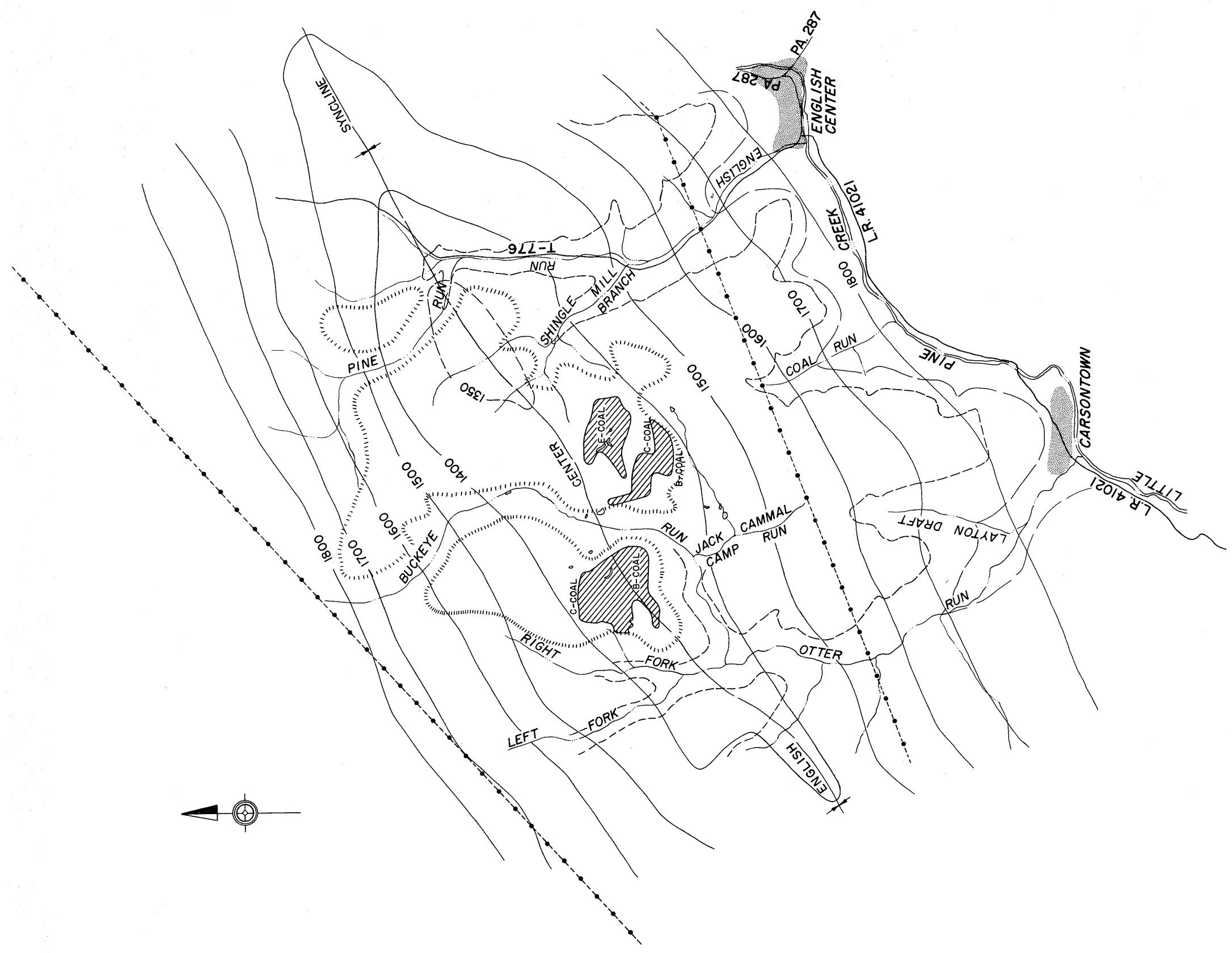
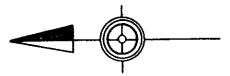


## Geological Examination of Project (SL-1 60) Area


The approximately 30,000 acres that comprise the Otter Run and English Run watershed(s) is located within one of the major physiographic divisions of North America. This division is called the Appalachian Highlands, and is subdivided into several provinces, in which the general subsurface structure has continuously controlled the development and peculiarities of the topography. Thus, those portions of the topography section of this report (Page 9) dealing with natural topographic features of the project area, fall within this classification. The English Run and Otter Run watersheds are included in the Northern Plateau Province of the Appalachian Highlands and are particularly characteristic of Appalachian structure and topography (i.e., Geomorphology).

The structural geology of any region is described as the study of the arrangement or rearrangement of the materials which form the earth's crust (lithosphere) and is based upon the observable portion of the lithosphere. The primary object of structural geology is to determine the character as well as the space and time relationships of the deformation, while the primary object of stratigraphy is to determine the order of geological events; therefore, the following discussion of the areal geology will reflect the intimate relationship between stratigraphy and structural geology.

The oldest observed formation in the study watersheds is the Catskill Red Sandstone of the Upper Devonian period of geologic time. This sedimentary formation is of clastic or mechanical origin, and is exposed along the streams at the lower edge of the project area. The action of Little Pine Creek, English Run, Otter Run, and Coal Run, serving as the principal agents of subaerial erosion, has exposed this formation (Catskill Red SS) for considerable distances up these streams from their mouths. The review of deep welllogs for the surrounding area indicated that this particular sandstone formation achieves an average thickness of more than 2500 feet. Since all the ingredients for rapid erosion, such as, high fluctuations in volume and velocity, steep gradients, normal sediment loads,



LEGEND

- 1800 — STRUCTURE CONTOURS ON TOP OF BURGOON SANDSTONE ..
- 1350 — .. AT 100' CONTOUR INTERVALS
- SAME AS ABOVE ... AT 50' CONTOUR INTERVALS (LOCALLY)
- - - CONTACT BETWEEN MAUCH CHUNK FORMATION AND POCONO SANDSTONE (BURGOON)
- - - CONTACT BETWEEN CATSKILL RED BEDS AND POCONO SANDSTONE (LOWER)
- ||||| COAL DEPOSIT OUTLINE
-  COAL REMOVED BY STRIP MINING (BED NAMED)
- - - TROUGH OF SYNCLINE

COMMONWEALTH OF PENNSYLVANIA  
DEPARTMENT OF ENVIRONMENTAL RESOURCES

ENGLISH RUN  
MINE DRAINAGE STUDY  
MAP NO. 5 - GEOLOGY

SCALE  
1" = 4000'  
OCT. 1971

PREPARED BY  
ENGLISH ENGINEERING CORP.  
WILLIAMSPORT, PENNSYLVANIA

etc., are present in the aforementioned streams, one can expect erosion of the Catskill Sandstone to continue and even greater stretches of this sandstone formation to be exposed in the future.

Lying on top of the aforementioned Catskill Sandstone is still another thick deposit of material known as the Pocono Sandstone. This clastic sandstone is a part of a great series of delta deposits and alluvial fans which were laid down during the Lower Carboniferous (Mississippian) Age. This particular formation from central Pennsylvania has been accurately correlated with marine facies (shales and limestones) of the Mississippi Valley. Deep well gas and oil exploration in the locality indicates this formation to be from 400 to 800 feet in thickness. The Pocono Sandstone has been exposed extensively throughout the project area by fairly recent continental glaciation and is the dominant formation within the Otter Run and English Run watersheds.

The next geologic horizon encountered is the Mauch Chunk Red Stone. This formation, of the Mississippian (Lower Carboniferous) period, as is the Pocono Sandstone, surfaces throughout the region and forms a perimeter around the Pottsville Conglomerate and the Lower Productive Coal Measures. Since this red stone is soft and friable, stream erosion is more rapid where it is encountered; therefore, evidence of this erosional speed-up serves as an indication of the coal measures that lie above it. Most of the Mauch Chunk Red Stone outcrops at elevations well above the valley floors and is limited in extent, since the major portion of it was removed during the glaciation of the last great ice age. Although no well-logs are available, surface evidence indicates that this formation probably does not exceed 100 feet in thickness anywhere throughout the area.

The Pottsville Conglomerate, the basal series of the Pennsylvanian period, underlies the local coal measures, which once overlay the entire region but since have been largely eroded away. The few remaining pockets of coal comprise what is known locally as the Little Pine Creek Coal Basin. The Pottsville Conglomerate and the coals of the area

(Lower Productive Coal Measures) have in some instances been intermixed, undoubtedly during the most recent and widespread period of continental glaciation in North America (Pleistocene).

The coal measures of the area, are from the Pennsylvanian period of geologic time, and have been exposed through test-pits and drifts at many places on the Otter Run and English Run watersheds, although few, if any, natural outcrops are visible. The three coal beds that have been mined within the boundaries of the study project are from the bottom to the top; the B (Blossburg) Coal, the C (Cushing) Coal, and the E (Smut) Coal. In addition, the still deeper A (Bear Creek) Coal has been drilled but not mined. The B-Coal, considered the best of the local coals, probably has an average thickness of between four and five feet, while the C-Coal ranges in thickness from three to four feet. The E-Coal, due to its near surface position, was first to be removed by stripping, though it was considered a marginal commercial steam coal. The A-Coal lies below the desirable Blossburg seam and because it is only one to two feet in thickness and of doubtful quality it is not considered minable.

The coal of the Blossburg seam, (B-Coal) is known to be low in sulfur and ash, and high in volatile content, making it desirable for higher utilization than its present function as a steam coal. However, limited quantity and geographic location probably restrict its use to that of a high grade steam coal. On the other hand, the Cushing coal (C-Coal) probably has reached its highest order of utilization as a steam coal.

An ultimate analysis (Andrew McCreath & Son, Inc.) of the Blossburg Coal taken from the English Mine on warrant 4359, is as follows:

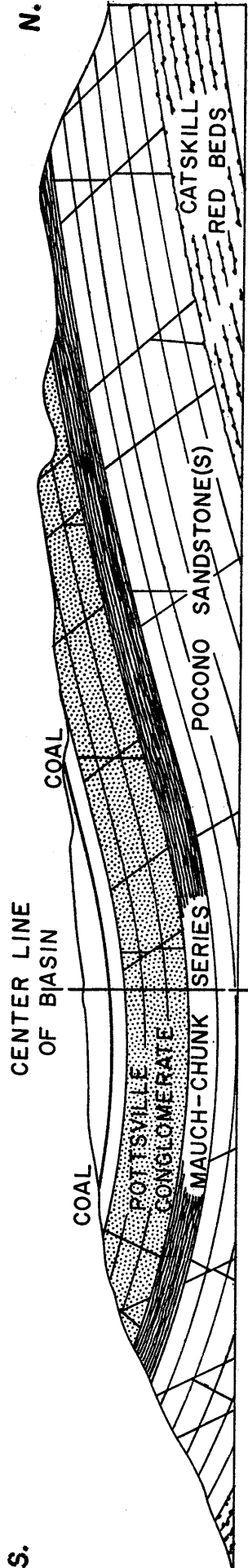
	Upper Bench	Middle Bench	Lower Bench
Water @ 225°	0.760	0.900	0.860
Volatile Matter	19.700	20.250	19.820
Fixed Carbon	68.390	68.962	65.328
Sulfur	0.675	0.593	0.817
Ash	<u>10.475</u>	<u>9.295</u>	<u>13.175</u>
Total	100.000	100.000	100.000

The coals of this locale are geologically the oldest beds to be found within the Pennsylvanian period. Since coal is usually traceable to the Carboniferous Age, and most frequently to the Pennsylvanian period (often accorded separate systematic rank, but here included within the Carboniferous) it is generally referred to as occurring in the upper portion of the Pennsylvanian (Upper Coal Measures or Pittsburgh series) or the lower portion of this period (Lower Coal Measures or Pottsville series). Pottsville, in addition to being a generic name for the Lower Coal Measures or series, is also the name given to the conglomerate formation in which these coals are discovered. Thus, the coals under discussion with such local names as the Blossburg or Cushing Coal are portions of the Pottsville formation and lying beneath the well known Freeport and Kittanning Coals of central Pennsylvania.

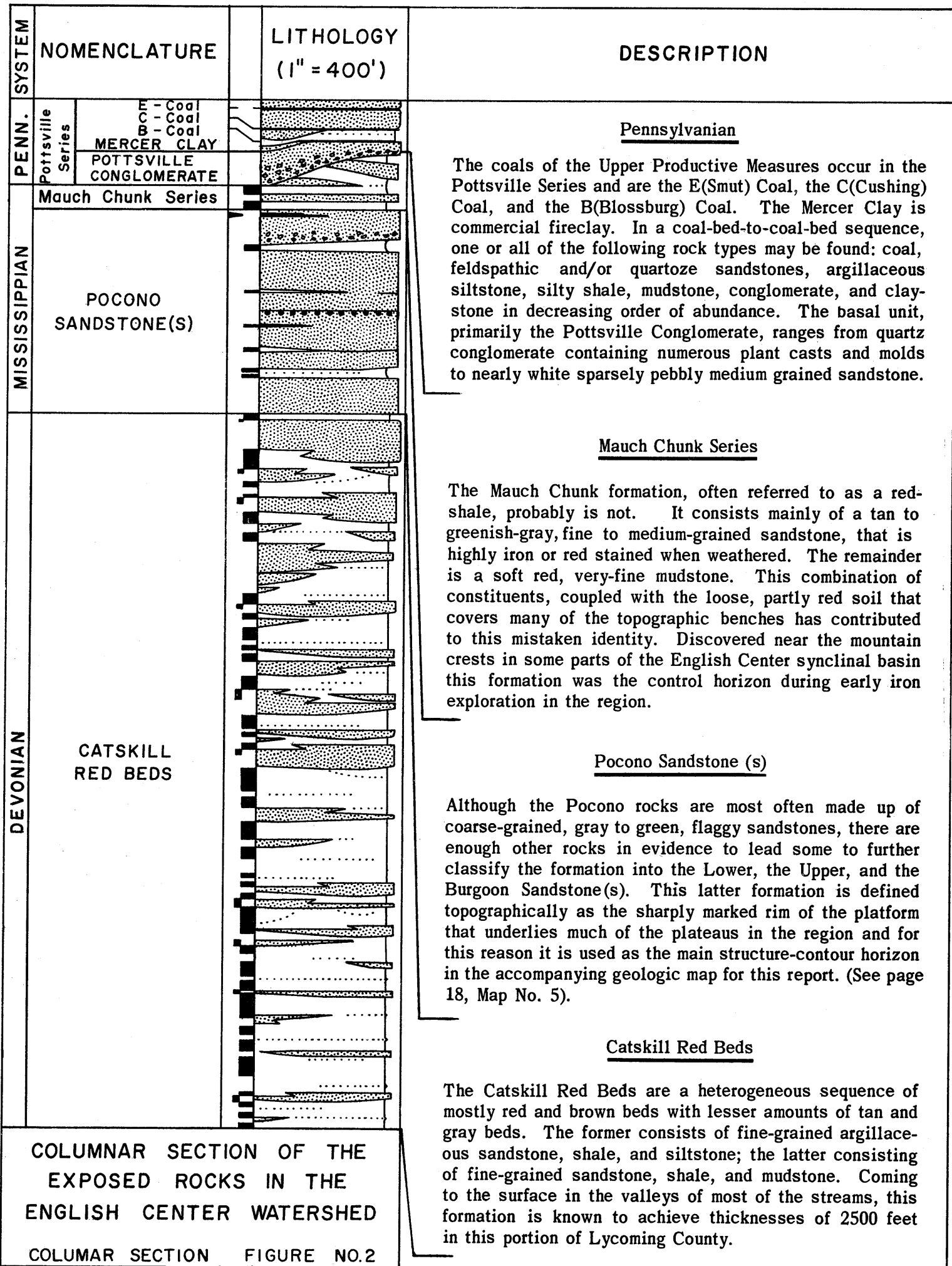
Generally speaking, the rocks of the Little Pine Creek Coal Basin are controlled by a major interruption - the English Center Syncline. The axis of this syncline (trough) runs through the middle of the local coal measures in a southwest-northeast direction. This particular syncline is but one of an associated series of anticlines (arches) and synclines (troughs) that go to make up the Northern Plateau Province. The dip in the northern part of the coal basin is generally southward, while in the southern part of the basin the dip is to the north-northwest reflecting the influence of the English Center Syncline.

Many small, local, and sometimes very sharp irregularities are evident on even a casual inspection of strip pits or examination of drill-hole logs. This local structure or varying slopes of the strata can have great significance on mine drainage with respect to both active and abandoned mines. The coal itself can best be described as rolling in nature which is often the significant or controlling factor in determining a mining program for large protracted areas to be stripped.

Since the watersheds of the region are extensively wooded, erosional patterns are restricted to streambank erosion and stream bedload movement except for areas in which man has induced areal erosion through road building, strip-mining, power line construction, and similar commercial activities.



LITTLE PINE CREEK COAL BASIN



COLUMNAR SECTION OF THE EXPOSED ROCKS IN THE ENGLISH CENTER WATERSHED

COLUMAR SECTION FIGURE NO.2



# DRILLING LOG

For English Engineering Corporation Date 6-8-71

On English Run Watershed Twp. Pine County Lycoming State Pa.

Hole No. 2 Size 8" El. 1597.82' Remarks \_\_\_\_\_ Figure No. 3

CLASSIFICATION	Thickness of Strata FEET	Depth From Surface FEET
Overburden	4.0	4.0
Shale	12.0	16.0
Coal (C)	5.0	21.0
Conglomerate	4.0	25.0
Sandstone	10.0	35.0
<p>No. 3 Size 8" El. 1599.70'</p>		
Overburden	5.0	5.0
Shale	24.0	29.0
Coal (C)	3.0	32.0
Shale	3.0	35.0
<p>No. 4 Size 8" El. 1600.75'</p>		
Overburden	6.0	6.0
Shale	14.0	20.0
Sandstone	5.0	25.0
Conglomerate	7.0	32.0
Coal (C)	3.0	35.0
<p>No. 5 Size 8" El. 1600.20' (Hit opening @ 34.0')</p>		
Overburden	3.0	3.0
Shale	11.0	14.0
Sandstone	12.0	26.0
Conglomerate	8.0	34.0
Opening	---	---
<p>No. 6 Size 8" El. 1599.49' 6-9-71</p>		
Overburden	7.0	7.0
Shale	15.0	22.0
Sandstone	4.0	26.0
Conglomerate	8.0	34.0
Coal (C)	3.0	37.0