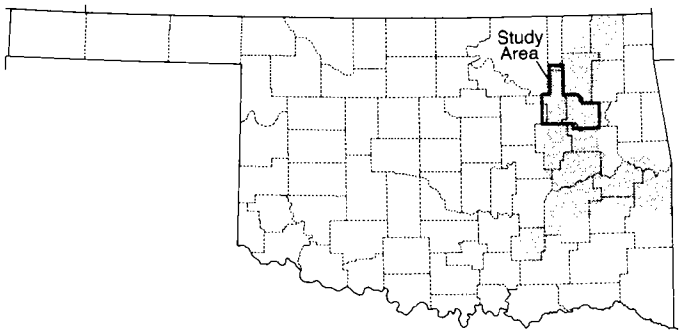
OKLAHOMA GEOLOGICAL SURVEY
MAP GM-33

APPENDIXES



Coal Geology of Tulsa, Wagoner, Creek, and Washington Counties, Oklahoma

LeRoy A. Hemish

1990

OKLAHOMA GEOLOGICAL SURVEY
MAP GM-33

APPENDIXES

Coal Geology of Tulsa, Wagoner, Creek, and Washington Counties, Oklahoma

LeRoy A. Hemish

CONTENTS

Oklahoma Geological Survey
Charles J. Mankin, *Director*
The University of Oklahoma
Norman, Oklahoma

1990

Appendix 1: Coal Resources and Reserves by Township and Range and by Coal Bed

(thousands of short tons)

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
								T15N, R17E, WAGONER COUNTY									
SECOR																	
	Measured																
	0-20																
	20-40																
	40-100			5	14					5	14			5	14		
	>100																
	Total			5	14					5	14			5	14		
	Indicated																
	0-20																
	20-40																
	40-100	10	18	35	89					45	107			45	107		
	>100			138	354					138	354			138	354		
	Total	10	18	173	443					183	461			183	461		
	Inferred																
	0-20																
	20-40																
	40-100																
	>100			571	1,470					571	1,470			571	1,470		
	Total			571	1,470					571	1,470			571	1,470		
	Grand Total	10	18	749	1,927					759	1,945			759	1,945		
TULLAHASSEE																	
	Measured																
	0-20	4	6							4	6			4	6	4	5
	20-40																
	40-100																
	>100																
	Total	4	6							4	6			4	6	4	5
	Indicated																
	0-20	18	31							18	31			18	31	18	24
	20-40																

40-100												
>100												
Total	18	31					18	31		18	31	18	24
Inferred												
0-20	51	80					51	80		51	80	51	66
20-40	67	109					67	109		67	109		
40-100	52	84					52	84		52	84		
>100													
Total	170	273					170	273		170	273	51	66
Grand Total	192	310					192	310		192	310	73	95
COMBINED GRAND TOTALS	202	328	749	1,927			951	2,255		951	2,255	73	95

T15N, R18E, WAGONER COUNTY

TULLAHASSEE												
Measured												
0-20	3	5					3	5		3	5	3	4
20-40	3	4					3	4		3	4		
40-100												
>100												
Total	6	9					6	9		6	9	3	4
Indicated												
0-20												
20-40												
40-100												
>100												
Total												
Inferred												
0-20												
20-40												
40-100												
>100												
Total												
Grand Total	6	9					6	9		6	9	3	4

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
										T16N, R12E, CREEK AND TULSA COUNTIES							
DAWSON																	
	Measured																
	0-20	37	68	62	161					99	229	3	8	102	237	99	184
	20-40	7	11	18	46					25	57			25	57	18	37
	40-100																
	>100																
	Total	44	79	80	207					124	286			127	294	117	221
	Indicated																
	0-20	10	18	127	337					137	355			137	355	137	284
	20-40	56	101	92	238					148	339			148	339	92	190
	40-100																
	>100																
	Total	66	119	219	575					285	694			285	694	229	474
	Inferred																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Grand Total	110	198	299	782					409	980	3	8	412	988	346	695
										T16N, R14E, WAGONER COUNTY							
CROWEBURG																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																

40-100	6	9			6	9	6	9		
>100			13	32	13	32	13	32		
Total	6	9	13	32	19	41	19	41		
Inferred										
0-20										
20-40										
40-100										
>100			157	425	157	425	157	425		
Total			157	425	157	425	157	425		
Grand Total	6	9	170	457	176	466	176	466		
MINERAL										
Measured										
0-20										
20-40										
40-100										
>100										
Total										
Indicated										
0-20										
20-40			3	8	3	8	3	8		
40-100			19	51	19	51	19	51		
>100			68	183	68	183	68	183		
Total			90	242	90	242	90	242		
Inferred										
0-20			28	92	28	92	28	92	28	74
20-40			55	139	55	139	55	139		
40-100			172	463	172	463	172	463		
>100			1,348	3,639	1,348	3,639	1,348	3,639		
Total			1,603	4,333	1,603	4,333	1,603	4,333	28	74
Grand Total			1,693	4,575	1,693	4,575	1,693	4,575	28	74
COMBINED GRAND TOTALS	6	9	1,863	5,032	1,869	5,041	1,869	5,041	28	74

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
										T16N, R15E, WAGONER COUNTY							
CROWEBURG																	
	Measured																
	0-20	4	8	20	56					24	64	4	10	28	74	24	51
	20-40	2	4	19	52					21	56			21	56	21	45
	40-100	13	25	52	139					65	164			65	164	2	4
	>100			102	255					102	255			102	255		
	Total	19	37	193	502					212	539			216	549	47	100
	Indicated																
	0-20	15	27	24	66					39	93			39	93	39	75
	20-40	16	27	22	62					38	89			38	89	22	49
	40-100	39	68	53	148					92	216			92	216	7	18
	>100			259	660					259	660			259	660		
	Total	70	122	358	936					428	1,058			428	1,058	68	142
	Inferred																
	0-20			1	4					1	4			1	4	1	3
	20-40			2	5					2	5			2	5	2	4
	40-100			5	17					5	17			5	17	2	5
	>100			54	166					54	166			54	166		
	Total			62	192					62	192			62	192	5	12
	Grand Total	**89**	**159**	**613**	**1,630**					**702**	**1,789**	**4**	**10**	**706**	**1,799**	**120**	**254**
MINERAL																	
	Measured																
	0-20	17	27	13	30					30	57			30	57	30	46
	20-40	9	15							9	15			9	15		
	40-100	19	31							19	31			19	31		
	>100			9	22					9	22			9	22		
	Total	45	73	22	52					67	125			67	125	30	46
	Indicated																
	0-20	20	40	68	170					88	210			88	210	87	168
	20-40	11	22	14	34					25	56			25	56		
	40-100	5	12	28	69					33	81			33	81		
	>100			314	792					314	792			314	792		
	Total	36	74	424	1,065					460	1,139			460	1,139	87	168

Inferred												
0-20												
20-40			30	76	30	76			30	76		
40-100			106	266	106	266			106	266		
>100			503	1,268	503	1,268			503	1,268		
Total			639	1,610	639	1,610			639	1,610		
Grand Total	81	147	1,085	2,727	1,166	2,874			1,166	2,874	117	214
COMBINED GRAND TOTALS	170	306	1,698	4,357	1,868	4,663	4	10	1,872	4,673	237	468

T16N, R16E, WAGONER COUNTY

BLUEJACKET

Measured												
0-20	5	8			5	8			5	8	5	6
20-40	3	4			3	4			3	4		
40-100												
>100												
Total	8	12			8	12			8	12	5	6
Indicated												
0-20	6	9			6	9			6	9	6	8
20-40												
40-100												
>100												
Total	6	9			6	9			6	9	6	8
Inferred												
0-20												
20-40												
40-100												
>100												
Total												
Grand Total	14	21			14	21			14	21	11	14

SECOR

Measured												
0-20	22	39	30	80	52	119	66	189	118	308	52	95
20-40	37	65	121	313	158	378			158	378	133	268

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	40-100	93	177	1,658	4,570					1,751	4,747			1,751	4,747		
	>100			617	1,662					617	1,662			617	1,662		
	Total	152	281	2,426	6,625					2,578	6,906			2,644	7,095	185	363
	Indicated																
	0-20	7	11							7	11			7	11	7	9
	20-40	52	88	8	19					60	107			60	107	13	22
	40-100	217	433	1,491	3,962					1,708	4,395			1,708	4,395		
	>100			334	795					334	795			334	795		
	Total	276	532	1,833	4,776					2,109	5,308			2,109	5,308	20	31
	Inferred																
	0-20																
	20-40																
	40-100	226	447							226	447			226	447		
	>100																
	Total	226	447							226	447			226	447		
	Grand Total	654	1,260	4,259	11,401					4,913	12,661	66	189	4,979	12,850	205	394
	COMBINED GRAND TOTALS	668	1,281	4,259	11,401					4,927	12,682	66	189	4,993	12,871	216	408
	T16N, R17E, WAGONER COUNTY																
BLUEJACKET																	
	Measured																
	0-20	173	309	5	11					178	320			178	320	178	256
	20-40	79	148							79	148			79	148	2	4
	40-100	1	3							1	3			1	3		
	>100																
	Total	253	460	5	11					258	471			258	471	180	260
	Indicated																
	0-20	244	458	1	3					245	461			245	461	245	368
	20-40	340	649							340	649			340	649	1	1
	40-100	17	28							17	28			17	28		
	>100																
	Total	601	1,135	1	3					602	1,138			602	1,138	246	369

Inferred												
0-20	226	448			226	448			226	448	226	358
20-40	243	460			243	460			243	460		
40-100	67	127			67	127			67	127		
>100												
Total	536	1,035			536	1,035			536	1,035	226	358
Grand Total	1,390	2,630	6	14	1,396	2,644			1,396	2,644	652	987
SECOR												
Measured												
0-20	10	20	138	386	148	406	740	2,120	888	2,526	148	325
20-40	23	47	604	1,723	627	1,770			627	1,770	618	1,401
40-100	153	276	2,085	5,593	2,238	5,869			2,238	5,869		
>100			380	957	380	957			380	957		
Total	186	343	3,207	8,659	3,393	9,002			4,133	11,122	766	1,726
Indicated												
0-20			63	164	63	164			63	164	63	131
20-40			23	60	23	60			23	60	23	48
40-100	16	28	64	158	80	186			80	186		
>100			522	1,296	522	1,296			522	1,296		
Total	16	28	672	1,678	688	1,706			688	1,706	86	179
Inferred												
0-20			244	722	244	722			244	722	244	578
20-40			475	1,375	475	1,375			475	1,375	475	1,100
40-100			307	941	307	941			307	941		
>100												
Total			1,026	3,038	1,026	3,038			1,026	3,038	719	1,678
Grand Total	202	371	4,905	13,375	5,107	13,746	740	2,120	5,847	15,866	1,571	3,583
DRYWOOD												
Measured												
0-20	60	85			60	85	4	6	64	91	60	68
20-40												
40-100												
>100												
Total	60	85			60	85			64	91	60	68

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Indicated																
	0-20	6	9							6	9			6	9	6	7
	20-40																
	40-100																
	>100																
	Total	6	9							6	9			6	9	6	7
	Inferred																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Grand Total	66	94							66	94	4	6	70	100	66	75
TULLAHASSEE																	
	Measured																
	0-20	19	30							19	30	1	1	19	31	19	24
	20-40	17	27							17	27			17	27		
	40-100	12	19							12	19			12	19		
	>100																
	Total	48	76							48	76			49	77	19	24
	Indicated																
	0-20	8	14							8	14			8	14	8	11
	20-40	44	71							44	71			44	71		
	40-100																
	>100																
	Total	52	85							52	85			52	85	8	11
	Inferred																
	0-20	74	119							74	119			74	119	74	96
	20-40	191	310							191	310			191	310		
	40-100	1,530	2,478							1,530	2,478			1,530	2,478		
	>100																
	Total	1,795	2,907							1,795	2,907			1,795	2,907	74	96
	Grand Total	1,895	3,068							1,895	3,608	1	1	1,896	3,069	101	131

COMBINED GRAND TOTALS	3,553	6,163	4,911	13,389	8,464	19,552	745	2,127	9,209	21,679	2,390	4,776

T16N, R18E, WAGONER COUNTY

ROWE												
Measured												
0-20	12	23			12	23			12	23	12	18
20-40	8	15			8	15			8	15		
40-100	12	20			12	20			12	20		
>100												
Total	32	58			32	58			32	58	12	18
Indicated												
0-20	18	34			18	34			18	34	18	27
20-40	7	14			7	14			7	14		
40-100	10	16			10	16			10	16		
>100												
Total	35	64			35	64			35	64	18	27
Inferred												
0-20												
20-40												
40-100												
>100												
Total												
Grand Total	67	122			67	122			67	122	30	45
TULLAHASSEE												
Measured												
0-20	6	10			6	10			6	10	6	8
20-40	18	29			18	29			18	29		
40-100	5	9			5	9			5	9		
>100												
Total	29	48			29	48			29	48	6	8
Indicated												
0-20	9	14			9	14			9	14	9	11
20-40	47	76			47	76			47	76		
40-100	44	71			44	71			44	71		
>100												
Total	100	161			100	161			100	161	9	11

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20	99	161							99	161			99	161	99	128
	20-40	162	262							162	262			162	262		
	40-100	344	557							344	557			344	557		
	>100																
	Total	605	980							605	980			605	980	99	128
	Grand Total	734	1,189							734	1,189			734	1,189	114	147
	COMBINED GRAND TOTALS	801	1,311							801	1,311			801	1,311	144	192
							T17N, R12E, CREEK AND TULSA COUNTIES										
DAWSON																	
	Measured																
	0-20			49	175					49	175	1	3	50	178	49	140
	20-40			25	88					25	88			25	88	25	71
	40-100			5	18					5	18			5	18		
	>100																
	Total			79	281					79	281			80	284	74	211
	Indicated																
	0-20			119	406					119	406			119	406	119	325
	20-40	7	12	133	412					140	424			140	424	82	223
	40-100			313	1,070					313	1,070			313	1,070		
	>100			24	79					24	79			24	79		
	Total	7	12	589	1,967					596	1,979			596	1,979	201	548
	Inferred																
	0-20			354	1,088					354	1,088			354	1,088	354	870
	20-40	12	21	423	1,271					435	1,292			435	1,292	374	917
	40-100	132	238	1,475	4,380					1,607	4,618			1,607	4,618		
	>100			1,366	4,078					1,366	4,078			1,366	4,078		
	Total	144	259	3,618	10,817					3,762	11,076			3,762	11,076	728	1,787
	Grand Total	151	271	4,286	13,065					4,437	13,336	1	3	4,438	13,339	1,003	2,546

JENKS												
Measured												
0-20												
20-40												
40-100												
>100												
Total												
Indicated												
0-20												
20-40												
40-100												
>100												
Total												
Inferred												
0-20												
20-40			11	37		11	37			11	37	7	20
40-100			439	1,422		439	1,422			439	1,422		
>100													
Total			450	1,459		450	1,459			450	1,459	7	20
Grand Total			450	1,459		450	1,459			450	1,459	7	20
COMBINED GRAND TOTALS	151	271	4,736	14,524		4,887	14,795	1	3	4,888	14,798	1,010	2,566

T17N, R13E, TULSA COUNTY

JENKS												
Measured												
0-20												
20-40												
40-100												
>100												
Total												
Indicated												
0-20												
20-40												
40-100												
>100												
Total												

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20			136	466					136	466			136	466	136	372
	20-40			261	894					261	894			261	894	261	715
	40-100			328	1,121					328	1,121			328	1,121		
	>100																
	Total			725	2,481					725	2,481			725	2,481	397	1,087
	Grand Total			725	2,481					725	2,481			725	2,481	397	1,087

T17N, R14E, TULSA COUNTY

MINERAL

	Measured																
	0-20			9	26					9	26			9	26	9	20
	20-40			6	16					6	16			6	16		
	40-100			11	27					11	27			11	27		
	>100			6	15					6	15			6	15		
	Total			32	84					32	84			32	84	9	20
	Indicated																
	0-20			25	62					25	62			25	62	25	50
	20-40			12	29					12	29			12	29		
	40-100			19	48					19	48			19	48		
	>100			21	53					21	53			21	53		
	Total			77	192					77	192			77	192	25	50
	Inferred																
	0-20			75	188					75	188			75	188	75	150
	20-40			68	172					68	172			68	172		
	40-100			102	257					102	257			102	257		
	>100			721	1,818					721	1,818			721	1,818		
	Total			966	2,435					966	2,435			966	2,435	75	150
	Grand Total			1,075	2,711					1,075	2,711			1,075	2,711	109	220

T17N, R15E, WAGONER COUNTY

CROWEBURG										
Measured										
0-20	2	3			2	3	2	3	2	2
20-40	3	5			3	5	3	5		
40-100	5	7			5	7	5	7		
>100										
Total	10	15			10	15	10	15	2	2
Indicated										
0-20	2	5	1	1	3	6	3	6	3	5
20-40	2	4	1	1	3	5	3	5	3	4
40-100	5	11			5	11	5	11		
>100										
Total	9	20	2	2	11	22	11	22	6	9
Inferred										
0-20										
20-40										
40-100										
>100										
Total										
Grand Total	19	35	2	2	21	37	21	37	8	11
MINERAL										
Measured										
0-20	6	10	5	13	11	23	11	23	11	18
20-40	6	10	5	13	11	23	11	23		
40-100	12	21	15	38	27	59	27	59		
>100			22	55	22	55	22	55		
Total	24	41	47	119	71	160	71	160	11	18
Indicated										
0-20										
20-40										
40-100										
>100										
Total										
Inferred										
0-20	4	8	97	256	101	264	101	264	101	211
20-40			114	292	114	292	114	292		

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	40-100			68	172					68	172			68	172		
	>100																
	Total	4	8	279	720					283	728			283	728	101	211
	Grand Total	28	49	326	839					354	888			354	888	112	229
TEBO																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																
	40-100	39	58							39	58			39	58		
	>100																
	Total	39	58							39	58			39	58		
	Inferred																
	0-20	98	145							98	145			98	145	98	116
	20-40	115	171							115	171			115	171		
	40-100	579	858							579	858			579	858		
	>100																
	Total	792	1,174							792	1,174			792	1,174	98	116
	Grand Total	831	1,232							831	1,232			831	1,232	98	116
	COMBINED GRAND TOTALS	878	1,316	328	841					1,206	2,157			1,206	2,157	218	356

T17N, R16E, WAGONER COUNTY

TEBO

Measured
0-20
20-40

40-100										
>100										
Total										
Indicated										
0-20	1	2	1	2			1	2	1	2
20-40	9	13	9	13			9	13		
40-100	32	46	32	46			32	46		
>100										
Total	42	61	42	61			42	61	1	2
Inferred										
0-20	25	38	25	38			25	38	25	30
20-40	4	6	4	6			4	6		
40-100	1	1	1	1			1	1		
>100										
Total	30	45	30	45			30	45	25	30
Grand Total	72	106	72	106			72	106	26	32
WEIR-PITTSBURG										
Measured										
0-20					1	2	1	2		
20-40										
40-100										
>100										
Total							1	2		
Indicated										
0-20										
20-40										
40-100										
>100										
Total										
Inferred										
0-20										
20-40										
40-100										
>100										
Total										
Grand Total					1	2	1	2		

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
BLUEJACKET																	
	Measured																
	0-20	160	246							160	246			160	246	160	197
	20-40	17	26							17	26			17	26		
	40-100	43	66							43	66			43	66		
	>100																
	Total	220	338							220	338			220	338	160	197
	Indicated																
	0-20	395	605							395	605			395	605	395	484
	20-40	224	343							224	343			224	343		
	40-100	222	327							222	327			222	327		
	>100																
	Total	841	1,275							841	1,275			841	1,275	395	484
	Inferred																
	0-20	132	201							132	201			132	201	132	161
	20-40	126	192							126	192			126	192		
	40-100	305	450							305	450			305	450		
	>100																
	Total	563	843							563	843			563	843	132	161
	Grand Total	1,624	2,456							1,624	2,456			1,624	2,456	687	842
SECOR																	
	Measured																
	0-20	3	6	6	15					9	21	1	1	10	22	9	17
	20-40	1	3	5	13					6	16			6	16	5	10
	40-100	2	3	3	6					5	9			5	9		
	>100																
	Total	6	12	14	34					20	46			21	47	14	27
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																

Inferred													
0-20													
20-40													
40-100													
>100													
Total													
Grand Total	6	12	14	34		20	46	1	1	21	47	14	27
COMBINED GRAND TOTALS	1,702	2,574	14	34		1,716	2,608	2	3	1,718	2,611	727	901

T17N, R17E, WAGONER COUNTY

DRYWOOD

Measured													
0-20								1	1	1	1		
20-40													
40-100													
>100													
Total										1	1		
Indicated													
0-20													
20-40													
40-100													
>100													
Total													
Inferred													
0-20													
20-40													
40-100													
>100													
Total													
Grand Total								1	1	1	1		

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
								T17N, R18E, WAGONER COUNTY									
ROWE																	
	Measured																
	0-20	190	352							190	352	42	72	232	424	190	282
	20-40	23	42							23	42			23	42		
	40-100	1	2							1	2			1	2		
	>100																
	Total	214	396							214	396			256	468	190	282
	Indicated																
	0-20	341	616							341	616			341	616	341	493
	20-40	52	100							52	100			52	100		
	40-100	14	23							14	23			14	23		
	>100																
	Total	407	739							407	739			407	739	341	493
	Inferred																
	0-20	123	210	68	150					191	360			191	360	191	288
	20-40	37	77	28	63					65	140			65	140	28	50
	40-100																
	>100																
	Total	160	287	96	213					256	500			256	500	219	338
	Grand Total	781	1,422	96	213					877	1,635	42	72	919	1,707	750	1,113
								T18N, R12E, CREEK and TULSA COUNTIES									
DAWSON																	
	Measured																
	0-20			80	271	8	37			88	308	107	337	195	645	88	246
	20-40			12	36	9	41			21	77			21	77	21	62
	40-100					9	39			9	39			9	39		
	>100					24	108			24	108			24	108		
	Total			92	307	50	225			142	532			249	869	109	308
	Indicated																
	0-20			350	1,293	12	53			362	1,346			362	1,346	362	1,077
	20-40			311	1,009	14	61			325	1,070			325	1,070	325	856

40-100	362	1,176	37	111	399	1,287			399	1,287		
>100	60	171	159	683	219	854			219	854		
Total	1,083	3,649	222	908	1,305	4,557			1,305	4,557	687	1,933
Inferred												
0-20	390	1,360			390	1,360			390	1,360	390	1,088
20-40	600	1,992			600	1,992			600	1,992	600	1,593
40-100	2,247	6,974			2,247	6,974			2,247	6,974		
>100	3,477	10,934	106	470	3,583	11,404			3,583	11,404		
Total	6,714	21,260	106	470	6,820	21,730			6,820	21,730	990	2,681
Grand Total	7,889	25,216	378	1,603	8,267	26,819	107	337	8,374	27,156	1,786	4,922
JENKS												
Measured												
0-20	33	100			33	100			33	100	33	81
20-40	11	34			11	34			11	34		
40-100												
>100												
Total	44	134			44	134			44	134	33	81
Indicated												
0-20	69	98			69	98			69	98	69	172
20-40	110	336			110	336			110	336		
40-100	158	485			158	485			158	485		
>100												
Total	337	919			337	919			337	919	69	172
Inferred												
0-20	162	499			162	499			162	499	162	399
20-40	380	930			380	930			380	930		
40-100	898	2,749			898	2,749			898	2,749		
>100												
Total	1,440	4,178			1,440	4,178			1,440	4,178	162	399
Grand Total	1,821	5,231			1,821	5,231			1,821	5,231	264	652
COMBINED GRAND TOTALS	9,710	30,447	378	1,603	10,088	32,050	107	337	10,195	32,387	2,050	5,574

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
								T18N, R13E, TULSA COUNTY									
JENKS																	
	Measured																
	0-20			21	70					21	70			21	70	21	56
	20-40			41	134					41	134			41	134	41	107
	40-100																
	>100																
	Total			62	204					62	204			62	204	62	163
	Indicated																
	0-20			101	345					101	345			101	345	101	276
	20-40			74	252					74	252			74	252	74	201
	40-100			1	3					1	3			1	3		
	>100																
	Total			176	600					176	600			176	600	175	477
	Inferred																
	0-20			68	233					68	233			68	233	68	186
	20-40			52	178					52	178			52	178	52	142
	40-100			50	173					50	173			50	173		
	>100																
	Total			170	584					170	584			170	584	120	328
	Grand Total			408	1,388					408	1,388			408	1,388	357	968
								T18N, R14E, TULSA COUNTY									
CROWEBURG																	
	Measured																
	0-20											314	847	314	847		
	20-40			19	57					19	57			19	57	19	46
	40-100			15	46					15	46			15	46		
	>100																
	Total			34	103					34	103			348	950	19	46
	Indicated																
	0-20																
	20-40			27	68					27	68			27	68		

40-100	413	1,190	413	1,190			413	1,190		
>100	18	51	18	51			18	51		
Total	458	1,309	458	1,309			458	1,309		
Inferred										
0-20	47	118	47	118			47	118	47	95
20-40	163	412	163	412			163	412		
40-100	1,230	3,156	1,230	3,156			1,230	3,156		
>100	2,259	5,694	2,259	5,694			2,259	5,694		
Total	3,699	9,380	3,699	9,380			3,699	9,380	47	95
Grand Total	4,191	10,792	4,191	10,792	314	847	4,505	11,639	66	141
MINERAL										
Measured										
0-20										
20-40										
40-100										
>100										
Total										
Indicated										
0-20										
20-40										
40-100										
>100										
Total										
Inferred										
0-20										
20-40										
40-100	356	833	356	833			356	833		
>100	30	66	30	66			30	66		
Total	386	899	386	899			386	899		
Grand Total	386	899	386	899			386	899		
COMBINED GRAND TOTALS	4,577	11,691	4,577	11,691	314	847	4,891	12,538	66	141

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
								T18N, R15E, WAGONER COUNTY									
CROWEBURG																	
	Measured																
	0-20			114	423					114	423	1,339	4,563	1,453	4,986	114	338
	20-40			105	349					105	349			105	349	105	279
	40-100			148	488					148	488			148	488		
	>100			3	10					3	10			3	10		
	Total			370	1,270					370	1,270			1,709	5,833	219	617
	Indicated																
	0-20			53	184					53	184			53	184	53	147
	20-40			30	96					30	96			30	96	30	77
	40-100			746	2,354					746	2,354			746	2,354		
	>100			341	958					341	958			341	958		
	Total			1,170	3,592					1,170	3,592			1,170	3,592	83	224
	Inferred																
	0-20																
	20-40																
	40-100			208	682					208	682			208	682		
	>100			1,017	2,928					1,017	2,928			1,017	2,928		
	Total			1,225	3,610					1,225	3,610			1,225	3,610		
	Grand Total			2,765	8,472					2,765	8,472	1,339	4,563	4,104	13,035	302	841
MINERAL																	
	Measured																
	0-20	43	74	14	35					57	109			57	109	57	87
	20-40	24	43	69	192					93	235			93	235	69	154
	40-100	13	21	4	9					17	30			17	30		
	>100																
	Total	80	138	87	236					167	374			167	374	126	241
	Indicated																
	0-20	74	139	197	638					271	777			271	777	271	628
	20-40	70	138	220	531					290	669			290	669	25	61
	40-100	89	168	387	939					476	1,107			476	1,107		
	>100																
	Total	233	445	804	2,108					1,037	2,553			1,037	2,553	296	689

Inferred										
0-20	68	139	363	919	431	1,058	431	1,058	431	846
20-40	13	27	455	1,153	468	1,180	468	1,180		
40-100	97	200	4,219	10,504	4,316	10,704	4,316	10,704		
>100			67	146	67	146	67	146		
Total	178	366	5,104	12,722	5,282	13,088	5,282	13,088	431	846
Grand Total	491	949	5,995	15,066	6,486	16,015	6,486	16,015	853	1,776
TEBO										
Measured										
0-20										
20-40	7	10			7	10	7	10		
40-100	8	12			8	12	8	12		
>100										
Total	15	22			15	22	15	22		
Indicated										
0-20	46	68			46	68	46	68	46	51
20-40	91	134			91	134	91	134		
40-100	219	323			219	323	219	323		
>100										
Total	356	525			356	525	356	525	46	51
Inferred										
0-20	51	75			51	75	51	75	51	60
20-40	86	127			86	127	86	127		
40-100	999	1,475			999	1,475	999	1,475		
>100										
Total	1,136	1,677			1,136	1,677	1,136	1,677	51	60
Grand Total	1,507	2,224			1,507	2,224	1,507	2,224	97	111
WEIR-PITTSBURG										
Measured										
0-20	28	59			28	59	28	59	28	47
20-40	30	62			30	62	30	62	13	22
40-100	2	5			2	5	2	5		
>100										
Total	60	126			60	126	60	126	41	69

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Indicated																
	0-20	16	31							16	31			16	31	16	25
	20-40	154	309							154	309			154	309		
	40-100	339	671							339	671			339	671		
	>100																
	Total	509	1,011							509	1,011			509	1,011	16	25
	Inferred																
	0-20	1	1							1	1			1	1		
	20-40	23	42							23	42			23	42		
	40-100	308	557							308	557			308	557		
	>100																
	Total	332	600							332	600			332	600		
	Grand Total	901	1,737							901	1,737			901	1,737	57	94
	COMBINED GRAND TOTALS	2,899	4,910	8,760	23,538					11,659	28,448	1,339	4,563	12,998	33,011	1,309	2,822
										T18N, R16E, WAGONER COUNTY							
TEBO																	
	Measured																
	0-20	16	23							16	23	1	1	17	24	16	18
	20-40	27	39							27	39			27	39		
	40-100	1	2							1	2			1	2		
	>100																
	Total	44	64							44	64			45	65	16	18
	Indicated																
	0-20	6	9							6	9			6	9	6	7
	20-40	3	5							3	5			3	5		
	40-100	30	45							30	45			30	45		
	>100																
	Total	39	59							39	59			39	59	6	7
	Inferred																
	0-20																
	20-40																

40-100														
>100														
Total														
Grand Total	83	123					83	123	1	1	84	124	22	25
WEIR-PITTSBURG														
Measured														
0-20	101	184	64	141			165	325	4	8	169	333	165	260
20-40	34	52					34	52			34	52	1	2
40-100														
>100														
Total	135	236	64	141			199	377			203	385	166	262
Indicated														
0-20	287	488	23	50			310	538			310	538	310	430
20-40	160	268					160	268			160	268		
40-100	184	300					184	300			184	300		
>100														
Total	631	1,056	23	50			654	1,106			654	1,106	310	430
Inferred														
0-20	248	453					248	453			248	453	248	363
20-40	187	333					187	333			187	333		
40-100	700	1,191					700	1,191			700	1,191		
>100														
Total	1,135	1,977					1,135	1,977			1,135	1,977	248	363
Grand Total	1,901	3,269	87	191			1,988	3,460	4	8	1,992	3,468	724	668
COMBINED GRAND TOTALS	1,984	3,392	87	191			2,071	3,583	5	9	2,076	3,592	746	693
						T18N, R17E, WAGONER COUNTY								
ROWE														
Measured														
0-20	159	297	147	360	2	7	308	664	2	4	308	664	276	532
20-40	130	244	138	345			268	589			268	589	92	189
40-100	95	170	66	152			161	322			161	322		
>100														
Total	384	711	351	857	2	7	737	1,575			739	1,579	368	721

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Indicated																
	0-20	177	328	640	1,500					817	1,828			817	1,828	817	1,763
	20-40	282	412	383	904					665	1,316			665	1,316	306	571
	40-100	273	487	41	95					314	582			314	582		
	>100																
	Total	732	1,227	1,064	2,499					1,796	3,726			1,796	3,726	1,123	2,334
	Inferred																
	0-20	1	1	532	1,232					533	1,233			533	1,233	533	986
	20-40	3	6	23	52					26	58			26	58	16	29
	40-100	10	17							10	17			10	17		
	>100																
	Total	14	24	555	1,284					569	1,308			569	1,308	549	1,015
	Grand Total	1,130	1,962	1,970	4,640	2	7			3,102	6,609	2	4	3,104	6,613	2,040	4,070
							T18N, R18E, WAGONER COUNTY										
ROWE																	
	Measured																
	0-20	2	2							2	2	2	3	4	5	2	2
	20-40	1	1							1	1			1	1		
	40-100																
	>100																
	Total	3	3							3	3			5	6	2	2
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20			178	401					178	401			178	401	178	321
	20-40			15	34					15	34			15	34	15	27

40-100														
>100														
Total			193	435			193	435			193	435	193	348
Grand Total	3	3	193	435			196	438	2	3	198	441	195	350

T19N, R12E, TULSA COUNTY

DAWSON

Measured														
0-20														
20-40														
40-100														
>100														
Total														
Indicated														
0-20					2	7	2	7			2	7	2	5
20-40					2	7	2	7			2	7	2	5
40-100					2	8	2	8			2	8		
>100					7	32	7	32			7	32		
Total					13	54	13	54			13	54	4	10
Inferred														
0-20					49	216	49	216			49	216	49	172
20-40					32	143	32	143			32	143	32	114
40-100					374	1,649	374	1,649			374	1,649		
>100			73	312	503	2,218	576	2,530			576	2,530		
Total			73	312	958	4,226	1,031	4,538			1,031	4,538	81	286
Grand Total			73	312	971	4,280	1,044	4,592			1,044	4,592	85	296

T19N, R13E, TULSA COUNTY

DAWSON

Measured														
0-20			5	23	3	12	8	35	868	3,845	876	3,880	8	29
20-40			31	133	10	44	41	177			41	177	41	142
40-100			31	127	16	40	47	167			47	167		
>100														
Total			67	283	29	96	96	379			964	4,224	49	171

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Indicated																
	0-20			73	308	132	538			205	846			205	846	205	676
	20-40			92	393	75	334			167	727			167	727	167	582
	40-100			227	962	251	1,128			478	2,090			478	2,090		
	>100																
	Total			392	1,663	458	2,000			850	3,663			850	3,663	372	1,258
	Inferred																
	0-20					344	1,535			344	1,535			344	1,535	344	1,228
	20-40					374	1,679			374	1,679			374	1,679	374	1,343
	40-100			792	3,352	1,056	4,752			1,848	8,104			1,848	8,104		
	>100			541	2,023					541	2,023			541	2,023		
	Total			1,333	5,375	1,774	7,966			3,107	13,341			3,107	13,341	718	2,571
Grand Total				1,792	7,321	2,261	10,062			4,053	17,383	868	3,845	4,921	21,228	1,139	4,000

T19N, R14E, TULSA COUNTY

CROWEBURG																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20																
	20-40																
	40-100			133	335					133	335			133	335		
	>100			464	1,169					464	1,169			464	1,169		
	Total			597	1,504					597	1,504			597	1,504		

Grand Total			597	1,504		597	1,504			597	1,504		

T19N, R15E, WAGONER COUNTY

IRON POST												
Measured												
0-20	68	107	51	116		119	223			119	223	119	177
20-40	46	76	8	19		54	95			54	95	8	15
40-100													
>100													
Total	114	183	59	135		173	318			173	318	127	192
Indicated													
0-20	308	547	30	76		338	623			338	623	338	490
20-40	446	765	19	43		465	808			465	808	19	35
40-100													
>100													
Total	754	1,312	49	119		803	1,431			803	1,431	357	525
Inferred													
0-20													
20-40	36	53				36	53			36	53		
40-100													
>100													
Total	36	53				36	53			36	53		
Grand Total	904	1,548	108	254		1,012	1,802			1,012	1,802	484	717
CROWEBURG													
Measured													
0-20								1,738	5,006	1,738	5,006		
20-40			22	66		22	66			22	66	22	53
40-100			104	270		104	270			104	270		
>100			9	24		9	24			9	24		
Total			135	360		135	360			1,873	5,366	22	53
Indicated													
0-20													
20-40			46	133		46	133			46	133	46	107
40-100			1,079	2,798		1,079	2,798			1,079	2,798		
>100			621	1,603		621	1,603			621	1,603		
Total			1,746	4,534		1,746	4,534			1,746	4,534	46	107

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20																
	20-40			2	4					2	4			2	4		
	40-100			2,923	7,422					2,923	7,422			2,923	7,422		
	>100			2,046	5,156					2,046	5,156			2,046	5,156		
	Total			4,971	12,582					4,971	12,582			4,971	12,582		
	Grand Total			6,852	17,476					6,852	17,476	1,738	5,006	8,590	22,482	68	160
MINERAL																	
	Measured																
	0-20	95	171	9	27	88	446			192	644			192	644	192	516
	20-40	3	6	24	64	16	79			43	149			43	149	40	114
	40-100			153	538	129	626			282	1,164			282	1,164		
	>100																
	Total	98	177	186	629	233	1,151			517	1,957			517	1,957	232	630
	Indicated																
	0-20	115	213	132	512	153	814			400	1,539			400	1,539	400	1,231
	20-40	183	343	122	455	166	888			471	1,686			471	1,686	288	1,074
	40-100	276	479	1,065	2,819	124	660			1,465	3,958			1,465	3,958		
	>100			19	45					19	45			19	45		
	Total	574	1,035	1,338	3,831	443	2,362			2,355	7,228			2,355	7,228	688	2,305
	Inferred																
	0-20	56	116	274	741	25	124			355	981			355	981	355	785
	20-40	34	71	367	931					401	1,002			401	1,002	5	15
	40-100	952	1,736	1,295	2,987					2,247	4,723			2,247	4,723		
	>100			1,031	2,319					1,031	2,319			1,031	2,319		
	Total	1,042	1,923	2,967	6,978	25	124			4,034	9,025			4,034	9,025	360	800
	Grand Total	1,714	3,135	4,491	11,438	701	3,637			6,906	18,210			6,906	18,210	1,280	3,735
	COMBINED GRAND TOTALS	2,618	4,683	11,451	29,168	701	3,637			14,770	37,488	1,738	5,006	16,508	42,494	1,832	4,612

T19N, R16E, WAGONER COUNTY

DRYWOOD

Measured										
0-20										
20-40										
40-100										
>100										
Total										
Indicated										
0-20	1	2		1	2		1	2	1	1
20-40										
40-100										
>100										
Total	1	2		1	2		1	2	1	1
Inferred										
0-20	132	215		132	215		132	215	132	172
20-40	169	259		169	259		169	259		
40-100										
>100										
Total	301	474		301	474		301	474	132	172
Grand Total	302	476		302	476		302	476	133	173

T20N, R13E, TULSA COUNTY

DAWSON

Measured										
0-20						635	2,516	635	2,516	
20-40		65	264	65	264			65	264	65	211
40-100		230	925	230	925			230	925		
>100										
Total		295	1,189	295	1,189			930	3,705	65	211
Indicated										
0-20		112	512	112	512			112	512	112	409
20-40		352	1,392	352	1,392			352	1,392	352	1,114
40-100		1,128	4,469	1,128	4,469			1,128	4,469		
>100		130	515	130	515			130	515		
Total		1,722	6,888	1,722	6,888			1,722	6,888	464	1,523

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20			583	1,940					583	1,940			583	1,940	583	1,552
	20-40			551	1,878					551	1,878			551	1,878	551	1,502
	40-100			1,143	4,113					1,143	4,113			1,143	4,113		
	>100			2,501	9,904					2,501	9,904			2,501	9,904		
	Total			4,778	17,835					4,778	17,835			4,778	17,835	1,134	3,054
	Grand Total			6,795	25,912					6,795	25,912	635	2,516	7,430	28,428	1,663	4,788
							T21N, R13E, TULSA COUNTY										
DAWSON																	
	Measured																
	0-20			110	298					110	298	4	13	114	311	110	239
	20-40			25	65					25	65			25	65	25	52
	40-100																
	>100																
	Total			135	363					135	363			139	376	135	291
	Indicated																
	0-20			198	500					198	500			198	500	198	400
	20-40			163	411					163	411			163	411	157	317
	40-100			365	919					365	919			365	919		
	>100																
	Total			726	1,830					726	1,830			726	1,830	355	717
	Inferred																
	0-20			370	920					370	920			370	920	370	736
	20-40			518	1,294					518	1,294			518	1,294	261	550
	40-100			4,303	10,723					4,303	10,723			4,303	10,723		
	>100																
	Total			5,191	12,937					5,191	12,937			5,191	12,937	631	1,286
	Grand Total			6,052	15,130					6,052	15,130	4	13	6,056	15,143	1,121	2,294

T21N, R14E, TULSA COUNTY

DAWSON

Measured										
0-20					12	28	12	28		
20-40										
40-100										
>100										
Total							12	28		
Indicated										
0-20	27	62	27	62			27	62	27	50
20-40	10	24	10	24			10	24		
40-100										
>100										
Total	37	86	37	86			37	86	27	50
Inferred										
0-20	170	398	170	398			170	398	170	318
20-40	5	11	5	11			5	11		
40-100										
>100										
Total	175	409	175	409			175	409	170	318
Grand Total	212	495	212	495	12	28	224	523	197	368

T22N, R12E, TULSA COUNTY

CEDAR BLUFF

Measured										
0-20										
20-40										
40-100										
>100										
Total										
Indicated										
0-20										
20-40										
40-100										
>100										
Total										

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20	10	14							10	14			10	14	10	11
	20-40	85	129							85	129			85	129		
	40-100	879	1,274							879	1,274			879	1,274		
	>100																
	Total	974	1,417							974	1,417			974	1,417	10	11
	Grand Total	974	1,417							974	1,417			974	1,417	10	11
DAWSON																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20																
	20-40																
	40-100																
	>100			1,313	4,253					1,313	4,253			1,313	4,253		
	Total			1,313	4,253					1,313	4,253			1,313	4,253		
	Grand Total			1,313	4,253					1,313	4,253			1,313	4,253		
COMBINED GRAND TOTALS		974	1,417	1,313	4,253					2,287	5,670			2,287	5,670	10	11

T22N, R13E, TULSA COUNTY

CEDAR BLUFF

Measured												
0-20	18	32	20	56	38	88	1	2	39	90	38	71
20-40	20	43	148	392	168	435			168	435	136	286
40-100	39	75	9	21	48	96			48	96		
>100												
Total	77	150	177	469	254	619			255	621	174	357
Indicated												
0-20	36	61	128	358	164	419			164	419	164	335
20-40	77	133	83	230	160	363			160	363	83	184
40-100	354	605	20	45	374	650			374	650		
>100												
Total	467	799	231	633	698	1,432			698	1,432	247	519
Inferred												
0-20	132	201	3	7	135	208			135	208	135	167
20-40	288	359			288	359			288	359		
40-100	190	308			190	308			190	308		
>100												
Total	610	868	3	7	613	875			613	875	135	167
Grand Total	1,154	1,817	411	1,109	1,565	2,926	1	2	1,566	2,928	556	1,043

TULSA

Measured												
0-20	57	81			57	81			57	81	57	65
20-40	6	8			6	8			6	8		
40-100												
>100												
Total	63	89			63	89			63	89	57	65
Indicated												
0-20	103	148			103	148			103	148	103	119
20-40	255	367			255	367			255	367		
40-100	22	32			22	32			22	32		
>100												
Total	380	547			380	547			380	547	103	119
Inferred												
0-20	28	40			28	40			28	40	28	32
20-40	319	460			319	460			319	460		

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	40-100	982	1,414							982	1,414			982	1,414		
	>100																
	Total	1,329	1,914							1,329	1,914			1,329	1,914	28	32
	Grand Total	1,772	2,550							1,772	2,550			1,772	2,550	188	216
DAWSON																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100			119	387					119	387			119	387		
	Total			119	387					119	387			119	387		
	Indicated																
	0-20																
	20-40			5	14					5	14			5	14		
	40-100			162	378					162	378			162	378		
	>100			970	3,142					970	3,142			970	3,142		
	Total			1,137	3,534					1,137	3,534			1,137	3,534		
	Inferred																
	0-20																
	20-40			4	9					4	9			4	9		
	40-100			1,718	4,019					1,718	4,019			1,718	4,019		
	>100			3,937	12,316					3,937	12,316			3,937	12,316		
	Total			5,659	16,344					5,659	16,344			5,659	16,344		
	Grand Total			6,915	20,265					6,915	20,265			6,915	20,265		
COMBINED GRAND TOTALS		2,926	4,367	7,326	21,374					10,252	25,741	1	2	10,253	25,743	744	1,259

T22N, R14E, TULSA COUNTY

DAWSON										
Measured										
0-20	23	74	23	74	623	2,011	646	2,085	23	61
20-40	45	150	45	150			45	150	32	95
40-100	154	570	154	570			154	570		
>100	26	102	26	102			26	102		
Total	248	896	248	896			871	2,907	55	156
Indicated										
0-20	119	438	119	438			119	438	119	350
20-40	445	1,569	445	1,569			445	1,569	424	1,216
40-100	896	2,854	896	2,854			896	2,854		
>100	306	1,139	306	1,139			306	1,139		
Total	1,766	6,000	1,766	6,000			1,766	6,000	543	1,566
Inferred										
0-20	271	1,026	271	1,026			271	1,026	271	821
20-40	472	1,784	472	1,784			472	1,784	472	1,427
40-100	1,565	5,178	1,565	5,178			1,565	5,178		
>100	2,592	8,140	2,592	8,140			2,592	8,140		
Total	4,900	16,128	4,900	16,128			4,900	16,128	743	2,248
Grand Total	6,914	23,024	6,914	23,024	623	2,011	7,537	25,035	1,341	3,970

T23N, R12E, WASHINGTON COUNTY

CEDAR BLUFF
Measured
0-20
20-40
40-100
>100
Total
Indicated
0-20
20-40
40-100
>100
Total

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	Inferred																
	0-20																
	20-40																
	40-100	229	392							229	392			229	392		
	>100																
	Total	229	392							229	392			229	392		
	Grand Total	229	392							229	392			229	392		
DAWSON																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Inferred																
	0-20																
	20-40																
	40-100																
	>100			490	1,586					490	1,586			490	1,586		
	Total			490	1,586					490	1,586			490	1,586		
	Grand Total			490	1,586					490	1,586			490	1,586		
COMBINED GRAND TOTALS		229	392	490	1,586					719	1,978			719	1,978		

T23N, R13E, WASHINGTON COUNTY

CEDAR BLUFF

Measured										
0-20	31	57			31	57	31	57	31	46
20-40	9	16	12	33	21	49	21	49	1	1
40-100			31	81	31	81	31	81		
>100										
Total	40	73	43	114	83	187	83	187	32	47
Indicated										
0-20	170	253	15	38	185	291	185	291	185	232
20-40	121	207	87	231	208	438	208	438	50	102
40-100	281	516	200	501	481	1,017	481	1,017		
>100										
Total	572	976	302	770	874	1,746	874	1,746	235	334
Inferred										
0-20	212	357	169	417	381	774	381	774	381	618
20-40	248	430	332	830	580	1,260	580	1,260	139	277
40-100	618	1,085	150	370	768	1,455	768	1,455		
>100										
Total	1,078	1,872	651	1,617	1,729	3,489	1,729	3,489	520	895
Grand Total	1,690	2,921	996	2,501	2,686	5,422	2,686	5,422	787	1,276

DAWSON

Measured										
0-20										
20-40										
40-100										
>100										
Total										
Indicated										
0-20										
20-40										
40-100										
>100			59	191	59	191	59	191		
Total			59	191	59	191	59	191		
Inferred										
0-20										
20-40										

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Coal	Category of Reliability and Depth (ft)	Remaining Resources 0.8-1.2 ft Acres	Tons	1.2-2.4 ft Acres	Tons	2.4-3.5 ft Acres	Tons	>3.5 ft Acres	Tons	Total Remaining Resources Acres	Tons	Mined or Lost in Mining* Acres	Tons	Original Resources Acres	Tons	Reserves Acres	Tons
	40-100																
	>100			2,016	6,532					2,016	6,532			2,016	6,532		
	Total			2,016	6,532					2,016	6,532			2,016	6,532		
	Grand Total			2,075	6,723					2,075	6,723			2,075	6,723		
COMBINED GRAND TOTALS		1,690	2,921	3,071	9,224					4,761	12,145			4,761	12,145	787	1,276
DAWSON																	
	Measured																
	0-20																
	20-40																
	40-100																
	>100																
	Total																
	Indicated																
	0-20																
	20-40																
	40-100			147	381					147	381			147	381		
	>100																
	Total			147	381					147	381			147	381		
	Inferred																
	0-20																
	20-40																
	40-100			2,007	5,276					2,007	5,276			2,007	5,276		
	>100			1,456	3,670					1,456	3,670			1,456	3,670		
	Total			3,463	8,946					3,463	8,946			3,463	8,946		
	Grand Total			3,610	9,327					3,610	9,327			3,610	9,327		

T23N, R14E, WASHINGTON COUNTY

*Coal mined or lost in mining is not categorized by depth, thickness, or category of reliability.

Appendix 2: Measured Sections and Core-Hole Logs

Measured Section 1

NE¼NE¼NE¼ sec. 1, T. 15 N., R. 17 E., and SW¼SE¼SE¼SE¼ sec. 36, T. 16 N., R. 17 E., Wagoner County. Measured from top of prominent hill north and west to creek bed, by LeRoy A. Hemish. Field notebook designation TW-4-81-H. (Estimated elevation at top of section, 690 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Sandstone, light-brown, fine-grained, noncalcareous, thick-bedded; large rectangular blocks resulting from jointing litter slope below the outcrop (unnamed sandstone)	19.0
Shale, gray-brown, weathered; interval is poorly exposed	42.0
Shale, black; includes some small, orange clay-ironstone concretions near top of unit	1.6
Ironstone, dark-reddish-brown to purplish-black; includes some black limestone; also includes some poorly preserved fossil shell remnants (Doneley Limestone)	0.4
Shale, black and reddish-orange; includes a highly ferruginous layer at base of unit	0.2
Shale, dark-olive-gray	28.0
Siltstone, purplish-brown, well-indurated, calcareous in part	0.1
Shale, black, brittle; contains calcareous joint-fillings	7.0
Limestone, reddish-brown, impure, silty, sandy, iron-stained, highly fossiliferous; occurs as lenses that thicken to 2.5 ft, or pinch out laterally along the outcrop (Sam Creek Limestone)	1.5
Shale, dark-gray	5.0
Limestone, dark-purplish-black, silty, fossiliferous; occurs as discontinuous lenses	0.2
Shale, purplish-black, brittle, highly silty, calcareous; includes some thin, purplish-brown, impure limestone stringers; grades in part laterally into well-indurated, black siltstone; contains fossil burrows	12.0
Shale, black, fissile; weathers to gray-brown flakes on the outcrop; includes some clay-ironstone concretions; middle part of unit poorly exposed	36.0
Coal, black, hard, shiny (Tullahassee)	0.8
Underclay, light-gray; grades downward into gray shale	2.8
Limestone, light-blue-gray to very dark-gray, impure and silty in part; highly fossiliferous, with common, well-preserved horn corals and brachiopods; occurs in part as dense, brown, rounded, irregular or dumbbell-shaped, 6-in.-thick masses that weather out of enclosing matrix and litter creek bed (Spaniard Limestone)	0.6

McAlester Formation:

Siltstone, light-gray with reddish-brown, ferruginous staining, thin-bedded; includes fossil tracks and trails on stratification surfaces; base of unit covered	2.6
Total	159.8

Measured Section 2

NE¼NW¼NW¼SW¼ sec. 3, T. 16 N., R. 12 E., Tulsa County. Measured in highwall of small, abandoned strip pit, by LeRoy A. Hemish. Field notebook designation TW-3-80-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
Silt, dark-gray-brown, clayey, sandy; contains organic material and subangular clasts of reddish-brown, fine-grained sandstone from topographically higher bedrock outcrop (alluvium)	1.0

MARMATON GROUP

Holdenville Formation:

Shale, reddish-brown, grading downward to light-gray mottled with reddish-brown iron oxides	4.0
Shale, dark-gray to black, highly carbonaceous	0.3
Coal, black, soft, weathered (Dawson)	0.6
Shale, purple-brown, highly carbonaceous; breaks into paper-like fragments	0.7
Coal, black, shiny (Dawson)	0.8
Underclay, light-gray (total thickness not exposed)	0.6
Total	8.0

Measured Section 3

SW¼SW¼SE¼SE¼ sec. 4, T. 16 N., R. 12 E., Creek County. Measured in cutbank of North Duck Creek, by LeRoy A. Hemish. Field notebook designation TW-7-80-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
Silt, light-brown-gray (alluvium of North Duck Creek)	3.6
Gravel, reddish-brown to gray-brown; clasts predominantly subangular, reddish-brown sandstone; imbricated (alluvium)	2.0

MARMATON GROUP

Holdenville Formation:

Shale, black, highly carbonaceous; includes thin coal stringers in upper 3 in.	1.0
Coal, black, reddish-brown iron-oxide staining on cleat surfaces (Dawson)	0.4
Underclay, dark-gray; includes abundant black, carbonized plant compressions (excavated below coal on floor of dry creek bed; total thickness unknown)	1.1
Total	8.1

Measured Section 4

NW¼SW¼SW¼NE¼ sec. 17, T. 16 N., R. 12 E., Creek County. Measured in east side of road cut, 75 ft south of J. B. Reynolds Memorial at entrance to Oakwood Cemetary, by LeRoy A. Hemish. Field notebook designation TW-6-80-H. (Estimated elevation at top of section, 730 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Seminole Formation:	
Sandstone, light-brown with orange-brown specks, fine-grained, noncalcareous, thin-bedded	8.0
Shale, medium-gray, micaceous, fissile; includes carbonized fossil plant fragments on stratification surfaces; locally includes very thin beds of brown, very fine-grained sandstone	2.6
Shale, black, carbonaceous	0.2
Coal, black (Tulsa)	0.2
Shale, dark-gray; includes two thin coal stringers	0.5
MARMATON GROUP	
Holdenville Formation:	
Underclay, light-gray	1.5
Covered interval	3.0
Sandstone, buff to light-reddish-brown, fine-grained, highly calcareous, bioturbated	1.0
Shale, light-gray, calcareous	2.5
Total	19.5

Measured Section 5

SE¼SE¼SE¼NW¼ sec. 1, T. 16 N., R. 14 E., Wagoner County. Measured in steep-sided ravine in the Conjada Mountains, by LeRoy A. Hemish. Field notebook designation TW-46-80-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, light-olive-brown; includes abundant small, dark-reddish-brown ironstone concretions that weather into flakes on the outcrop	3.0
Limestone, gray-brown, impure, sandy, fossiliferous, thin-bedded, black and carbonaceous in part (Verdigris Limestone)	0.4
Shale, brown with orange mottling, calcareous, weathered	1.2
Limestone, yellow-brown, massive, impure, sandy, highly fossiliferous; crinoid columns very abundant, (Verdigris Limestone)	0.8
Shale, dark-gray, highly calcareous; includes a 1-in.-thick bed of black, highly carbonaceous shale about midway in unit	1.4
Shale, black, brittle, platy, noncalcareous; contains spheroidal, black phosphatic nodules	1.6
Shale, very dark-gray to black, highly carbonaceous; nearly coaly shale in part	0.8
Shale, medium-gray with orange-brown bands, clayey	6.0
Siltstone, gray-brown to black, very thin-bedded; abundant black, carbonized plant material on stratification surfaces	2.0
Shale, gray-brown; includes thin siltstone stringers	11.8
Siltstone, dark-gray-brown, laminated; includes abundant black, carbonized plant compressions and well-preserved fossil plant impressions; micaceous; grades downward into very fine-grained, gray sandstone that forms ledge across ravine and creates 8-ft-high waterfall	10.0
Shale, olive-brown, silty and sandy, poorly exposed	12.0
Limestone, brown, impure, sandy, highly fossiliferous; well-preserved trails on sole of bed (McNabb Limestone)	0.3
Shale, olive-brown; includes discontinuous stringers and lenses of brownish-gray, impure limestone	2.4
Limestone, brown, massive to wavy-bedded, fossiliferous, impure, sandy (McNabb Limestone)	2.0
Shale, olive-brown; includes discontinuous stringers and lenses of brownish-gray, impure limestone	4.0
Limestone, purple-brown, very sandy, sparingly fossiliferous (McNabb Limestone)	0.3
Sandstone, light-yellow-gray, very fine-grained, ripple-marked, calcareous; forms bluff along creek	5.0
Total	65.0

Measured Section 6

SW¼NW¼SW¼NE¼ sec. 2, T. 16 N., R. 14 E., Wagoner County. Measured in cut made for spillway of Lake Bixhoma and down gully at end of spillway, by LeRoy A. Hemish. Field notebook designation TW-43-80-H. (Estimated elevation at top of section, 785 ft.)

	Thickness (ft)
Clay, dark-brown, sandy, gravelly; includes abundant angular boulders, cobbles, and pebbles of reddish-brown, fine-grained sandstone; total thickness not measured (colluvium)	6.0

CABANISS GROUP

Senora Formation:

Limestone, yellow-brown, fossiliferous, silty, massive to thin-bedded; shaly in middle part of unit (Breezy Hill Limestone)	11.5
Shale, olive-brown, silty, calcareous in part; includes some interbedded reddish-brown siltstone to very fine-grained sandstone stringers and lenses; contains black, carbonized plant fragments; also includes scattered dark-brown, discoidal limestone concretions about 4-6 in. thick and 1-1.5 ft in diameter; unit grades downward into dark-gray-brown, highly calcareous, silty shale	34.0
Limestone, very dark-gray, with some reddish-brown iron-oxide staining; impure, sandy, shaly, thin-bedded; weathers out to form narrow, resistant ledge on outcrop	0.4
Shale, dark-brown-gray to very dark-gray, highly calcareous; contains scattered, well-indurated, sandy limestone stringers	12.0
Shale, black, very highly carbonaceous, fissile; present at top of bench about two-thirds of distance down from top to bottom of cut	0.1
Shale, black, highly silty, calcareous; includes fossiliferous zone of predominantly gastropod and brachiopod shells in upper 2 ft of unit that weather out and litter the outcrop in great abundance; some fossils in dark-gray limestone nodules	34.0
Sandstone, dark-gray, with maroon iron-oxide staining; calcareous, very fine-grained, thin-bedded, shaly; siltstone in part; cut by brown, very fine-grained sandstone dikes extending into overlying and underlying units	0.5
Shale, very dark-gray to olive-gray, highly silty, calcareous; weathers to olive-brown; noncalcareous in lower part, with black, carbonaceous material on stratification surfaces	19.5
Limestone, gray; weathers reddish-brown; thin-bedded, silty, fossiliferous; forms resistant ledge in gully floor, creating waterfall (Verdigris Limestone)	0.5
Shale, gray-brown with orange banding, calcareous; includes a 2-in.-thick bed of gray, fossiliferous limestone	1.6
Limestone, gray; weathers brown; thin-bedded, silty, fossiliferous; highly shaly in lower 6 in. of unit; forms lower resistant ledge at brink of waterfall (Verdigris Limestone)	1.1
Shale, black, brittle, fissile; contains rounded, black, phosphatic nodules	2.5
Shale, gray with orange-brown banding; includes black, carbonized plant compressions	3.5

Shale, very dark-brown-gray with brown iron-oxide staining, carbonaceous; more resistant than overlying unit; includes some clay-ironstone concretions.....	0.6
Shale, gray, silty; contains large shaly concretions up to 5 ft in diameter in upper part of unit that are well exposed in bed of gully; lower part of unit includes gray, discoidal, silty limestone concretions about 2 in. thick and 1 ft in diameter (base of unit covered).....	17.2
Total	145.0

Measured Section 7

NW¼NE¼SE¼NE¼ sec. 2, T. 16 N., R. 14 E., Wagoner County. Measured in tributary gully of Mountain Creek just above the flood plain, by LeRoy A. Hemish. Field notebook designation TW-33-80-H. (Estimated elevation at top of section, 660 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, fine- to medium-grained, medium-bedded, noncalcareous (total thickness not measured).....	5.0
Covered interval.....	20.0
Shale, light-gray, silty, weathers light-gray brown.....	5.0
Shale, blue-gray, clayey.....	1.0
Shale, black, fissile, highly carbonaceous.....	0.2
Shale, reddish-brown, streaked with dark-gray, highly oxidized.....	0.8
Ironstone, reddish-brown, very hard.....	0.1
Shale, dark-olive-gray-brown, includes black film of carbonaceous material on stratification surfaces.....	1.6
Limestone, gray; weathers brown; wavy-bedded, dense, burrow-marked on base of bottom bed, highly fossiliferous (McNabb Limestone).....	0.6
Limestone, highly sandy, shaly, impure, fossiliferous, weakly indurated (McNabb Limestone).....	2.5
Limestone, brown, highly fossiliferous, massive, nodular in part, impure, silty (McNabb Limestone).....	1.8
Shale, gray with streaks of orange-brown, highly calcareous, highly silty; includes several thin beds and discontinuous layers of brown, impure fossiliferous limestone.....	2.3
Sandstone, medium-gray, very fine-grained, thin-bedded, noncalcareous, micaceous; includes flattened, ferruginous, hematite-red, sandy concretions about 3-4 in. in diameter; "rooster-tail" markings common on some bedding planes.....	4.1
Total	45.0

Measured Section 8

SE¼NW¼ sec. 1, T. 16 N., R. 15 E., Wagoner County. Measured in gullies tributary to northeast-flowing branch of Concharty Creek, by LeRoy A. Hemish. Field notebook designation TW-28-80-H. (Estimated elevation at top of section, 730 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, medium-grained, medium- to thick-bedded, noncalcareous; conglomeratic at base of unit, with impressions of various plant fragments abundant (Chelsea Sandstone) (total thickness not measured)	15.0
Covered interval	25.0
Shale, gray; weathers light-gray-brown; includes some very thin, well-indurated, ferruginous siltstone beds that weather to reddish-brown flakes on the outcrop	18.0
Ironstone, purplish-black with reddish-brown and orange rind	0.2
Shale, gray; weathers light-gray-brown; includes some very thin, well-indurated, ferruginous siltstone beds that weather to reddish-brown flakes on the outcrop	14.0
Covered interval	5.0
Limestone, very dark-gray, impure, shaly, carbonaceous, fossiliferous (Tiawah Limestone)	0.2
Shale, dark-gray to black	2.0
Limestone, brown, very dark-gray to maroon on broken surfaces, coquinoidal; thin wavy beds (Tiawah Limestone)	1.0
Shale, black, fissile; contains small, rounded, black phosphatic nodules; hard and brittle in bottom 2 ft	6.8
Shale, gray with reddish-brown iron-oxide staining	0.2
Shale, gray with yellow streaks	0.2
Coal, black, weathered (Tebo)	0.5
Underclay, light-purplish-gray with red stains	0.6
Shale, very light-gray with yellow streaks, gypsiferous; weathers nearly white on outcrop; grades downward into sandy shale	3.0
Sandstone, buff, very fine-grained, thin-bedded; weathers white	2.0
Siltstone, olive-gray, shaly	3.3
Covered interval	13.0
Siltstone, light-brown, interbedded with light olive-brown shale, thin-bedded, cross-laminated in part; includes some 1-in.-thick beds of very fine-grained, buff sandstone	15.0
Shale, greenish-gray, silty	15.0
Total	140.0

Measured Section 9

NE¼NE¼SE¼NE¼ sec. 2, T. 16 N., R. 15 E., Wagoner County. Measured in road cut west side of gravel road, by LeRoy A. Hemish. Field notebook designation TW-29-80-H. (Estimated elevation at top of section, 630 ft.)

	Thickness (ft)
Clay, orange-brown, silty, gravelly; contains angular boulders and cobbles of dark-reddish-brown sandstone (colluvium)	4.0
CABANISS GROUP	
Senora Formation:	
Shale, black, fissile; includes small, rounded, black phosphatic nodules; weathers orange and purplish-black, carbonaceous	2.2
Coal, black, soft, weathered (Tebo)	0.5
Underclay, light-gray with orange mottling	0.8
Shale, light-gray, silty	2.0
Siltstone, very light-gray and orange, very thin-bedded, weathers white	1.0
Sandstone, buff, very fine-grained, micaceous, thin-bedded, cross-bedded in part, noncalcareous	2.5
Shale, olive-brown, fissile; interbedded with several 2- to 3-in.-thick beds of well-indurated, light-brown siltstone and very fine-grained sandstone; rectangularly jointed	5.0
Total	18.0

Measured Section 10

NW¼SW¼NW¼ sec. 6, T. 16 N., R. 15 E., and NE¼NE¼ sec. 1, T. 16 N., R. 14 E., Wagoner County. Measured in steep part of valley of tributary gully of Mountain Creek, from base of stock pond northwest to covered area, by LeRoy A. Hemish. Field notebook designation TW-35-80-H. (Estimated elevation at top of section, 920 ft.)

	Thickness (ft)
MARMATON GROUP	
Wewoka Formation:	
Sandstone, dark-reddish-brown, fine- to medium-grained, medium-bedded, noncalcareous, ferruginous; flute marks prominent on soles of beds	27.0
Shale, light-gray with orange mottling, very silty, noncalcareous; includes discontinuous, light-gray to brown, very fine-grained, thin-bedded to massive sandstone lenses that contain abundant black, carbonized plant compressions	3.5

CABANISS GROUP

Senora Formation:

Shale, black, highly carbonaceous; includes black, phosphatic nodules from about 0.5 to 2 in. in diameter (Excello Shale)	0.3
Shale, light-gray; weathers buff with orange spots; highly calcareous; includes thin, fossiliferous limestone stringers	4.2
Limestone, dark-gray; weathers brown; silty, fossiliferous, thin- to medium-bedded; shaly in bottom half of unit (Breezy Hill Limestone)	7.0
Limestone, light-gray, massive, very sparingly fossiliferous; weathers light-yellow-gray; breaks with conchoidal fracture; thin-bedded in basal 2 ft (Breezy Hill Limestone)	7.0
Shale, gray with orange mottling	3.5
Shale, silty, light-olive-gray, interbedded with thin stringers of light-brown, micaceous, calcareous siltstone and very fine-grained sandstone that weather to resistant flakes littering the outcrop slope	54.0
Shale, black, fissile; contains rounded phosphatic nodules; contact with overlying unit sharp	3.0
Limestone, dark-gray, very impure, shaly, fossiliferous	0.3
Shale, dark-gray, silty, fissile; cut by large rectangular joints	38.2
Shale, light-gray, clayey	25.0
Limestone, very dark-gray, impure, shaly, very thin-bedded, fossiliferous	0.4
Shale, brown, clayey, calcareous	0.6
Covered interval	15.0
Shale, yellow-gray, weathered; unit includes a 1-in.-thick bed of black, highly carbonaceous shale 3 ft from base	6.0
Sandstone, reddish-brown, ferruginous, fine-grained, massive, noncalcerous	3.5
Sandstone, buff to light-gray, massive to thin-bedded, fine-grained, noncalcareous; basal contact sharp and uncomformable	8.8
Shale, light-gray, highly silty	2.7
Covered interval	15.0
Shale, olive-brown	3.0
Limestone, brown, massive, fossiliferous, impure (McNabb Limestone)	1.8
Shale, brown, calcareous; includes thin stringerss of brown, fossiliferous, impure limestone	4.0
Limestone, brown, impure, fossiliferous, irregularly bedded (McNabb Limestone)	1.2
Shale, sandy, impure, carbonaceous	3.5
Sandstone, buff; stained reddish-brown in part; fine-grained, hard, thin-bedded (base covered)	6.0
Total	244.5

Measured Section 11

SW¼NW¼NE¼SE¼ sec. 6, T. 16 N., R. 15 E., Wagoner County. Measured in side of narrow, deep gully on the east slope of Conjada Mountains, by LeRoy A. Hemish. Field notebook designation TW-39-80-H. (Estimated elevation at top of section, 815 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, buff to reddish-brown, fine-grained, noncalcareous, medium-bedded (total thickness not measured).....	2.0
Shale, olive-gray; weathers tan; includes one or more 1-in.-thick beds of buff, highly calcareous, very fine-grained sandstone about 25 ft from top of unit.....	54.0
Limestone, gray; weathers brown; massive, hard, highly fossiliferous (Verdigris Limestone).....	0.4
Limestone, dark-gray, highly carbonaceous, sandy, impure, platy (Verdigris Limestone).....	0.8
Shale, black, fissile, brittle; includes small, spheroidal, phosphatic nodules.....	5.5
Limestone, black with orange rind, unfossiliferous, very dense; occurs as discontinuous lenses.....	0.5
Coal, black (Croweburg).....	1.5
Underclay, gray with orange banding.....	1.4
Sandstone, light-gray-brown and reddish-brown, noncalcareous, fine-grained, micaceous, streaked through and stained by iron oxide; includes abundant black, carbonized plant fragments; irregularly bedded.....	0.2
Shale, medium-gray, silty, micaceous; stained by iron oxide; includes some tan siltstone laminae; zone of reddish-brown ironstone concretions 2 ft from base of unit.....	19.7
Limestone, dark-gray; weathers brown; impure, fossiliferous, massive, hard (McNabb Limestone).....	0.5
Shale, dark-olive-brown to very dark-gray, carbonaceous, noncalcareous.....	1.4
Limestone, gray-brown; weathers light-brown; sandy, nodular-bedded, sparingly fossiliferous (McNabb Limestone)....	1.8
Shale, light-gray with orange bands; weathers yellow; very highly calcareous; includes thin stringers and discontinuous lenses of sandy limestone.....	3.0
Limestone, brownish-gray, sandy, massive, very dense (McNabb Limestone).....	0.8
Siltstone, grayish-brown with maroon tones on freshly broken surfaces, calcareous, shaly, micaceous, thin-bedded; includes minor amount of black, carbonaceous flecks; grades into underlying unit.....	3.0
Sandstone, light-gray with some hematite-red staining, very fine-grained, thin-bedded, micaceous, well indurated, noncalcareous.....	7.0
Sandstone, buff, very fine-grained, silty, interbedded with olive-brown shale; base covered.....	21.5
Total	125.0

Measured Section 12

SE¼SE¼NE¼SE¼ sec. 6, T. 16 N., R. 15 E., Wagoner County. Measured in cutbank of intermittent stream on east flank of Conjada Mountains, by LeRoy A. Hemish. Field notebook designation TW-40-80-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
Gravel, brown, silty, clayey; contains boulders and cobbles of sandstone and limestone (alluvium).....	5.0
CABANISS GROUP	
Senora Formation:	
Shale, light-gray and yellow, clayey; contains black, carbonized plant fragments; includes orange siltstone stringers that weather to flakes on the outcrop.....	0.8
Coal, black, soft, highly weathered (Mineral).....	0.8
Underclay, light-gray and orange.....	0.9
Shale, light-olive-gray, silty, with black, carbonized plant fragments; contains reddish-brown clay-ironstone concretions with plant fossils (to creek bed).....	3.0
Total	10.5

Measured Section 13

SE¼SE¼NW¼SE¼ sec. 6, T. 16 N., R. 15 E., Wagoner County. Measured in highwall of old, abandoned strip pit and gully below, by LeRoy A. Hemish. Field notebook designation TW-31-80-H. (Estimated elevation at top of section, 760 ft.)

	Thickness (ft)
Clay, buff to reddish-brown, very sandy; contains angular boulders of reddish-brown, ferruginous sandstone (colluvium).....	3.0
CABANISS GROUP	
Senora Formation:	
Limestone, dark-gray, sandy, dense, fossiliferous, with abundant crinoid columns, weathers orange-brown (Verdigris Limestone).....	0.5
Shale, black, fissile; includes small, rounded, black phosphatic nodules; also includes a 6-in.-thick, discontinuous zone of rounded and flattened, highly calcareous, orange-brown septarian concretions as much as 20 in. in diameter near base of unit.....	6.0
Coal, black (Croweburg).....	1.8
Underclay, light-gray with orange bands.....	1.1
Sandstone, light-yellow-gray with reddish-brown staining, silty and shaly, fissile, micaceous, very fine-grained....	0.8
Sandstone, buff with reddish-brown staining, noncalcareous, fine-grained, thin-bedded, micaceous.....	2.7

Shale, gray with orange banding, highly silty (base not exposed)	0.5
Total	16.4

Measured Section 14

NE¼NW¼SW¼SE¼ sec. 6, T. 16 N., R. 15 E., Wagoner County. Measured from top of highwall to floor of abandoned strip pit, by LeRoy A. Hemish. Field notebook designation TW-30-80-H. (Estimated elevation at top of section, 775 ft.)

	Thickness (ft)
Rubble, reddish-brown to buff; composed largely of huge blocks of ferruginous, fine- to medium-grained, massive sandstone (colluvium)	4.0
CABANISS GROUP	
Senora Formation:	
Shale, light-gray; weathers to tannish-gray	26.0
Limestone, dark-gray, impure, very sandy in part, fossiliferous, thin-bedded; weathers to brown and maroon (Verdigris Limestone)	1.0
Shale, light-gray, very highly calcareous	0.3
Limestone, gray, fossiliferous, highly impure, thinly interbedded with calcareous shale (Verdigris Limestone)	0.9
Limestone, dark-gray, fossiliferous, very dense, massive, weathers brown (Verdigris Limestone)	0.5
Shale, black; contains small, black phosphatic nodules and black and orange, calcareous ironstone concretions as much as 5 in. thick and 12 in. in diameter	5.5
Total	38.2

Note: Croweburg coal was mined at this site, but is no longer exposed; however, 22 in. of Croweburg coal is exposed in an old, abandoned strip pit about 1/8 mi to the northeast.

Measured Section 15

SW¼NW¼SW¼SE¼ and SW¼NE¼SW¼SE¼ sec. 7, T. 16 N., R. 15 E., Wagoner County. Measured in highwall of abandoned strip mine and east down abandoned haul road, by LeRoy A. Hemish. Field notebook designation TW-41-80-H. (Estimated elevation at top of section, 795 ft.)

	Thickness (ft)
Clay, yellow-brown, noncalcareous; contains fragments of highly weathered shale (colluvium)	2.0

CABANISS GROUP

Senora Formation:

Shale, black, clayey	0.4
Shale, black with purple-brown iron staining on stratification surfaces, brittle, platy	0.2
Shale, olive-brown	4.0
Limestone, reddish-brown, highly ferruginous; occurs as discontinuous concretions	0.2
Shale, olive-brown; includes two zones of small calcareous clay-ironstone concretions near bottom of interval; weathers brown	10.0
Shale, gray to olive-gray with minor orange banding; weathers tannish-gray	16.0
Limestone, dark-gray; weathers brownish-gray; impure, sandy, micaceous, carbonaceous, thin-bedded; trails and burrows very abundant on soles of beds (Verdigris Limestone)	0.4
Shale, dark-gray, noncalcareous	0.2
Limestone, gray; weathers brownish-gray; impure, sandy, contains abundant fragments of crinoids, bryozoans, and other marine fauna; thin-bedded; more indurated and not as shaly as limestone above overlying shale unit (Verdigris Limestone)	0.4
Shale, dark-gray, noncalcareous	0.3
Limestone, gray; weathers brown; silty, dense, fossiliferous, hard (Verdigris Limestone)	0.7
Shale, black, brittle, fissile	3.0
Ironstone, black with reddish-brown rind; occurs as large, discontinuous, discoidal concretions	0.5
Shale, black, brittle, fissile; includes a 6-in.-thick bed of soft, clayey, black shale about midway in unit; contains small, spheroidal, phosphatic nodules	3.4
Shale, light-gray, soft, clayey	0.8
Coal, black, shaly, fissile	0.1
Coal, black, hard (Croweburg)	1.2
Underclay, light-gray with orange banding; black, carbonized plant material abundant	1.5
Shale and siltstone, light-tannish-brown, interlaminated	0.5
Sandstone, buff with reddish-brown iron-oxide staining, very fine-grained, ripple-marked, noncalcareous, well-indurated	0.1
Sandstone, buff, thin-bedded, shaly, ripple-marked, noncalcareous, very fine-grained	12.5
Shale, buff, silty, sandy; poorly exposed	5.4
Limestone, gray-brown, massive, dense, highly fossiliferous (McNabb Limestone)	0.4
Shale, olive-brown; weathers orange; includes abundant black, carbonized plant fragments	2.0
Limestone, orange-brown, sandy, bioturbated, well-indurated; fossils rare (McNabb Limestone)	0.4
Shale, orange-brown	0.7
Limestone, yellow-brown, sandy, fossiliferous, nodular-bedded (McNabb Limestone)	1.0
Shale, orange to yellow-gray; includes discontinuous, thin lenses of impure, sandy limestone	6.5

Sandstone, buff to light-reddish-brown, very highly calcareous, very fine-grained, thick-bedded, highly resistant, ledge-forming	1.6
Sandstone, buff to light-brown, very fine-grained, thinly laminated, shaly, micaceous; includes abundant black, carbonized flecks of plant material on stratification surfaces (base covered)	18.0
Total	94.4

Measured Section 16

S½NW¼NE¼ sec. 18, T. 16 N., R. 15 E., Wagoner County. Measured in highwall of small, abandoned strip mine and down gully below the mine, by LeRoy A. Hemish. Field notebook designation TW-42-80-H. (Estimated elevation at top of section, 775 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, olive-gray, weathers tannish-brown; includes thin stringers of hard, orange, silty ironstone concretions	4.0
Limestone, gray-brown, impure, shaly, silty, very thin-bedded, platy, micaceous; includes black flecks of carbonaceous material (Verdigris Limestone)	0.7
Shale, gray, silty	0.2
Limestone, dark-gray; weather orange-brown; fossiliferous, medium- to thin-bedded; includes black, carbonized plant fragments (Verdigris Limestone)	0.4
Shale, dark-gray with orange banding, calcareous; includes small, discontinuous lenses of dark-gray limestone	0.6
Limestone, gray-brown; weathers orange-brown; silty, dense, fossiliferous, massive (Verdigris Limestone)	0.5
Shale, black, brittle, fissile; includes discontinuous zone of large, orange ironstone concretions with black interiors about 3 ft from bottom of unit	7.6
Coal, black, hard (Croweburg)	1.4
Underclay, light-gray with orange banding; grades downward into underlying unit	1.6
Shale, gray with orange banding; contains very thin stringers of orange clay-ironstone that weather into resistant flakes on the outcrop	1.5
Sandstone, light-grayish-tan streaked with reddish-brown iron oxide, very fine-grained, wavy-bedded, noncalcareous; forms ledge on small knoll east of spoil piles	0.5
Shale, tannish-gray with orange banding; interbedded with thin beds of tannish-brown, partly ferruginous, very fine-grained sandstone that weather into chips on the outcrop	15.0
Covered interval	10.0
Shale, olive-gray	3.0
Limestone, dark-gray, weathers brown, highly fossiliferous, impure, silty, wavy-bedded (McNabb Limestone)	0.4

Shale, brown	1.6
Limestone, dark-gray-brown, highy fossiliferous, impure, silty, massive to wavy-bedded in part (McNabb Limestone)	1.2
Shale, olive-brown; weathers brown; contains thin stringers and discontinuous lenses of impure limestone	6.2
Limestone, gray and brown; weathers orange-brown; impure, sandy, well-indurated, thin- to medium-bedded, sparingly fossiliferous (McNabb Limestone)	0.4
Sandstone, light-gray, thin-bedded, calcareous, very fine-grained, micaceous; weathers brown; well-indurated; grades into underlying unit	15.0
Siltstone, brown-gray, very thin-bedded, interbedded with very fine-grained sandstone and shale; includes abundant black, carbonized plant material on stratification planes (base covered)	22.2
Total	94.0

Measured Section 17

SW¼SW¼NW¼SE¼ sec. 1, T. 16 N., R. 16 E., Wagoner County. Measured in highwall of abandoned strip pit, by LeRoy A. Hemish. Field notebook designation TW-49-80-H. (Estimated elevation at top of section, 590 ft.)

	Thickness (ft)
Silt, dark-brown, clayey; includes scattered clasts of gravel (alluvium)	1.2
KREBS GROUP	
Boggy Formation:	
Shale, orange-brown, highly weathered; includes stringers of clay-ironstone that weather into flat flakes; also includes discontinuous zones of orange ironstone concretions 1-2 in. thick at base of unit	3.0
Shale, black, brittle, platy; contains small, spheroidal, phosphatic nodules	1.5
Limestone, dark-gray; weathers brown; highly fossiliferous, impure, massive; occurs as discontinuous lenses (Inola Limestone)	0.5
Coal, black with reddish-brown staining, soft, weathered (Bluejacket)	0.4
Underclay, light-gray and orange; contains purple-brown, carbonaceous, fossil plant material	1.9
Shale, dark-gray-brown with orange and maroon staining, weathered; includes abundant fossil plant material	1.0
Shale, black, highly carbonaceous; includes lenses of well-indurated, very dark-gray, very fine-grained sandstone as much as 3 ft long and 4 in. thick	2.0
Covered to water level in pit	4.5
Total	16.0

Note: Secor coal was mined at this location, but slumping of the highwall and water in the pit presently cover the bed.

Measured Section 18

NW¼NE¼NE¼NE¼ sec. 13, T. 16 N., R. 16 E., Wagoner County. Measured in highwall of active strip pit operated by Turner Brothers, Inc., by LeRoy A. Hemish. Field notebook designation TW-2-83-H. (Estimated elevation at top of section, 610 ft.)

	Thickness (ft)
Silt, brown, contains thin laminae of coarse sand in places	5.5
KREBS GROUP	
Boggy Formation:	
Shale, orange and gray with red-brown streaks and mottling, very highly weathered, clayey; stratification no longer evident	5.0
Shale, medium-gray; contains some very dark-gray layers; partly weathered, silty in part	14.0
Shale, black; weathers brown and yellow on stratification planes; fissile	1.3
Limestone, dark-gray, impure, silty, dense, massive; contains abundant very small brachiopods, fusilinids, and crinoid fragments (Inola Limestone)	1.0
Coal, black with red-brown streaks, very shaly (Bluejacket coal)	0.1
Underclay, light-gray with orange streaks; contains coalified root fragments	1.0
Shale, medium-gray with red-orange staining on fracture surfaces	3.0
Coal, black, pyritic, shaly; thins laterally to 0.5 in. (Peters Chapel coal)	0.1
Shale, dark-gray, silty	0.2
Shale, medium-gray, slickensided	1.0
Shale, dark-gray, silty, fissile; contains discoidal, gray claystone concretions 6-10 in. in diameter	7.2
Shale, very dark-gray to black, fissile, carbonaceous	1.1
Limestone, medium-gray, dense, hard, impure, very fine-grained, massive, sparsely fossiliferous	0.3
Shale, medium-gray, very silty	0.8
Sandstone, light-gray; interlaminated with medium-gray, shaly siltstone; hard, medium- to thick-bedded; contains abundant black, carbonized plant fragments	18.0
Shale, medium-gray, silty; contains abundant well-preserved, black plant compressions, seed-fern leaves common	1.2
Coal, black, bright, bituminous; contains some pyrite veins (Secor coal)	1.5
Sandstone, dark-gray-brown, silty, hard; contains abundant black, carbonized plant fragments	0.2
Total	62.5

Measured Section 19

NE¼NW¼SW¼SE¼ sec. 6, T. 16 N., R. 17 E., Wagoner County. Measured in highwall of active strip pit operated by Bill's Coal Company, Inc., by LeRoy A. Hemish. Field notebook designation TW-47-80-H. (Estimated elevation at top of section, 610 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Shale, brown with orange mottling; highly weathered; contains ironstone concretions in lower part	11.0
Shale, black, brittle, highly carbonaceous	1.4
Limestone, dark-gray, impure, fossiliferous, massive, dense (Inola Limestone)	0.9
Shale, brown with black and white streaks, gypsiferous, coaly, calcareous in upper 1 in	0.5
Coal, black (Bluejacket)	0.3
Underclay, orange in upper 3 in., light-yellow-gray in lower part	1.0
Shale, light-gray with orange bands, silty; zone of hard, dark-gray, 2-in.-thick, noncalcareous concretions at base of unit	8.0
Shale, black, fissile, highly carbonaceous; includes thin selenite crystals	0.7
Siltstone, medium-gray, well-indurated, noncalcareous; includes well-preserved, black plant compressions	16.0
Shale, dark-gray, highly carbonaceous, silty	0.5
Coal, black, hard; with minor pyrite (Secor)	1.4
Underclay, light-gray, with abundant black plant compressions	1.0
Total	42.7

Measured Section 20

SE¼SW¼NE¼NW¼ sec. 8, T. 16 N., R. 17 E., Wagoner County. Measured in highwall of active strip pit operated by Local Coal Company, Inc., by LeRoy A. Hemish. Field notebook designation TW-48-80-H. (Estimated elevation at top of section, 616 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Shale, light-brown streaked with gray and orange, silty	15.0
Ironstone, very dark-brown with reddish-brown interior	0.3
Shale, black, fissile, highly carbonaceous	1.5
Siltstone, medium-gray, weathers yellow-gray, laminated, micaceous, moderately well-indurated; includes black, carbonized plant fossils on stratification surfaces	18.2
Coal, black, shiny; includes some pyrite fracture-fillings; white calcite on cleat surfaces (Secor)	1.7

Underclay, light-gray with abundant black plant compressions; moderately hard in lower part; total thickness not exposed	1.0
Total	37.7

Measured Section 21

SE¼SW¼SW¼SW¼ sec. 8, T. 16 N., R. 17 E., Wagoner County. Measured in highwall of active strip pit operated by Bill's Coal Company, by LeRoy A. Hemish. Field notebook designation TW-3-83-H. (Estimated elevation at top of section, 632 ft.)

	Thickness (ft)
Sand, gray-brown, silty, contains organic material (soil)	1.1
Sand, light-orange-brown, very fine-grained, silty	2.3
Clay, yellow-brown with orange and gray mottling, silty, unbedded, rectangularly jointed	9.5
KREBS GROUP	
Boggy Formation:	
Shale, light-yellow-brown with dark-red-brown, orange, and purple-black mottling, very highly weathered, silty, stratification obscure	1.1
Sandstone, light-tan with dark-brown staining on joint surfaces, very fine-grained, cross-laminated, silty	8.0
Sandstone, light-gray, interlaminated with medium-gray shaly siltstone, hard, medium-bedded; contains black, carbonized plant fragments	19.0
Shale, medium-gray, silty; contains abundant well-preserved, black carbonized plant fossils with disseminated pyrite on surface of plant compressions, seed-fern leaves common	1.0
Coal, black with white kaolinite and pyrite on cleat surfaces, bright, bituminous (Secor coal)	1.7
Sandstone, very dark-gray, shaly, hard; contains abundant black, carbonized plant compressions (total thickness unknown)	0.1
Total	43.8

Measured Section 22

NW¼NW¼NW¼NE¼ sec. 24, T. 16 N., R. 17 E., Wagoner County. Measured in cutbank of stream in pasture south of bridge, by LeRoy A. Hemish. Field notebook designation TW-5-81-H. (Estimated elevation at top of section, 570 ft.)

	Thickness (ft)
Silt, sandy, brown; contains organic material in upper part of unit (alluvium)	6.0

KREBS GROUP

Boggy Formation:

Sandstone, light-brown, thin-bedded, very fine-grained, noncalcareous (Bluejacket Sandstone)	2.0

Savanna Formation:

Shale, light-gray, weathers tan	1.1
Clay-ironstone, orange-brown	0.1
Shale, very dark-gray, silty	1.0
Limestone, reddish-brown, hard, fossiliferous	0.3
Shale, gray with orange iron-oxide staining in joints	1.5
Coal, black (Drywood)	0.1
Underclay, light-gray (covered to stream bed)	0.9
Total	13.0

Measured Section 23

NW¼NW¼NE¼NE¼ sec. 32, T. 16 N., R. 17 E., Wagoner County. Measured in highwall of active strip pit operated by Paulson Construction Company, Inc., by LeRoy A. Hemish. Field notebook designation TW-1-83-H. (Estimated elevation at top of section, 560 ft.)

	Thickness (ft)
Sand, light-brown, very fine-grained, well sorted, silty, unstratified	1.2
Clay and sand, dark-red and yellow-brown, compact, contains minor gravel particles	4.8
Sand, light-pink, medium- to coarse-grained, includes some very coarse-grained laminae, with large-scale cross-bedding, unconsolidated	16.0
Clay, dark-red, plastic, compact	3.5

KREBS GROUP

Boggy Formation:

Shale, medium-gray, fissile; contains abundant black, carbonaceous plant compressions, seed-fern leaves common	1.3
Coal, black, minor pyrite deposits on cleat surfaces, bright, bituminous (Secor coal)	1.3
Underclay, dark-gray, silty, hard; contains abundant black, carbonaceous plant fragments (total thickness unknown)	0.4
Total	28.5

Measured Section 24

NE¼NE¼NE¼ sec. 7, T. 16 N., R. 18 E., Wagoner County. Measured from top of bluff overlooking the Verdigris River northeast down ravine, by LeRoy A. Hemish. Field notebook designation TW-16-81-H. (Estimated elevation at top of section, 622 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Sandstone, buff, fine-grained, noncalcareous, medium- to thin-bedded, ripple-marked (unnamed sandstone).....	26.0
Shale, medium-gray; weathers gray-brown.....	4.5
Ironstone, reddish-brown to orange.....	0.1
Shale, medium-gray; weathers gray-brown; includes scattered reddish-brown to dark-brown clay-ironstone concretions.....	36.0
Shale, very dark-gray to black with brown banding; includes very thin stringers of brown, well-indurated siltstone.....	4.0
Coal, black (Rowe).....	0.7
Underclay, light-gray with orange banding.....	1.0
Sandstone, light-gray with reddish-brown staining, very fine-grained, very thin-bedded, shaly in part.....	6.0
Shale, gray-brown.....	8.3
Shale, black to dark-olive-gray (to water level in river).....	15.0
Total	101.6

Measured Section 25

NW¼NE¼SW¼SW¼ sec. 2, T. 17 N., R. 12 E., Tulsa County. Measured in west bank of Coal Creek 20 yd north of concrete dam on the Sunoco-DX tank farm, by LeRoy A. Hemish. Field notebook designation TW-5-80-H. (Estimated elevation at top of section, 665 ft.)

	Thickness (ft)
MARMATON GROUP	
Holdenville Formation:	
Shale, dark-brown to gray-brown; includes thin strata of reddish-brown sandstone at base of unit that forms narrow ledge; weathered fragments of sandstone litter underlying slope and conceal upper part of unit below.....	5.5
Shale, dark-brown to black, highly carbonaceous, fissile....	4.0
Shale, dark-gray.....	2.0
Limestone, brown-gray to gray; occurs as discontinuous, rounded and flattened septarian concretions.....	0.3
Shale, dark-gray.....	5.6
Coal, black; cleat surfaces coated with reddish-brown iron oxides; some yellow staining on weathered surfaces; scattered fragments of gray, silicified wood present in upper 6 in. of bed (Dawson).....	2.0
Underclay, dark-gray.....	1.7
Sandstone, light-gray with reddish-brown iron-oxide staining, fine-grained, bedding disturbed (base of unit not exposed).....	1.4
Total	22.5

Measured Section 26

NE¼SW¼NW¼SW¼ sec. 21, T. 17 N., R. 14 E., Tulsa County. Measured in east bluff of Arkansas River, by LeRoy A. Hemish. Field notebook designation TW-23-80-H. (Estimated elevation at top of section, 620 ft.)

	Thickness (ft)
MARMATON GROUP	
Wewoka Formation:	
Sandstone, reddish-brown, ferruginous, thin-bedded, fine-grained, noncalcareous	10.0
Sandstone, gray-brown, very fine-grained, shaly, weakly indurated, very thin-bedded, calcareous	1.9
Fort Scott Formation:	
Shale, black, fissile; includes small phosphatic nodules (Little Osage Shale)	7.1
Limestone, brownish-gray, fossiliferous, impure, sandy, irregularly bedded (Blackjack Creek Limestone)	1.0
CABANISS GROUP	
Senora Formation:	
Shale, black, brittle, fissile; includes abundant irregularly rounded and flattened phosphatic nodules as much as 4 in. in diameter (Excello Shale)	0.9
Limestone, dirty-gray, irregularly thin-bedded to massive, fossiliferous, silty (Breezy Hill Limestone)	4.5
Limestone, dark-gray, highly shaly, fossiliferous, weakly indurated, thin-bedded (Breezy Hill Limestone)	2.0
Shale, very dark-gray (base covered)	2.0
Total	29.4

Note: At this site, the Iron Post coal is absent from its usual position a few inches below the Breezy Hill Limestone.

Measured Section 27

SW¼SE¼NW¼SW¼ sec. 28, T. 17 N., R. 14 E., Tulsa County. Measured in north bluff of Snake Creek, by LeRoy A. Hemish. Field notebook designation TW-22-80-H. (Estimated elevation at top of section, 600 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, brown; dark-gray on freshly broken surfaces; silty, highly fossiliferous, massive (Breezy Hill Limestone)	2.5

Shale, brown, clayey, calcareous.....	2.0
Shale, medium-gray to very dark-gray.....	15.0
Limestone, dark-gray, shaly, fossiliferous; weathers dark-gray-brown; tracks, trails, and burrows abundant.....	0.1
Shale, black, fissile (to water level in Snake Creek).....	1.4
Total	21.0

Note: At this site, the Iron Post coal is absent from its usual position a few inches below the Breezy Hill Limestone.

Measured Section 28

NW¼SE¼NE¼ and SW¼NE¼NE¼ sec. 34, T. 17 N., R. 14 E., Tulsa County. Measured in gully south of curve in blacktop road along abandoned trail, by LeRoy A. Hemish. Field notebook designation TW-32-80-H. (Estimated elevation at top of section, 790 ft.)

	Thickness (ft)
MARMATON GROUP	
Wewoka Formation:	
Sandstone, buff to reddish-brown, medium-grained, noncalcareous, medium-bedded, flute marks abundant on soles of beds (total thickness not measured).....	24.0
Shale, gray, weathers tannish-brown, poorly exposed.....	18.0
Sandstone, olive-gray, weathers brown to reddish-brown, fine-grained, thin- to medium-bedded, noncalcareous, sedimentary structures formed by scour abundant.....	7.8
Shale, olive-gray, weathers buff; includes thin stringers of orange clay-ironstone concretions that weather into flakes littering the outcrop.....	6.2
Fort Scott Formation(?):	
Sandstone, brown with black staining on weathered surfaces, very fine-grained, shaly, noncalcareous, bedding highly bioturbated.....	1.5
CABANISS GROUP	
Senora Formation:	
Shale, black, fissile; contains rounded, black, phosphatic nodules (Excello Shale).....	1.8
Limestone, dark-gray, weathers light-brown, highly fossiliferous, impure, medium- to thick-bedded in upper part; becomes thin-bedded and shaly in lower part, forms prominent ledge around hill (Breezy Hill Limestone).....	10.4
Shale, olive-gray, fissile, weathers gray-brown with minor orange banding; includes thin beds of highly calcareous, very fine-grained sandstone at base of unit.....	23.0

Shale, dark-gray; includes a few 5-in.-thick septarian concretions as much as 1 ft in diameter near top of unit	2.3
Shale, dark-gray, fissile; includes scattered silty, discoidal limestone concretions; interbedded with orange, very thin-bedded siltstone (base of unit covered)	7.0
Total	102.0

Measured Section 29

SE¼NE¼NW¼NW¼ and NW¼NW¼NE¼NW¼ sec. 36, T. 17 N., R. 14 E., Tulsa County. Measured in ravine on east slope of Conjada Mountains, by LeRoy A. Hemish. Field notebook designation TW-34-80-H. (Estimated elevation at top of section, 685 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, fine-grained, noncalcareous, medium-bedded (total thickness not measured	5.0
Covered interval	25.0
Shale, olive-brown, weathers to thin brown flakes on outcrop; includes discontinuous zone of clay-ironstone concretions 2 in. from base of unit	5.5
Limestone, dark-gray, weathers brownish-gray, sandy, highly fossiliferous; trace fossils abundant on sole of basal bed; wavy-bedded, thin-bedded (McNabb Limestone)	0.5
Shale, tan-brown, calcareous; includes thin stringers of fossiliferous, impure limestone	1.9
Limestone, brown, sandy, highly fossiliferous, irregularly bedded to massive in lower part, dense, hard (McNabb Limestone)	1.3
Shale, tannish-brown, calcareous; includes thin stringers of brown, fossiliferous, silty limestone	3.2
Limestone, brown, impure, sandy, fossiliferous, massive to thin-bedded in upper part, hard (McNabb Limestone)	1.4
Sandstone, light-gray, very fine-grained, silty, shaly, very thin-bedded, weakly indurated, noncalcareous, micaceous, weathers tan; includes some interbedded siltstone	18.0
Sandstone, buff, very fine-grained, noncalcareous, thin-bedded, well-indurated, shaly locally; includes zone of ferruginous, sandy concretions at base of unit	0.8
Shale, olive-gray, silty, fissile, micaceous; includes tiny particles of black, carbonaceous material on stratification surfaces; locally includes large, gray, shaly, noncalcareous, oblate concretions (base of unit covered)	30.0
Total	92.6

Measured Section 30

NW¼NE¼SE¼SW¼ sec. 31, T. 17 N., R. 15 E., Wagoner County. Measured in deeply eroded gully directly south of east end of guard rail of bridge over Mountain Creek, south side of U.S. Highway 64, by LeRoy A. Hemish. Field notebook designation TW-37-80-H. (Estimated elevation at top of section, 660 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, medium-gray to olive-brown, silty; includes thin orange-brown, ferruginous siltstone beds that weather to resistant flakes on the outcrop; minor amount of black, carbonized plant material on stratification surfaces; ironstone concretions in upper part of unit.....	22.0
Coal, black; some reddish-brown iron-oxide staining on cleat surfaces (Mineral).....	1.0
Clay, black to purple-brown; includes some coaly material; grades into underlying unit.....	0.1
Underclay, light-gray with orange streaks; abundant black, carbonized plant material included.....	0.9
Shale, medium-gray with orange mottling.....	1.5
Sandstone, light-gray to buff, micaceous, very fine-grained, thin-bedded; siltstone in part; dark-purplish-brown, carbonized plant fragments abundant; interval includes some brownish-gray shale beds interlaminated with light-gray siltstone in middle part of unit; well-indurated in lower part of exposure (upper part of Chelsea Sandstone).....	26.5
Covered inverval.....	10.0
Total	62.0

Measured Section 31

NW¼SW¼SW¼ and SW¼NW¼SW¼ sec. 31, T. 17 N., R. 15 E., Wagoner County. Measured in ravine tributary to Mountain Creek in the Conjada Mountains, by LeRoy A. Hemish. Field notebook designation TW-36-80-H. (Estimated elevation at top of section, 744 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, yellow-brown, highly weathered.....	1.0
Shale, black, highly carbonaceous; contains small, spheroidal, phosphatic nodules.....	0.5
Shale, light-gray, weathers yellow-gray with orange mottling.....	6.5
Coal, black, soft, weathered (Croweburg).....	0.7
Underclay, light-gray with orange mottling and reddish-brown banding.....	1.1

Sandstone, buff with reddish-brown, iron-oxide-stained concretionary beds about 6 in. thick; fine-grained, noncalcareous, thin-bedded to massive, cross-bedded in part; in places along outcrop, prominent erosional remnants stand out as massive blocks	14.5
Shale, gray-brown with orange mottling; weathers buff	4.7
Limestone, gray-brown, impure, highly fossiliferous; interval is poorly exposed, but appears to include at least three massive, dense, resistant beds 4-8 in. thick, separated by sandy, calcareous shale (McNabb Limestone)	8.0
Shale, reddish-brown, sandy, poorly exposed	0.8
Shale, dark-gray with orange banding	0.2
Coal, black, thins to 0.5 in. laterally (unnamed)	0.1
Sandstone, reddish-brown to very dark-gray-brown, thin-bedded, noncalcareous; includes abundant black, carbonized plant fragments on stratification surfaces; highly carbonaceous	0.9
Covered interval	80.0
Sandstone, light-gray, weathers buff, noncalcareous, very fine-grained, very thin-bedded, micaceous, interlaminated with siltstone; current marks abundant; highly shaly in part, well-indurated in lower 15 ft (forms sharp ledge creating waterfall a short distance above Mountain Creek) (Chelsea Sandstone)	50.0
Covered to water level in Mountain Creek	5.0
Total	174.0

Measured Section 32

SW¼NW¼SW¼SE¼ sec. 31, T. 17 N., R. 15 E., Wagoner County. Measured in road cut on south side of U.S. Highway 64 about 100 yd west of crest of hill on highway, by LeRoy A. Hemish. Field notebook designation TW-38-80-H. (Estimated elevation at top of section, 667 ft.)

	Thickness (ft)
Clay, brown, silty; contains angular reddish-brown sandstone boulders, cobbles, and pebbles, as well as shale fragments (colluvium)	9.0

CABANISS GROUP

Senora Formation:

Shale, olive-brown with orange mottling; includes very thin, orange, ferruginous siltstone stringers that weather into flakes on the outcrop; carbonized plant fragments on stratification surfaces	18.0
Coal, black (Mineral)	0.9
Sandstone, orange-brown and purple-gray, carbonaceous, fine-grained, noncalcareous	0.3
Shale, black to dark-purplish-gray, highly carbonaceous; includes a 0.5-in.-thick bed of coal in upper part of unit	0.2
Sandstone, buff, very fine-grained, noncalcareous, thin-bedded	0.4

Shale, gray-brown, silty; black carbonized plant fragments abundant on stratification planes	0.5
Siltstone, light-gray and brown, interlaminated with shale, fissile	12.7
Sandstone, light-gray and brown with reddish-brown iron-oxide staining, thin-bedded, noncalcareous, very fine-grained, well-indurated (base covered) (upper part of Chelsea Sandstone)	5.0
Total	47.0

Measured Section 33

E½NE¼SW¼ and NW¼NW¼NW¼SE¼ sec. 9, T. 17 N., R. 16 E., Wagoner County. Measured from top of hill in the center of the south one-half of the section, through abandoned coal mine, to base of gully directly east of the center of the section, by LeRoy A. Hemish. Field notebook designation TW-27-80-H. (Estimated elevation at top of section, 750 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, buff to light-brown, fine-grained, noncalcareous, thin- to medium-bedded; covered slope above a topographic bench in middle part of unit indicates presence of a shale unit; exposed surfaces of sandstone are characterized by well-defined ripple marks	20.0
Siltstone, black to reddish-brown, micaceous, ferruginous, carbonaceous, laminated, weakly indurated	1.5
Shale, dark-gray-brown, fissile, highly silty in upper part	15.0
Covered to base of spoil piles around old, abandoned coal mine; material in spoil piles and poorly exposed outcrops indicates that at least the lower few feet of this interval consists of black, fissile, highly carbonaceous shale containing black, phosphatic nodules and reddish-brown and orange septarian concretions with shrinkage cracks forming a 1 in. by 1 in. checked pattern and containing calcite fillings displaying reddish-brown and orange liesegang rings; the Weir-Pittsburg coal bed was mined at this location, but is no longer exposed	50.0
KREBS GROUP	
Boggy Formation:	
Sandstone, reddish-brown, ferruginous, fine-grained, medium-bedded, noncalcareous	10.0
Shale, gray, fissile	1.0
Ironstone, orange and blue-black	0.2
Shale, gray, fissile	2.3
Covered interval	20.0

Shale, tan; includes small orange to brownish-black clay-ironstone concretions that weather into small fragments on the outcrop.....	8.0
Sandstone, buff, very fine-grained, thin-bedded, noncalcareous; outcrop forms small bench on slope of hill.....	0.4
Shale, dark-purplish-gray; contains abundant, very thin, orange to reddish-brown, ferruginous, silty, fissile, concretionary beds that weather to flakes on the outcrop..	3.6
Sandstone and shale, interval includes a few poorly exposed beds of buff to reddish-brown, fine-grained sandstone about 1-2 ft thick, separated by gray shale beds. Debris from overlying units largely conceals this part of the section.....	48.0
Total	180.0

Measured Section 34

SE¼SE¼NE¼NW¼ sec. 15, T. 17 N., R. 16 E., Wagoner County. Measured in cutbank of tributary stream of Fife Creek just northwest of small, abandoned coal pit, by LeRoy A. Hemish. Field notebook designation TW-18-81-H. (Estimated elevation at top of section, 550 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Shale, black, platy, carbonaceous, weathers brown.....	1.0
Ironstone, black, weathers brown.....	0.1
Shale, black, platy, carbonaecous, weathers brown.....	2.9
Ironstone, black, sparingly fossiliferous, weathers brown; thickens locally and includes a 1-in.-thick bed of highly fossiliferous black limestone at base of unit (Inola Limestone).....	0.3
Shale, black, platy, carbonaceous (to water level in creek).....	1.2
Total	5.5

Note: Coal bed not exposed, but longtime local resident reported thicknesses of 0.8-1.3 ft of coal from well drilling and old mine workings in the area (Bluejacket coal).

Measured Section 35

NW¼SW¼SW¼SW¼ sec. 25, T. 17 N., R. 16 E., Wagoner County. Measured in cutbank of Car Creek about 100 yd downstream from the bridge at the southeast corner of sec. 26, T. 17 N., R. 16 E., by LeRoy A. Hemish. Field notebook designation TW-44-80-H. (Estimated elevation at top of section, 557 ft.)

	Thickness (ft)
KREBS GROUP	
Boggy Formation:	
Shale, dark-gray with orange banding; includes stringers of hard, orange, weakly calcareous clay-ironstone concretions near top of unit	4.5
Shale, black, streaked with yellow and orange	1.9
Shale, brown, silty; contains white, powdery, noncalcareous mineral deposits (gypsum?)	0.2
Limestone, gray-brown to black, impure, shaly, fossiliferous, thin-bedded; includes abundant black, carbonaceous material (Inola Limestone)	1.4
Shale, medium-gray with orange streaks	0.4
Coal, black, hard (Bluejacket)	0.8
Underclay, light-gray streaked with orange	0.9
Shale, light-gray; includes well-indurated layers of orange, ferruginous, silty concretions (to water level in creek)	2.9
Total	13.0

Measured Section 36

SW¼SE¼SW¼NE¼ sec. 36, T. 17 N., R. 16 E., Wagoner County. Measured in slope of hill adjacent to tributary stream of Gar Creek, by LeRoy A. Hemish. Field notebook designation TW-45-80-H. (Estimated elevation at top of section, 580 ft.)

	Thickness (ft)
Covered	5.0
KREBS GROUP	
Boggy Formation:	
Shale, yellow-gray with orange bands, clayey, weathered, orange in bottom 2 in	6.0
Coal, black, soft (Bluejacket)	0.1
Clay, orange to dark-gray-brown; thin coal stringer included	0.1
Coal, black, shiny, hard (Bluejacket)	0.8
Underclay, light-gray with orange banding; carbonized plant compressions abundant	1.1
Total	13.1

Measured Section 37

SE¼SE¼SW¼NW¼ sec. 33, T. 17 N., R. 17 E., Wagoner County. Measured in cutbank of Strawberry Creek adjacent to old, abandoned strip pit, by LeRoy A. Hemish. Field notebook designation TW-3-81-H. (Estimated elevation at top of section, 565 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Shale, brown, grading downward to gray-brown, highly weathered	5.0
Ironstone, septarian concretions, reddish-brown	0.1
Shale, very dark-gray; includes a discontinuous layer of thin, discoidal ironstone concretions about 1 ft above base of unit	3.9
Ironstone, reddish-brown with rectangular jointing	0.1
Shale, black; weathers to small, brittle flakes	1.5
Ironstone, reddish-brown with rectangular jointing	0.1
Shale, black, hard, weathers to small, brittle flakes	0.8
Ironstone, reddish-brown; with rectangular jointing; weathers to form irregular, brick-like blocks that pave the stream bed; includes some septarian concretions; very sparingly fossiliferous	0.2
Shale, black, brittle, silty	4.8
Total	16.5

Note: Strata were excavated 1.5 ft below the base of the dry stream bed without encountering the base of the black shale unit. Drywood coal was mined at this location; thickness of bed unknown.

Measured Section 38

NE¼NW¼SE¼NE¼ sec. 9, T. 17 N., R. 18 E., Wagoner County. Measured on southwest side of cut for Missouri Pacific Railroad, directly west of U.S. Highway 69, by LeRoy A. Hemish. Field notebook designation TW-13-81-H. (Estimated elevation at top of section, 588 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Shale, orange-brown, highly weathered; contains weathered clay-ironstone concretions	2.0
Limestone, medium-gray, weathers buff; thin-bedded and shaly in upper part, massive in lower part; fossiliferous, horn corals abundant (Spaniard Limestone)	3.1
McAlester Formation:	
Siltstone, orange with light-gray-brown bands, clayey, ferruginous, carbonaceous	0.2
Coal, black, weathered (Spaniard)	0.1
Underclay, very light-gray with pink and orange streaks, highly silty	1.2
Sandstone, buff to dark-brown, micaceous, very fine-grained, ferruginous in part, thin-bedded; contains black, carbonaceous plant fragments	1.3

Shale, brownish-gray, silty, micaceous; contains abundant flecks of black, carbonaceous plant material.....	3.4
Total	11.3

Measured Section 39

SW¼SW¼SW¼NW¼ sec. 27, T. 17 N., R. 18 E., Wagoner County. Measured in cutbank of stream directly east from bridge, by LeRoy A. Hemish. Field notebook designation TW-14-81-H. (Estimated elevation at top of section, 553 ft.)

	Thickness (ft)
Clay, orange-brown, silty gravelly (alluvium).....	3.0
KREBS GROUP	
Savanna Formation:	
Shale, gray, weathers brown; black, carbonaceous material abundant on stratification surfaces.....	3.5
Shale, black; includes dark-reddish-brown clay-ironstone concretions.....	2.2
Ironstone, reddish-brown, black on freshly broken surfaces, fossiliferous; occurs in lensing masses (Doneley Limestone).....	0.3
Coal, black (Rowe).....	0.1
Underclay, light-gray with orange streaks.....	1.7
Sandstone, buff, weathers dark-brown, very fine-grained, thin-bedded; fossil tracks and trails abundant on stratification surfaces (to water level in creek).....	1.0
Total	11.8

Measured Section 40

SW¼NE¼SE¼NW¼ sec. 33, T. 17 N., R. 18 E., Wagoner County. Measured in old, abandoned strip mine, by LeRoy A. Hemish. Field notebook designation TW-15-81-H. (Estimated elevation at top of section, 530 ft.)

	Thickness (ft)
Silt, brown (alluvium).....	3.0
Gravel, orange-brown, silty and clayey (alluvium).....	6.0
KREBS GROUP	
Savanna Formation:	
Shale, black, brittle.....	3.0
Coal, black, hard (Rowe).....	0.7
Underclay, light-gray to medium-gray.....	1.0
Total	13.7

Measured Section 41

SW¼SW¼NE¼NW¼ sec. 11, T. 18 N., R. 12 E., Tulsa County. Measured in road cut on west side of U.S. Highway 75 directly south of 171st Street exit ramp, by LeRoy A. Hemish. Field notebook designation TW-9-80-H. (Estimated elevation at top of section, 838 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Coffeyville Formation:	
Sandstone, pale-yellowish-orange with dark-reddish-brown iron-oxide staining, fine-grained, noncalcareous, well-indurated; tracks, trails, and burrow features abundant on stratification surfaces	3.0
Shale, pale-yellowish-brown with dark-yellowish-orange mottling, partly oxidized; feels "soapy"	1.2
Sandstone, as above	0.8
Shale, as above	1.8
Sandstone, as above	0.4
Shale, as above	0.8
Shale, grayish-black to black, fissile; includes small spheroidal, phosphatic nodules in lower part of unit	10.0
Shale, grayish-black with olive-brown staining on stratification surfaces, clayey; lacks fissile weathering characteristics of overlying unit	1.3
Limestone, light-gray; occurs as discoidal concretions	0.1
Shale, as above	2.8
Limestone, gray; occurs as oblate concretions, some containing pelecypod fossils	0.3
Shale, dark-gray	6.8
Checkerboard Formation:	
Limestone, pale-yellowish-brown, very fossiliferous, marine shells and crinoid columnals abundant, dense, massive, weathers moderate-brown (Checkerboard Limestone)	3.2
Seminole Formation:	
Shale, dark-gray with dark-reddish-brown iron-oxide deposits on stratification surfaces	3.0
Shale, black, carbonaceous; separated from overlying unit by a thin iron-oxide layer	0.3
Shale, black, very carbonaceous; forms bench on outcrop; coaly shale in part; includes thin stringers of pure coal <1 in. thick (Checkerboard coal interval)	0.5
Underclay, light-gray	1.0
Shale, light-brownish-gray with dark-reddish-brown iron-oxide stains, silty; interstratified with thin layers of siltstone and very fine-grained sandstone; base of unit covered	12.7
Total	50.0

Measured Section 42

SW¼NW¼NW¼SW¼ sec. 30, T. 18 N., R. 13 E., Tulsa County. Measured in west wall of excavation on bluff overlooking Arkansas River flood plain, by LeRoy A. Hemish. Field notebook designation TW-2-80-H. (Estimated elevation at top of section, 665 ft.)

	Thickness (ft)
MARMATON GROUP	
Holdenville Formation:	
Sandstone, light-brown to buff, micaceous, noncalcareous, fine-grained, medium-bedded in upper 5 ft; thin-bedded in lower part, with cross-bedded channel-fillings occurring locally; includes some shaly, silty, and coaly layers near base of unit	14.0
Coal, black with yellow and reddish-brown staining on cleat surfaces; includes a 3-in.-thick, black, carbonaceous shale parting 8 in. from top of unit (Jenks)	1.7
Underclay, medium-gray with reddish-brown staining; grades downward into underlying clay-shale unit	4.3
Shale, dark-gray; contains scattered reddish-brown, silty clay-ironstone concretions	2.9
Sandstone, light-orange-brown, very fine-grained, noncalcareous, well-indurated; thickness variable along the outcrop, laminated; locally fills channels cut into underlying shale unit	5.0
Shale, dark-gray, noncalcareous; includes some light-gray, interbedded siltstones and sandstones, as well as numerous 1-in.-thick discoidal and stratiform, reddish-brown clay-ironstone concretions (total thickness not exposed)	16.1
Total	44.0

Measured Section 43

NE¼SE¼SE¼SW¼ sec. 30, T. 18 N., R. 13 E., Tulsa County. Measured in east-facing bluff above flood plain of Polecat Creek, by LeRoy A. Hemish. Field notebook designation TW-8-80-H. (Estimated elevation at top of section, 740 ft.)

	Thickness (ft)
MARMATON GROUP	
Holdenville Formation:	
Sandstone, reddish-brown, ferruginous, fine-grained, medium-bedded	2.8
Sandstone, buff, very fine-grained, silty and shaly, thin-bedded	1.2
Shale, light-gray-brown, silty; includes alternating beds of very fine-grained buff, silty sandstone; poorly exposed	23.0
Shale, medium-gray, weathers brown	5.0

Shale, dark-brown to black, fissile; includes abundant black, carbonized plant compressions on stratification surfaces as well as small, black, phosphatic nodules.....	3.5
Coal, black, hard (Jenks).....	1.0
Clay, purple-brown.....	0.3
Coal, black, hard (Jenks).....	0.9
Underclay, dark-gray with yellow streaks; abundant fossil plant fragments on stratification surfaces.....	2.0
Sandstone, buff with reddish-brown iron-oxide staining, fine-grained, bioturbated; contains fossil plant molds and some fossil marine animals; includes silty, shaly beds locally; forms ledge in bluff.....	3.3
Shale, light-gray-brown.....	8.0
Shale, light-gray-brown; includes beds of sandstone and siltstone; interval is mostly covered by debris from overlying beds.....	70.0
Total	121.0

Measured Section 44

NW¼NE¼SW¼SE¼ sec. 23, T. 18 N., R. 14 E., Tulsa County. Measured in cutbank of stream, by LeRoy A. Hemish. Field notebook designation TW-26-80-H. (Estimated elevation at top of section, 675 ft.)

	Thickness (ft)
Clay, orange, silty (alluvium).....	6.0
CABANISS GROUP	
Senora Formation:	
Shale, buff, heavily weathered.....	1.8
Limestone, gray-brown, purplish-pink and brown on weathered surfaces; impure, sandy and silty; fossiliferous, with numerous brachiopod shells; irregularly bedded; forms floor of creek for short distance along outcrop (Breezy Hill Limestone).....	1.5
Sandstone, buff, highly calcareous, micaceous, very fine-grained, shaly, thin-bedded.....	0.5
Siltstone, buff, shaly, highly calcareous, thin-bedded.....	1.0
Shale, dark-gray, calcareous; includes some thin, well-indurated, shaly limestone beds.....	1.0
Shale, light-orange-brown, calcareous, weathered.....	2.0
Sandstone, orange-brown, noncalcareous, very fine-grained, micaceous, thin-bedded.....	0.1
Shale, gray, highly silty, noncalcareous, weathers tannish-brown.....	3.0
Limestone, dark-gray and purplish-pink, highly silty, highly fossiliferous, irregularly thin-bedded; crops out in creek bed.....	0.3
Shale, dark-gray, calcareous, silty.....	0.1

Shale, gray with orange banding, noncalcareous, micaceous, silty; includes brown, carbonized plant fragments (base of unit not exposed).....	2.0
Total	19.3

Note: At this site, the Iron Post coal is absent from its usual position a few inches below the Breezy Hill Limestone.

Measured Section 45

SE¼SE¼SE¼SW¼ sec. 1, T. 18 N., R. 15 E., Wagoner County. Measured in road ditch from top of hill to bottom of valley, by LeRoy A. Hemish. Field notebook designation TW-21-80-H. (Estimated elevation at top of section, 740 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, red to dark-reddish-brown, fine- to medium-grained, ferruginous, noncalcareous, cross-bedded (Chelsea Sandstone).....	15.0
Shale, light-gray to tan with orange mottling; abundant brown and black, carbonized plant fragments on stratification surfaces.....	11.0
Shale, black, carbonaceous, fissile.....	5.0
Shale, light-gray with orange mottling, clayey; carbonized plant fragments on stratification surfaces.....	8.5
Ironstone, orange-brown to black, calcareous, fissile.....	0.2
Shale, gray with orange mottling.....	6.3
Ironstone, purplish-red to dark-gray, banded, calcareous in part, sparingly fossiliferous.....	0.2
Shale, medium-gray.....	5.2
Limestone, tannish-gray with dark-pink mottling, hard, massive, silty, fossiliferous (Tiawah Limestone).....	1.5
Shale, blue-gray.....	0.5
Shale, black.....	0.2
Shale, light-gray, clayey.....	0.1
Coal, black, soft (unnamed).....	0.1
Underclay, light-gray, smooth, carbonized plant fragments included.....	0.4
Sandstone, tannish-gray with reddish-brown mottling; abundant black, carbonized plant fragments on stratification surfaces, very thin-bedded, silty and clayey.....	1.8
Limestone, dark-gray, weathers light-brown-gray, massive, fossiliferous (Tiawah Limestone).....	1.4
Shale, olive-gray and orange with reddish-brown and black staining on fracture surfaces, fissile; includes bed of rectangular clay-ironstone concretions about 4-6 in. long, 3 in. wide, and 1-2 in. thick in middle of unit.....	2.6
Clay-ironstone, orange with purple-red and black interior on freshly broken surfaces; rectangular jointing gives concretions a brick-like appearance.....	0.2

Shale, black, fissile; includes reddish-brown, ferruginous, clayey, siltstone stringers	2.5
Shale, black, fissile; includes a few small, rounded, phosphatic nodules; characterized by rectangular joints	2.4
Coal, black, soft, weathered (Tebo)	0.4
Underclay, light-gray with yellow and orange mottling; black, carbonized plant fragments abundant	2.0
Shale, green-gray (to covered area at base of hill)	2.8
Total	70.3

Measured Section 46

SW¼SW¼SE¼SE¼ sec. 7, T. 18 N., R. 15 E., Wagoner County. Measured in eroded road ditch directly southeast of Knight Industries plant, by LeRoy A. Hemish. Field notebook designation TW-10-80-H. (Estimated elevation at top of section, 750 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, brown, highly oxidized (poorly exposed)	1.0
Covered interval	4.0
Limestone, brown, silty, highly fossiliferous, massive (base well exposed, but total thickness uncertain) (Breezy Hill Limestone)	1.5
Shale, orange-brown, highly oxidized (Kinnison Shale)	0.8
Sandstone, reddish-brown, ferruginous, very highly calcareous, irregularly thin-bedded; contains fossil marine fauna; grades into underlying unit	0.7
Sandstone, reddish-brown, ferruginous, calcareous; contains black, carbonized plant compressions; thin-bedded; includes thin layers of shale	3.4
Limestone, dark-gray-brown, impure, fossiliferous; highly sandy and silty; marine fauna abundant	0.5
Sandstone, reddish-brown with gray streaks, shaly, thin-bedded, ferruginous, micaceous; black, carbonized plant fragments abundant (base of unit not exposed) (Lagonda Sandstone)	10.0
Total	21.9

Note: At this site, the Iron Post coal is absent from its usual position below the Breezy Hill Limestone and Kinnison Shale. The top of the Lagonda zone extends to the base of the Kinnison Shale.

Measured Section 47

NE¼SE¼NW¼SE¼ sec. 29, T. 18 N., R. 15 E., Wagoner County. Measured in cutbank of stream, by LeRoy A. Hemish. Field notebook designation TW-20-80-H. (Estimated elevation at top of section, 650 ft.)

	Thickness (ft)
Silt, dark-brown, organic (topsoil developed on alluvium)...	2.0

CABANISS GROUP

Senora Formation:

Shale, light-brown, highly weathered; includes thin, reddish-brown stringers of clay-ironstone.....	2.5
Coal, black, weathered (Mineral).....	0.4
Clay, purplish-brown.....	0.1
Coal, black, weathered (Mineral).....	0.2
Shale, very dark-gray with reddish-brown staining, carbonaceous; includes black, carbonized plant fragments on stratification surfaces.....	1.3
Coal, black, weathered (Mineral).....	0.8
Underclay, light-gray with orange bands.....	0.7
Shale, medium-gray with reddish-brown iron-oxide staining, silty (base of unit covered).....	1.5
Total	9.5

Measured Section 48

NW¼NE¼SW¼SE¼ sec. 29, T. 18 N., R. 15 E., Wagoner County. Measured in cutbank of stream, by LeRoy A. Hemish. Field notebook designation TW-19-81-H. (Estimated elevation at top of section, 658 ft.)

	Thickness (ft)
Clay, dark-brown, silty, organic (topsoil developed on alluvium).....	2.0
Clay, gray-brown, silty (alluvium).....	3.0

CABANISS GROUP

Senora Formation:

Shale, olive-gray, weathers brown, silty; includes black, carbonized plant compressions on stratification surfaces; also includes small reddish-brown clay-ironstone concretions.....	6.0
Coal, black, weathered; includes a very thin clay parting (Mineral).....	0.4
Shale, very dark-gray, carbonaceous; includes some well-preserved fossil leaf impressions on stratification surfaces; in part stained orange by iron oxides.....	0.7
Coal, black, impure, flaky in part (Mineral).....	0.6
Underclay, gray with reddish-brown iron-oxide staining; contains black, carbonized plant fragments.....	1.1
Sandstone, medium-gray, weathering light-yellow-brown, very fine-grained, thin-bedded, noncalcareous; includes abundant well-preserved, black, carbonized plant fragments on stratification surfaces (base of unit covered)...	1.5
Total	15.3

Measured Section 49

SW¼SW¼NW¼NW¼ sec. 18, T. 18 N., R. 16 E., Wagoner County. Measured in east bank of Coal Creek, by LeRoy A. Hemish. Field notebook designation TW-17-80-H. (Estimated elevation at top of section, 613 ft.)

	Thickness (ft)
Silt, dark-gray-brown, organic (soil zone)	1.2
Silt, sandy, light-brown; contains scattered small fragments of coal (alluvium)	2.5
Gravel, light-reddish-brown, clayey; contains coal and black shale fragments (alluvium)	2.0
CABANISS GROUP	
Senora Formation:	
Shale, black, brittle, fissile; contains small rounded phosphatic nodules	0.8
Coal, black; stained yellow and reddish-brown on weathered surfaces (lower split of Weir-Pittsburg coal)	0.4
KREBS GROUP	
Boggy Formation:	
Underclay, medium-gray with yellow staining on weathered surfaces	0.8
Shale, light-gray with orange mottling; contains clayey, soft, ferruginous concretions	3.0
Siltstone, reddish-brown, shaly, ferruginous	0.2
Siltstone, light-gray with reddish-brown mottling, shaly	2.1
Total	13.0

Measured Section 50

NE¼NW¼NW¼SW¼ sec. 18, T. 18 N., R. 16 E., Wagoner County. Measured in cutbank of tributary of Coal Creek where stream flows through small abandoned mine, by LeRoy A. Hemish. Field notebook designation TW-19-80-H. (Estimated elevation at top of section, 614 ft.)

	Thickness (ft)
Silt, brownish-gray; includes shaly gravel at base of unit (alluvium)	4.0
CABANISS GROUP	
Senora Formation:	
Shale, black with reddish-brown staining on exposed surfaces, fissile, brittle, highly carbonaceous	2.5
Coal, black with reddish-brown and yellow staining on cleat surfaces (upper split of Weir-Pittsburg coal)	0.8

Shale, black, coaly; includes hard coal stringers as much as 1 in. thick	0.5
Shale, black, hard; includes rounded phosphatic nodules; rectangular jointing; locally coated with white and yellow, noncalcareous mineral precipitates	1.2
Coal, black with orange, white and yellow mineral precipitates on exposed surfaces (lower split of Weir-Pittsburg coal)	0.4

KREBS GROUP

Boggy Formation:

Underclay, gray with orange and reddish-brown staining	0.8
Shale, light-gray with reddish-brown and yellow staining, silty; base of unit covered by water in creek	2.8
Total	13.0

Measured Section 51

N½NE¼NW¼ sec. 19, T. 18 N., R. 16 E., and W½SW¼ sec. 18, T. 18 N., R. 16 E., Wagoner County. Measured from top of prominent ridge northwest to north-east-flowing tributary stream of Coal Creek, by LeRoy A. Hemish. Field notebook designation TW-6-81-H and TW-18-80-H (combined). (Estimated elevation at top of section, 772 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, fine-grained, micaceous, cross-bedded; base covered (Chelsea Sandstone)	12.0
Covered interval	40.0
Limestone, reddish-brown to purplish-brown, highly ferruginous, oolitic; caps small knoll just south of east-west fence line along north edge of section (Tiawah)	0.8
Shale, gray-brown; includes two layers of 2-in.-thick clay-ironstone concretions	20.0
Sandstone, light-brown, very fine-grained, micaceous, noncalcareous; grades downward into silty shale	5.2
Shale, light-gray-brown with some gray to very dark-gray beds; lower part of unit poorly exposed	64.0
Shale, medium- to dark-gray, light-brown where weathered; forms floor of creek over a distance of 0.2 mi south from underlying limestone ledge	18.0
Limestone, very dark-gray to black; includes reddish-brown, iron-oxide-stained, egg-sized concretions; shaly in part; clay ironstone laterally along the outcrop; sparingly fossiliferous	0.2
Limestone, light-tannish-gray, hard; displays excellent cone-in-cone structure; not continuous	0.2
Clay-ironstone, orange with dark-gray interior on freshly broken surfaces; calcareous in part; sparingly fossiliferous; rectangular jointing; outcrop in floor of creek	

has the appearance of a brick-paved road.....	0.2
Shale, black with reddish-brown, silty beds, weakly calcareous; locally includes a 1-in.-thick bed of reddish-brown limestone about 1 in. below top of unit.....	2.4
Shale, black, fissile; includes a few rounded, phosphatic nodules; rectangular jointing.....	2.0
Coal, black, stained yellow on exposed surfaces (upper split of Weir-Pittsburg coal).....	0.8
Shale, black, coaly.....	0.5
Shale, black, brittle, fissile; includes small, black, phosphatic nodules; rectangular jointing.....	0.9
Coal, black; stained yellow on exposed surfaces (lower split of Weir-Pittsburg coal).....	0.4

KREBS GROUP

Boggy Formation:

Underclay, light-gray, stained yellow.....	1.0
Shale, light-gray with light-brown mottling (to water level in creek).....	1.0
Total	169.6

Measured Section 52

NW¼SW¼ sec. 31, T. 18 N., R. 16 E., Wagoner County. Measured along southeast-flowing tributary of Fife Creek in north part of the NW¼SW¼, by LeRoy A. Hemish. Field notebook designation TW-25-80-H. (Estimated elevation at top of section, 645 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, gray-brown.....	2.0
Coal, black, soft (unnamed).....	0.2
Underclay, light-gray.....	0.5
Siltstone, buff and reddish-brown, sandy, weakly indurated; includes abundant black, carbonized plant fragments.....	0.8
Shale, gray-brown, silty; includes carbonized plant fragments.....	0.5
Limestone, brown and orange-brown; dark-gray on freshly broken surfaces; silty, fossiliferous; includes a 2-in.-thick, shaly limestone bed locally (Tiawah Limestone).....	0.7
Shale, medium-gray.....	4.0
Shale, black, fissile.....	1.2
Limestone, black, highly shaly, fossiliferous.....	0.2
Shale, black, fissile, highly carbonaceous.....	0.6
Shale, gray and reddish-brown; includes abundant carbonized fossil plant fragments.....	0.3
Limestone, light-tannish-gray, fossiliferous (Tiawah Limestone).....	0.4
Shale, olive-gray; includes abundant reddish-brown, calcareous ironstone concretions.....	0.9

Ironstone, reddish-brown and purplish-black; limestone in part, fossiliferous; weathers to rounded blocks about 4-6 in. across	0.2
Shale, olive-gray; includes numerous orange, discoidal and oblate clay-ironstone concretions	3.0
Shale, black	1.0
Ironstone, reddish-brown with black interior on freshly broken surfaces; occurs as flattened discoidal concretions as much as 1 ft in diameter	0.2
Shale, black, fissile; includes some very thin beds of olive-gray to reddish-brown, ferruginous siltstone	2.0
Shale, black, brittle, platy; includes small, rounded, black, phosphatic nodules; characterized by large rectangular joints	2.0
Shale, very dark-gray, soft	0.8
Coal, black (Tebo)	0.7
Shale, black and reddish-purple, fissile, coaly	0.3
Limestone, black to very dark-gray, weathers gray-brown; occurs only locally	0.2
Underclay, light-greenish-gray with orange mottling	1.0
Shale, medium-gray, silty	1.3
Total	25.0

Note: This section was measured along a series of normal faults upthrown to the north. Sequences of beds thus occur repetitiously, giving the impression of several beds of coal occurring at successively higher elevations in the upstream direction.

Measured Section 53

NE¼NW¼NE¼SW¼ sec. 31, T. 18 N., R. 16 E., Wagoner County. Measured in cutbank of Fife Creek about 10 ft north from east-west fence line that bisects the section, by LeRoy A. Hemish. Field notebook designation TW-2-81-H. (Estimated elevation at top of section, 643 ft.)

	Thickness (ft)
Silt, dark-gray-brown; contains organic matter (topsoil)	2.5
Silty, clayey, sandy, light-gray-brown mottled with reddish-brown iron oxides (alluvium)	3.0
Gravel, reddish-brown mottled gray-brown, highly impure, silty; includes angular, cobble-sized fragments of reddish-brown sandstone and assorted clasts of brown petrified wood	3.0

CABANISS GROUP

Senora Formation:

Coal, black (Tebo)	0.5
Underclay, gray with reddish-orange iron-oxide staining on stratification surfaces and joints; includes black, carbonized plant compressions	1.5
Covered to water level in Fife Creek	1.0
Total	11.5

Measured Section 54

SW¼SW¼ and NW¼NE¼SW¼ sec. 31, T. 18 N., R. 16 E., Wagoner County. Measured from top of hill in road ditch in a north and northeasterly direction, then along Fife Creek to juncture of south-flowing tributary stream, by LeRoy A. Hemish. Field notebook designation TW-24-80-H. (Estimated elevation at top of section, 726 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, reddish-brown, ferruginous, fine-grained, noncalcareous, thin-bedded (Chelsea Sandstone).....	17.0
Covered, probably shale.....	3.0
Sandstone, very dark-gray to black, highly carbonaceous, laminated, very fine-grained, micaceous, silty.....	0.7
Sandstone, buff, micaceous, fine-grained, noncalcareous, thin-bedded, cross-bedded in part; locally conglomeratic..	19.5
Shale, dark-gray; contains black, carbonized plant fragments; includes very thin beds of ferruginous, reddish-brown siltstone; weathers gray-brown with orange streaks..	10.5
Sandstone, reddish-brown, ferruginous, noncalcareous, medium-grained; conglomeratic in bottom 2 in., with abundant clay-ironstone pebbles.....	0.5
Covered interval, with intermittent poor exposures of gray shale.....	23.0
Shale, gray-brown, weathered (exposed in creek bank below 3 ft of gravelly, clayey alluvium).....	0.8
Coal, black, soft, weathered (unnamed).....	0.1
Underclay, light-yellow-gray.....	0.1
Siltstone, light-gray-brown with orange and purple-brown streaks, unbedded, noncalcareous; includes abundant carbonized plant fragments.....	1.6
Limestone, dark-gray with reddish-brown staining, fossiliferous, very hard; forms resistant ledge in creek bed (Tiawah Limestone).....	0.4
Covered interval.....	3.0
Limestone, dark-gray with reddish-brown staining; highly ferruginous and silty in upper part; highly fossiliferous; weathered surface has hackly appearance due to abundance of broken fossil shells (Tiawah Limestone).....	0.6
Shale, gray with orange banding.....	2.0
Covered interval.....	7.2
Shale, black, brittle; includes small, rounded phosphatic nodules.....	2.0
Shale, very dark-gray, soft.....	0.8
Coal, black; includes very hard, dark-gray pods of silty pyrite; well-preserved, silicified tree stumps and other pieces of petrified wood abundant in association with the coal bed (Tebo).....	0.7
Shale, reddish-brown to black, coaly.....	0.1
Limestone, very dark-gray, weathers light-gray-brown; occurs locally in depressions at the top of underlying unit.....	0.2
Underclay, light-greenish-gray with orange mottling.....	1.0

Shale, medium-gray, silty.....	1.2
Total	96.0

Measured Section 55

SE¼NW¼SE¼NE¼ sec. 32, T. 18 N., R. 16 E., Wagoner County. Measured in cutbank of Fife Creek, by LeRoy A. Hemish. Field notebook designation TW-17-81-H. (Estimated elevation at top of section, 599 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, black, weathers dark-purplish-gray with orange streaks; contains flat, reddish-brown clay-ironstone concretions ranging from 0.5 to 6 in. thick and as much as 2 ft in diameter.....	8.0
Coal, black, weathered, stained reddish-brown on cleat surfaces (Weir-Pittsburg).....	0.5
KREBS GROUP	
Boggy Formation:	
Underclay, light-gray with some yellow mottling.....	1.1
Sandstone, light-gray on freshly broken surfaces; stained dark-reddish-brown; includes abundant black, carbonized plant fragments; well-indurated, very fine-grained, noncalcareous (base not exposed).....	0.1
Total	9.7

Measured Section 56

NE¼SE¼SE¼NW¼ sec. 9, T. 18 N., R. 17 E., Wagoner County. Measured in small ravine directly northeast from end of abandoned steel bridge across Old River Channel (Verdigris), by LeRoy A. Hemish. Field notebook designation TW-8-81-H. (Estimated elevation at top of section, 560 ft.)

	Thickness (ft)
Clay, gravelly, orange-brown; contains abundant rounded clasts of brown chert (alluvium).....	10.0
KREBS GROUP	
Savanna Formation:	
Shale, olive-gray, weathers tan; includes a 0.5-in.-thick layer of brown ironstone near top of unit.....	4.5
Ironstone, purplish-brown, very dark-gray on freshly broken surfaces.....	0.1
Shale, black; contains small, black, phosphatic nodules.....	2.4

Limestone, black, fossiliferous; weathers to gray-brown, discoidal masses 3-4 in. in diameter on outcrop (Doneley Limestone)	0.1
Shale, black; contains small, black, phosphatic nodules	2.5
Coal, black, reddish-brown iron-oxide staining on cleat surfaces (Rowe)	1.1
Underclay, light-gray with red and pink mottling and streaking	2.0
Shale, light-gray with orange mottling; includes abundant small clay-ironstone concretions	2.5
Siltstone, light-gray to greenish-tan, shaly; contains ferruginous streaks	0.9
Shale, olive-gray with orange streaks; includes abundant well-formed selenite crystals as much as 2 in. long that weather out and litter the surface of the outcrop	2.0
Coal, black (0.25-in.-thick), and brownish-gray underclay	0.3
Shale, medium-gray; contains abundant small, purplish-brown clay-ironstone concretions that weather to pop-corn-like shapes littering the surface of the outcrop	15.5
Limestone, reddish-brown and greenish-blue, impure, sandy, shaly in middle of unit; contains scattered, poorly preserved fossils; characterized by irregular, knobby surfaces on outcrops owing to weathering of highly disturbed bedding (Sam Creek Limestone)	2.0
Siltstone, blue-gray, micaceous, noncalcareous, thin-bedded, bioturbated	5.3
Total	51.2

Measured Section 57

NE¼NE¼SW¼NE¼ sec. 9, T. 18 N., R. 17 E., Wagoner County. Measured on north-facing slope of hill directly north of galvanized steel barn at top of hill, by LeRoy A. Hemish. Field notebook designation TW-9-81-H. (Estimated elevation at top of section, 562 ft.)

	Thickness (ft)
Clay, gravelly, orange-brown, oxidized; contains abundant water-worn clasts of brown chert (alluvium)	6.0
KREBS GROUP	
Savanna Formation:	
Shale, olive-gray, weathers light-brown	10.5
Ironstone, brown to purplish-brown	0.1
Shale, black	2.9
Limestone, very dark-gray, impure, silty, highly fossiliferous (Doneley Limestone)	0.1
Shale, dark-olive-gray-brown, fossiliferous, highly calcareous	2.0
Coal, black, weathered (Rowe)	1.0
Underclay, light-gray with orange ferruginous bands	1.0
Shale, light-gray with orange mottling (covered to base of hill)	2.4
Total	26.0

Measured Section 58

SE¼NE¼NW¼SE¼ sec. 9, T. 18 N., R. 17 E., Wagoner County. Measured in eroded spillway on southwest side of stock pond, by LeRoy A. Hemish. Field notebook designation TW-10-81-H. (Estimated elevation at top of section, 563 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Shale, olive-gray, weathers tan; includes stringers of reddish-brown clay-ironstone concretions	7.0
Ironstone, orange-brown; purple-black on freshly broken surfaces	0.1
Shale, black; weathers dark-gray-brown; includes layers of reddish-brown clay-ironstone concretions; small, black, phosphatic nodules common	5.5
Limestone, very dark-gray-brown, highly fossiliferous; includes black, carbonaceous, shaly material (Doneley Limestone)	0.1
Shale, dark-gray-brown, highly calcareous and carbonaceous	0.5
Coal, black with reddish-brown iron-oxide staining on cleat surfaces (Rowe)	1.3
Underclay, light-gray with orange streaks	1.5
Shale, light-tannish-gray	2.0
Total	18.0

Measured Section 59

E½NE¼NW¼ sec. 26, T. 18 N., R. 17 E., Wagoner County. Measured on northeast side of Osage Mound, by LeRoy A. Hemish. Field notebook designation TW-11-81-H. (Estimated elevation at top of section, 682 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Sandstone, light- to dark-brown, fine-grained, massive to medium-bedded, ripple-marked, noncalcareous, micaceous, ferruginous in part (unnamed sandstone)	20.0
Shale, gray, weathers light-brown, poorly exposed	22.0
Covered interval	20.0
Shale, black, weathers gray-brown; includes layers of reddish-brown clay-ironstone concretions	5.0
Disturbed ground; includes spoils from abandoned strip mine; materials consist of fragments of black and gray-brown shale, black coal, reddish-brown clay-ironstone, and gray fossiliferous limestone (Doneley). Coal bed not exposed, but a measured section by Govett (1959, p. 127) indicates that the coal is 1.3 ft thick at this location (Rowe)	5.0

Shale, gray-brown; includes orange fragments of weathered clay-ironstone concretions; interval poorly exposed.....	30.0
Limestone, medium-gray, fossiliferous, impure, silty; some purple-brown staining on knobby, weathered surfaces; exposed in waterways on east side of north-south fence line in NW¼NW¼NE¼ sec. 26 (Sam Creek Limestone).....	2.0
Total	104.0

Measured Section 60

NE¼NW¼SW¼NW¼ sec. 5, T. 18 N., R. 18 E., Wagoner County. Measured on east side of prominent outlier, from top of hill to covered area at base, by LeRoy A. Hemish. Field notebook designation TW-7-81-H. (Estimated elevation at top of section, 731 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Sandstone, light-brown, fine-grained, micaceous, thin-bedded, noncalcareous; contact with underlying unit sharp; middle part of unit includes shaly sandstone (unnamed sandstone).....	24.0
Shale, light-gray-brown, weathered; includes stringers and concretions of reddish-brown clay-ironstone.....	30.0
Shale, black, brittle; includes thin stringers and veins of orange, highly ferruginous, clayey silt.....	7.0
Coal, black, soft, weathered (Rowe).....	0.6
Underclay, light-gray with orange mottling.....	1.4
Sandstone, dark-brown, ferruginous, fine-grained, medium-bedded, well-indurated, noncalcareous, ripple-marked; includes abundant fossil tracks and trails on stratification surfaces (base of unit covered).....	3.0
Total	66.0

Measured Section 61

SW¼NW¼SW¼SW¼ sec. 31, T. 18 N., R. 18 E., Wagoner County. Measured in road cut on west side of gravel road directly south of Billy Creek, by LeRoy A. Hemish. Field notebook designation TW-12-81-H. (Estimated elevation at top of section, 565 ft.)

	Thickness (ft)
KREBS GROUP	
Savanna Formation:	
Sandstone, dark-orange-brown, fine-grained, massive to irregularly medium-bedded, ferruginous.....	5.5
Sandstone, buff, very fine-grained, micaceous, thin-bedded, siltstone in part; includes some well-indurated, reddish-brown ironstone concretions.....	5.0

Limestone, dark-gray, massive, impure, silty, fossiliferous; horn corals abundant (Spaniard Limestone).....	3.5
McAlester Formation:	
Siltstone, dark-reddish-brown, highly calcareous, highly ferruginous, weakly indurated; 0.04-in.-thick coal seam at bottom of unit (Spaniard).....	0.2
Underclay, light-gray with orange streaks; includes some small clay-ironstone concretions and coalified plant material (covered to water in Billy Creek).....	2.6
Total	16.8

Measured Section 62

SW¼NW¼SW¼NW¼ sec. 35, T. 19 N., R. 12 E., Tulsa County. Measured in gully along east side of Union Avenue, Tulsa, directly southeast of Mooser Creek bridge, by LeRoy A. Hemish. Field notebook designation TW-4-80-H. (Estimated elevation at top of section, 645 ft.)

	Thickness (ft)
SKIATOOK GROUP	
Seminole Formation:	
Shale, buff to light-gray with purple-brown and orange mottling, clayey, weathered.....	1.0
Coal, black; includes very thin clay partings in upper part of unit (Tulsa).....	0.7
MARMATON GROUP	
Holdenville Formation:	
Underclay, light-tannish-gray with orange streaks; includes abundant, black, carbonized plant fragments.....	1.0
Shale, light-gray-brown with orange mottling; becomes increasingly silty downward.....	2.0
Sandstone, light-gray-brown, silty, shaly, very fine-grained, thin-bedded.....	0.5
Sandstone, gray-brown, fine-grained, thin-bedded, micaceous, ripple-marked (to bed of Mooser Creek).....	4.8
Total	10.0

Measured Section 63

SE¼NE¼SE¼NE¼ sec. 36, T. 19 N., R. 14 E., Tulsa County. Measured in east bluff of creek on west side of blacktop road about 100 yd south of bridge, by LeRoy A. Hemish. Field notebook designation TW-16-80-H. (Estimated elevation at top of section, 670 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, gray-brown, yellowish-gray on weathered surfaces, silty, highly fossiliferous, medium-bedded.....	5.0
Limestone, dark-gray-brown, highly shaly and silty, fossiliferous, irregularly thin-bedded.....	1.3
Shale, tannish-brown with white flecks, highly calcareous, weathered.....	0.4
Coal, black, soft (Iron Post).....	0.3
Underclay, dark-gray-brown, highly silty, noncalcareous; includes abundant black, carbonized plant fragments and root casts.....	0.5
Siltstone, tan, micaceous, shaly.....	0.5
Sandstone, light-grayish-tan, calcareous, very fine-grained; medium-bedded to thin-bedded in lower 8 in.; forms resistant ledge on outcrop.....	2.0
Siltstone, gray with dark-reddish-brown mottling, laminated; interstratified with yellow-gray shale and minor sandstones.....	5.0
Total	15.0

Measured Section 64

SW¼SW¼SW¼NW¼ sec. 2, T. 19 N., R. 15 E., Wagoner County. Measured in slope on south side of small stock pond, by LeRoy A. Hemish. Field notebook designation TW-13-80-H. (Estimated elevation at top of section, 590 ft.)

	Thickness (ft)
Disturbed ground (fill, consisting of gravel and brown and gray shale).....	5.0
CABANISS GROUP	
Senora Formation:	
Coal, black, shiny (Mineral).....	0.1
Shale, black, coaly; contains abundant carbonized plant fragments; includes streaks of coal fractions of an inch thick.....	1.9
Sandstone, buff to light-orange-brown, very fine-grained, micaceous, thin- to medium-bedded (base of unit not exposed).....	3.0
Total	10.0

Measured Section 65

SE¼NW¼NE¼NE¼ sec. 6, T. 19 N., R. 15 E., Wagoner County. Measured in road cut on north side of blacktop road from top of hill down to covered area at base of hill, by LeRoy A. Hemish. Field notebook designation TW-11-80-H. (Estimated elevation at top of section, 640 ft.)

	Thickness (ft)
Silt, brown; contains organic matter (soil zone).....	2.0
Clay, red, ferruginous, noncalcareous; contains small, black fragments of highly weathered coal (alluvium).....	3.0
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray with yellow staining on weathered surfaces, massive, fossiliferous, hard.....	1.5
CABANISS GROUP	
Senora Formation:	
Clay, yellow-brown, highly calcareous.....	0.5
Shale, black, fissile; includes oblate, phosphatic nodules as much as 1 in. in diameter; shale characterized by rectangular jointing.....	3.4
Limestone, dark-gray, light-gray on exposed surfaces, massive, sparingly fossiliferous.....	1.6
Shale, black, fissile, highly calcareous.....	0.4
Limestone, black, shaly, very impure.....	0.6
Limestone, medium-gray, thick-bedded, fossiliferous, hard...	9.0
Clay, gray-brown, highly calcareous.....	0.3
Clay, reddish-brown to orange, highly ferruginous.....	0.1
Shale, black, highly carbonaceous.....	0.2
Coal, black with reddish-brown iron-oxide staining on cleat surfaces, hard (Iron Post).....	0.9
Underclay, light-gray with orange mottling.....	0.9
Sandstone, light-gray to buff, very fine-grained, silty and shaly, weakly indurated, thin-bedded.....	1.0
Sandstone, reddish-brown, fine-grained, well-indurated; forms minor ledge on outcrop; cross-bedded.....	1.0
Shale, gray; includes thin beds of ferruginous siltstone and some very dark-gray shale; grades downward into shaly sandstone; base of unit poorly exposed.....	14.6
Total	41.0

Measured Section 66

SW¼NE¼NE¼NE¼ sec. 7, T. 19 N., R. 15 E., Wagoner County. Measured from top of hill, where road curves southeast, to bridge across Spunky Creek, by LeRoy A. Hemish. Field notebook designation TW-15-80-H. (Estimated elevation at top of section, 649 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Limestone, light-gray, yellowish-gray on exposed surfaces, fossiliferous, silty, medium-bedded; well exposed in roadbed	10.0
Clay, brown, calcareous	0.2
Shale, reddish-brown to gray-brown, ferruginous, highly weathered	0.3
Coal, black, soft (Iron Post)	1.3
Underclay, dark-gray-brown (total thickness not exposed)	0.2
Covered interval	1.0
Sandstone, light-brown, very fine-grained, micaceous, medium-bedded	1.5
Shale, gray with orange mottling, silty	4.1
Sandstone, reddish-brown, ferruginous, fine-grained, medium-bedded	2.0
Shale, light-brown-gray, silty; includes thin beds of dark-gray-brown siltstone and very fine-grained sandstone	5.4
Sandstone, brown, fine-grained, cross-bedded; fills channels in underlying shale unit	8.5
Shale, dark-gray-brown; contains abundant black, carbonized plant fragments	5.5
Total	40.0

Measured Section 67

NW¼SW¼NE¼NW¼ sec. 9, T. 19 N., R. 15 E., Wagoner County. Measured in highwall of active strip pit operated by McNabb Coal Company, by LeRoy A. Hemish. Field notebook designation TW-12-80-H. (Estimated elevation at top of section, 657 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Shale, brown, oxidized, silty	12.0
Shale, gray, silty in part	21.0
Limestone, medium-gray, fossiliferous, medium-bedded; locally includes thin shaly limestone strata (Verdigris Limestone)	9.8
Shale, black, brittle; contains small, black, phosphatic nodules	4.2
Shale, light-gray; includes spheroidal, gray limestone concretions 6-20 in. in diameter, mostly in upper part of unit	30.0
Coal, black, hard; some white calcite on cleavage surfaces (Croweburg)	1.5

Limestone, black, extremely well-indurated (McNabb Limestone)	0.1
Total	78.6

Measured Section 68

NW¼NW¼NW¼NW¼ sec. 17, T. 19 N., R. 15 E., Wagoner County. Measured in road cut from top of hill to covered area at base of slope, by LeRoy A. Hemish. Field notebook designation TW-14-80-H. (Estimated elevation at top of section, 671 ft.)

	Thickness (ft)
MARMATON GROUP	
Fort Scott Formation:	
Limestone, light-gray with light-yellow-brown staining, irregularly bedded, silty, fossiliferous	2.0
CABANISS GROUP	
Senora Formation:	
Shale, black, fissile; purple-brown where weathered; poorly exposed	4.8
Limestone, light-gray; creamy-white on weathered surfaces; very hard; fossiliferous, with crinoid columns abundant; medium- to thin-bedded, with some thin beds of shaly limestone near base of unit	10.4
Clay, buff, highly calcareous	0.2
Shale, reddish-brown to black; ferruginous in upper part; highly carbonaceous and coaly in lower part	0.2
Coal, black with reddish-brown staining on cleat surfaces, soft, weathered (Iron Post)	1.0
Underclay, light-gray	0.7
Siltstone, light-gray with orange mottling	0.8
Sandstone, light-gray with orange streaks and mottling, very fine-grained; contains fossil plant fragments and root casts, thin-bedded (base of unit not exposed)	2.9
Total	23.0

Measured Section 69

NE¼NE¼NW¼SW¼ sec. 27, T. 19 N., R. 15 E., Wagoner County. Measured in cutbank of tributary of Adams Creek, by LeRoy A. Hemish. Field notebook designation TW-1-81-H. (Estiamted elevation at top of section, 600 ft.)

	Thickness (ft)
Silt, dark-brown (alluvium)	3.0

CABANISS GROUP

Senora Formation:

Shale, tan, highly weathered; includes thin layers of light-brown clay-ironstone concretions that weather into flakes on the outcrop in lower 1 ft of unit.....	6.5
Coal, black with reddish-brown and light-yellow banding, impure, shaly, weathered (Mineral).....	1.2
Shale, very dark-gray with reddish-brown banding, highly carbonaceous; coaly shale in part; includes abundant plant compressions.....	1.0
Coal, black with reddish-brown banding, impure, shaly (Mineral).....	1.5
Underclay, dark-gray to black in upper 6 in. of unit; includes abundant carbonaceous material.....	1.0
Shale, gray with reddish-brown iron-oxide staining, silty; includes abundant reddish-brown, sideritic nodules.....	1.7
Sandstone, gray, silty, very fine-grained, micaceous; includes sideritic nodules and black, carbonized plant compressions; thin-bedded, noncalcareous; forms floor of creek below outcrop (upper part of Chelsea Sandstone).....	1.5
Total	17.4

Measured Section 70

NW¼SW¼ sec. 31, T. 19 N., R. 16 E., Wagoner County. Measured from top of hill north about 0.25 mi along fence line on west side of section, by LeRoy A. Hemish. Field notebook designation TW-20-80-H. (Estimated elevation at top of section, 755 ft.)

	Thickness (ft)
CABANISS GROUP	
Senora Formation:	
Sandstone, red to dark-reddish-brown, fine-grained, noncalcareous, ferruginous; contains fossil plant molds (Chelsea).....	15.0
Shale, gray-brown; includes a red to purple-black, 4-in.-thick, calcareous, sparingly fossiliferous ironstone bed about 15 ft below top of unit.....	45.0
Limestone, gray to dark-pink and gray in part; weathers dirty-gray; massive to irregularly thin-bedded, fossiliferous (Tiawah Limestone).....	1.6
Covered interval.....	3.0
Limestone, gray and dark-pink, fossiliferous, hard, weathers dirty-gray (Tiawah Limestone).....	2.5
Covered interval.....	10.4
Shale, gray, weathers buff; includes bed of small, box-like ironstone concretions.....	3.0
Shale, black, fissile, highly carbonaceous, brittle; includes small, rounded, phosphatic nodules.....	1.2
Coal, black (Tebo).....	0.3
Underclay, light-gray with orange mottling.....	0.5
Shale, gray with hematite-red streaks and mottling.....	5.0

Shale, gray with greenish tinge, soft.....	5.5
Covered interval.....	5.0
Sandstone, buff, very fine-grained, medium- to thin-bedded; cross-bedded in part; forms bench around hill.....	3.5
Shale and sandstone, light-gray-brown, interbedded; sandstone is very fine-grained and cross-laminated in part....	15.0
Sandstone, light-brown, very fine-grained; contains burrows, tracks, and trails; thin-bedded, with beds showing cross-laminae.....	1.0
Siltstone, light-brown, shaly, slightly carbonaceous (base of unit covered).....	15.0
Total	132.5

Measured Section 71

NE¼NW¼NE¼SE¼ sec. 27, T. 21 N., R. 13 E., Tulsa County. Measured in cutbank of small stream by LeRoy A. Hemish. Field notebook designation TW-1-80-H. (Estimated elevation at top of section, 618 ft.)

	Thickness (ft)
Silt, brown; includes scattered gravel clasts; buff in lower 1 ft (alluvium).....	3.0
Clay, gravelly, yellow-brown and orange; includes sandstone and coal fragments (alluvium).....	1.2
MARMATON GROUP	
Holdenville Formation:	
Shale, light-brown, clayey; includes black, carbonized plant fragments on stratification surfaces.....	1.2
Shale, purple-brown; includes abundant carbonized plant fragments and streaks of coal.....	0.3
Coal, black, soft, weathered (Dawson).....	1.0
Underclay, buff to light-gray-brown.....	1.1
Siltstone, light-gray-brown; includes black, carbonized plant fragments; grades downward into very fine-grained sandstone at level of creek bed.....	2.2
Total	10.0

Measured Section 72

NW¼NE¼NE¼SW¼ sec. 31, T. 22 N., R. 14 E., Tulsa County. Measured in highwall of active strip pit operated by Empire Construction Company, by LeRoy A. Hemish. Field notebook designation TW-1-79-H. (Estimated elevation at top of section, 680 ft.)

	Thickness (ft)
MARMATON GROUP	
Holdenville Formation:	
Shale, brown; streaked with gray, partly oxidized in lower 4 ft of unit; highly clayey and weathered, with a 1-ft-thick, dark-brownish-gray, organic-soil zone at top of upper 10 ft of unit	14.0
Shale, gray (grades laterally into a black, brittle, highly carbonaceous shale)	1.0
Shale, dark-gray, coaly; includes several shiny, black stringers of hard coal	0.8
Coal, black, hard; includes fillings of pyrite and white calcite on cleat surfaces (Dawson)	1.3
Underclay, black to very dark-gray; includes thin stringers of coal	0.3
Underclay, dark-gray; includes abundant black plant fragments	0.3
Total	17.7

Core-Hole Log 1

SE¼SW¼NE¼NE¼SE¼ sec. 6, T. 22 N., R. 13 E., Tulsa County. Drilled in pasture at north edge of small farm pond 310 ft FEL and 2,200 ft FSL. Field notebook designation C-TW-1. (Surface elevation, estimated from topographic map, 686 ft.)

	Thickness (ft)
Silt, dusky-yellowish-brown; contains organic material	2.0
Sand, moderate-yellowish-brown, silty, clayey, noncalcareous, unconsolidated	3.5
SKIATOOK GROUP	
Coffeyville Formation:	
Siltstone, moderate-yellowish-brown to grayish-orange with dark-yellowish-orange bands, shaly, micaceous, noncalcareous, bioturbated; interstratified with well-indurated, very fine-grained sandstone layers 1-2 in. thick	6.2
Sandstone and silty shale, medium-light-gray and medium-dark-gray with some moderate-yellowish-bands, interstratified, noncalcareous, extensively bioturbated; includes some black, macerated plant fragments	2.7
Sandstone and silty shale, medium-light-gray and medium-dark-gray, interstratified, noncalcareous, extensively bioturbated; includes some black, macerated plant fragments	4.6
Sandstone, medium-light-gray, very fine-grained, interlaminated with medium-dark-gray shale, wavy-bedded, noncalcareous, bioturbated; contains black, macerated plant material	5.5

Sandstone, medium-gray, fine- to very fine-grained, massive, noncalcareous; contains black, macerated plant fragments	5.5
Sandstone, medium-dark-gray with medium-light-gray bands, silty, micaceous, noncalcareous; contains abundant black, macerated plant fragments	1.0
Sandstone, medium-gray, very fine-grained, cross-laminated; siltstone in part; includes black, macerated plant material; contains a repetitive sequence of fining-upward units 1-5 in. thick with scour-and-fill features at the base of each unit; shaly in bottom 6 in.	4.9
Shale, medium-dark-gray, contains black, carbonized plant material, noncalcareous	0.3
Coal, black, very friable, includes abundant pyrite and white calcite on cleat surfaces (Cedar Bluff)	1.2
Underclay, medium-light-gray, contains black, carbonized plant fragments	0.6
Sandstone, medium-gray and light-greenish-gray, very fine-grained, silty, noncalcareous, interstratified with thin shale laminae, cross-stratified, scour and slump features common	2.2
Sandstone, light-greenish-gray with medium-gray bands, fine- to very fine-grained, noncalcareous; soft-sediment deformation features common; includes abundant black, macerated plant fragments	8.5
Sandstone, light-gray, fine-grained, massive, noncalcareous; contains black, macerated plant fragments and some light-brownish-gray, sideritic concretions about 1 in. thick; includes some thin laminae and rare interbedded medium-dark-gray shale stringers in bottom 2 ft of unit	5.0
Sandstone, medium-dark-gray and light-greenish-gray, very fine-grained, shaly, banded, cross-bedded in part, noncalcareous, soft-sediment deformation features common; contains black, macerated plant material	6.3
Shale, medium-dark-gray, silty, interstratified with laminae and thin beds of very fine-grained, light-greenish-gray sandstone, cross-bedded in part, noncalcareous; contains some soft-sediment deformation features; includes some minor bioturbation features and black, macerated plant fragments	31.0
Shale, medium-dark-gray, silty, noncalcareous; contains sparse bioturbation features; includes some light-greenish-gray sandstone layers 1/32 to 0.5 in. thick, generally spaced 12-18 in. apart	6.0
Shale, medium-dark-gray, silty, noncalcareous, interbedded with thin layers of hard siltstone, bioturbated in places; includes a 5-in.-thick layer of bioturbated, very fine-grained, silty sandstone from 105.3 to 105.7 ft; includes some black, macerated plant fragments	23.0
Shale, medium-dark-gray, silty, noncalcareous	48.0
Shale, dark-gray to medium-dark-gray, noncalcareous, includes several medium-light-gray to light-brownish-gray, 0.5- to 2-in.-thick sideritic concretions	22.4

Sandstone, dark-gray with pale-blue bands, impure, shaly, noncalcareous, very fine-grained, micaceous, extensively bioturbated, evenly laminated; includes some minor scour-and-fill features and soft-sediment deformation features; contains abundant black, macerated plant material on stratification surfaces..... 13.6

Sandstone, pale-blue and dark-gray, very fine-grained, shaly, noncalcareous, micaceous, bioturbated, wavy-bedded; includes abundant black, macerated plant fragments, and some laminae of black, bright coal; contains minor soft-sediment deformation features; ratio of sand-sized grains to silt- and clay-sized grains greater than in overlying unit; grades into underlying unit..... 16.0

Shale, dark-gray, silty, noncalcareous, interstratified with lenses and thin layers of very fine-grained, medium-light-gray sandstone, bioturbated; contains black, macerated plant fragments on stratification surfaces; includes some soft-sediment deformation features..... 29.0

Shale, dark-gray to medium-dark-gray, silty, noncalcareous; contains some bioturbation features and siltstone laminae in upper 7 ft of unit..... 14.0

Shale, dark-gray, silty, noncalcareous, interstratified with cross-laminated layers of medium-light-gray, very fine-grained sandstone 1/64 to 1.75 in. thick; includes some minor bioturbation features..... 4.1

Shale, medium-dark-gray, silty, noncalcareous; contains minor black, carbonized plant fragments and pyrite on stratification surfaces; includes sparsely distributed light-brownish-gray sideritic concretions about 1 in. thick; contains some siltstone strata 1/16 to 1 in. thick in middle part of unit; rare pyritized pelecypods observed from 278 to 279 ft; grades into highly calcareous, fossiliferous shale in lower 2 in..... 22.2

Limestone, dark-gray, impure, highly shaly, fossiliferous, contains abundant small crinoid columnals; interfingers with underlying unit..... 0.1

Shale, black, hard, brittle, pyritic in upper part; contains some calcite fracture fillings; includes some phosphatic nodules and thin coal stringers..... 4.6

Shale, black, brittle, very calcareous; contains pyritized fossil shell fragments; grades into underlying unit..... 0.2

Limestone, dark-gray, impure, shaly, very shaly in upper 2 in., fossiliferous; contains abundant small brachiopod shell fragments and crinoid columnals..... 0.5

Shale, black, hard, brittle, noncalcareous; contains phosphatic nodules..... 2.4

Checkerboard Formation:

Limestone, light-gray to medium-dark-gray, hard, dense, fine-grained; contains abundant fossil shell fragments and small crinoid columnals (Checkerboard Limestone)..... 3.2

Seminole Formation:

Sandstone, medium-dark-gray with closely spaced, thin light-gray bands, very fine-grained, shaly, noncalcareous, flat-bedded to wavy-bedded, with some cross-laminations, bioturbated; grades into underlying unit.....	7.7
Siltstone, medium-dark-gray, shaly, includes some sandstone laminae in upper 6 in., noncalcareous; contains some pyritic burrows; becomes weakly calcareous in the lower 1 ft; includes a 3-in.-thick, dense, medium-gray, calcareous concretion at base of unit.....	3.9
Shale, dark-gray, noncalcareous, contains black, carbonized and pyritic plant fragments.....	2.6
Shale, brownish-black, very carbonaceous; contains thin stringers of bright, black coal; includes calcite and minor pyrite on fracture surfaces.....	0.4
Shale, medium-dark-gray, silty, noncalcareous; contains black, carbonized and pyritic plant fragments; grades into underlying unit.....	0.2
Siltstone, medium-dark-gray, noncalcareous, sandy, contains black, carbonized and pyritic plant fragments.....	0.2
Sandstone, medium-light-gray with medium-dark-gray bands, very fine-grained, shaly, noncalcareous, wavy-laminated and cross-bedded, micaceous; contains abundant black, macerated plant material on stratification surfaces; grades into underlying unit.....	6.7
Siltstone, medium-dark-gray with closely spaced light-gray laminations, interlaminated with very fine-grained sandstone, noncalcareous, bioturbated; grades into underlying unit.....	3.5
Shale, medium-dark-gray, very silty, noncalcareous; includes numerous light-brownish-gray, sideritic concretions 1/8 to 1 in. thick.....	6.2
Coal, black, moderately friable; includes pyrite on stratification surfaces (Tulsa).....	0.2
Shale, medium-dark-gray, silty, noncalcareous, contains black, carbonized plant compressions.....	0.1
Siltstone, medium-dark-gray, noncalcareous; contains abundant, black carbonized plant fragments on stratification surfaces.....	0.6
Sandstone, medium-dark-gray with light-gray bands, very fine-grained, shaly, noncalcareous, wavy-laminated and cross-bedded in part; contains some soft-sediment deformation features; includes black, macerated plant material on stratification surfaces; bioturbated in places.....	7.4
Shale, medium-dark-gray, silty; interbedded with several 4- to 5-in.-thick units of very fine-grained, massive to cross-bedded sandstone spaced 1-3 ft apart vertically, noncalcareous; includes some light-brownish-gray, sideritic concretions 0.25-1 in. thick; contains abundant, black macerated plant fragments on stratification surfaces.....	10.6

MARMATON GROUP

Holdenville Formation:

Siltstone, dark-gray to grayish-black, carbonaceous, very fine-grained, dense, hard, noncalcareous (paleosol?).....	0.2
Siltstone, medium-dark-gray, dense, hard, massive, contains black, carbonized plant remains.....	0.4
Sandstone, greenish-gray, very fine- to fine-grained, noncalcareous, extensively bioturbated; thin-bedded in lower part; bedding mostly obscured in upper part.....	4.8
Sandstone and siltstone, medium-gray with light-gray bands, very fine-grained, shaly, noncalcareous, extensively bioturbated, even-bedded; includes some light-brownish-gray, sideritic concretions; contains black, carbonized plant fragments, fines upward.....	5.8
Sandstone, medium-light-gray, massive, fine- to very fine-grained, noncalcareous, interbedded with medium-dark-gray, wavy-bedded, bioturbated, shaly sandstone containing black, macerated plant fragments.....	15.6
Sandstone, medium-dark-gray, very fine-grained, noncalcareous, wavy-laminated, shaly in part; contains abundant silt-sized grains; includes some contorted layers of light-gray, very fine-grained sandstone.....	22.9
Siltstone, medium-dark-gray, noncalcareous, contains closely spaced laminae of light-gray, very fine-grained sandstone in places; grades into underlying unit.....	5.2
Sandstone, medium-dark-gray with light-gray bands, very fine-grained, shaly, noncalcareous, wavy-laminated; bioturbated in part; contains black, macerated plant fragments on stratification surfaces.....	6.5
Sandstone, medium-dark-gray, very fine-grained, noncalcareous, laminated, shaly; contains abundant silt-sized grains; grades into underlying unit.....	8.0
Siltstone, medium-dark-gray, shaly, contains some laminae of medium-light-gray, very fine-grained sandstone, noncalcareous; grades into underlying unit.....	10.0
Shale, medium-dark-gray, very silty, noncalcareous; includes rare light-brownish-gray, sideritic concretions about 0.25 in. thick.....	22.0
Shale, medium-dark-gray, silty, calcareous, contains marine fossils; also contains pyritized trace fossils on stratification surfaces; becomes dark-gray and extremely calcareous in lower 2 ft.....	3.8
Limestone, dark-gray to grayish-black, hard, shaly, nonfossiliferous; exhibits cone-in-cone structure.....	0.3
Shale, dark-gray, hard, silty, calcareous in upper 1 ft; includes some light-brownish-gray, sideritic concretions about 0.25 in. thick; contains pyritized trace fossils on stratification surfaces.....	6.0
Shale, dark-gray to grayish-black, calcareous, contains sparsely distributed marine fossils and pyritized trace fossils.....	1.2
Shale, black, hard, brittle, noncalcareous; contains white calcite on fracture surfaces; includes well-preserved brachiopod fossils and phosphatic nodules; lower 1 in. contains abundant pyritized fossils.....	1.9
Coal, black, bright, moderately friable; includes minor calcite and pyrite on cleat surfaces (Dawson coal).....	1.8

Underclay, medium-dark-gray, silty, bioturbated; contains black, carbonized plant fragments; includes some calcareous fossil remnants in lower part of unit.....	2.0
Sandstone, medium-gray, very silty and clayey, noncalcareous, contains streaks of black, carbonaceous material; bedding disturbed.....	1.0
Total	470.0

Core-Hole Log 2

SE¼SE¼SE¼SW¼SE¼ sec. 32, T. 24 N., R. 14 E., Washington County. Drilled in pasture at northwest edge of pond 90 ft FSL and 1,500 ft FEL. Field notebook designation C-TW-2. (Surface elevation, estimated from topographic map, 655 ft.)

	Thickness (ft)
Silt, brownish-gray, clayey; contains organic material.....	1.0
Silt, dark-yellowish-brown, clayey; contains some gravel-sized clasts of moderate-reddish-brown ironstone.....	1.5
SKIATOOK GROUP	
Coffeyville Formation:	
Shale, grayish-orange to pale-yellowish-brown, flaky, oxidized; contains interstratified layers of very fine-grained sandstone.....	6.5
Shale, light-olive-gray with some dark-yellowish-orange bands, interlaminated with very fine-grained sandstone, bioturbated; includes some medium-gray bands in lower 2 ft; partly weathered.....	4.3
Shale, medium-dark-gray; interstratified with very fine-grained, light-gray sandstone; noncalcareous, bioturbated; includes sparsely distributed brachiopods; contains black, macerated plant fragments and rare calcite crusts on stratification surfaces; proportion of sandstone decreases markedly below 30 ft.....	23.8
Shale, medium-dark-gray, silty, noncalcareous; contains widely spaced, light-brownish-gray, sideritic concretions about 1 in. thick; bioturbated in part; includes some calcitic brachiopods on stratification surfaces.....	9.4
Shale, medium-dark-gray, weakly calcareous; contains some fossil hash and small crinoid columnals.....	0.1
Shale, black, hard, brittle, noncalcareous; includes some white calcite along fractures; pyritic, contains phosphatic nodules.....	4.5
Shale, grayish-black, extremely calcareous, pyritic, silty; contains some small, poorly preserved fossil fragments; grades into underlying unit.....	0.6
Limestone, dark-gray with white mottling, impure, silty, shaly, pyritic, fossiliferous; contains abundant fossil hash.....	1.0
Shale, grayish-black, weakly calcareous, pyritic, hard, brittle; contains small phosphatic nodules.....	0.4

Limestone, dark-gray, fine-grained, extremely hard, dense, sparsely fossiliferous	0.4
Shale, black, hard, brittle, calcareous, pyritic, contains phosphatic nodules	3.0

Checkerboard Formation:

Shale, grayish-black, silty, extremely calcareous; contains sparsely distributed fossils; grades into underlying unit	0.4
Limestone, dark-gray, extremely impure and shaly; contains abundant deformed bivalve shells as much as 2 in. long; grades into underlying unit	3.6
Shale, dark-gray, silty, very calcareous, contains fossil marine shells	1.8
Shale, dark-gray, silty, calcareous, bioturbated; contains some sparesely distributed marine shells and minor pyrite; includes some hard, dense, medium-gray calcareous concretions as much as 3 in. thick; grades into underlying unit	8.7
Limestone, dark-gray to very light-gray; impure and shaly in dark parts, particularly in upper 6 in. and lower 6 in.; very fossiliferous; marine shells and crinoid fragments abundant; dense and hard in light-colored parts; carbonaceous in lower 6 in. (Checkerboard Limestone)	5.0

Seminole Formation:

Sandstone, medium-dark-gray with closely spaced light-gray bands, very fine-grained, shaly, noncalcareous, cross-laminated; scour-and-fill features and soft-sediment deformation features common; contains black, macerated plant fragments on stratification surfaces	6.0
Shale, medium-gray, closely interlaminated with medium-light gray very fine-grained sandstone, noncalcareous, even-bedded; includes some minor black, macerated plant fragments on stratification surfaces; contains light-brownish-gray sideritic concretion about 1 in. thick in lower part of unit; proportion of sand-sized grains decreases downward	9.0
Shale, medium-dark-gray, silty, noncalcareous; contains light-brownish-gray, sideritic concretions 1/8 to 1 in. thick and minor black, carbonized plant compressions	10.1
Shale, medium-dark-gray, silty, noncalcareous; includes laminae of very fine-grained sandstone spaced at about 0.5-in. intervals; contains several light-brownish-gray, sideritic concretions about 0.5-1 in. thick	3.7
Shale, medium-dark-gray, silty, noncalcareous; contains several ironstone concretions about 1/8 to 0.5 in. thick; includes black, carbonized plant compressions in lower 2 ft	6.2
Shale, medium-dark-gray, silty, noncalcareous; interstratified with cross-laminated layers of very fine-grained sandstone in part; includes abundant black, macerated plant fragments on stratification surfaces; contains light-brownish-gray, sideritic concretions 0.5-1 in. thick	13.4
Shale, grayish-black, carbonaceous	0.2

Coal, black, bright, very friable; includes pyrite on cleat surfaces (Tulsa)..... 0.1

MARMATON GROUP

Holdenville Formation:

Siltstone, dark-gray, hard, unbedded; contains black, carbonized plant material in upper 6 in.; appears to be a paleosol; grades into underlying unit..... 1.0

Sandstone, greenish-gray, very fine-grained, clayey, noncalcareous, extensively bioturbated, fines upward; bedding disturbed in upper 1 ft of unit; becomes obscurely thin-bedded in lower part; grades into underlying unit..... 4.3

Sandstone, medium-gray and light-gray, very fine-grained, shaly, thin-bedded in part, extensively bioturbated; bedding contorted in part; noncalcareous, micaceous; contains black, macerated plant material on stratification surfaces; cross-laminated in some places; includes light-brownish-gray, sideritic concretions 1/8 to 1 in. thick..... 26.0

Siltstone, medium-gray, shaly, noncalcareous; grades into underlying unit..... 1.0

Shale, medium-gray, silty and sandy, noncalcareous..... 13.5

Siltstone, medium-gray, shaly, hard, noncalcareous; contains abundant laminae of light-gray, very fine-grained sandstone; becomes finer-grained downward and grades into underlying unit..... 14.5

Shale, medium-gray, silty, hard, noncalcareous; contains minor black, carbonized plant fragments below 200 ft; includes rare laminae of very fine-grained sandstone in upper few feet of unit; contains small pyritized trace fossils..... 36.4

Shale, dark-gray, noncalcareous; contains small pyritized trace fossils..... 3.9

Shale, black, hard, brittle, pyritic, noncalcareous; contains rare brachiopod fossils; includes white calcite in fracture fillings..... 2.2

Limestone, dark-gray, dense, hard, nonfossiliferous..... 0.2

Shale, grayish-black, very carbonaceous, coaly..... 0.3

Coal, black, bright, moderately friable; contains minor pyrite and white calcite on cleat surfaces (Dawson)..... 0.9

Sandstone, medium-light-gray to light-bluish-gray, clayey, extensively bioturbated; includes black, carbonaceous material in upper 6 in..... 1.8

Sandstone, medium-light-gray with medium-dark-gray bands, very fine- to fine-grained, shaly, thin- to thick-bedded, noncalcareous; contains numerous soft-sediment deformation features; bioturbated in upper part; includes abundant black, macerated plant fragments on stratification surfaces; becomes increasingly shaly downward..... 20.4

Limestone, very light-gray, hard, conglomeratic; contains rounded clasts of reworked limestone up to 1.5 in. long and 0.5 in. thick; includes some crinoid columnals..... 0.8

Shale, medium-dark-gray, silty, extremely calcareous; contains minor pyritic trace fossils and rare small flecks of black, carbonized plant fragments on stratification surfaces	1.9
Limestone, medium-dark-gray with abundant white fossils, impure, silty, very fossiliferous; bivalves abundant; interbedded with layers of extremely calcareous shale 1-4 in. thick	3.5
Shale, medium-dark-gray, silty, extremely calcareous, fossiliferous; contains bivalves and crinoid columnals; includes a 1-in.-thick, shaly, very fossiliferous limestone layer about 1.5 ft below top of unit	2.7
Total	260.0

Core-Hole Log 3

NW¼SW¼SE¼SW¼ sec. 1, T. 18 N., R. 17 E., Wagoner County, Oklahoma. Well cored by Oklahoma Geological Survey; lithological descriptions by LeRoy A. Hemish. Drilled in field directly north from pond, 550 ft FSL and 1,600 ft FWL. Field notebook designation C-TW-3. (Surface elevation, estimated from topographic map, 588 ft.)

	Thickness (ft)
Sand, grayish-brown, silty; contains organic matter	1.0
Clay, dark-yellowish-brown, silty, sandy, noncalcareous, unconsolidated	2.0
Clay, light-brown to moderate-reddish-brown, silty, sandy, noncalcareous, unconsolidated	3.5
KREBS GROUP	
Savanna Formation:	
Shale, medium-light-gray and dark-yellowish-orange, noncalcareous	1.5
Coal, black, very friable, minor white gypsum on cleat surfaces (Rowe coal)	0.8
Underclay, brownish-gray with dark-yellowish-orange streaks, soft, sandy in lower 8 in	2.1
Sandstone, medium-gray, shaly, noncalcareous	1.2
Shale, medium-gray, sandy, noncalcareous	1.9
Shale, medium-dark-gray, silty, noncalcareous	1.6
Shale, grayish-black, fissile, carbonaceous, noncalcareous; contains minor pyrite; calcareous in lower 6 in	16.4
Shale, black, brittle, weakly calcareous in upper part to very calcareous in lower 2 ft; contains abundant marine fossils and small, pyrite-filled burrows; includes a 1-in.-thick, shaly, fossiliferous limestone layer at 36 ft	4.7
Coal, black, moderately friable; contains pyrite layers and white calcite on cleat surfaces (unnamed coal)	0.2
Underclay, medium-dark-gray; contains black carbonized plant fragments	1.6
Mudstone, medium-gray, noncalcareous	2.5
Shale, light-brownish-gray and medium-gray; contains scattered carbonaceous shale streaks	7.3

Shale, medium-dark-gray, noncalcareous; contains pyrite-filled burrows and lenses; includes numerous light-brownish-gray sideritic bands, 1/8 in. thick or less.....	10.2
Limestone, brownish-gray, hard, fossiliferous, fine-grained.	0.1
Sandstone, dark-gray, silty, very fine-grained, weakly calcareous; contains scattered fossil fragments; grades into underlying unit.....	0.6
Limestone, medium-dark-gray, very sandy, fine-grained, cross-bedded; contains fossil shells and fossil fragments; becomes grayish-black and shaly in lower 6 in. (Sam Creek Limestone).....	2.1
Shale, grayish-black, weakly calcareous; contains white, calcareous, fossil shells and fossil fragments.....	0.8
Shale, black, carbonaceous; contains thin layers of bright, hard coal (Sam Creek coal).....	0.1
Shale, grayish-black to dark-gray, noncalcareous; contains pyrite-filled burrows.....	0.6
Underclay, light-gray, rooted, churned, sandy.....	3.2
Shale, medium-light-gray, silty, sandy, noncalcareous; contains brownish-gray, sandstone-filled burrows; grades into underlying unit.....	2.0
Siltstone, dark-gray with light-gray streaks, shaly, sandy, noncalcareous, burrowed; grades into underlying unit.....	2.0
Shale, grayish-black, silty, noncalcareous; contains light-brownish-gray sideritic concretions up to 1 in. thick; includes numerous light-gray sandstone-filled burrows and streaks in places, as well as pyrite-filled burrows...	9.0
Shale, grayish-black, noncalcareous; contains rare pyrite-filled burrows and widely spaced, thin, light-brownish-gray sideritic layers; contact with underlying unit sharp.	10.2
Limestone, medium-gray, dense, hard, fine-grained, impure, silty, fossiliferous; contains abundant white shells and fossil fragments (Spaniard Limestone).....	1.5

McAlester Formation:

Shale, medium-gray to dark-gray, noncalcareous, silty in lower 4 in.....	0.7
Sandstone, very light-gray with dark-gray streaks, very fine-grained, shaly, very calcareous.....	0.1
Shale, grayish-black, noncalcareous, carbonaceous, pyritic; contains thin layers of coal in lower part.....	0.5
Coal, black, bright, very friable; contains pyrite in layers and on cleats (Spaniard coal).....	0.4
Sandstone, medium-light-gray to light-gray, very fine-grained, noncalcareous, rooted in upper 1 ft, churned to 96 ft, wavy bedded and burrowed below 96 ft.....	7.0
Siltstone, medium-dark-gray, noncalcareous, burrowed; contains some low-angle crossbeds, convolute beds, and wavy beds; includes a light-brownish-gray, 3-in.-thick sideritic concretion at 99.7 ft; grades into underlying unit.....	3.6
Shale, medium-dark-gray, silty, noncalcareous; includes light-brownish-gray sideritic concretions up to 0.75 in. thick.....	1.1
Shale, medium-dark-gray, calcareous, fossiliferous.....	0.4

Limestone, light-brownish-gray to medium-light-gray, fine-grained, hard, silty; contains shaly layers at 105.5 ft and 106 ft; includes a 0.5-in.-thick layer of black, coaly, carbonaceous shale at base of unit.....	3.1
Sandstone, medium-gray to light-gray, very fine-grained, noncalcareous, rippled in part; rooted in upper 4 in.; contains some coalified plant material in upper 2 in.; includes some medium-gray shale streaks in places.....	3.1
Shale, medium-gray, silty, interbedded with light-gray, very fine-grained sandstone, noncalcareous, rippled, burrowed.....	1.3
Shale, grayish-black with scattered light-gray siltstone and very fine-grained sandstone streaks, noncalcareous, flat-bedded, burrowed; contains rare, light-brownish-gray sideritic concretions up to 1 in. thick; includes pyrite layers and masses up to 1 in. thick, and a 0.75-in.-thick, very calcareous, fossiliferous layer in lower 1 in. of unit.....	25.0
Siltstone, medium-gray, shaly, interstratified with light-gray, very fine-grained sandstone, noncalcareous; contains some low-angle cross-bedding, convolute bedding, carbonized and pyritized plant fragments, and minor bioturbation features.....	7.0
Shale, medium-dark-gray, noncalcareous, silty in upper 6 in.; noncalcareous; contains rare burrows, slickensides, fractures filled with white calcite, and light-brownish-gray sideritic concretions up to 3 in. thick; becomes grayish-black in lower 3 ft of unit; calcareous, with rare fossils in lower 2 ft.....	4.0
Shale, dark-gray, silty, very calcareous; grades into underlying unit.....	0.3
Siltstone, medium-light-gray with dark-gray mottling, very calcareous, shaly; extensively burrowed; contains some very fine-grained sandstone.....	0.7
Shale, medium-gray, flaky, noncalcareous, slickensided.....	0.7
Shale, dark-gray to grayish-black, noncalcareous, slickensided, fractured; contains white calcite in veinlets, in blebs, and in thin crusts on bedding planes; includes some pyrite-filled burrows, and light-brownish-gray sideritic concretions up to 1 in. thick.....	20.3
Siltstone, dark-gray, shaly, very calcareous; contains pyrite-filled burrows.....	0.8
Limestone, dark-gray, impure, silty, fine-grained; contains abundant fossil shells and fossil hash.....	0.1
Shale, dark-gray, silty, noncalcareous; contains streaks of light-gray, calcareous siltstone and rare fossil shells...	1.4
Sandstone, medium-light-gray, very fine-grained, interbedded with dark-gray shale; contains some brownish-gray limestone concretions, burrows, pyrite masses, and black carbonized plant debris on stratification planes; cross-bedded.....	1.2
Shale, grayish-black, noncalcareous; contains white, calcareous, very fine-grained sandstone in burrows and in thin layers on bedding planes; includes minor pyrite and light-brownish-gray sideritic concretions up to 1 in. thick; lower contact irregular.....	12.5
Shale, light-brownish-gray, noncalcareous.....	0.4

Sandstone, medium-gray, very fine-grained, massive, noncalcareous; fault-contact with underlying unit; dip angle of fault is 55°	0.3
Shale, medium-gray, noncalcareous, blocky fracture, slickensided	5.3
Shale, medium-dark-gray with light-brownish-gray bands and light-gray streaks, noncalcareous; contains some very fine-grained sandstone in thin layers and in burrows; includes rare coal spars and scattered sideritic concretions	7.0
Shale, dark-gray, noncalcareous; contains thin light-brownish-gray siderite bands and rare streaks of light-gray siltstone; includes sparse fossil shells and pyrite-filled burrows	6.6
Coal, black, bright, moderately friable, pyritic (Stigler[?] coal)	0.3
Underclay, dark-gray; contains black carbonized plant fragments	0.5
Siltstone, medium-light-gray, clayey, noncalcareous, rippled	0.4
Sandstone, light-gray with dark-gray shale streaks, very fine-grained, noncalcareous, rippled, cross-bedded in part, burrowed; contains minor pyrite; becomes very shaly in lower 6 in	2.2
Siltstone, medium-dark-gray, noncalcareous; contains rare, scattered, calcareous and pyritized marine fossils	1.0
Shale, black, noncalcareous; contains pyrite-filled burrows and rare pyritized fossil shells	2.3
Shale, black, calcareous; contains rare pyrite-filled burrows	0.3
Limestone, grayish-black, very shaly; contains abundant fossil hash	0.1
Underclay, medium-light-gray, burrowed in part, rooted in upper 2 in	0.3
Shale, medium-gray with light-gray and medium-dark-gray bands; includes some very fine-grained sandstone streaks; burrowed	3.3
Shale, dark-gray, silty; contains rare pyrite-filled burrows and fossil fragments; noncalcareous; includes light-brownish-gray sideritic concretions up to 1 in. thick	4.5
Shale, black, very calcareous; contains abundant white fossil fragments	0.5
Mississippian System:	
Shale, black, irregularly interbedded with light-olive-gray shale, noncalcareous	0.7
Shale, light-olive-gray, noncalcareous; contains brownish-gray, limestone-filled burrows concentrated in lower 7 in.	1.3
Limestone, white to pinkish-gray with greenish-gray flecks mottled in upper part, very fossiliferous, coarsely crystalline, hard; includes some light-olive-gray shale streaks in lower 4 in	4.4
Shale, brownish-gray with olive tint, very calcareous; fossiliferous in part; includes abundant white limestone-filled burrows and layers	2.7
Total	230.4

Core-Hole Log 4

NE¼NW¼SE¼SE¼ sec. 36, T. 18 N., R. 15 E., Wagoner County, Oklahoma. Well cored by Oklahoma Geological Survey; lithological descriptions by LeRoy A. Hemish. Drilled in pasture just west of farm pond 1,200 ft FSL and 760 ft FEL. Field notebook designation C-TW-4. (Surface elevation, estimated from topographic map, 690 ft.)

	Thickness (ft)
Sand, dark-yellowish-brown, very fine-grained, unconsolidated; contains organic matter	2.0
CABANISS GROUP	
Senora Formation:	
Sandstone, dark-yellowish-orange with dark-reddish-brown bands, very fine-grained, micaceous, noncalcareous, weathered, clayey in upper part (Chelsea Sandstone)	3.0
Shale, moderate-yellowish-brown and dusky-brown, clayey, noncalcareous, weathered; becomes moderate-yellowish-brown with light-gray and dark-yellowish-orange streaks below 9 ft	10.0
Shale, olive-gray to dark-gray with dark-yellowish-orange bands, noncalcareous, partly weathered	5.0
Shale, dark-gray, noncalcareous; includes rare dark-yellowish-orange iron-oxide staining on bedding planes	5.0
Shale, grayish-black, noncalcareous; contains light-brownish-gray sideritic concretions up to 2 in. thick	5.0
Shale, dark-gray, very calcareous; contains scattered pyrite-filled burrows and light-brownish-gray sideritic concretions up to 2 in. thick	3.1
Shale, grayish-black, noncalcerous; contains scattered pyrite-filled burrows and rare calcareous fossil shells; becomes calcareous below 39.3 ft; includes a 2.5-in.-thick, medium-light-gray limestone concretion at 41.1 ft	11.7
Shale, grayish-black, noncalcareous	1.5
Shale, grayish-black, very calcareous; contains pyrite-filled burrows and abundant fossil shells; grades into underlying unit	0.3
Limestone, grayish-black, very shaly; contains abundant white fossil shells and fossil hash	0.1
Shale, black, weakly calcareous, very carbonaceous	0.1
Coal, black, moderately friable, white calcite on cleat surfaces (unnamed coal)	0.1
Underclay, medium-dark-gray, silty, hard, weakly calcareous, carbonaceous	0.1
Limestone, light-gray with medium-dark-gray streaks, shaly; sandy in upper part; contains abundant white fossil shells and fossil hash from 47.6 to 49 ft, and scattered fossils below 49 ft; grades downward into calcareous, fossiliferous shale (Tiawah Limestone)	3.1

Shale, grayish-black, calcareous, contains scattered fossil shells, rare burrows, and light-brownish-gray limestone and sideritic concretions up to 1 in. thick; pyrite-filled burrows concentrated from 54.9 to 55 ft, and limestone-filled burrows concentrated from 59.3 to 59.6 ft	9.5
Coal, black, moderately friable, white calcite and pyrite on cleats and bedding planes (Tebo coal)	0.6
Underclay, medium-dark-gray to light-gray; contains black, carbonized plant fragments	0.4
Shale, medium-gray, soft, burrowed; includes a fossiliferous, light-gray, 2-in.-thick limestone concretion at 63.8 ft	4.4
Shale, grayish-black, calcareous; contains scattered, white, fossil shells and pyrite-filled burrows	3.1
Shale, grayish-black, noncalcareous; contains rare fossil shells and pyrite-filled burrows	1.9
Coal, black, moderately friable, white calcite on cleats; includes a 0.75-in.-thick mass of pyrite (RC coal)	0.2
Shale, medium-gray, noncalcareous; includes some disseminated pyrite in lower 3 in. of unit	3.7
Shale, medium-light-gray, very calcareous, bioturbated	0.6
Shale, medium-light-gray; silty, noncalcareous, bioturbated; contains brownish-gray, sandstone-filled burrows	2.1
Shale, medium-light-gray with light-gray bands, noncalcareous; contains streaks of siltstone, and sandstone-filled burrows; includes a 1.25-in.-thick limestone concretion at 79 ft	3.5
Shale, grayish-black, noncalcareous; contains rare carbonized and pyritic plant compressions	9.9
Shale, dark-gray, noncalcareous; contains rare pyrite-filled burrows and light-brownish-gray sideritic concretions up to 3.5 in. thick	7.8
Sandstone, light-gray with dark-gray streaks, very fine-grained, bioturbated, noncalcareous; includes minor black, macerated plant material	1.5
Shale, medium-gray, silty, noncalcareous; contains scattered pyrite-filled burrows and abundant black, carbonized and pyritized plant compressions; includes rare streaks of light-gray, very fine-grained sandstone as well as light-brownish-gray, sideritic concretions up to 1.5 in. thick	6.7
Sandstone, medium-light-gray with dark-gray streaks, very fine-grained, micaceous, noncalcareous, cross-bedded in part, wavy-bedded in part; contains some black macerated plant debris on bedding planes; includes some burrows in lower 6 ft of unit	19.8
Siltstone, medium-dark-gray with white streaks, shaly, noncalcareous, micaceous, burrowed, flat-bedded to wavy-bedded in part; includes some very fine-grained sandstone layers, black macerated plant debris, and a 1-in.-thick sideritic concretion at 126.2 ft	1.8
Sandstone, medium-gray with white streaks, shaly, rippled and cross-laminated in part, noncalcareous, micaceous, burrowed in part; includes some black macerated plant material on bedding planes; microfaulted in places; contains convolute beds and scour features; slickensided on fracture surfaces; grades into underlying unit	13.2

Siltstone, medium-dark-gray, noncalcareous, micaceous, microfaulted; contains streaks of light-gray, very fine-grained sandstone in upper part; bioturbated extensively from 144 to 146 ft; slickensided on fracture surfaces; includes black macerated plant debris on bedding planes in places; grades into underlying unit..... 47.2

Shale, medium-gray, silty, hard, noncalcareous; includes sparse streaks of light-gray, very fine-grained sandstone, slickensided..... 12.3

Shale, dark-gray, noncalcareous; contains rare pyritized brachiopod fossils and pyrite-filled burrows; includes a 2.25-in.-thick, sparsely fossiliferous, dense, light-brownish-gray limestone concretion from 210.4 to 210.6 ft..... 13.2

Shale, grayish-black, noncalcareous; contains scattered, white, calcareous and pyritic fossil shells and shell fragments as well as white calcite in veins, and pyrite in layers; includes rare pyrite-filled burrows; becomes calcareous from 219 to 220.2 ft, and from 225.7 to 226.6 ft..... 13.1

Coal, black, moderately friable; contains white calcite on cleats and thin crusts and laminae of pyrite on bedding planes (Weir-Pittsburg coal)..... 0.3

KREBS GROUP

Boggy Formation:

Siltstone, grayish-black, carbonaceous, noncalcareous; grades into underlying unit..... 0.1

Sandstone, light-gray with medium-gray streaks, very fine-grained, churned and rooted; contains black carbonized plant fragments; cross-laminated in part..... 6.0

Sandstone, medium-light-gray with medium-dark-gray bands; interbedded with siltstone and shaly siltstone, very fine-grained, noncalcareous; scour features and low-angle cross-bed features common; unit includes five well-defined graded-bed sequences from 0.5 to 1.5 ft thick..... 5.3

Siltstone, medium-gray, sandy, noncalcareous, rippled in places; contains some low-angle cross-bedded sandstone layers as well as convolute sandstone beds; grades into underlying unit..... 19.0

Shale, medium-gray, silty, noncalcareous; contains light-brownish-gray sideritic concretions up to 1 in. thick..... 2.7

Shale, medium-dark-gray to dark-gray, noncalcareous; contains scattered, pyritized pelecypod valves about 0.5 in. long..... 11.0

Shale, grayish-black, noncalcareous; contains some white, calcareous, fossil shells and pyrite-filled burrows; includes light-brownish-gray sideritic concretions up to 4 in. thick..... 14.6

Coal, black, moderately friable, minor pyrite and calcite on cleat surfaces (Wainwright coal)..... 0.7

Underclay, medium-dark-gray to medium-gray, carbonaceous, slickensided..... 1.0

Siltstone, medium-gray, shaly, noncalcareous, rooted..... 0.3

Sandstone, medium-light-gray, very silty and shaly, micaceous, noncalcareous, very fine-grained; contains black, carbonized plant compressions; grades into underlying unit	0.9
Shale, dark-gray, noncalcareous, carbonaceous; contains some coaly streaks at base of unit	0.7
Underclay, medium-dark-gray, slickensided; contains dark-gray to black, carbonaceous and coaly streaks; burrowed	2.2
Shale, grayish-black, noncalcareous; brittle; contains pyritized trace fossils and white, calcareous shells and shell fragments; includes light-brownish-gray sideritic concretions up to 3 in. thick	5.6
Shale, dark-gray, very calcareous, hard; contains scattered, white fossil shells and fossil hash, and pyritized trace fossils; becomes weakly calcareous to noncalcareous in lower 1 ft	4.0
Siltstone, medium-gray, calcareous; contains pyritized trace fossils; intertongued with underlying unit	1.6
Shale, grayish-black to dark-gray, noncalcareous; contains burrows and rare, white, fossil shells	1.5
Sandstone, medium-gray, very calcareous, very fine-grained, churned	0.5
Shale, grayish-black, noncalcareous, slickensided	0.5
Siltstone, medium-dark-gray, shaly, very calcareous; contains scattered, white, fossil shells and shell fragments; burrowed; grades into underlying unit	3.4
Sandstone, medium-gray with light-gray streaks, very fine-grained, silty, micaceous; microfaulted in places; contains convolute beds and wavy laminae in part	5.5
Siltstone, medium-gray, sandy, micaceous, noncalcareous, slickensided; contains light-brownish-gray sideritic concretions up to 3 in. thick; grades into underlying unit	36.0
Shale, medium-dark-gray, silty, noncalcareous; contains rare carbonized and pyritized wood fragments	22.0
Shale, medium-dark-gray, noncalcareous; contains pale-yellowish-brown sideritic concretions up to 2 in. thick; includes rare, black, carbonized wood fragments and fossil shells in lower 1 ft of unit	24.2
Shale, grayish-black, noncalcareous; contains light-brownish-gray sideritic and rare calcareous concretions up to 2.5 in. thick; includes scattered, white fossil shells and pyrite-filled burrows; becomes black, with increased fossil content at 409 ft; calcareous from 424.4 to 426.0 ft, with a 0.5-in.-thick, shaly, bioclastic limestone layer at 425.3 ft	43.8
Total	440.0

Appendix 3: Analyses of Coals

In Table A3-1, the analyses are grouped first by township and range, progressing from south to north and west to east, respectively. Within each township block, coal analyses are listed according to the age of the data report, from oldest to youngest. Coal beds are arranged alphabetically by name within the age group. Averages of the data from two or more analyses were computed only if: (1) samples of the coal were collected in the same township; (2) data were reported in the same year; (3) analyses were performed on coal samples from the same coal bed; (4) analyses were reported under identical conditions, such as "as received basis" or "moisture free basis"; and (5) analyses were done in the same laboratory.

Table A3-2 contains data from individual samples of coal collected and analyzed by OGS personnel. Listing of analyses is alphabetical, by names of coal beds. Location of sample sites can be obtained by referring to the map numbers (see footnote *a*, Table A3-2).

TABLE A3-1.--AVERAGE ANALYSES OF COALS IN CREEK, TULSA, WAGONER, AND WASHINGTON COUNTIES, OKLAHOMA

Township/Range	Coal bed and rank[a]	Sample condition[b]	Proximate Analysis (%) Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
T16N, R12E	Dawson	1	6.3	32.5	39.6	21.6	0.6	9,333	½	1	OGS	1981
	--	2	N/A	34.7	42.3	23.0	0.6	9,963				
		3	N/A	45.1	54.9	N/A		12,943				
T16N, R15E	Croweburg	1	3.4	38.5	50.1	8.0	2.1	12,591	1½	1	OGS	1981
	--	2	N/A	39.8	51.9	8.3	2.2	13,047				
		3	N/A	43.5	56.5	N/A		14,225				
T16N, R16E	Secor	1	3.9	35.1	57.3	3.7	0.5	14,013		1	Company	1982
	--	2	N/A	36.5	59.6	3.9	0.5	14,581				
		3	N/A	38.0	62.0	N/A		15,166				
	Secor	1	3.8	37.7	54.8	3.7	1.5	14,021	7½	1	OGS	1983
	--	2	N/A	39.2	56.9	3.9	1.6	14,567				
		3	N/A	40.8	59.2	N/A		15,158				
T16N, R17E	Secor	1	1.6	40.8	52.5	5.1	2.4	14,026		2	OGS	1976
	hvAb	2	N/A	41.4	53.3	5.3	2.5	14,250				
		3	N/A	43.7	56.3	N/A		15,013				
	Bluejacket	1	2.2	38.9	45.5	13.4	4.1	12,656	8½	5	Company	1978
	--	2	N/A	39.8	46.6	13.6	4.2	12,941				
		3	N/A	46.2	53.8	N/A		14,981				
	Drywood	1	1.4	39.9	45.8	12.9	4.1	12,941		1	Company	1978
	--	2	N/A	40.5	46.4	13.1	4.2	13,125				
		3	N/A	46.6	53.4	N/A		15,104				
	Secor	1	4.0	37.0	56.6	2.4	0.6	14,197		1	Company	1979
	--	2	N/A	38.5	59.0	2.5	0.6	14,793				
		3	N/A	39.5	60.5	N/A		15,174				
	Secor	1	4.1	35.9	57.8	2.2	0.5	14,271		2	Company	1979
	--	2	N/A	37.4	60.3	2.3	0.6	14,873				
		3	N/A	38.3	61.7	N/A		15,221				
	Secor	1	2.7	35.5	55.7	6.1	1.6	13,682	4½	7	Company	1979
	--	2	N/A	36.4	57.4	6.2	1.6	14,062				
		3	N/A	38.8	61.2	N/A		14,991				
	Secor	1	3.7	35.8	53.8	6.7	1.7	13,595		1	Company	1979
	--	2	N/A	37.2	55.9	6.9	1.8	14,118				
		3	N/A	40.0	60.0	N/A		15,164				
	Secor	1	3.1	35.3	56.3	5.3	2.0	13,807	8	3	OGS	1981
	hvAb	2	N/A	36.4	58.1	5.4	2.1	14,254				
		3	N/A	38.5	61.5	N/A		15,068				
	Tullahassee	1	3.4	38.5	49.7	8.4	4.2	13,336	8½	1	OGS	1981
	hvAb	2	N/A	39.8	51.5	8.7	4.3	13,800				
		3	N/A	43.7	56.3	N/A		15,115				
	Secor	1	3.9	35.0	57.7	3.4	0.7	14,124		1	Company	1982
	--	2	N/A	36.5	60.0	3.5	0.8	14,689				
		3	N/A	37.8	62.2	N/A		15,232				
	Secor	1	4.4	34.3	59.2	2.1	0.5	14,204	6½	14	Company	1982
	--	2	N/A	35.8	62.0	2.2	0.5	14,858				
		3	N/A	36.6	63.4	N/A		15,192				

Township/Range	Coal bed and rank[a]	Sample condition[b]	Proximate Analysis (%) Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
	Secor	1	7.1	32.0	57.9	3.0	0.5	12,180		1	Company	1982
	--	2	N/A	34.4	62.3	3.3	0.5	13,111				
		3	N/A	35.6	64.4	N/A		13,558				
	Secor	1	3.9	35.5	58.4	2.2	0.5	14,225	7½	2	OGS	1983
	hvAb	2	N/A	36.9	60.8	2.3	0.5	14,810				
		3	N/A	37.8	62.2	N/A		15,143				
T17N, R12E	Dawson	1	5.6	36.0	41.2	17.2	2.7	10,833	1½	1	OGS	1981
	--	2	N/A	38.2	43.8	18.0	2.8	11,473				
		3	N/A	46.6	53.4	N/A		12,535				
T17N, R16E	Bluejacket	1	3.9	36.1	46.3	13.7	6.5	12,320		1	USBM	1916
	hvAb	2	N/A	37.6	48.2	14.2	6.8	12,810				
		3	N/A	43.8	56.2	N/A		14,951				
	Bluejacket	1	10.3	35.1	47.9	6.7	1.4	11,332	4	2	OGS	1981
	--	2	N/A	39.3	53.4	7.3	1.5	12,535				
		3	N/A	42.4	57.6	N/A		13,535				
T17N, R18E	Rowe	1	2.1	38.3	51.5	8.1	3.9	13,620	8	1	OGS	1981
	hvAb	2	N/A	39.1	52.6	8.3	4.0	13,907				
		3	N/A	42.7	57.3	N/A		15,166				
T18N, R13E	Jenks	1	1.6	39.9	49.3	9.2	3.8	13,670		1	USBM	1913
	hvAb	2	N/A	40.5	50.2	9.3	3.8	13,890				
		3	N/A	44.6	55.4	N/A	4.2	15,310				
	Jenks	1	14.0	37.3	38.7	10.0	1.1	9,291		1	OGS	1981
	--	2	N/A	43.4	45.0	11.6	1.3	10,801				
		3	N/A	49.1	50.9	N/A		12,225				
T18N, R15E	Croweburg	1	8.3	34.0	51.0	6.7	2.5	12,580		1	USBM	1914
	hvBb	2	N/A	37.1	55.6	7.3	2.8	13,710				
		3	N/A	40.0	60.0	N/A		14,800				
	Croweburg	1	7.2	34.7	50.1	8.0	3.0	12,460		2	USBM	1926
	hvBb	2	N/A	37.4	54.0	8.6	3.3	13,400				
		3	N/A	40.9	59.1	N/A	3.6	14,670				
	Croweburg	1	5.2	35.9	51.5	7.4	3.5	12,750		1	OGS	1928
	hvBb	2	N/A	37.9	54.3	7.8	3.7	13,450				
		3	N/A	41.1	58.9	N/A		14,588				
	Croweburg	1	8.4	36.3	47.3	8.0	3.1	12,320		5	OGS	1944
	hvBb	2	N/A	39.6	51.7	8.7	3.4	13,450				
		3	N/A	43.4	56.6	N/A	3.7	14,740				
	Croweburg	1	10.0	33.2	49.1	7.7	0.7	10,772		1	OGS	1976
	--	2	N/A	36.9	54.5	8.6	0.8	11,967				
		3	N/A	40.3	59.7	N/A		13,088				
	Mineral	1	5.0	33.3	46.0	15.7	3.7	11,284		1	OGS	1976
	hvBb	2	N/A	35.0	48.5	16.5	3.9	11,878				
		3	N/A	42.0	58.0	N/A		14,225				
T18N, R16E	Tebo	1	7.1	35.5	49.9	7.5	1.1	11,770	½	1	OGS	1981
	--	2	N/A	38.2	53.8	8.0	1.2	12,666				
		3	N/A	41.6	58.4	N/A		13,775				
	Weir-Pittsburg	1	3.3	37.3	48.0	11.4	5.6	12,247	4	2	OGS	1981
	--	2	N/A	38.6	49.7	11.7	5.7	12,667				
		3	N/A	43.7	56.3	N/A		14,350				
T18N, R17E	Rowe	1	7.4	34.6	49.6	8.4	1.1	11,762	1½	1	OGS	1981
	--	2	N/A	37.4	53.5	9.1	1.2	12,705				
		3	N/A	41.1	58.9	N/A		13,977				
T18N, R18E	Spaniard?	1	0.8	35.0	46.1	18.1	3.9	12,198		1	OGS	1976
	--	2	N/A	35.3	46.5	18.2	3.9	12,223				
		3	N/A	43.2	56.8	N/A		14,942				
T19N, R12E	Tulsa	1	10.8	36.4	38.9	13.9	0.6	10,020		1	OGS	1981
	--	2	N/A	40.8	43.7	15.5	0.7	11,232				
		3	N/A	48.3	51.7	N/A		13,299				
T19N, R13E	Dawson	1	6.3	37.7	47.8	8.2	3.8	12,690		1	USBM	1914
	hvAb	2	N/A	40.2	51.0	8.8	4.0	13,550				
		3	N/A	44.1	55.9	N/A	4.4	14,850				

Township/Range	Coal bed and rank[a]	Sample condition[b]	Proximate Analysis (%) Moisture[c]	Volatile matter	Fixed carbon	Ash[c]	Sulfur (%)	Btu/lb	Free swelling index	Number of analyses (whole seam)	Data source[d]	Year reported
	Dawson	1	6.4	36.5	49.1	8.0	3.7	12,510		1	USBM	1926
	hvBb	2	N/A	39.0	52.4	8.6	4.0	13,370				
		3	N/A	42.7	57.3	N/A	4.4	14,620				
	Dawson	1	6.3	35.7	48.1	9.9	4.1	12,363		3	OGS	1928
	hvBb	2	N/A	38.1	51.3	10.6	4.4	13,194				
		3	N/A	42.6	57.4	N/A	4.9	14,753				
T19N, R15E	Croweburg	1	7.0	33.6	53.2	6.2	1.2	12,750		6	OGS	1944
	hvBb	2	N/A	36.2	57.1	6.7	1.3	13,710				
		3	N/A	38.8	61.2	N/A	1.4	14,690				
	Croweburg	1	3.9	36.4	52.3	7.4	2.2	12,998	5½	2	OGS	1976
	hvAb	2	N/A	37.9	54.4	7.7	2.3	13,533				
		3	N/A	41.0	59.0	N/A		14,662				
	Mineral	1	4.7	26.4	36.5	32.4	3.0	8,627		4	OGS	1976
	hvBb	2	N/A	27.6	38.3	34.1	3.1	9,037				
		3	N/A	42.2	57.8	N/A		13,608				
	Croweburg	1	3.5	35.2	56.1	5.2	0.4	13,624	6½	1	OGS	1981
	hvAb	2	N/A	36.4	58.1	5.5	0.5	14,119				
		3	N/A	38.6	61.4	N/A		14,932				
	Iron Post	1	3.1	39.0	54.4	3.5	2.0	13,616	6	1	OGS	1981
	hvAb	2	N/A	40.3	56.1	3.6	2.1	14,059				
		3	N/A	41.8	58.2	N/A		14,582				
	Mineral	1	17.8	24.4	26.8	31.0	0.6	5,762		1	OGS	1981
	--	2	N/A	29.7	32.6	37.7	0.7	7,010				
		3	N/A	47.7	52.3	N/A		11,253				
T20N, R13E	Dawson	1	6.7	36.3	48.3	8.7	3.4	12,540		1	USBM	1914
	hvBb	2	N/A	38.9	51.7	9.4	3.6	13,450				
		3	N/A	42.9	57.1	N/A		14,823				
	Dawson	1	6.1	35.5	48.7	9.7	4.3	12,330		3	USBM	1942
	hvBb	2	N/A	37.8	51.8	10.4	4.6	13,130				
		3	N/A	42.1	57.9	N/A	5.1	14,640				
T22N, R13E	Cedar Bluff	1	5.6	35.2	43.0	16.2	5.6	11,425	6½	1	OGS	1986
	hvAb	2	N/A	37.3	45.6	17.1	5.9	12,105				
		3	N/A	45.0	55.0	N/A		14,607				
	Dawson	1	3.3	35.4	48.6	12.7	3.9	12,686	8	1	OGS	1986
	hvAb	2	N/A	36.6	50.3	13.1	4.0	13,119				
		3	N/A	42.1	57.9	N/A		15,102				
	Tulsa	1	2.4	39.1	40.3	18.2	2.0	12,085	6½	1	OGS	1986
	hvAb	2	N/A	40.1	41.3	18.6	2.1	12,385				
		3	N/A	49.2	50.8	N/A		15,221				
T22N, R14E	Dawson	1	6.1	38.4	47.3	8.2	3.8	12,740		1	USBM	1914
	hvAb	2	N/A	40.8	50.5	8.7	4.1	13,560				
		3	N/A	44.8	55.2	N/A		14,865				
	Dawson	1	4.2	37.5	46.6	11.7	4.7	12,590		1	OGS	1928
	hvAb	2	N/A	39.1	48.7	12.2	4.9	13,140				
		3	N/A	44.6	55.4	N/A		14,970				
	Dawson	1	2.1	39.8	47.0	11.1	4.3	12,777	7½	1	OGS	1980
	hvAb	2	N/A	40.5	48.2	11.3	4.4	13,057				
		3	N/A	45.8	54.2	N/A		14,720				
T24N, R14E	Dawson	1	4.1	38.0	49.5	8.4	3.7	13,003	7	1	OGS	1986
	hvAb	2	N/A	39.6	51.6	8.8	3.9	13,562				
		3	N/A	43.4	56.6	N/A		14,864				
	Tulsa	1	4.2	41.2	47.6	7.0	1.5	13,482	2½	1	OGS	1986
	hvAb	2	N/A	43.1	49.7	7.3	1.6	14,080				
		3	N/A	46.4	53.6	N/A		15,182				

[a]hvAb, high-volatile A bituminous; hvBb, high-volatile B bituminous; --, not classified.

[b]1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

[c]N/A, not applicable.

[d]Company, coal company or other industry-related source; OGS, Oklahoma Geological Survey; USBM, United States Bureau of Mines.

TABLE A3-2.--ANALYSES OF COALS IN CREEK, TULSA, WAGONER, AND WASHINGTON COUNTIES, OKLAHOMA
(Samples collected by the author and tested by the Oklahoma Geological Survey Chemistry Laboratory.)

Sample number	Map number[a] (Pls. 1-3)	Coal bed and rank[b]	Sample condition[c]	Proximate analysis (%) Moisture	Volatile matter	Fixed carbon	Ash	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[d]
80C33H	MS 35, Pl. 3	Bluejacket --	1	1.8	37.6	52.7	7.9	2.1	13,444	7½	1980	Cb
			2	N/A	38.2	53.8	8.0	2.1	13,696			
			3	N/A	41.6	58.4	N/A		14,893			
80C34H	MS 36, Pl. 3	Bluejacket --	1	18.9	32.7	43.0	5.4	0.6	9,221		1980	SO
			2	N/A	40.4	53.0	6.6	0.8	11,374			
			3	N/A	43.2	56.8	N/A		12,178			
86C25H	CH 1, Pl. 1	Cedar Bluff hvAb	1	5.6	35.2	43.0	16.2	5.6	11,425	6½	1986	Core
			2	N/A	37.3	45.6	17.1	5.9	12,105			
			3	N/A	45.0	55.0	N/A		14,607			
80C19H (Upper 9 in. of split sample)	MS 67, Pl. 2	Croweburg hvAb	1	4.4	35.0	56.9	3.7	0.4	13,768	6½	1980	AcSM
			2	N/A	36.6	59.5	3.9	0.4	14,402			
			3	N/A	38.1	61.9	N/A		14,986			
80C20H (Lower 9 in. of split sample)	MS 67, Pl. 2	Croweburg hvAb	1	2.6	35.4	55.2	6.8	0.5	13,481	6	1980	AcSM
			2	N/A	36.3	56.7	7.0	0.5	13,837			
			3	N/A	39.1	60.9	N/A		14,878			
80C30H (Upper 9 in. of split sample)	MS 13, Pl. 2	Croweburg hvBb	1	3.8	39.3	51.2	5.7	2.0	12,849	1½	1980	AbSM
			2	N/A	40.8	53.2	6.0	2.1	13,364			
			3	N/A	43.4	56.6	N/A		14,212			
80C31H (Lower 9 in. of split sample)	MS 13, Pl. 2	Croweburg hvBb	1	3.1	37.6	49.0	10.3	2.2	12,334	1½	1980	AbSM
			2	N/A	38.8	50.6	10.6	2.3	12,730			
			3	N/A	43.4	56.6	N/A		14,239			
79C20H (Upper 8 in. of split sample)	MS 72, Pl. 1	Dawson hvAb	1	1.7	41.7	48.5	8.1	3.4	13,464	8	1979	AcSM
			2	N/A	42.5	49.2	8.3	3.5	13,702			
			3	N/A	46.2	53.8	N/A		14,939			
79C21H (Lower 8 in. of split sample)	MS 72, Pl. 1	Dawson hvAb	1	2.6	37.9	45.5	14.0	5.2	12,090	7	1979	AcSM
			2	N/A	38.4	47.2	14.4	5.3	12,413			
			3	N/A	45.4	54.6	N/A		14,501			
80C15H (Upper 12 in. of split sample)	MS 25, Pl. 1	Dawson --	1	5.2	37.5	43.0	14.3	2.7	11,329	1	1980	Cb
			2	N/A	39.5	45.4	15.1	2.8	11,945			
			3	N/A	46.6	53.4	N/A		14,069			
80C16H (Lower 12 in. of split sample)	MS 25, Pl. 1	Dawson --	1	6.0	34.6	39.4	20.0	2.7	10,337	1½	1980	Cb
			2	N/A	36.9	42.3	20.8	2.8	11,002			
			3	N/A	46.8	53.2	N/A		13,897			
80C17H	MS 3, Pl. 1	Dawson --	1	6.3	32.5	39.6	21.6	0.6	9,333	½	1980	DCB
			2	N/A	34.7	42.3	23.0	0.6	9,963			
			3	N/A	45.1	54.9	N/A		12,943			
86C27H (Upper 10.5 in. of 21-in. bed)	CH 1, Pl. 1	Dawson --	1	3.3	34.9	47.0	14.8	4.1	12,289	8	1986	Core
			2	N/A	36.1	48.7	15.3	4.2	12,709			
			3	N/A	42.6	57.4	N/A		14,998			
86C28H (Lower 10.5 in. of 21-in. bed)	CH 1, Pl. 1	Dawson hvAb	1	3.4	35.9	50.1	10.6	3.7	13,084	8	1986	Core
			2	N/A	37.2	51.8	11.0	3.8	13,547			
			3	N/A	41.7	58.3	N/A		15,218			

Sample number	Map number[a] (Pls. 1-3)	Coal bed and rank[b]	Sample condition[c]	Proximate analysis (%) Moisture	Volatile matter	Fixed carbon	Ash	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[d]
86C30H	CH 2, Pl. 1	Dawson hvAb	1	4.1	38.0	49.5	8.4	3.7	13,003	7	1986	Core
			2	N/A	39.6	51.6	8.8	3.9	13,562			
			3	N/A	43.4	56.6	N/A		14,864			
80C18H	MS 65, Pl. 1	Iron Post hvAb	1	3.1	39.0	54.4	3.5	2.0	13,616	6	1980	RC
			2	N/A	40.3	56.1	3.6	2.1	14,059			
			3	N/A	41.8	58.2	N/A		14,582			
80C11H (Upper 8 in. of split sample)	MS 42, Pl. 2	Jenks --	1	14.2	38.5	36.0	11.3	1.0	9,370		1980	SP
			2	N/A	44.9	41.9	13.2	1.2	10,919			
			3	N/A	51.7	48.3	N/A		12,576			
80C12H (Lower 9 in. of split sample)	MS 42, Pl. 2	Jenks --	1	13.8	36.2	41.2	8.8	1.1	9,221		1980	SP
			2	N/A	42.0	47.7	10.3	1.3	10,696			
			3	N/A	46.8	53.2	N/A		11,924			
81C1H (Upper 14 in. of split sample)	MS 69, Pl. 3	Mineral --	1	25.4	23.4	23.0	28.2	0.3	4,393		1981	Cb
			2	N/A	31.4	30.8	37.8	0.4	5,890			
			3	N/A	50.4	49.6	N/A		9,469			
81C2H (Middle 9 in. of split sample)	MS 69, Pl. 3	Mineral --	1	13.1	21.1	27.5	38.3	0.4	5,638		1981	Cb
			2	N/A	24.3	31.6	44.1	0.5	6,489			
			3	N/A	43.4	56.6	N/A		11,608			
81C3H (Lower 9 in. of split sample)	MS 69, Pl. 3	Mineral --	1	10.6			28.2	1.1	8,016		1981	Cb
			2	N/A			31.5	1.2	8,968			
			3	N/A			N/A		13,092			
81C5H	MS 56, Pl. 3	Rowe	1	7.4	34.6	49.6	8.4	1.1	11,762	1½	1981	SO
			2	N/A	37.4	53.5	9.1	1.2	12,705			
			3	N/A	41.1	58.9	N/A		13,977			
81C6H	MS 40, Pl. 3	Rowe hvAb	1	2.1	38.3	51.5	8.1	3.9	13,620	8	1981	AbSM
			2	N/A	39.1	52.6	8.3	4.0	13,907			
			3	N/A	42.7	57.3	N/A		15,166			
80C35H (Upper 8½ in. of split sample)	MS 19, Pl. 2	Secor hvAb	1	1.9	36.4	53.0	8.7	2.2	13,358	7½	1980	AcSM
			2	N/A	37.0	54.1	8.9	2.2	13,621			
			3	N/A	40.7	59.3	N/A		14,952			
80C36H (Lower 8½ in. of split sample)	MS 19, Pl. 2	Secor hvAb	1	1.9	38.0	57.1	3.0	1.3	14,538	8	1980	AcSM
			2	N/A	38.7	58.3	3.0	1.3	14,826			
			3	N/A	40.0	60.0	N/A		15,288			
80C37H (Upper 10 in. of split sample)	MS 21, Pl. 2	Secor hvAb	1	2.9	33.4	56.6	7.1	2.5	13,464	7½	1980	AcSM
			2	N/A	34.4	58.3	7.3	2.6	13,870			
			3	N/A	37.1	62.9	N/A		14,967			
80C38H (Lower 10 in. of split sample)	MS 21, Pl. 2	Secor hvAb	1	2.0	36.6	58.6	2.8	1.3	14,376	8	1980	AcSM
			2	N/A	37.4	59.8	2.8	1.3	14,662			
			3	N/A	38.4	61.6	N/A		15,092			
83C15H (Upper 8 in. of split sample)	MS 23, Pl. 2	Secor hvAb	1	3.6	35.9	59.1	1.4	0.5	14,484	7½	1983	AcSM
			2	N/A	37.2	61.4	1.4	0.5	15,018			
			3	N/A	37.7	62.3	N/A		15,232			
83C16H (Lower 8 in. of split sample)	MS 23, Pl. 2	Secor hvAb	1	4.5	34.0	59.9	1.6	0.5	14,157	7½	1983	AcSM
			2	N/A	35.6	62.8	1.6	0.5	14,826			
			3	N/A	36.2	63.8	N/A		15,070			

Sample number	Map number[a] (Pls. 1-3)	Coal bed and rank[b]	Sample condition[c]	Proximate analysis (%) Moisture	Volatile matter	Fixed carbon	Ash	Sulfur (%)	Btu/lb	Free swelling index	Year sampled	Type of sample site[d]
83C17H (Upper 9 in. of split sample)	MS 18, Pl. 2	Secor hvAb	1	4.0	37.0	54.5	4.5	1.7	13,852	7½	1983	AcSM
			2	N/A	38.5	56.8	4.7	1.8	14,435			
			3	N/A	40.4	59.6	N/A		15,148			
83C18H (Lower 9 in. of split sample)	MS 18, Pl. 2	Secor hvAb	1	3.5	38.4	55.1	3.0	1.4	14,189	7½	1983	AcSM
			2	N/A	39.8	57.0	3.2	1.4	14,710			
			3	N/A	41.1	58.9	N/A		15,190			
83C19H (Upper 10 in. of split sample)	MS 20, Pl. 2	Secor hvAb	1	3.5	36.2	57.2	3.1	0.6	14,143	7	1983	AcSM
			2	N/A	37.5	59.3	3.2	0.6	14,656			
			3	N/A	38.7	61.3	N/A		15,140			
83C20H (Lower 10 in. of split sample)	MS 20, Pl. 2	Secor hvAb	1	4.3	35.8	57.5	2.4	0.4	14,112	7½	1983	AcSM
			2	N/A	37.4	60.1	2.5	0.4	14,743			
			3	N/A	38.4	61.6	N/A		15,119			
80C25H	MS 54, Pl. 2	Tebo --	1	7.1	35.5	49.9	7.5	1.1	11,770	½	1980	Cb
			2	N/A	38.2	53.8	8.0	1.2	12,666			
			3	N/A	41.6	58.4	N/A		13,775			
81C4H	MS 1, Pl. 2	Tullahassee hvAb	1	3.4	38.5	49.7	8.4	4.2	13,336	8½	1981	Cb
			2	N/A	39.8	51.5	8.7	4.3	13,800			
			3	N/A	43.7	56.3	N/A		15,115			
80C14H	MS 62, Pl. 3	Tulsa --	1	10.8	36.4	38.9	13.9	0.6	10,020		1980	SO
			2	N/A	40.8	43.7	15.5	0.7	11,232			
			3	N/A	48.3	51.7	N/A		13,299			
86C26H	CH 1, Pl. 3	Tulsa hvAb	1	2.4	39.1	40.3	18.2	2.0	12,085	6½	1986	Core
			2	N/A	40.1	41.3	18.6	2.1	12,385			
			3	N/A	49.2	50.8	N/A		15,221			
86C29H	CH 2, Pl. 3	Tulsa hvAb	1	4.2	41.2	47.6	7.0	1.5	13,482	2½	1986	Core
			2	N/A	43.1	49.7	7.3	1.6	14,080			
			3	N/A	46.4	53.6	N/A		15,182			
80C22H	MS 49, Pl. 1	Weir-Pittsburg --	1	3.3	37.4	49.6	9.7	6.3	12,528	5	1980	Cb
			2	N/A	38.7	51.3	10.0	6.5	12,958			
			3	N/A	43.0	57.0	N/A		14,402			
80C23H (Upper 10 in. of split sample)	MS 50, Pl. 1	Weir-Pittsburg --	1	4.1	37.0	49.4	9.5	4.3	12,254	4	1980	Cb
			2	N/A	38.6	51.4	10.0	4.5	12,775			
			3	N/A	42.8	57.2	N/A		14,186			
80C24H (Lower 5 in. of split sample)	MS 50, Pl. 1	Weir-Pittsburg --	1	1.7	38.0	43.7	16.6	7.2	11,953	4	1980	Cb
			2	N/A	38.7	44.4	16.9	7.3	12,162			
			3	N/A	46.5	53.5	N/A		14,642			

[a]Data point number on map (sample site) corresponds to measured-section number or core-hole number, Appendix 2.

[b]hvAb, high-volatile A bituminous; hvBb, high-volatile B bituminous; -- not classified.

[c]1 = as received; 2 = moisture-free; 3 = moisture- and ash-free.

[d]AbSM, abandoned strip mine; AcSM, active strip mine; Cb, cutbank of stream; Core, core hole; DCB, dry creek bed; RC, road cut; SO, slope outcrop; SP, shale pit.

Appendix 4: Cleat Orientations in Coals Sampled in Tulsa and Wagoner Counties

Coal	Face cleat	Butt cleat	Degrees of separation*	Location
Bluejacket	N. 36° W.	N. 53° E.	89	NW¼SW¼SW¼SW¼ sec. 25, T17N, R16E
	N. 34° W.	N. 59° E.	93	SW¼SE¼SW¼NE¼ sec. 36, T17N, R16E
Checkerboard	N. 64° W.	N. 29° E.	93	SE¼SW¼NW¼NE¼ sec. 34, T19N, R12E
Croweburg	N. 35° W.	N. 53° E.	88	SE¼SE¼NW¼SE¼ sec. 6, T16N, R14E
	N. 49° W.	N. 49° E.	98	NW¼SW¼NE¼SW¼ sec. 6, T16N, R15E
	N. 74° W.	N. 15° E.	89	SW¼NW¼SW¼SE¼ sec. 7, T16N, R15E
	N. 72° W.	N. 18° E.	90	NW¼SW¼NE¼NW¼ sec. 9, T19N, R15E
Dawson	N. 12° W.	N. 77° E.	89	SW¼SW¼SE¼SE¼ sec. 4, T16N, R12E
	N. 29° W.	N. 60° E.	89	NW¼NE¼SW¼SW¼ sec. 2, T17N, R12E
	N. 32° W.	N. 64° E.	96	NE¼NW¼NE¼SE¼ sec. 27, T21N, R13E
	N. 31° W.	N. 72° E.	103	NW¼NE¼NE¼SW¼ sec. 31, T22N, R14E
Iron Post	N. 35° W.	N. 57° E.	92	SE¼NW¼NE¼NE¼ sec. 6, T19N, R15E
	N. 40° W.	N. 55° E.	95	NW¼NW¼NW¼NW¼ sec. 17, T19N, R15E
Jenks	N. 28° W.	N. 57° E.	85	SW¼NW¼NW¼SW¼ sec. 30, T18N, R13E
Mineral	N. 45° W.	N. 43° E.	88	NE¼NE¼NW¼SW¼ sec. 27, T19N, R15E
	N. 63° W.	N. 31° E.	94	SW¼NW¼SW¼SE¼ sec. 31, T17N, R15E
	N. 62° W.	N. 27° E.	89	NW¼NE¼SE¼SW¼ sec. 31, T17N, R15E
Rowe	N. 34° W.	N. 59° E.	93	NW¼NE¼NE¼NE¼ sec. 7, T16N, R18E
	N. 31° W.	N. 60° E.	91	SW¼NE¼SE¼NW¼ sec. 33, T17N, R18E
	N. 55° W.	N. 40° E.	95	NE¼SE¼SE¼NW¼ sec. 9, T18N, R17E
Secor	N. 44° W.	N. 54° E.	98	NE¼NW¼SW¼SE¼ sec. 6, T16N, R17E
	N. 27° W.	N. 62° E.	89	SE¼SW¼NE¼NW¼ sec. 8, T16N, R17E
Tebo	N. 32° E.	N. 59° W.	91	NW¼NW¼NE¼SW¼ sec. 31, T18N, R16E
Tullahassee	N. 40° W.	N. 60° E.	100	SW¼SE¼SE¼SE¼ sec. 36, T16N, R17E
Tulsa	N. 39° W.	N. 52° E.	91	SW¼NW¼SW¼NW¼ sec. 35, T19N, R12E
Weir-Pittsburg	N. 35° W.	N. 55° E.	90	SW¼SW¼NW¼NW¼ sec. 13, T18N, R16E
	N. 50° W.	N. 42° E.	92	SW¼SW¼NW¼SW¼ sec. 18, T18N, R16E
	N. 45° W.	N. 55° E.	100	SW¼SW¼NW¼SW¼ sec. 18, T18N, R16E

*Separation is defined as the angular difference between the average face-cleat and butt-cleat directions. Ideal separation is 90°.