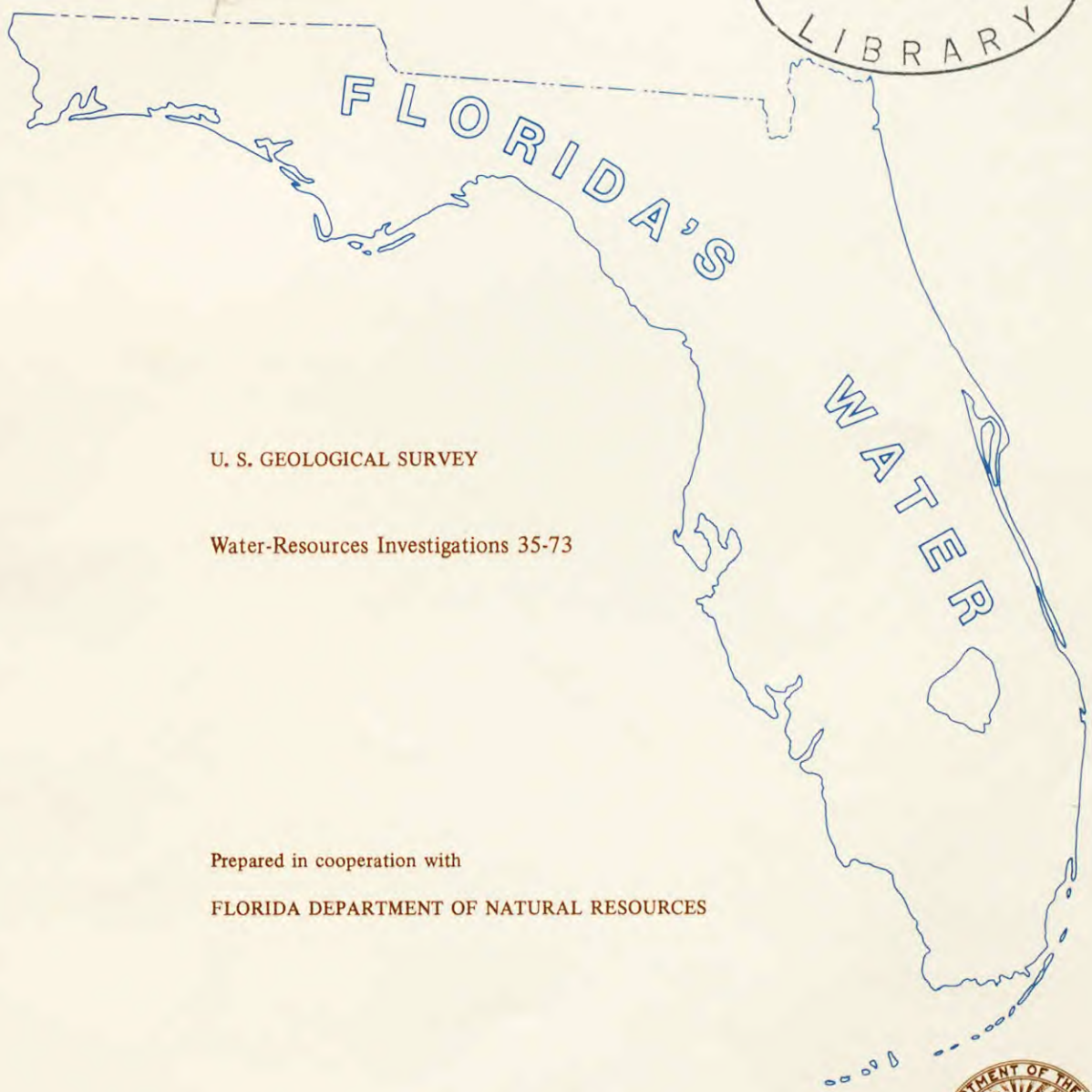
RECONNAISSANCE OF WATER QUALITY IN THE VICINITY OF SUNNILAND FIELD, COLLIER COUNTY, FLORIDA, 1971-72



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By E. T. Wimberly

U.S. GEOLOGICAL SURVEY

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Florida Department of Natural Resources

August 1973

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RECONNAISSANCE OF WATER QUALITY IN THE VICINITY OF SUNNILAND OIL FIELD, COLLIER COUNTY, FLORIDA, 1971-72

By

E. T. Wimberly

INTRODUCTION

Oil exploration in Florida began around the turn of the century in Escambia County (Gunter, 1949). Many test wells were drilled from 1900 until Humble Oil and Refining Company developed Florida's first producing well (Gulf Coast Realties Corp. No. 1) in September 1943 at Sunniland. (See fig. 1.) The first production well was drilled to 11,626 feet below sea level and had an initial production of 97 barrels of oil per day. Since this first well was developed many more have been drilled in the Sunniland field, and at this time (1973) 17 wells are producing about 50,000 barrels of oil per month (W. R. Oglesby, written commun., 1972). The Sunniland field, in north central Collier County, remained the chief oil producing field in Florida until 1966 when the Sunoco-Felda field, about 20 miles north of the Sunniland field, began producing more oil (Babcock, 1970). Oil produced in both fields is transported by pipeline to Port Everglades, on the east coast.

Anticipation of oil exploration in the Big Cypress area (fig. 1) aroused concern the effects a producing field would have on the quality of surface water in the area. The Florida Department of Natural Resources requested the U.S. Geological Survey to determine whether there have been any such effects. The 29-year old Sunniland oil field was chosen for this preliminary evaluation. A second phase of the investigation was to monitor the effects of building roads, drilling operations and other exploratory activities related to development of an oil field, on the quality of surface water in the areas of proposed exploration. This report presents the results of the first phase.

METHODS OF ANALYSIS

Surface drainage through the Sunniland oil field is generally to the south (McCoy, 1962). The land elevation ranges from 22 feet above sea level at site 5 (fig. 1) to 15 feet above sea level at site 1. To detect possible effects of the oil-field activities on the quality of surface water around the field, water samples were collected from sites 5, 6 and 9 north of the field, sites 7 and 8 within the field and from sites 1, 2, 3, 4 and 10 south of the field.

The water samples collected were analyzed for dissolved oxygen, specific conductance, hydrogen ion activity, chloride, organic and inorganic carbon, and oil and grease. Bottom sediment samples were analyzed only for oil and grease. Dissolved oxygen, specific conductance and pH were determined by instruments in the field (Brown, Skougstad and Fishman, 1971). Chloride was determined by titration with silver nitrate. Carbon was determined in the U.S. Geological Survey's water quality laboratory in Washington, D.C. Oil and grease samples were first analyzed by the Survey's water-quality laboratory in Ocala, Florida using a method approved by the Environmental Protection Agency (1971). The method of analysis was found to be invalid for determination of petroleum oils due to interference from indigenous organic material. In February 1972 water and sediment samples collected at a few sites around the Sunniland oil field were analyzed by another method that reduces natural interference and yields total hydrocarbon content. The samples were saponified and analyzed gravimetrically in the Survey's laboratory at Menlo Park, California (D. F. Goerlitz, written commun., 1972). Although this method indicates the quantity of total hydrocarbons present, it offers no hint concerning their type or origin. Therefore, again in July 1972 more samples were collected and sent to the Survey's laboratory in Washington, D.C. for analysis by gas chromatography. Since possible contamination from the oil field was the main concern, chromatograms obtained from the water and sediment samples were compared with chromatograms from an oil sample from the Sunniland field (H. J. Crump-Wiesner, written commun., 1972). This was done to determine if hydrocarbons were present in the water and sediment samples which were also present in the crude oil produced in the Sunniland oil field.

RAINFALL AND WATER LEVEL

Rainfall at Everglades City, Collier County, was above average in August and October 1971 and in February 1972. This station recorded 10.75 inches in August 1971 (3.41 inches above normal), 6.85 inches in October 1971 (2.35 inches above normal), and 3.03 inches (1.55 inches above normal) in February 1972.

An observation station on the Barron River Canal about 4 miles north of U.S. Highway 41 was used as an indicator of water levels in Collier County during the periods of sampling. As shown in the table below, the water level in the canal during the months was slightly above average except for July 1972 when the canal was just below the average.

	Monthly mean gage height (ft. msl)		Mean monthly gage height (ft. msl)
August 1971	4.59	August (1961-71)	4.34
October 1971	5.12	October (1961-71)	4.62
February 1972	3.24	February (1961-72)	3.05
July 1972	3.64	July (1961-72)	3.86

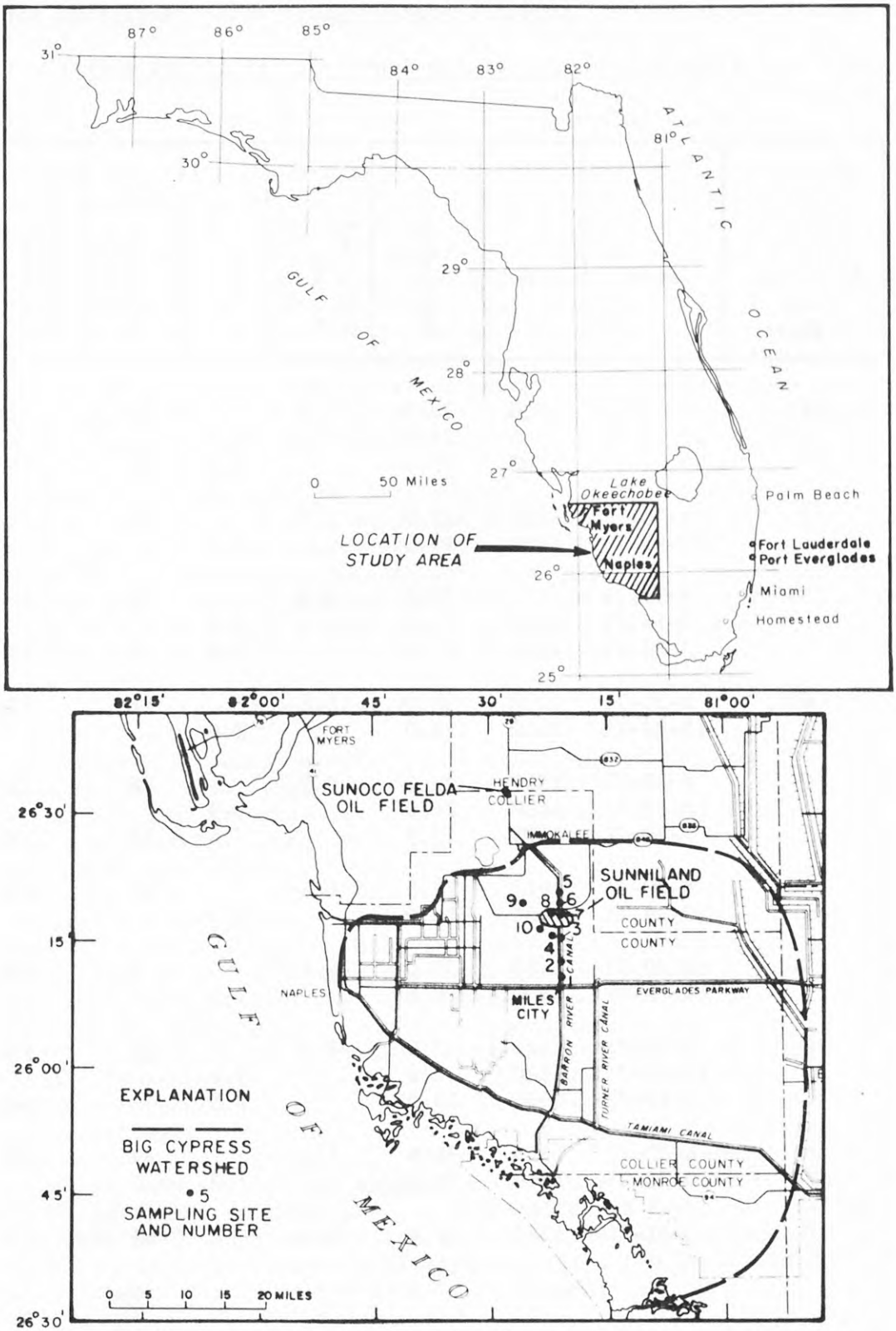

Figure 1.--Map of southwest Florida showing sampling sites in vicinity of Sunniland oil field.

Table 1.--Chemical and physical properties of water samples at selected sites in the area of the Sunniland oil field, 1971-72.

Sampling Site No.	Date	Time	Temperature (°C)	Dissolved Oxygen (mg/l)	pH	Chloride (Cl) (mg/l)	Specific conductance (Micromhos at 25°C)
1	8-30-71	1130	28.5	1.2		20	320
	10-28-71	1255	25.0		7.3		
	7- 2-72	1500	27.0		7.5	34	550
2	8-30-71	1700	28.0	1.0		20	258
	10-28-71	1330	25.0		7.5		
3	8-30-71	1215	29.0	0.8		25	350
	10-28-71	1400	25.0		7.1		
	7-20-72	1350	27.0		7.4	32	520
4	8-30-71	1230	31.0	11.2		46	338
	10-28-71	1350	28.0		8.0		
5	8-30-71	1330	29.0	0.9		28	374
	10-28-71	1430	26.0		6.9		
	7-20-72	1305	27.5		7.4	26	490
6	8-30-71	1415	29.5	1.4		11	410
	10-28-71	1445	26.0		6.9		
7	8-30-71	1450	35.0	6.9		6	370
	10-28-71	1500	29.0		7.8		
8	8-30-71	1510	33.0	8.3		21	338
	10-28-71	1520	31.0		9.1		
	7-19-72	0900	27.0		8.5	26	340
9	8-30-71	1555	31.0	7.4		39	490
	10-28-71	1600	28.0		7.2		
10	8-31-71	1245	31.0	8.5		65	530

RESULTS

The analyses of water samples in the area of the Sunniland oil field are listed in tables 1 and 2. Temperature, dissolved oxygen, pH and specific conductance were determined at each site for comparison. Chloride, organic carbon, and oil and grease were determined at each site because they are good indicators of possible pollution from an oil field.

The waters of the study area are Class III-recreation and propagation and management of fish and wildlife (FDPC 1972). Dissolved oxygen in water at all sites in the Barron River Canal (sites 1, 2, 3, 5 and 6) was below the limit set for Class III waters; low dissolved oxygen content is not uncommon in the canals in developed and natural areas of south Florida. Dissolved oxygen was highest, 11.2 mg/l, in water from (site 4) in a borrow pit south of the oil field. The pH ranged from 6.9 at sites 5 and 6 north of the oil field, to 9.1 at site 8, a grassy watering hole for cattle. The pH of water from all sites except site 8 were within the range (6.0-8.5) set for Class III waters. Specific conductance ranged from 258 to 550 micromhos per centimeter at 25°C.

Together with the oil that is produced in the Sunniland oil field, an even greater amount of salt water and brine is produced. The salt water and brine are returned to subsurface storage through disposal wells (Babcock, 1971). Therefore, the sampling for chloride, organic carbon, and oil and grease should indicate whether contamination is present. Chloride content ranged from 6 mg/l within the field to 65 mg/l at site 10 in a swampy area just south of the oil field. In all samples, which were collected from Class III waters, chloride content was in the range expected of this type of environment.

In August 1971, water samples were collected and analyzed for inorganic carbon, total organic carbon, and total carbon. Total organic carbon, in which we are the most interested, ranged from 8 mg/l at site 8 to 45 mg/l at site 10. These values are within the range expected in an uncontaminated environment of south Florida.

Samples for analysis of oil and grease were collected in August and October 1971. These analyses, however, included natural organic material. The gravimetric method mentioned previously, which reduced natural interference, was used on the samples collected February 1972. A water sample skimmed from the surface and a bottom sediment sample were collected at sites 1, 3, 5 and 8 in February 1972. This second method of analysis indicated hydrocarbons in sediment at all four sites but indicated nothing in the water samples. The hydrocarbons ranged from 22 mg/kg (milligrams/kilogram) at site 1 south of the oil field to 186 mg/kg north of the oil field at site 5. (See table 2.) To determine whether these hydrocarbons were of the variety which are produced in the Sunniland oil field, water and sediment samples were collected from the same four sites in July 1972, and the extracts from the samples were compared by gas chromatography with a sample of crude oil from the Sunniland field. Dissolved organic carbon ranged from 12 to 15 mg/l in

Table 2.--Analyses of water and sediments for carbon, oil and grease and crude oil at selected sites in the area of the Sunniland oil field, 1971-72.

Sampling Site No.	Date	Inorganic carbon (mg/l)	Total organic carbon (mg/l)	Total carbon (mg/l)	1/Oil and grease			2/Total hydrocarbons		Dissolved organic carbon (mg/l)	3/ Crude oil hydrocarbon		
					Water surface (mg/l)	0.5' below water surface (mg/l)	Bottom sediment (mg/kg)	Water surface (mg/l)	Bottom sediment (mg/kg)		Water surface (mg/l)	0.5' below water surface (mg/l)	Bottom sediment (mg/kg)
1	8-30-71	33	29	62	8.5	8.5	4,300						
	10-28-71						170						
	2- 3-72							0.0	22				
	7-20-72	63	17	80						15	0.0	0.0	0
2	8-30-71	26	33	59	7.5	7.0							
3	8-30-71	31	27	58	9.4	7.0	460						
	10-28-71						610						
	2- 3-72							0.0	38				
	7-20-72	58	16	74						12	0.0	0.0	0
4	8-30-71	18	7	25	15.0	5.6	220						
	10-28-71						980						
5	8-30-71	33	32	75	4.5	17.0	3,800						
	10-28-71						4,000						
	2- 3-72							0.0	186				
	7-20-72	56	14	70						15	0.0	0.0	0
6	8-30-71	33	34	67	17.0	3.3	130						
	10-28-71						370						

7	8-30-71	2	15	17	4.2	3.6	0						
	10-28-71						470						
8	8-30-71	18	23	41		4.9	610						
	10-28-71						280						
	2- 3-72							0.0	102				
	7-19-72	24	8	32						12	0.0	0.0	0
9	8-30-71	44	29	73	1.0	3.6	1,700						
	10-28-71						320						
10	8-31-71	48	45	93	15.0	0.0	600						

1/ Analysis by U.S. Geological Survey laboratory in Ocala, Florida
2/ Analysis by U.S. Geological Survey laboratory in Menlo Park, California
3/ Analysis by U.S. Geological Survey laboratory in Washington, D.C. Hydrocarbons of the type in the crude oil of the Sunniland field.

the samples collected in July. No crude oil was found in any of the water or sediment samples analyzed by gas chromatography using a flame ionization detector.

The method of analysis used on the February samples allows the hydrocarbons found to be anything from petroleum-related hydrocarbons to indigenous hydrocarbons. Based on the July 1972 analysis by chromatography, the hydrocarbons found in February 1972 came from sources other than the Sunniland oil field.

SUMMARY

Prospects of oil exploration in the Big Cypress stirred interest in the effects that oil field activities have on the quality of surface water in the area of the oil field. The Sunniland oil field, which has been operating since 1943 on the northwest corner of the Big Cypress, was selected as the site for investigation of these effects. The surface water in the area of the oil field was sampled and analyzed for chloride, organic carbon, oil and grease, and crude oil. The results of the tests for chloride, organic carbon, and crude oil indicated no contamination from the field. Oily substances were detected, by a gravimetric method of analysis, in the bottom sediment from the field and in the area surrounding the field in samples collected in February 1972. However, analysis by gas chromatography using flame ionization detector on the samples collected in July 1972 indicated no crude oil in samples of water or bottom sediment. The gravimetric method of analysis only reduced interference from indigenous materials; therefore, the oily substances detected in February 1972 may have come from natural sources or otherwise. In any case, the more refined method of analysis used on samples collected in July 1972 indicated no crude oil in the samples.

These preliminary findings indicate that surface water in the area of the Sunniland oil field is presently free of contamination from oil production.

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APPENDIX

SITES AT WHICH WATER AND SEDIMENT SAMPLES

WERE COLLECTED IN THE AREA OF THE SUNNILAND OIL FIELD, 1971-72

1 Barron River Canal at Miles City.
Location: Lat 26°09'53", long 81°20'44", sec.32, T.49S., R.30 E., at wooden bridge 0.7 miles north of Miles City.

2 Barron River Canal nr. Miles City.
Location: Lat 26°12'00", long 81°20'45", sec.17, T.49S., R.30E., at bridge 3.2 miles north of Miles City.

3 Barron River Canal site 2 nr. Miles City.
Location: Lat 26°14'48", long 81°20'34", sec.5, T.49S., R.30E., at wooden bridge 6.7 miles north of Miles City.

4 Borrow pit nr. Miles City
Location: Lat 26°14'48", long 81°20'32", sec.5, T.49S., R.30E., at east edge of borrow pit 6.7 miles north of Miles City.

5 Barron River Canal nr. Sunniland.
Location: Lat 26°20'20", long 81°20'37", sec.5, T.48S., R.30E., at culvert 2.5 miles north of SR 840.

6 Barron River Canal site 2 nr. Sunniland.
Location: Lat 26°18'56", long 81°20'35", sec.8, T.48S., R.30E., at culvert 0. 8 miles north of SR 840.

7 Drainage ditch nr. Sunniland.
Location: Lat 26°17'10", long 81°20'26", sec.20, T.48S., R.30E., at edge of ditch 1.3 miles north of Sunniland and ¼-mile east of SR 29.

8 Watering hole nr. Sunniland.
Location: Lat 26°17'06", long 81°20'42", sec.20, T.48S., R.30E., east edge of watering hole 1.3 miles north of Sunniland and ¼-mile west of SR 29.

9 Drainage ditch site 2 nr. Sunniland.
Location: Lat 26°18'57", long 81°24'00", sec.10, T.48S., R.29E., on Big Cypress Ranch 1.5 miles north of SR 840 and 4.3 miles west of SR 29.

10 Irrigation ditch in Mud Lake Strand nr. Sunniland.
Location: Lat 26°16'13", long 81°22'46", sec.25, T.48S., R.29E., edge of ditch 1 mile south of oil field road and 2 miles west of Sunniland.