2904	-2105	2595	-1796	2572	-1773
Factor #1	22-7N-11E	796			2627	-1831	2746	-1950	2609	-1813	2580	-1784
Weston 1	23-7N-11E	798			2589	-1791	2717	-1919	2570	-1772	2538	-1740
Chapman #1	24-7N-11E	866			2652	-1786	2772	-1906	2630	-1764	2600	-1734
Kamperman 1-24	24-7N-11E	789			2593	-1804	NDE		2567	-1778	2542	-1753
Rosa #1	24-7N-11E	806			2584	-1778	2719	-1913	2561	-1755	2529	-1723
Bob #1	25-7N-11E	896			2705	-1809	2826	-1930	2679	-1783	2635	-1739
Chapman 1-26	26-7N-11E	815			2634	-1819	2768	-1953	2618	-1803	F/O	
Eckles 1-26	26-7N-11E	834			2960	-2126	3090	-2256	2931	-2097	2895	-2061
Kamperman 1-27	27-7N-11E	833			2962	-2129	3089	-2256	2936	-2103	2904	-2071
Lott 1-28	28-7N-11E								2865	-2865	2836	-2836
Sultan Oil #1-28	28-7N-11E	803			2890	-2087	3006	-2203	2865	-2062	2836	-2033
Douglass #1	29-7N-11E	874			2811	-1937	2906	-2032	2792	-1918		
Eckles #1	29-7N-11E	856			2818	-1962	2918	-2062	2799	-1943	2772	-1916
Kamperman 1-29	29-7N-11E	857			2900	-2043	3009	-2152	2880	-2023	2852	-1995
Jackson #1	30-7N-11E	750			2799	-2049	2900	-2150	2778	-2028	2750	-2000
Kamperman 1-30	30-7N-11E	927			2950	-2023	3045	-2118	2929	-2002	2902	-1975
Thompson 1-30	30-7N-11E	863			2926	-2063	NDE		2905	-2042	2881	-2018
Anita #1	31-7N-11E	854			2906	-2052	3008	-2154	2885	-2031	2858	-2004
B.E. #1	31-7N-11E	747			2799	-2052	2903	-2156	2778	-2031	2750	-2003
B.E. #2	31-7N-11E	734			2787	-2053	NDE		2776	-2042	2740	-2006
Eckles #1	31-7N-11E	754			2807	-2053	2912	-2158	2788	-2034	2763	-2009
Eckles 3-31	31-7N-11E	744			2774	-2030	2882	-2138	2750	-2006	2724	-1980
Kamperman 1	31-7N-11E	787			2822	-2035	2928	-2141	2801	-2014	2774	-1987
Showalter #1	31-7N-11E	760			2784	-2024	2896	-2136	2765	-2005		760
Kamperman 1-32	32-7N-11E	769			2797	-2028	2914	-2145	2776	-2007	2748	-1979
Riley #1	32-7N-11E	754			2774	-2020	2885	-2131	2754	-2000		
Rogers #1	32-7N-11E	748			2786	-2038	2897	-2149	2768	-2020	2747	-1999
Benham 1	35-7N-11E	807			2960	-2153	NDE		2932	-2125	2896	-2089
Lott 1	2-7N-12E				2544	-2544	2673	-2673	2514	-2514	2476	-2476
Patsy 1-3	3-7N-12E				2450	-2450	NDE		2417	-2417	2380	-2380
Wagoner #1	4-7N-12E	724			2420	-1696	2554	-1830	2392	-1668	2356	-1632
Carpenter #1	5-7N-12E	799			2540	-1741	2659	-1860	2512	-1713	2482	-1683
Shields #1	6-7N-12E	714			2358	-1644	2470	-1756	2338	-1624	2310	-1596
Sanders #1	7-7N-12E	784			2503	-1719	2624	-1840	2481	-1697	2448	-1664
Sanders #2	7-7N-12E	878			2537	-1659	2656	-1778	2515	-1637	2485	-1607
Sarkey Unit #1	7-7N-12E	768			2456	-1688	2577	-1809	2428	-1660		768
Sarkeys #2	7-7N-12E								2444	-2444	2404	-2404
Sarkeys #1	7-7N-12E	801			2454	-1653	2577	-1776		801		801
Burleson #1	8-7N-12E	712			2442	-1730	2574	-1862	2418	-1706	2385	-1673
Cotton-Eckles #1	8-7N-12E	775			2621	-1846	NDE		2594	-1819		775
McAfee 1-12	12-7N-12E	772			2448	-1676	NDE		2414	-1642	2368	-1596
McAfee #1	13-7N-12E	725			2328	-1603	2465	-1740	2295	-1570	2245	-1520
McAfee 1-13	13-7N-12E	745			2336	-1591	2475	-1730	2306	-1561	2254	-1509
State #1	13-7N-12E	741			2345	-1604	NDE		2313	-1572	2267	-1526
W.C. Ratledge #1	13-7N-12E	725			2343	-1618	NDE		2312	-1587	2258	-1533
Mad Max 1-14	14-7N-12E	977			2552	-1575	2686	-1709	2518	-1541	2468	-1491
Owen #1-14	14-7N-12E	880			2528	-1648	2657	-1777	2496	-1616	2452	-1572
Sarkey #1	14-7N-12E	1007			2597	-1590	NDE		2566	-1559	2522	-1515
Sarkeys #1	14-7N-12E	954			2528	-1574	2662	-1708	2500	-1546	2456	-1502
Theel #1	14-7N-12E	966			2573	-1607	NDE		2542	-1576	2497	-1531
Thunderdome 1-14	14-7N-12E	875			2508	-1633	2638	-1763	2476	-1601	2427	-1552
Tom 2-14	14-7N-12E	913			2505	-1592	NDE		2477	-1564	2428	-1515
Kleinke #2	15-7N-12E				2472	-2472	NDE		2445	-2445	2402	-2402
Kleinke 4	15-7N-12E	918			2497	-1579	2638	-1720	2469	-1551	2417	-1499
Lott 1-15	15-7N-12E	893			2546	-1653	NDE		2515	-1622	2422	-1529
Myers 1	15-7N-12E				2498	-2498	NDE		2461	-2461	2418	-2418
Owens #1	15-7N-12E	851			2505	-1654	2636	-1785	2474	-1623	2428	-1577
Addington 1	16-7N-12E	863			2504	-1641	2638	-1775	2474	-1611	2438	-1575
Gilcrease 1	16-7N-12E				2493	-2493						
Gilcrease 3	16-7N-12E				2444	-2444	NDE		2415	-2415	2322	-2322
Hoehne 1-16	16-7N-12E	822			2428	-1606	2618	-1796	2450	-1628	2412	-1590
Perry 1	17-7N-12E	747			2481	-1734	2622	-1875	2453	-1706	2422	-1675
Sarkeys B-1	18-7N-12E	875			2528	-1653	NDE		2508	-1633	2476	-1601
Sarkeys C-1	18-7N-12E	917			2622	-1705	NDE		2597	-1680	2554	-1637
Shirley Jean	19-7N-12E	845			2660	-1815	2807	-1962	2640	-1795	2602	-1757
McCoy 1	20-7N-12E	672			2406	-1734	2546	-1874	2376	-1704	2334	-1662
Falcon Club 1-21	21-7N-12E	1000			2648	-1648	NDE		2616	-1616	2574	-1574
Falcon Club 2-21	21-7N-12E	886			2581	-1695	NDE		2548	-1662	2507	-1621
Falcon Club 3-21	21-7N-12E	953			2601	-1648	NDE			953	2517	-1564
Kern 1-21	21-7N-12E	870			2495	-1625	2632	-1762	2465	-1595	2424	-1554

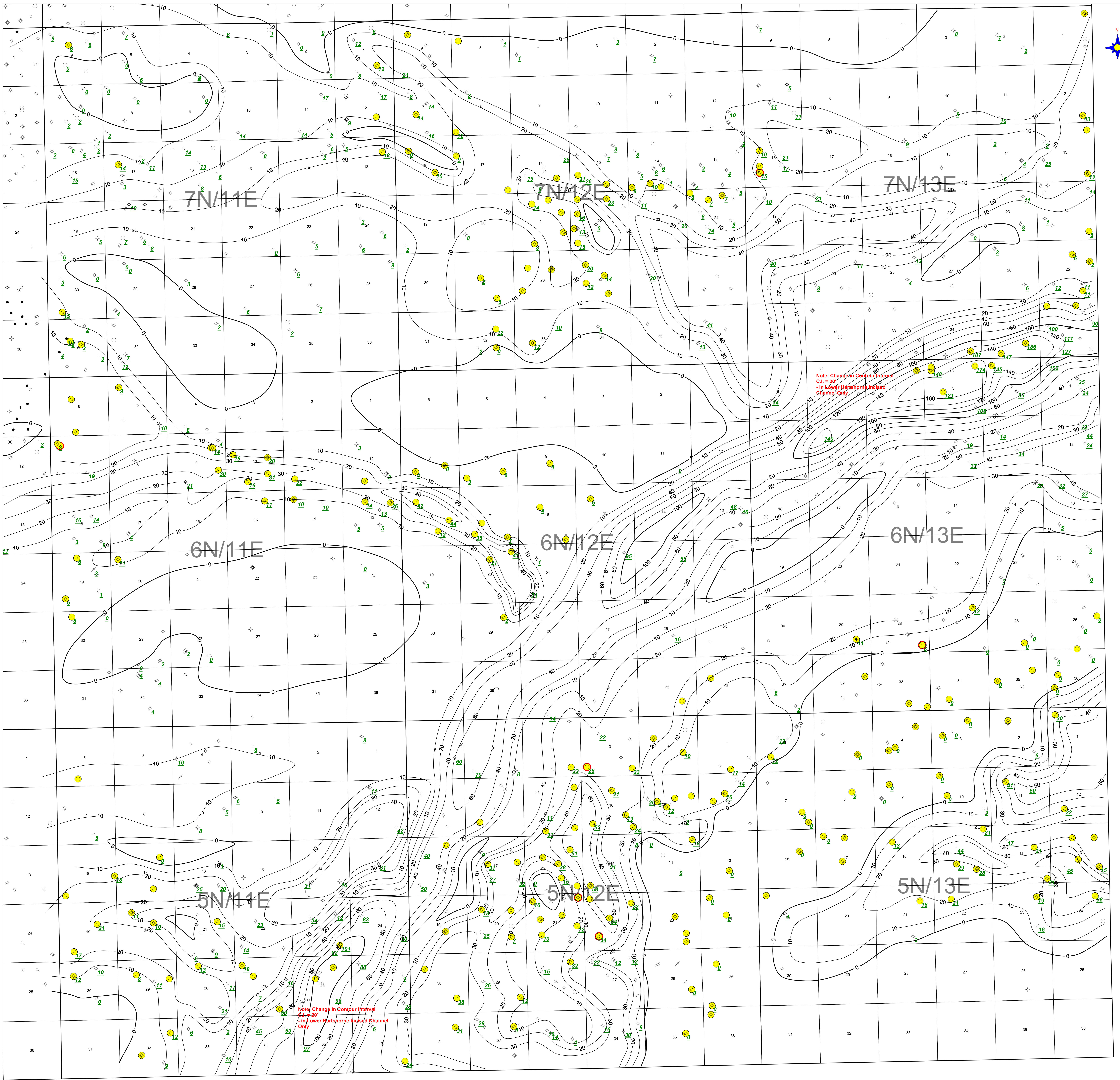
Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Broadstreet 1	22-7N-12E	970			2592	-1622	2733	-1763	2560	-1590	2516	-1546
C.G. Myers et al #1	22-7N-12E	912			2594	-1682	2748	-1836	2566	-1654	2522	-1610
Jonathan 1-22	22-7N-12E	760			2452	-1692	2594	-1834	2420	-1660	2372	-1612
Melissa 2-22	22-7N-12E	950			2608	-1658	2732	-1782	2578	-1628	2534	-1584
Michael 2-22	22-7N-12E	880			2554	-1674	2696	-1816	2524	-1644	2429	-1549
Holt 3-24	24-7N-12E	693			2332	-1639	NDE		2299	-1606	2244	-1551
Jackie Holt 2-23	23-7N-12E	740			2392	-1652	NDE		2361	-1621	2307	-1567
Upchurch 1	23-7N-12E	906			2586	-1680	NDE		2556	-1650	2510	-1604
Anderson 1-24	24-7N-12E	693			2360	-1667	NDE		2325	-1632	2270	-1577
Holt 1	24-7N-12E	737			2338	-1601	NDE		2308	-1571	2254	-1517
Mamie Sousea 1	24-7N-12E				2313	-2313			2283	-2283	2240	-2240
Rabke 1-24	24-7N-12E	693			2357	-1664	NDE		2324	-1631	2272	-1579
Ross 1-24	24-7N-12E	705			2315	-1610	NDE		2282	-1577	2234	-1529
Soused 3	24-7N-12E	734			2357	-1623	3494	-2760	2326	-1592	2277	-1543
Bruno 3-25	25-7N-12E	727			2477	-1750	NDE		2432	-1705	2372	-1645
Whitney Heirs 1-26	26-7N-12E	976			2888	-1912	NDE		2658	-1682	2606	-1630
Million 1-27	27-7N-12E	982			2666	-1684	NDE		2636	-1654	2587	-1605
Stipe 1-27	27-7N-12E	951			2646	-1695	NDE					
Stipe 2-27	27-7N-12E	905			2590	-1685	NDE		2560	-1655	2512	-1607
Hilseweck A-1-29	29-7N-12E	987			2574	-1587	2715	-1728	2546	-1559	2503	-1516
Stipe 1-29	29-7N-12E	838			2674	-1836	2776	-1938	2644	-1806	2597	-1759
Be Ann Puckett 1-32	32-7N-12E	978			2842	-1864	2987	-2009	2810	-1832	2772	-1794
Myers B-1	32-7N-12E	830			2975	-2145	NDE		2940	-2110	2890	-2060
Puckett 2-32	32-7N-12E	925			2990	-2065	NDE		2948	-2023	2898	-1973
Charles 1-33	33-7N-11E	638			2964	-2326	3093	-2455	2938	-2300	2905	-2267
Doss Royalty 1-33	33-7N-12E	698			2916	-2218	NDE		2878	-2180	2824	-2126
Stipe 1-33	33-7N-12E	926			2750	-1824	2892	-1966	2766	-1840	2663	-1737
Gladstein 1-34	34-7N-12E	946			2727	-1781	2868	-1922	2694	-1748	F/O? 2504'	
Stacy 1	35-7N-12E	796			2656	-1860	NDE		2621	-1825	2568	-1772
Casey 1-36	36-7N-12E	771			2618	-1847	2792	-2021	2579	-1808	2516	-1745
Richison 1	36-7N-12E	749			2589	-1840	2760	-2011	2557	-1808	2494	-1745
Brow 2-2	2-7N-13E	741			2356	-1615	2478	-1737	2321	-1580	2260	-1519
Vaughan 2-2 B	2-7N-13E	736			2344	-1608	NDE		2308	-1572	2242	-1506
Howard 1-3	3-7N-13E	662			2347	-1685	2482	-1820	2312	-1650	2247	-1585
Lee #1	6-7N-13E	857			2571	-1714	NDE		2540	-1683	2484	-1627
Proctor #1	7-7N-13E	964			2633	-1669	2770	-1806	2599	-1635	2534	-1570
Reed 1-7	7-7N-13E	744			2398	-1654	2540	-1796	2365	-1621	2304	-1560
Watkins 1-7	7-7N-13E	795			2437	-1642	2577	-1782	2406	-1611	2354	-1559
Wade 2-10	10-7N-13E	741			2392	-1651	2556	-1815	2362	-1621	2294	-1553
Wadley 1-11	11-7N-13E	733			2371	-1638	NDE		2341	-1608	2274	-1541
Herman #1-12	12-7N-13E	738			2552	-1814	2693	-1955	2518	-1780	2446	-1708
Wadley 1-12	12-7N-13E	751			2405	-1654	NDE		2371	-1620	2302	-1551
Duncan #1	13-7N-13E	785			2386	-1601	NDE					
Duncan #3	13-7N-13E	812			2436	-1624	NDE		2404	-1592	2335	-1523
Ward #1-13	13-7N-13E					0			2484	-2484	2408	-2408
Ward 2-13	13-7N-13E	698			2331	-1633	2524	-1826	2296	-1598	2224	-1526
Graham #1	14-7N-13E	786			2416	-1630	2583	-1797	2386	-1600	2315	-1529
Graham #2	14-7N-13E	770			2443	-1673	NDE		2410	-1640	2341	-1571
Graham #3	14-7N-13E	760			2406	-1646	NDE		2378	-1618	2304	-1544
Graham C #2	15-7N-13E				2411	-2411	NDE		2378	-2378	2310	-2310
Pearson 1-16	16-7N-13E	702			2358	-1656	2516	-1814	2326	-1624	2266	-1564
Crandell #1	18-7N-13E	726			2330	-1604	NDE		2298	-1572	2238	-1512
Crandell #1-18	18-7N-13E	729			2325	-1596	2473	-1744	2292	-1563	2240	-1511
Mooneyham 1-18	18-7N-13E	724			2321	-1597	NDE		2289	-1565	2236	-1512
Rockey #2-18	18-7N-13E	715			2311	-1596	NDE		2279	-1564	2222	-1507
Bush 1-19	19-7N-13E	683			2324	-1641	2480	-1797	2293	-1610	2238	-1555
Stergios #1-20	20-7N-13E	665			2338	-1673	2495	-1830	2307	-1642	2238	-1573
Graham #1	22-7N-13E	824			2540	-1716	2698	-1874	2510	-1686	2432	-1608
Pedersen #2	23-7N-13E	830			2538	-1708	NDE		2506	-1676	2432	-1602
Pederson #1	23-7N-13E	822			2494	-1672	NDE		2462	-1640	2384	-1562
Abney 1-24	24-7N-13E	884			2584	-1700	2738	-1854	2552	-1668	2477	-1593
Abney 3-24	24-7N-13E	910			2613	-1703	NDE		2577	-1667	2505	-1595
Hill 1-24	24-7N-13E	693			2393	-1700	NDE		2356	-1663	2282	-1589
Hitchcock 1-24	24-7N-13E	897			2633	-1736	2815	-1918	2598	-1701	2524	-1627
Whitehead 1-24	24-7N-13E	701			2356	-1655	NDE		2322	-1621	2250	-1549
Carver 1-25	25-7N-13E	692			2578	-1886	NDE		2540	-1848	2460	-1768
King #1	25-7N-13E	712			2456	-1744	NDE		2416	-1704	2336	-1624
King 2-25	25-7N-13E	714			2400	-1686	NDE		2357	-1643	2286	-1572
King 3-25	25-7N-13E	702			2431	-1729	NDE		2392	-1690	2320	-1618
King 4-25	25-7N-13E				2476	-2476	NDE		2436	-2436	2354	-2354
Collier 1-26	26-7N-13E	701			2488	-1787	NDE		2449	-1748	2378	-1677

Well	Location	KB	Top of UHCoal		Top of LHCoal		Top of Atoka		Top of Upper Marker (Unnamed Siltstone)		Base of Shale Marker	
Frederick #1	26-7N-13E	885			2587	-1702	2779	-1894	2552	-1667	2480	-1595
Holt 1-28	28-7N-13E	720			2515	-1795	2678	-1958	2482	-1762	2410	-1690
Holt 2-28	28-7N-13E	738			2540	-1802	NDE		2507	-1769	2435	-1697
Holt 1-29	29-7N-13E	715			2528	-1813	NDE		2494	-1779	2528	-1813
Walters 1-A	29-7N-13E	712			2536	-1824	2614	-1902	2504	-1792	2494	-1782
Elbert 1-30	30-7N-13E	724			2526	-1802	NDE		2491	-1767	2426	-1702
Helen 1	33-7N-13E	870			2693	-1823	NDE		2876	-2006	2810	-1940
Lucille #1	34-7N-13E	908			2707	-1799	2973	-2065	2689	-1781	2619	-1711
Lucille 2-34	34-7N-13E	900			NP		NDE		2685	-1785	2608	-1708
State 1-35	35-7N-13E	707			2549	-1842	2828	-2121	2520	-1813	2445	-1738
State 2-35	35-7N-13E	703			2510	-1807	2804	-2101	2482	-1779	2410	-1707
Brite 1-36	36-7N-13E	642			2365	-1723	NDE		2328	-1686	2264	-1622
JWP 1-36	36-7N-13E	658			2322	-1664	NDE		2298	-1640	2234	-1576
Madden 1-36	36-7N-13E	704			2479	-1775	2739	-2035	2449	-1745	2377	-1673
Painter #2	36-7N-13E	678			2413	-1735	NDE		2384	-1706	2303	-1625
Sheena 1-36	36-7N-13E	738			2523	-1785	NDE		2492	-1754	2409	-1671
Sunshine 1-36	36-7N-13E	671			2663	-1992	NDE		2632	-1961	2540	-1869
White AF #1	36-7N-13E	664			2607	-1943	NDE		2585	-1921	2518	-1854
Willie Mae 1-36	36-7N-13E	697			2454	-1757	NDE		2423	-1726	2352	-1655


Lamar East Field
Scipio Northwest Field
Ulan East Field
Horntown SE Field
Reams Northwest Field
Shady Grove Field
Cabannis NW Field
Hill Top North Field
South Pine Hollow Field
Hill Top Field
Stuart Southwest Field
7N/11E
7N/12E
7N/13E
6N/11E
6N/12E
6N/13E
5N/11E
5N/12E
5N/13E
Hartshorne Production
1" = 3000'
4000 0 4000 8000 12000 ft
PLATE 1
Basemap
Hartshorne Project
Pittsburg & Hughes Counties, OK
Author: CJG
Date: 15 May, 2004



Lamar East Field
Scipio Northwest Field
Ulan East Field
7N/11E
7N/13E
Horntown SE Field
Reams Northwest Field
Shady Grove Field
Cabannis NW Field
6N/11E
6N/12E
6N/13E
South Pine Hollow Field
Hill Top North Field
Hill Top Field
Stuart Southwest Field
5N/11E
5N/13E
Hartshorne Production
Hartshorne Production
Dates of Production
Cumulative Gas (Bcf)
Current Rate Gas (Mcfd)
Perforations
1" = 3000'
4000 0 4000 8000 12000 ft
PLATE 2
Hartshorne Production Map
Hartshorne Project
Pittsburg & Hughes Counties, OK
Author:
CJG
Date:
15 May, 2004



Hartshorne Production

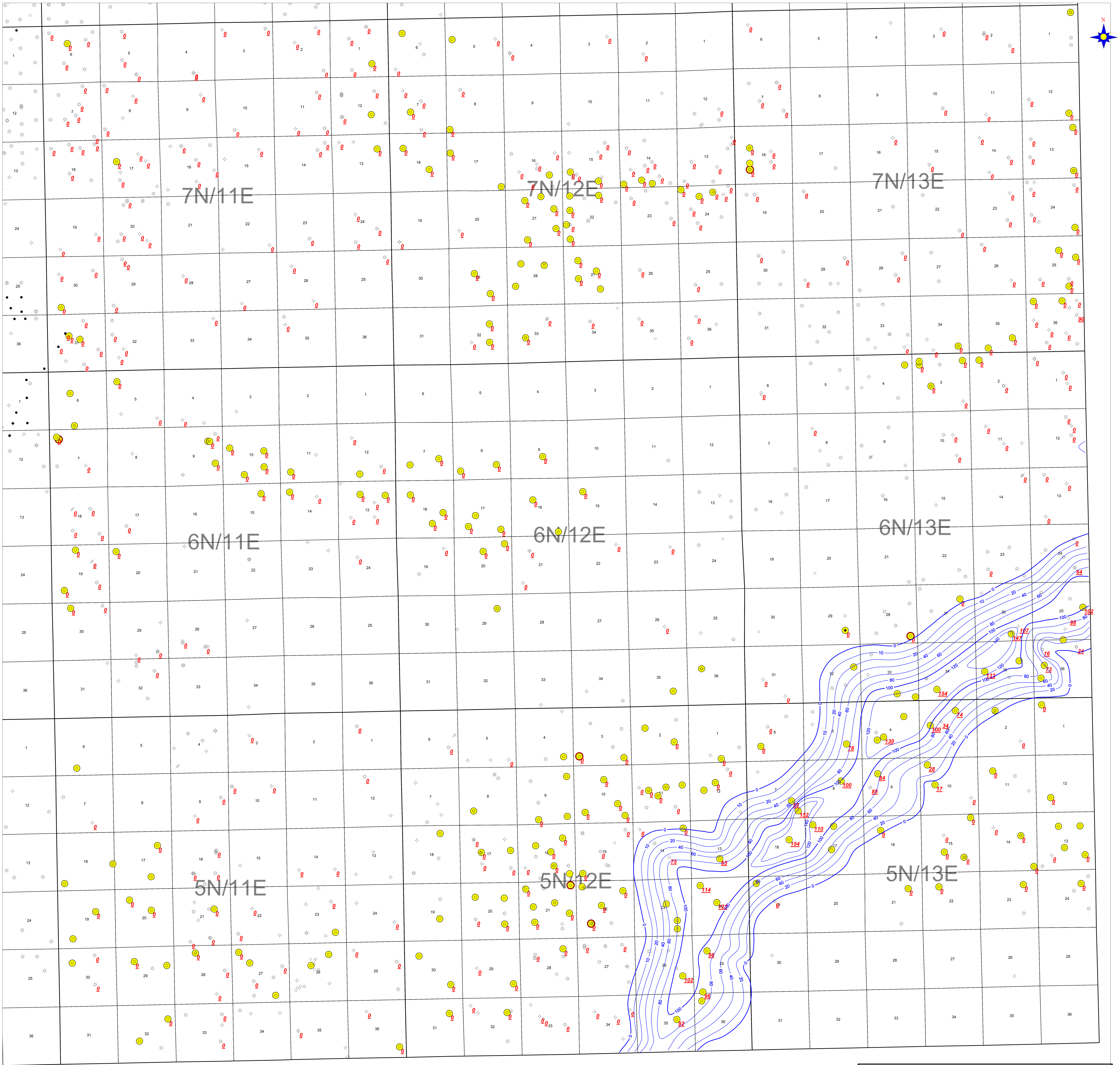
10

Gross Sand Value (50% Clean Sand Gamma Ray Cutoff)

1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 3		
Gross Sand Map: Lower Hartshorne Hartshorne Project Pittsburg & Hughes Counties, OK		
Author: CJG		Date: 15 May, 2004
C.I. = 20' (with 10' Contour for thinner sandstone bodies)		



Hartshorne Production

1" = 4000'

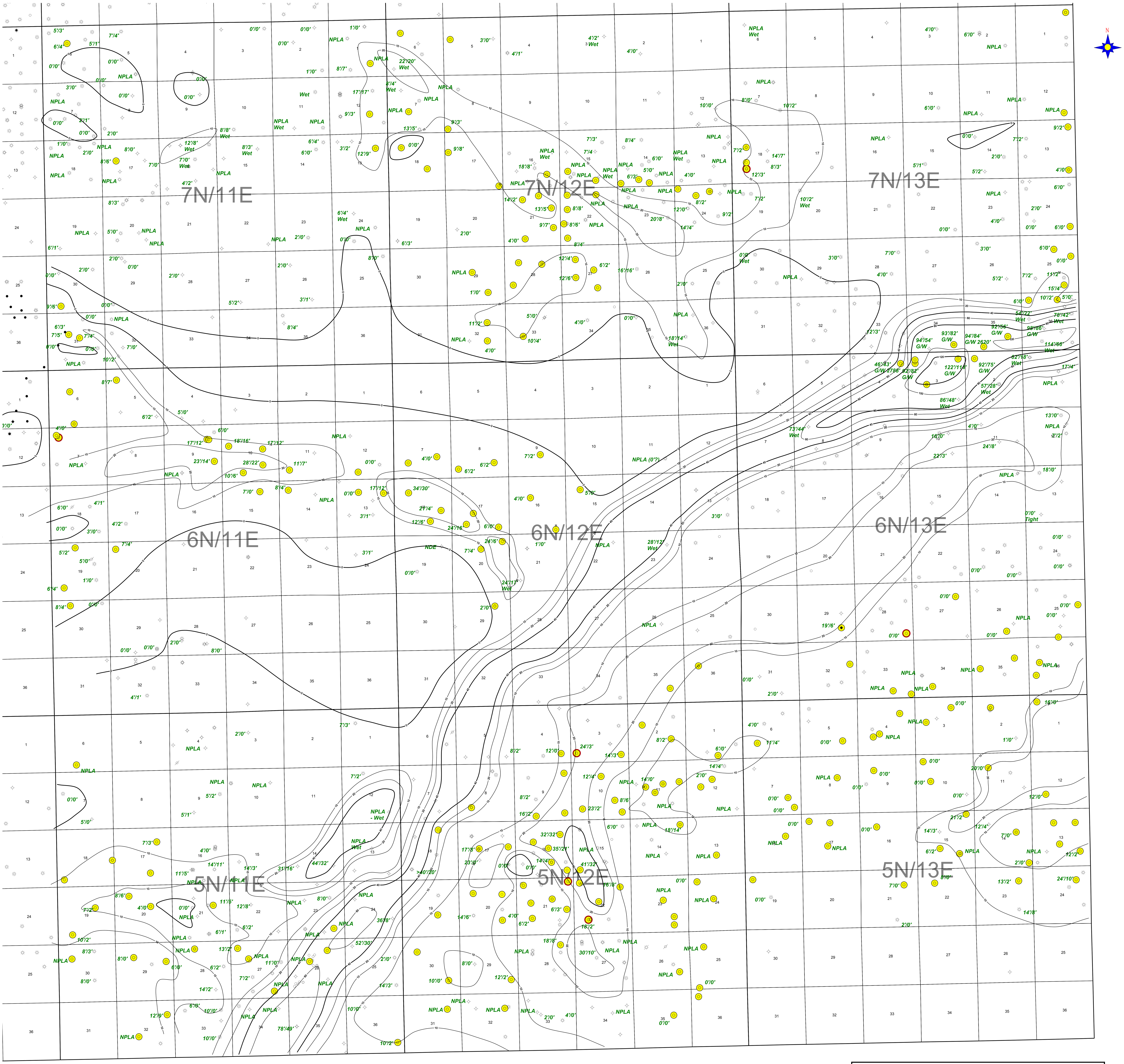
4000 0 4000 8000 12000 ft

PLATE 4

Gross Sand Map: Hartshorne Undifferentiated
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 15 May, 2004
C.I. = 20' (with 10' Contour for thinner sandstone bodies)		

10
Gross Sand Value (50% Clean Sand Gamma Ray Cutoff)



Hartshorne Production

12'/9'

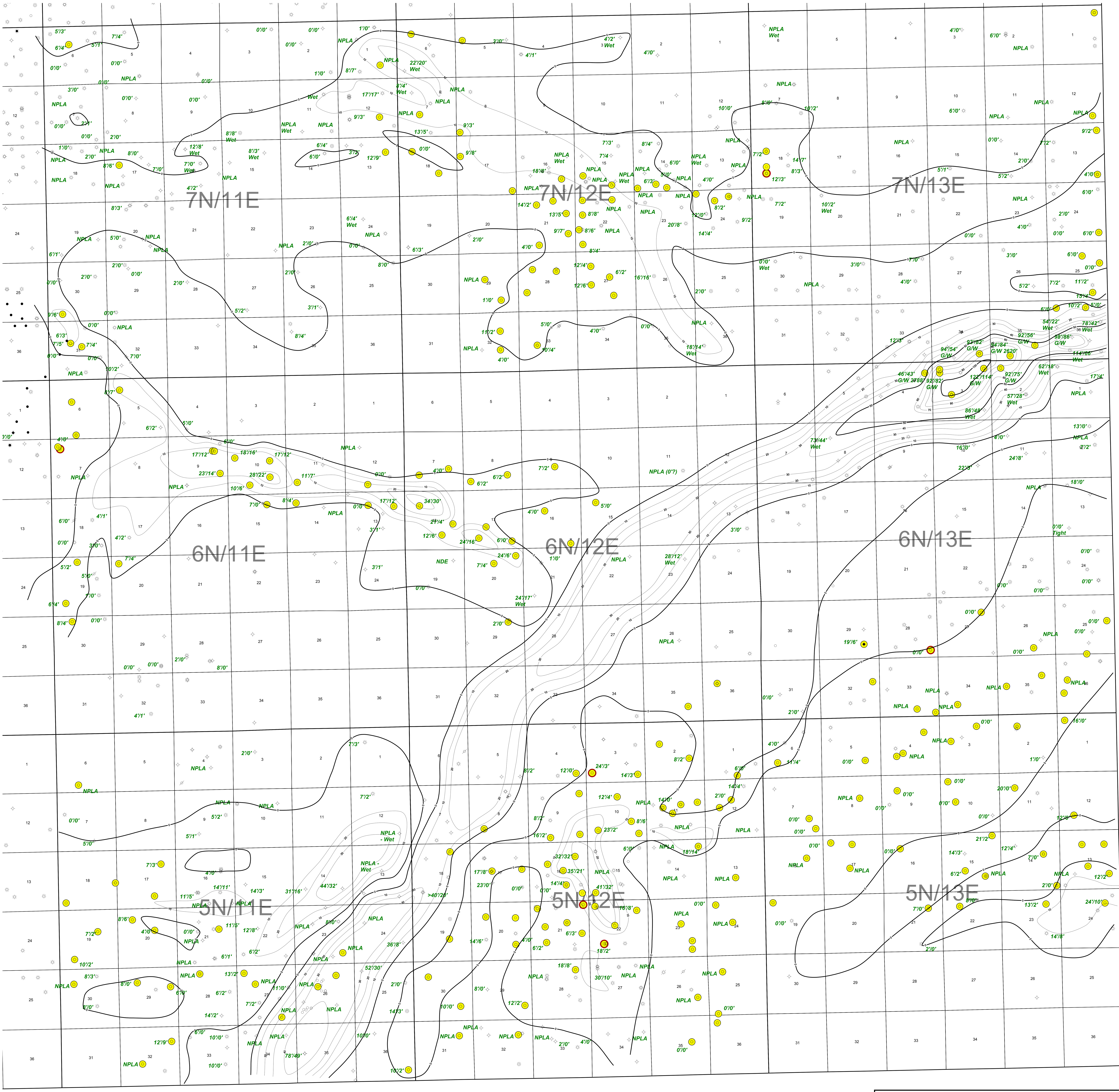
Net Sand Value
(Porosity >8%/>12%)

NPLA - No
Porosity Log
Available

1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 5		
Net Sand Isopach Map: Lower Hartshorne Porosity >8% Hartshorne Project Pittsburg & Hughes Counties, OK		
Author: CJG		Date: 26 June, 2004
C.I. = 10'	Porosity >8%	



1" = 4000'

4000 0 4000 8000 12000 ft

Hartshorne Production

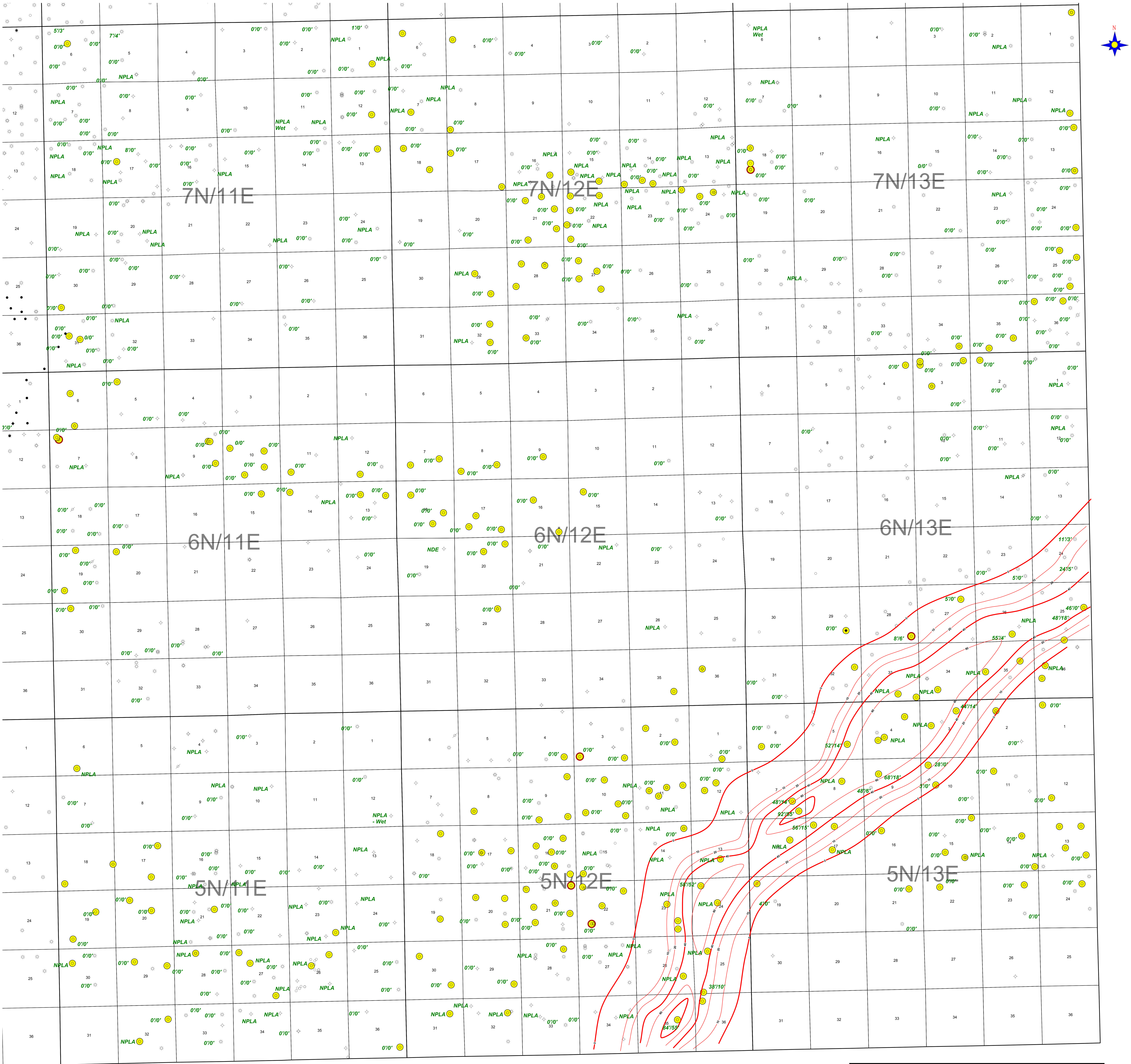
12'/9'
Net Sand Value
(Porosity
>8%/>12%)

NPLA - No
Porosity Log
Available

PLATE 6

Net Sand Isopach Map: Lower Hartshorne
Porosity >12%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 10'	Porosity > 12%	



1" = 4000'

4000 0 4000 8000 12000 ft

Hartshorne Production

12'/9'

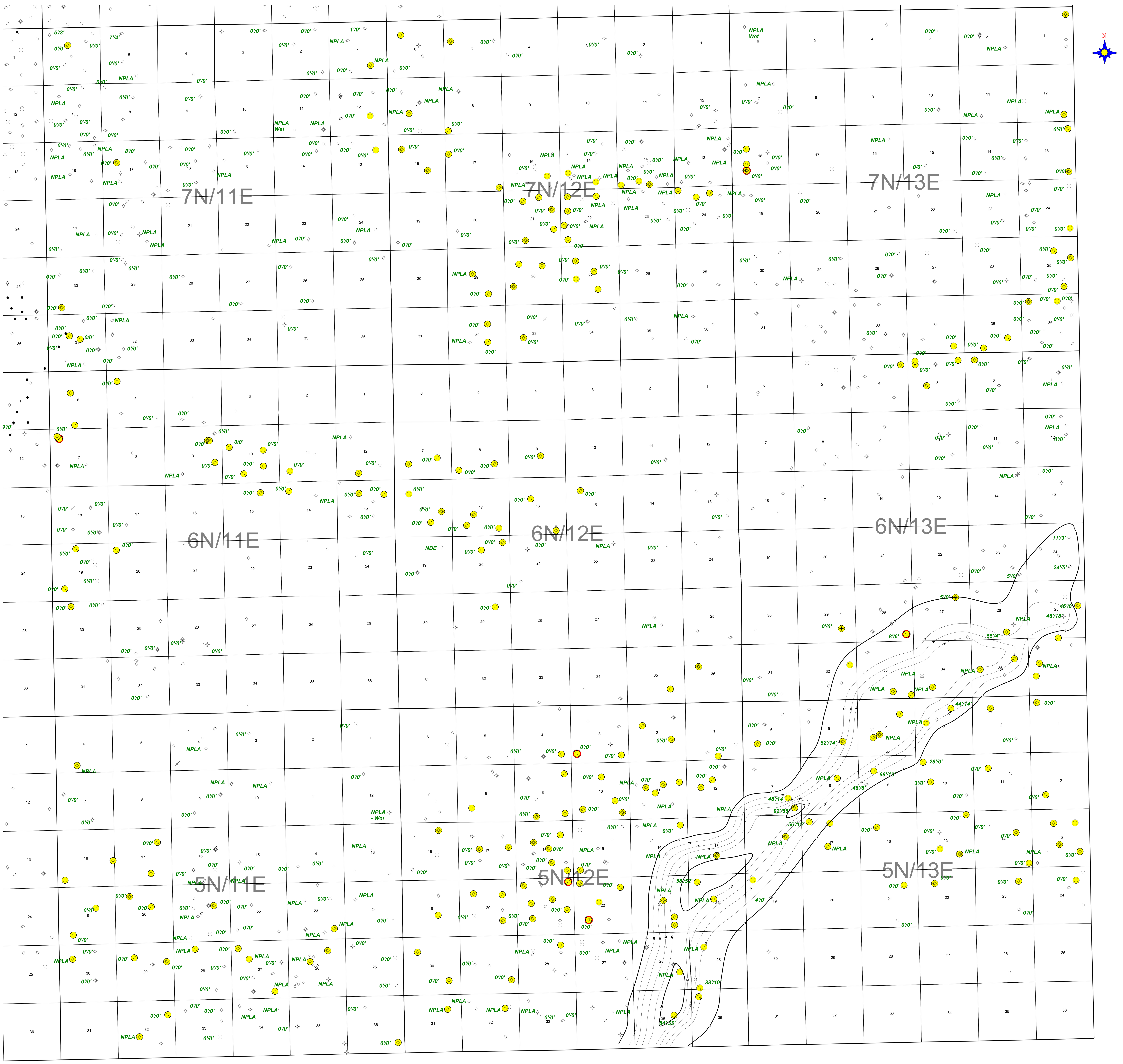
Net Sand Value
(Porosity >8%/>12%)

NPLA - No
Porosity Log
Available

PLATE 7

Net Sand Isopach Map: Hartshorne Undifferentiated
Porosity >8%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 10'	Porosity > 8%	



Hartshorne Production

12'/9'

Net Sand Value (Porosity >8%/>12%)

NPLA - No Porosity Log Available

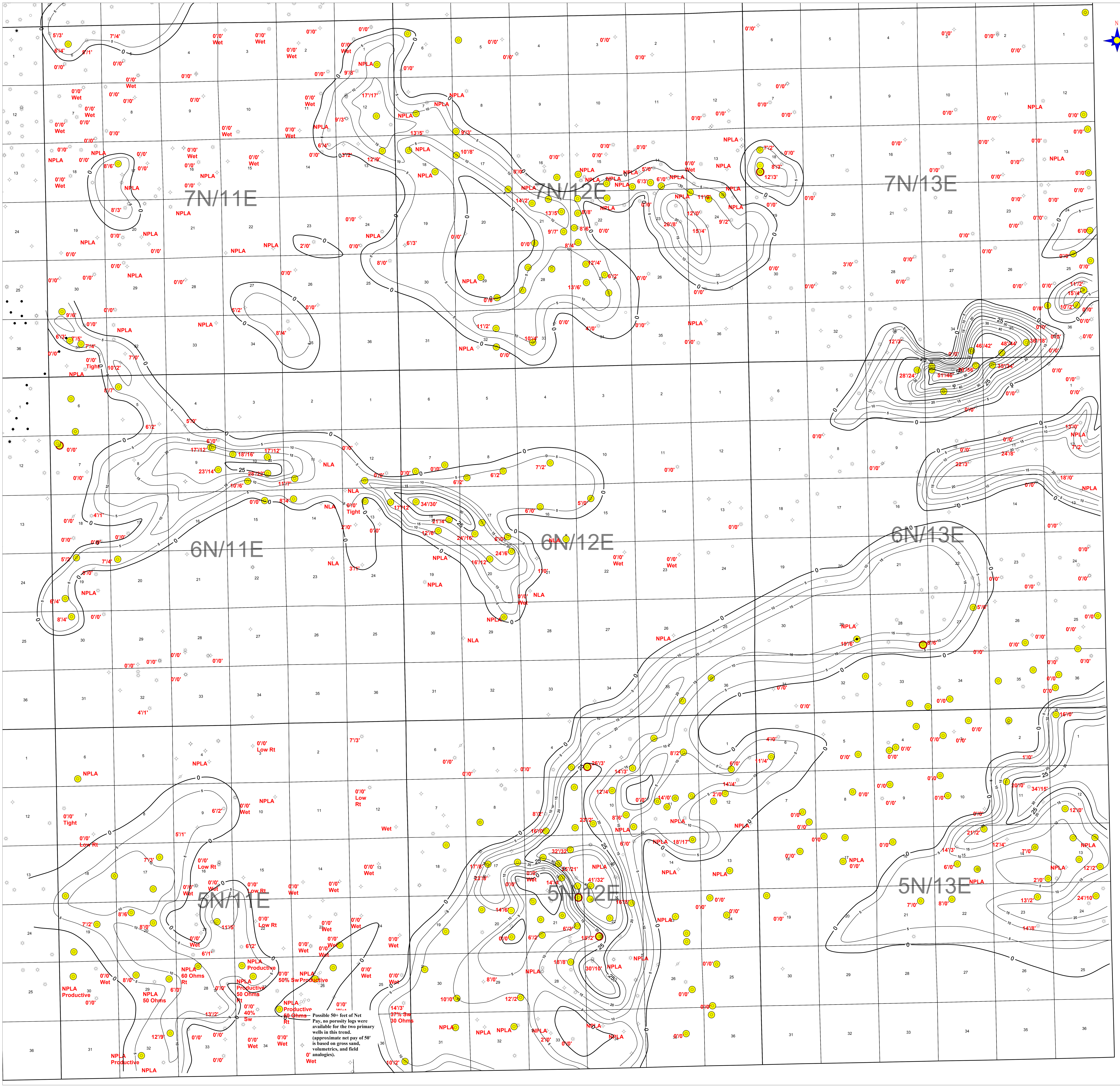
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 8

Net Sand Isopach Map: Hartshorne Undifferentiated
Porosity > 12%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 10'	Porosity > 12%	



Hartshorne Produciton

12'/9'

Net Pay Sand Value
(Porosity >8%, Sw <40%/
Porosity >12%, Sw<40%)

NPLA - No
Porosity Log
Available

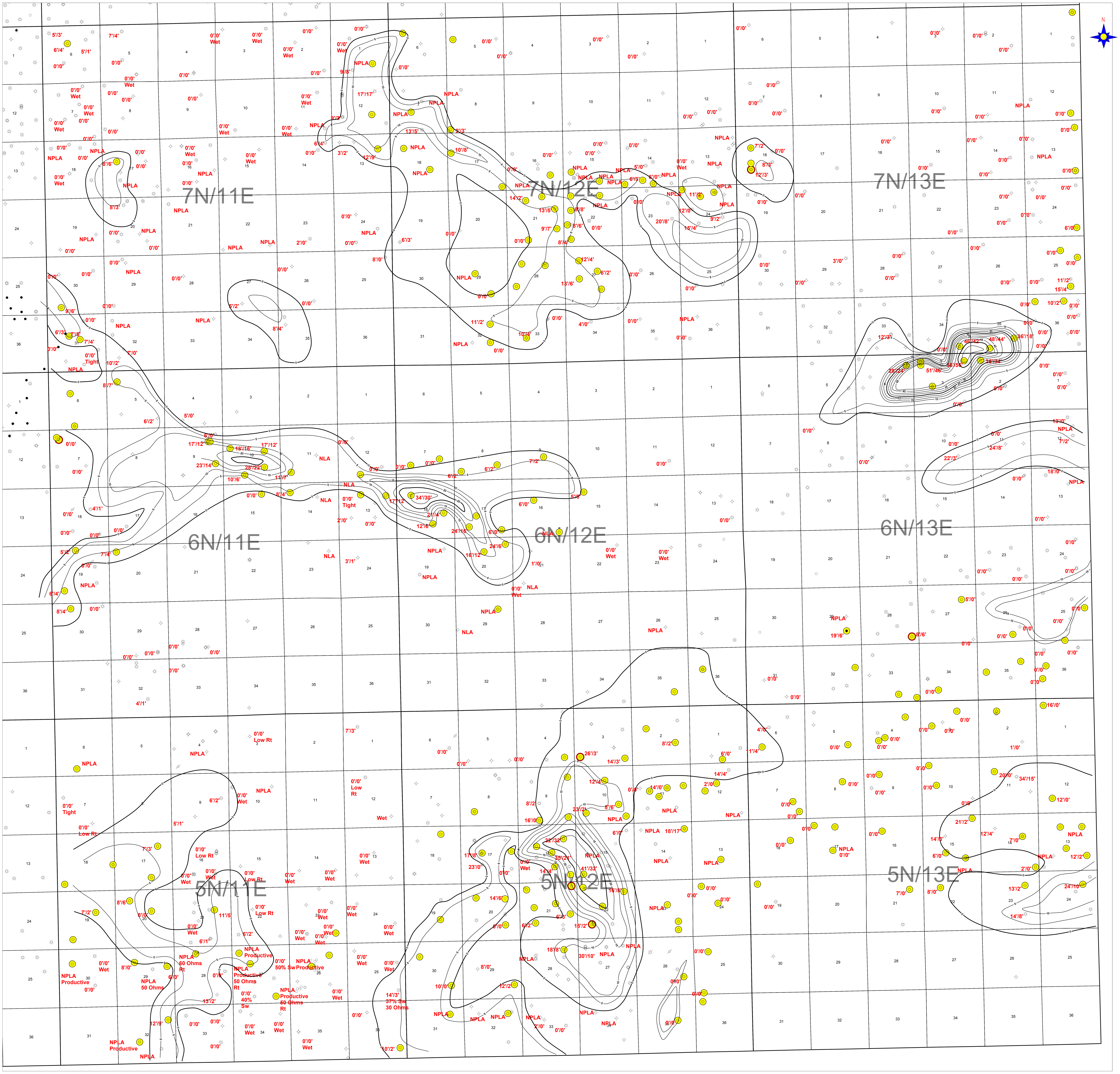
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 9

Net Pay Isopach Map: Lower Hartshorne
Porosity >8% and Sw <40%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 5'	Porosity >8%, Sw <40%	



Hartshorne Produciton

12'/9'

Net Pay Sand Value
(Porosity >8%, Sw <40%/
Porosity >12%, Sw<40%)

NPLA - No
Porosity Log
Available

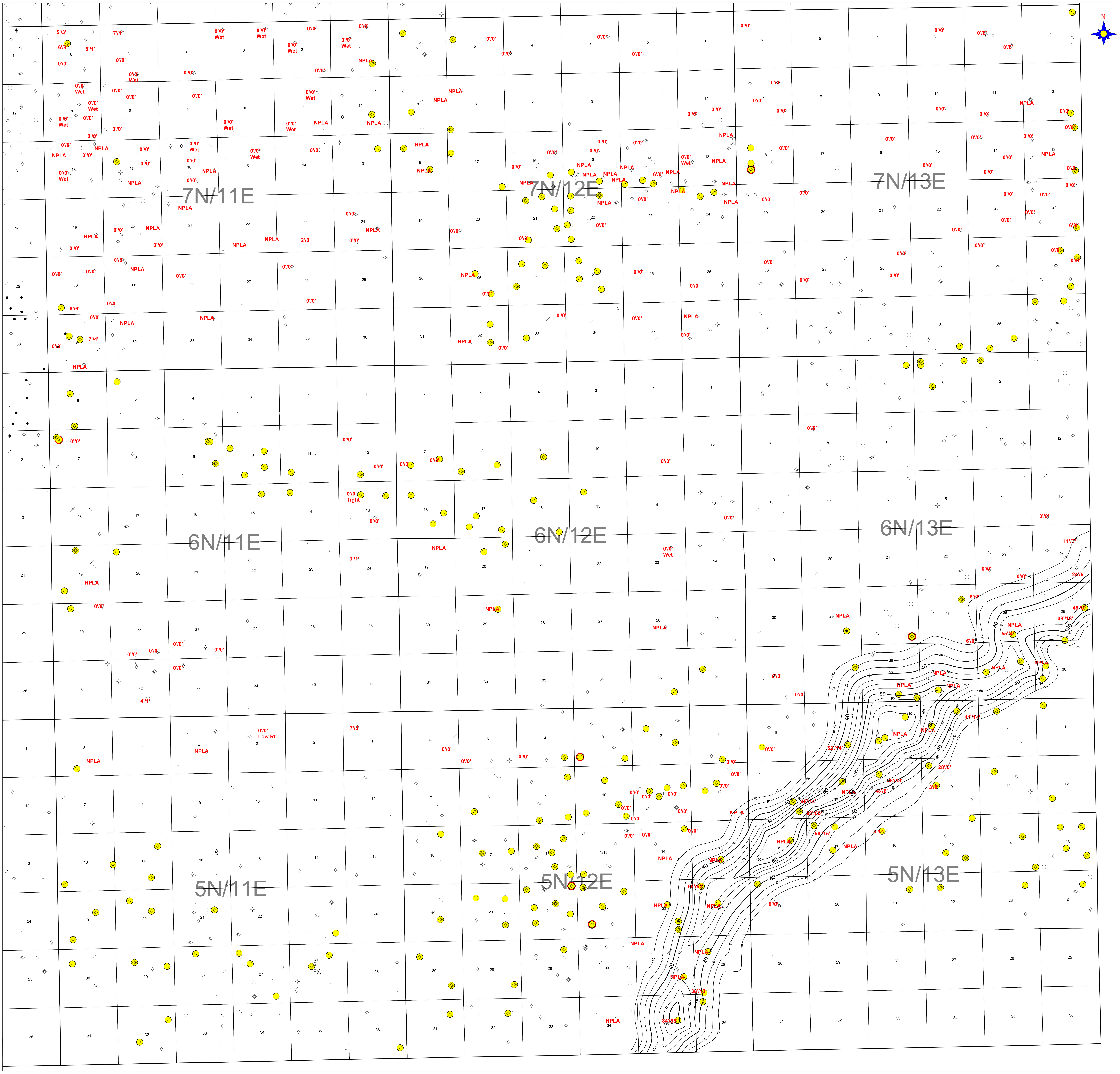
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 10

Net Pay Isopach Map: Lower Hartshorne
Porosity >12% and Sw <40%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 5'	Porosity >12%, Sw <40%	



Hartshorne Produciton

1" = 4000'

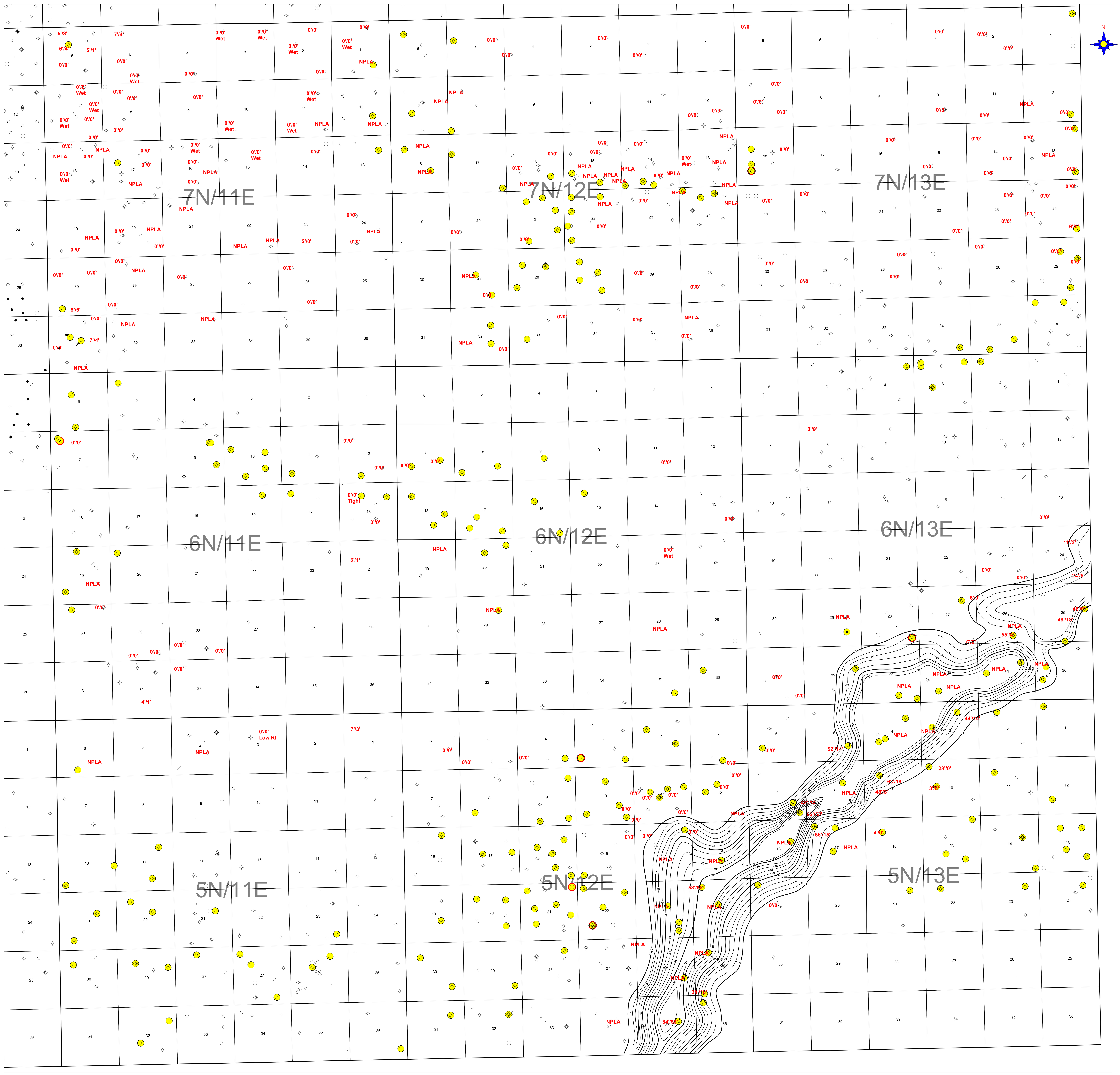
4000 0 4000 8000 12000 ft

12'/9'

Net Pay Sand Value
(Porosity >8% Sw <40%/
Porosity >12% Sw<40%)

NPLA - No
Porosity Log
Available

PLATE 11		
Net Pay Isopach Map: Hartshorne Undifferentiated Porosity >8% and Sw <40% Hartshorne Project Pittsburg & Hughes Counties, OK		
Author: CJG		Date: 26 June, 2004
C.I. = 5'	Porosity >8%, Sw <40%	



Hartshorne Produciton

12'/9'

Net Pay Sand Value
(Porosity >8%, Sw <40%/
Porosity >12%, Sw<40%)

NPLA - No
Porosity Log
Available

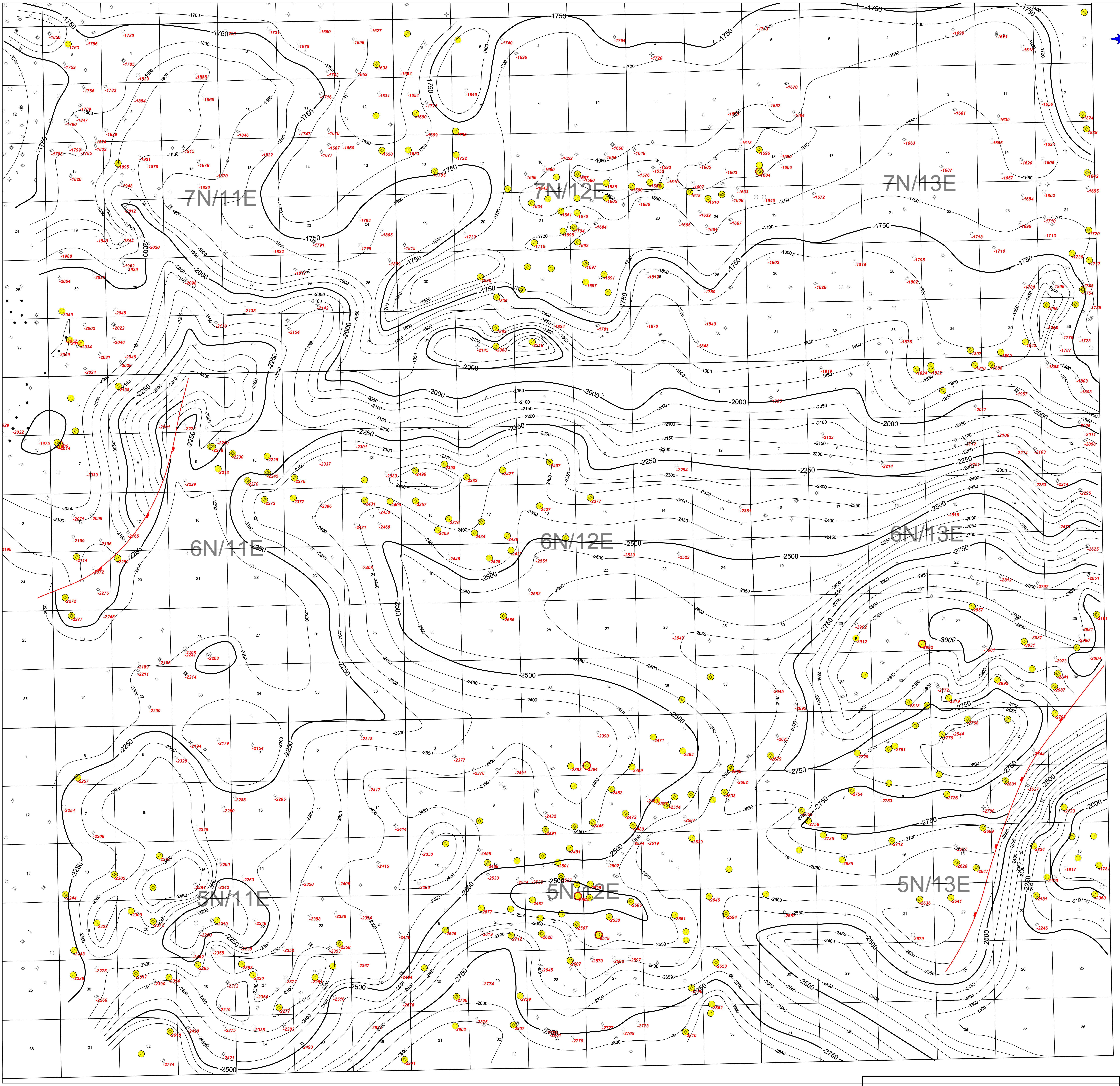
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 12

Net Pay Isopach Map: Hartshorne Undifferentiated
Porosity >12% and Sw <40%
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 5'	Porosity >12%, Sw <40%	



-2774
Top of Lower Hartshorne Coal (Subsea)

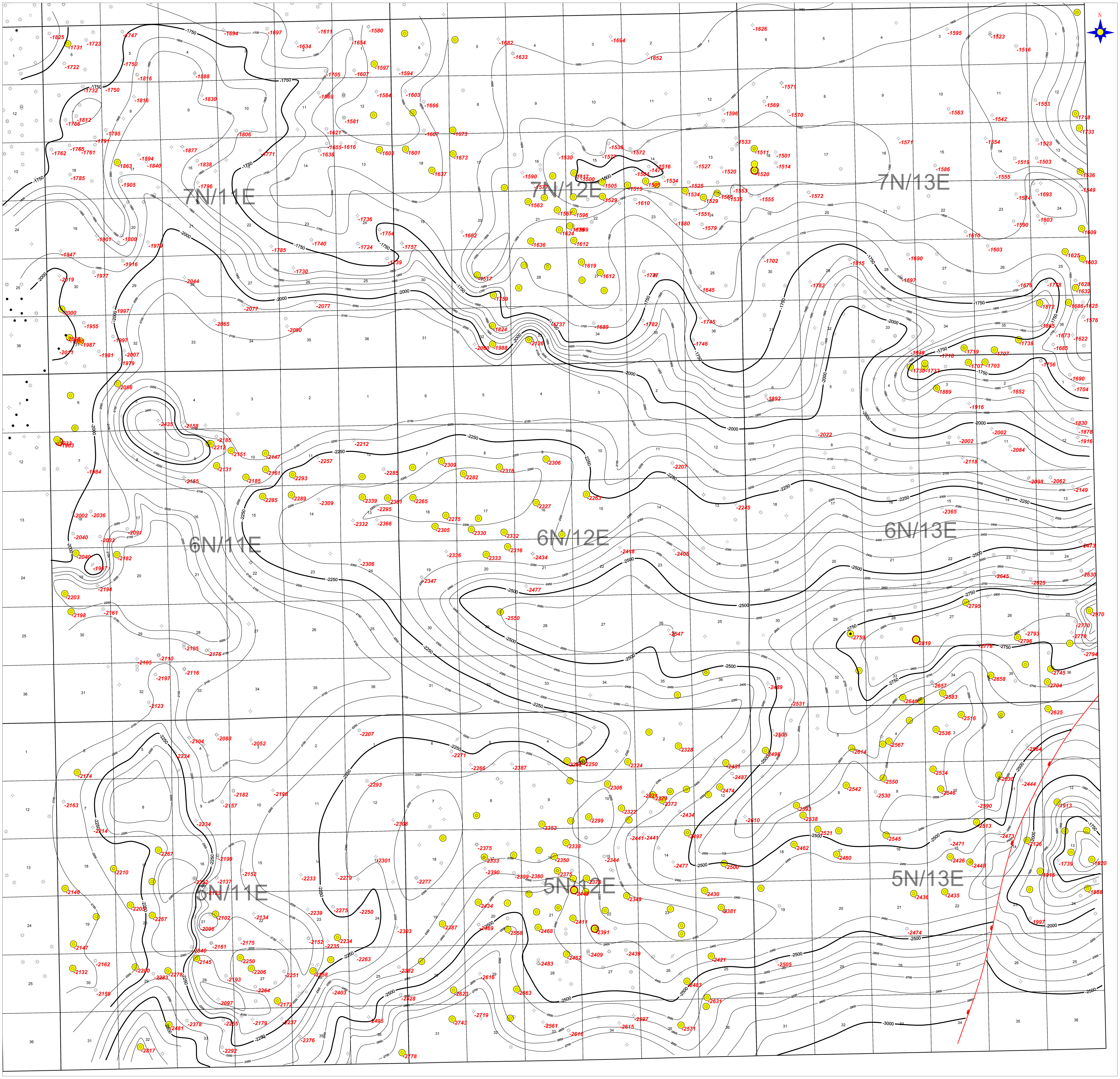
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 13

Structure Map: Top of Lower Hartshorne Coal
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author:		Date:
CJG		27 June, 2004
C.I. = 50'		



-2774

Top of Shale Marker (Subsea)

1" = 4000'

4000 0 4000 8000 12000 ft

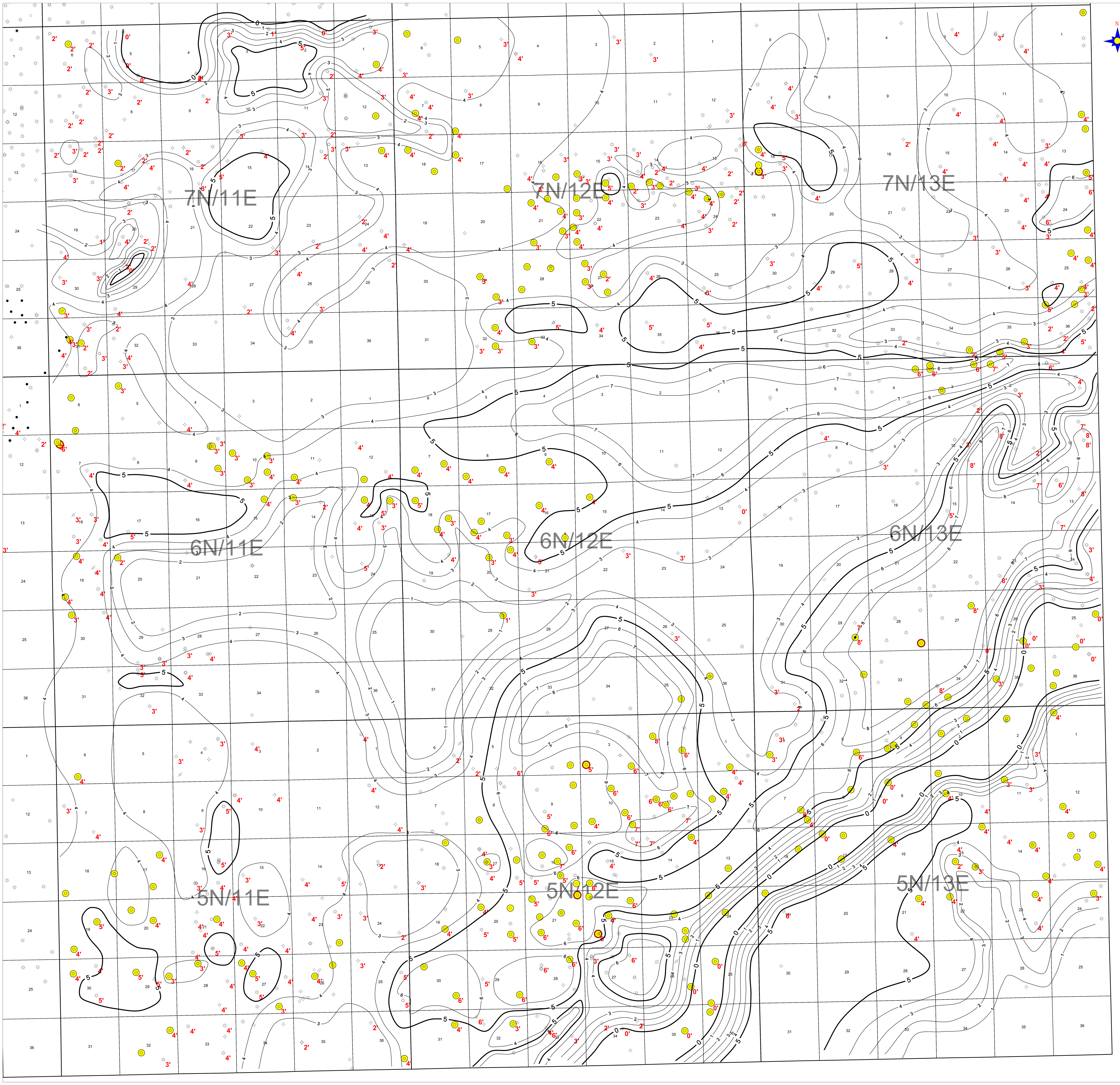
PLATE 14

Structure Map: Base of Shale Marker

Hartshorne Project

Pittsburg & Hughes Counties, OK

Author: CJG		Date: 27 June, 2004
C.I. = 50'		



3' - Coal Thickness Value

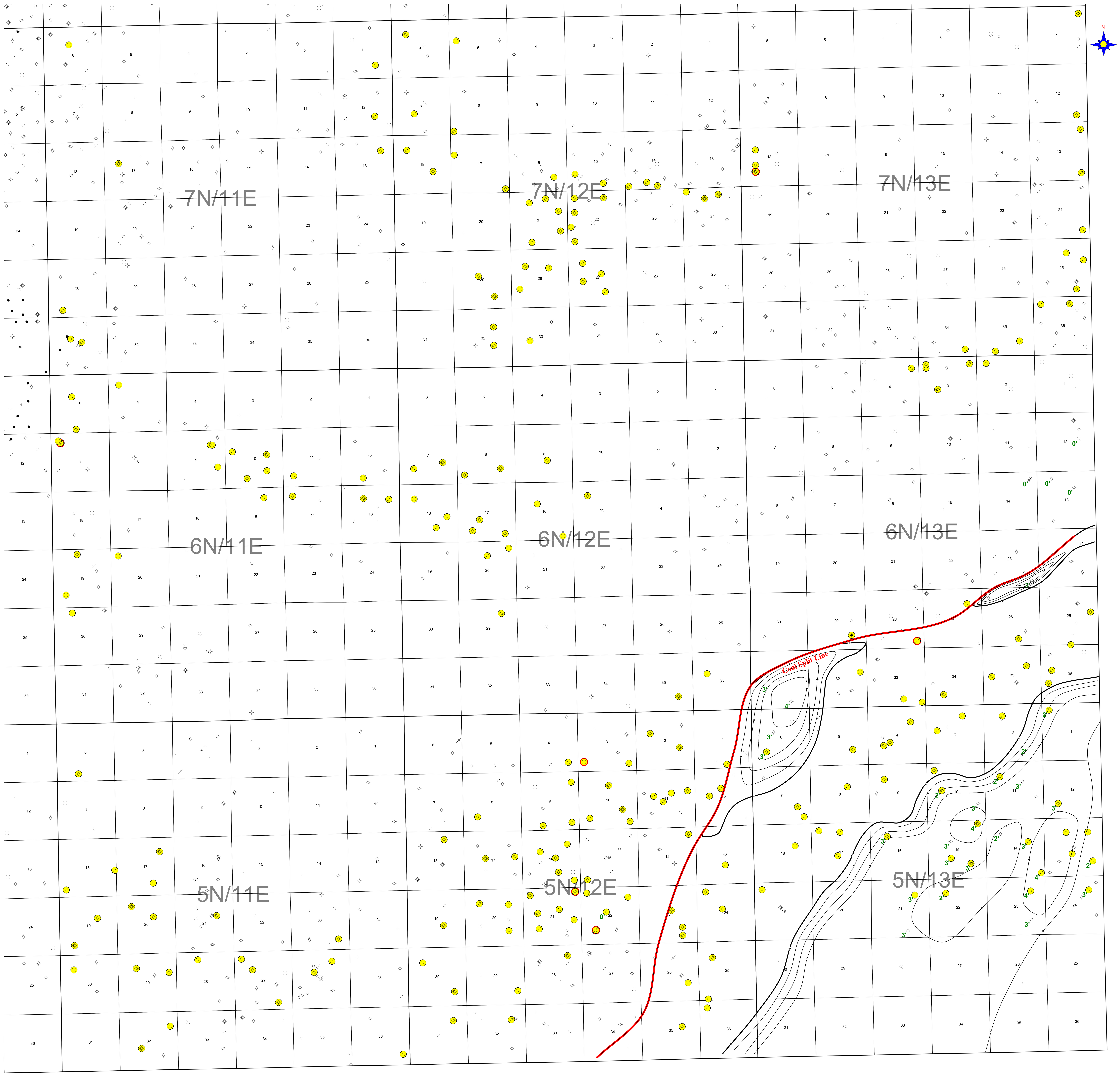
1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 15

Coal Thickness Isopach Map: Lower Hartshorne Coal
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 1'		



3' - Coal Thickness Value

1" = 4000'

4000 0 4000 8000 12000 ft

PLATE 16

Coal Thickness Isopach Map: Upper Hartshorne Coal
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 26 June, 2004
C.I. = 1'		

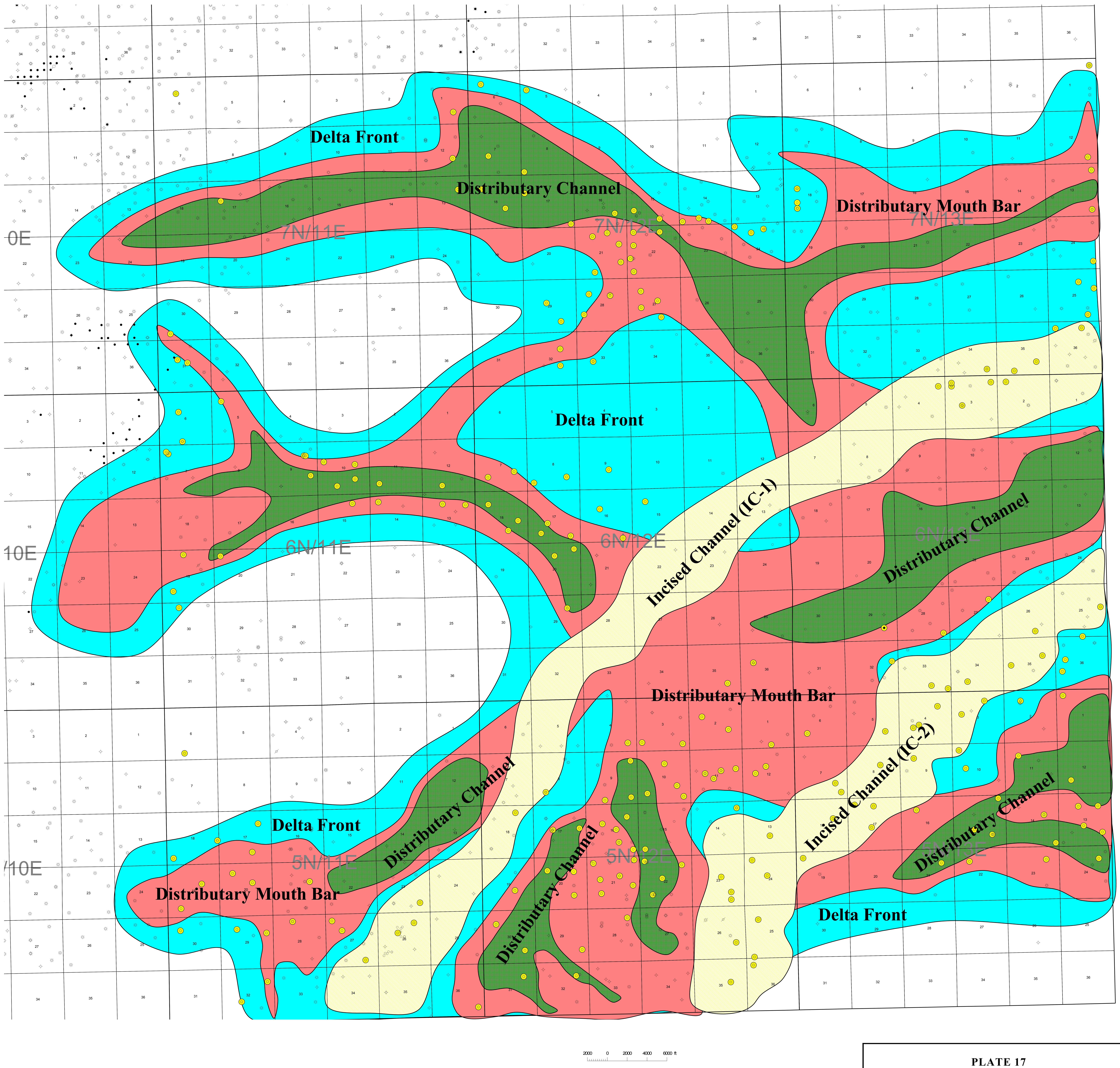


PLATE 17

Hartshorne Facies Map
Hartshorne Project
Pittsburg & Hughes Counties, OK

Author: CJG		Date: 27 June, 2004
	Scale: 1"=4000'	

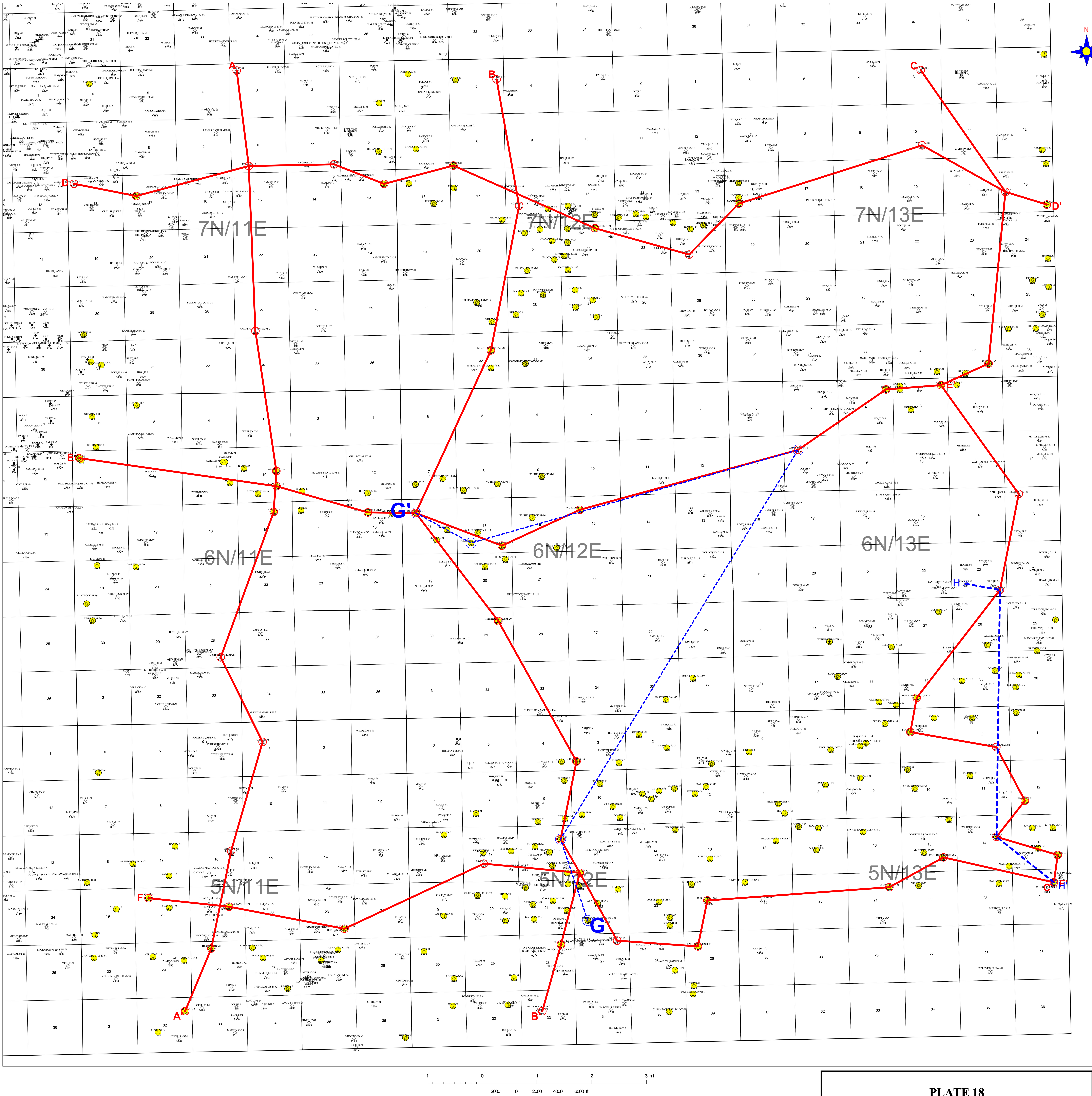


PLATE 18

Cross-Section Index Map
Pittsburg and Hughes Counties, Oklahoma

Author:		Date:
C. Godwin		27 June, 2004

Plate 19:
Stratigraphic Cross-Section A-A'
(North-South)

Datum: Top of Lower Hartshorne Coal
Vertical Scale: 2.5" = 100'
No Horizontal Scale

Plate 20:
Stratigraphic Cross-Section B-B'
(North to South)

Plate 21: Stratigraphic Cross-Section C-C' (North to South)

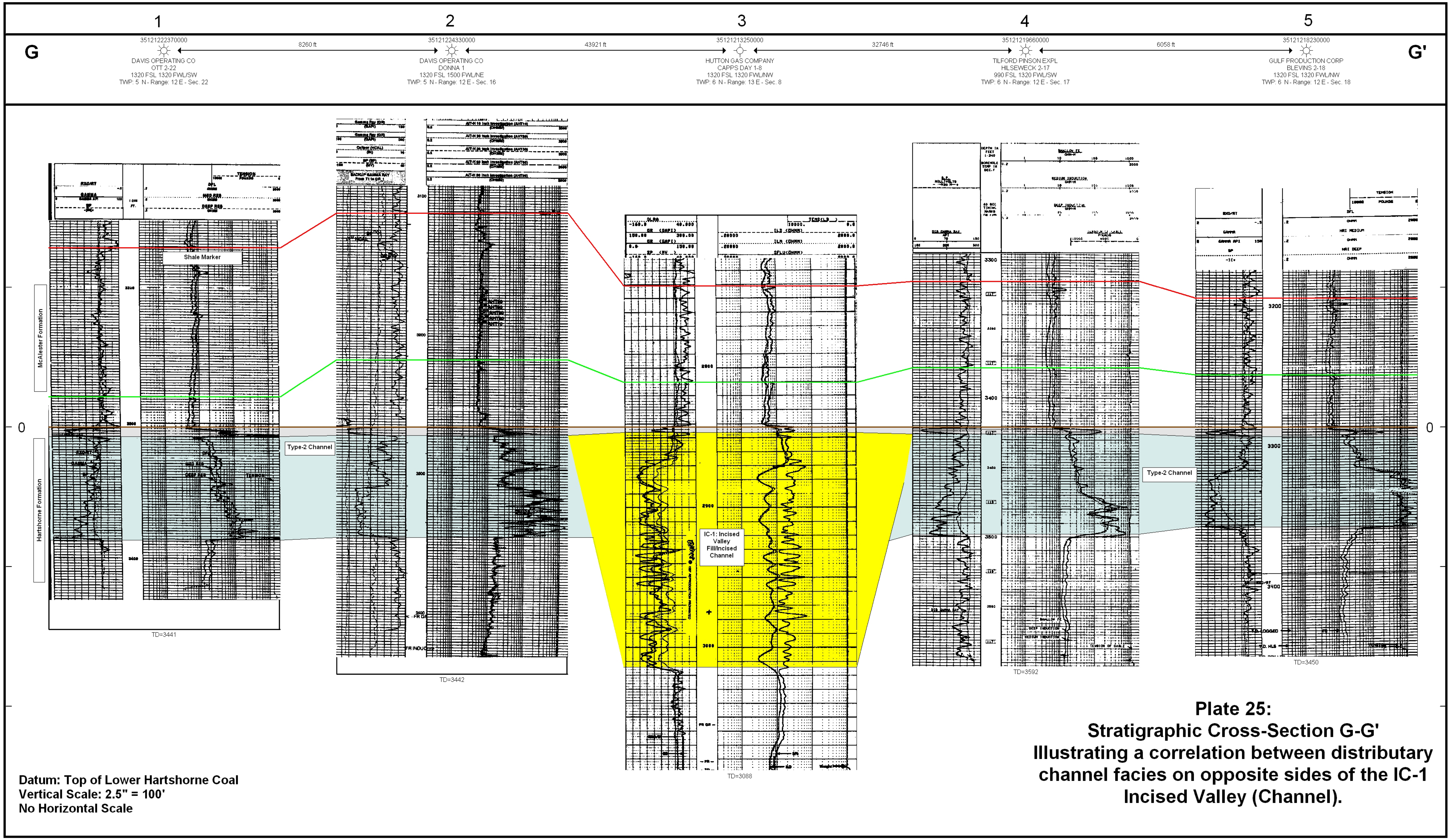
Datum: Top of Lower Hartshorne Coal
Vertical Scale: 2.5" =100'
No Horizontal Scale - Equally Spaced Logs

Plate 22:
Stratigraphic Cross-Section D-D'
(West to East)

Plate 23:
Stratigraphic Cross-Section
E-E' (West to East)

Datum: Upper Resistivity Marker
Vertical Scale: 2.5" = 100'
No Horizontal Scale

Plate 24:
Stratigraphic Cross-Section
F-F'
(West to East)



Datum: Top of Lower Hartshorne Coal
Vertical Scale: 2.5" = 100'
No Horizontal Scale

Plate 25: Stratigraphic Cross-Section G-G' Illustrating a correlation between distributary channel facies on opposite sides of the IC-1 Incised Valley (Channel).

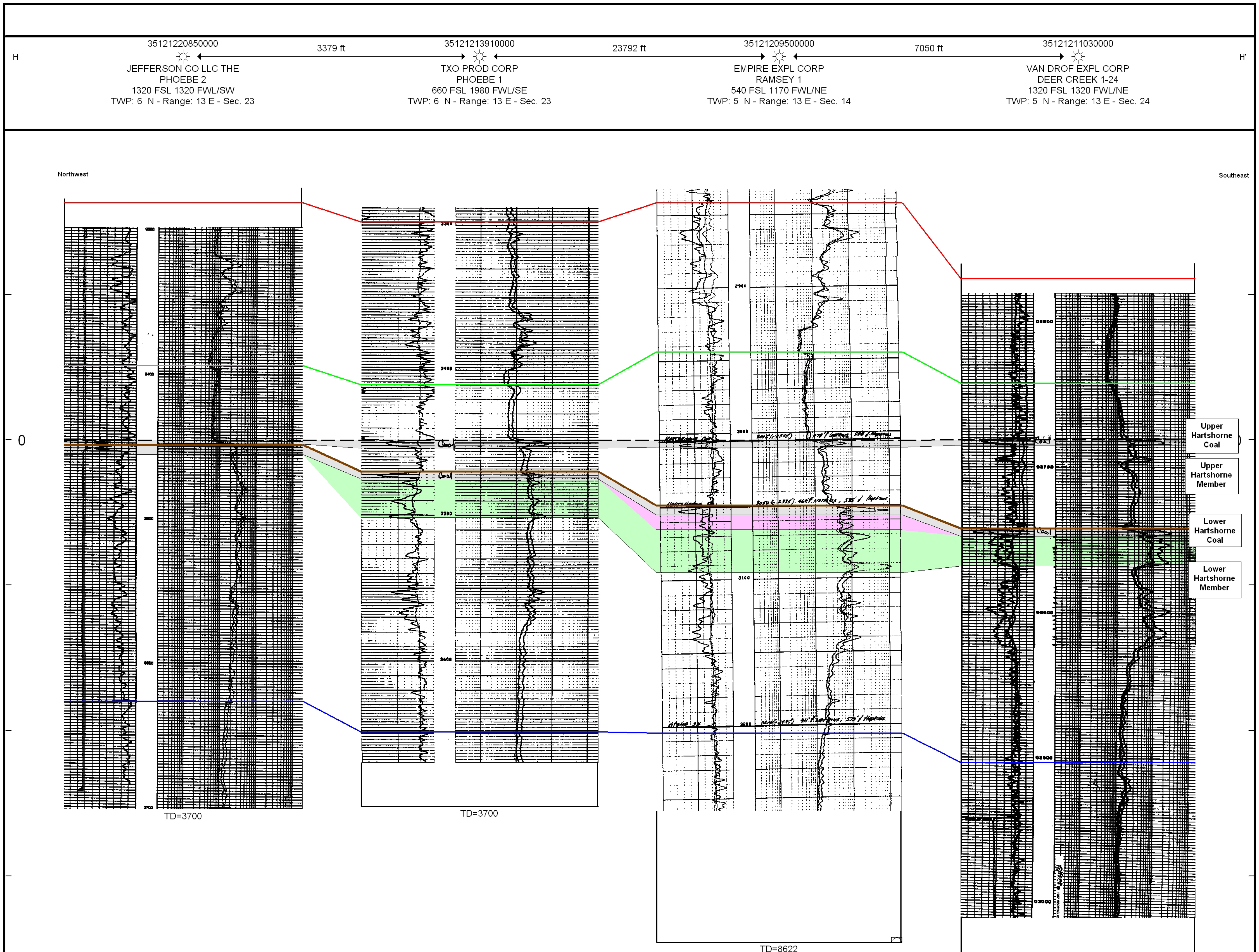


Plate 26:
Cross-Section H-H'
Cross-Section illustrating the development of the coal-split from the northwest (left) to the southeast (right)

Datum: Top of Hartshorne Formation
Vertcial Scale: 2.5" = 100'
No Horizontal Scale

VITA

Cory John Godwin

Candidate for the Degree of

Master of Science

Thesis: ELECTROFACIES, DEPOSITIONAL ENVIRONMENTS, AND PETROLEUM GEOLOGY OF THE HARTSHORNE FORMATION IN PARTS OF HUGHES AND PITTSBURG COUNTIES, OKLAHOMA

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Professional Memberships: American Association of Petroleum Geologists, Tulsa Geological Society, East Texas Geological Society, Shreveport Geological Society