



WATER-RIGHT DOCKET

Great Smoky Mountains National Park

Docket No: 28

CARVER BRANCH. SMOKEMOUNT CAMPGROUND

Preliminary Docket Information

00-00-0000: water right/source docket information

SEE GREAT SMOKY MOUNTAIN DOCKET NO. 1 FOR MAP
AND PRELIMINARY MAP SHOWING LOCATIONS OF
WATER SOURCES WITHIN THE PARK.

WATER RIGHTS DOCKET
Smokemont Campground
Great Smoky Mountains National Park



UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

P. O. Box 2857
Raleigh, North Carolina 27602

March 11, 1970

Mr. Ed Reed
→ Mr. Barte
Vic - we have prepared a reply to the effect that this has merit but why should NPS pay for it all - maybe States & Survey can contribute
em
3/31

Mr. Richard W. Ketcham
Supervisory Hydraulic Engineer
Office of Land Acquisition and
Water Resources
National Park Services
4228 Wisconsin Avenue, S.W.
Washington, D. C. 20242

L
file in
USGS
report file

Dear Dick:

Reference is made to my discussion with you, Ed Reed, and Garry Moore in your office on February 26 relative to additional studies in the Great Smoky Mountains National Park. The purpose of this letter is to confirm for the record the gist of my remarks.

Our report on the Great Smoky Mountains National Park, which you recently reviewed, is now in press as a USGS Hydrologic Atlas. In this report we subdivided the park into three areas on the basis of expected well yields. This is the information we believe is of most immediate interest to you in the development of your long-range plans. During the course of our studies in the park we made a series of step-drawdown tests on selected wells to determine the relation between yield and drawdown. A summary of the results of these tests is contained in our report.

Since the completion of the report I have continued, largely on my own time, with additional analyses of the pumping-test data. My principal objective in these analyses has been to develop improved techniques for estimating the maximum yield of wells in fractured rocks. There are, as I pointed out in our discussion, two aspects to this objective. The first is to predict the maximum yield based on data from a step-drawdown test. The second is to identify factors which might cause this yield to vary from one time to another.

It is not feasible in a letter such as this to discuss in detail the various phases and results of my analyses. However, some of

the results of the analysis of the Smokemont well data will indicate the highlights. Two step-drawdown tests were made on this well; the first on August 7, 1968, and the second on April 22, 1969. Attachments 1 and 2 are arithmetic plots of the drawdown data from these tests. Attachment 3 is a plot of the specific capacities (pumping rate in gpm divided by drawdown in feet) versus log of drawdown for both tests. The data tend to fall along straight lines, suggesting that the specific capacity varies inversely with the logarithm of drawdown. You will recall that we discussed possible explanations of this relationship.

Using specific capacity data from attachment 3, the graphs of yield versus drawdown shown in attachment 4 were obtained. Note that I have indicated on the April graph the bottom of the producing zone, as identified during the well construction, and the bottom of the well. The differences in predicted yields that can be obtained from these graphs are rather startling. They are summarized in the following table.

Date of Test	Predicted yields in gpm at drawdowns of	
	90 feet	140 feet
August 7, 1968	108	42
April 22, 1969	295	375

Which of these yields are correct? We do not know. In searching for an answer to this question the first problem concerns the radically different results obtained from the different tests. Three possible explanations have been identified so far. First, we know that the yield of some wells in fractured rocks improves during pumping tests because of the removal of drilling mud from the fractures. This may explain the higher yield of the second test. Second, the static water level during the April test was 1.2 feet higher than that during the August test. This may also have contributed to the differences in yields. Third, the tests were of different types to the extent that we proceeded in August directly from one step to the next, whereas in April the water level was permitted to recover between steps. These are the possible causes we have identified but neither may be the correct one.

As you know, prediction of yields by the methods outlined above involve certain assumptions, which may or may not be valid. For example, we are assuming that the relation of specific capacity and log of drawdown is constant at all pumping levels. This may not be correct. The relation may either improve or get worse at drawdowns greater than those we reached, or it may hold relatively constant either to the bottom of the producing zone or to the bottom of the well. Also, as noted above, it may vary with fluctuations in the static water level.

During our discussion in your office I showed you the specific capacity-drawdown relations of the GSMNP wells compared to the relations for "ideal" artesian and "ideal" water-table wells. I also discussed the results of analyses of other wells in the park, in addition to Smokemont, and the results of an analysis of a "theoretical" fractured rock well. Because I am pressed for time I will not attempt to summarize those discussions in this letter.

The point which I emphasized in our oral discussion and which is touched on in the above paragraphs is the problem of predicting the maximum yield of wells. Obviously this problem is of critical importance in the development of water supplies from fractured rock wells. It is, therefore, of importance to the Park Service not only in the Great Smoky Mountains, but also along the Blue Ridge Parkway and in other parks supplied by wells in fractured rocks.

Therefore, the purpose of my discussion with you was to solicit support for additional studies of this problem. The unused supply wells in the GSMNP provide an excellent opportunity for such studies.

Briefly, I believe the following studies should be undertaken:

1. Install two continuous water-level recorders on wells in the GSMNP. One of these should be the Smokemont well and the other should be a well not near a perennial stream. In accordance with our discussion, we are proceeding with plans to install these recorders as a part of our State-Federal cooperative program.
2. Acquire the use of a pump capable of yielding at least 300 gpm and running another series of tests on the Smokemont well. These should include step-drawdown tests with maximum drawdowns of at least 90 feet made when the static water level is at seasonal high and low levels. Next, pump the well at the maximum rate predicted from the step-drawdown tests until the drawdown stabilizes and compare this drawdown with that predicted from the step-test data.
3. Make a similar series of tests on other wells in the park which have yield characteristics different from the Smokemont well.
4. Make electric and gamma ray logs of the wells that are test pumped and inspect the wells with a TV camera to determine the spacing and appearance of fractures. The North Carolina Division of Ground Water has agreed to support this phase of the study. .

5. Analyze the data and prepare one or more reports, including an article for a technical journal.

I estimate that the cost of the work outlined above for which I need Park Service support is \$12,000. Please review your fund situation to determine if funds in this amount can be made available to us. We cannot schedule the additional studies before late summer or early fall so that the funds would not be needed until the 1971 fiscal year.

I hope the preceding discussion is adequate for your consideration of this project. If you need additional details or wish to explore any aspect of it further, please let me know.

It was a pleasure to see you, Ed, and Garry and I look forward to seeing you again this summer when you visit North Carolina on your field inspection trip.

Fondest personal regards,

Ralph C. Heath
District Chief

Enclosures

Copies with enclosures to:

~~Ed~~ Reed, NPS
Gary Rowe, GSMNP
Bill McMaster, USGS
Ed Kennedy, USGS
Gerald Meyer, USGS
Regional Hydrologist, ACR

RCH:rr

-4-

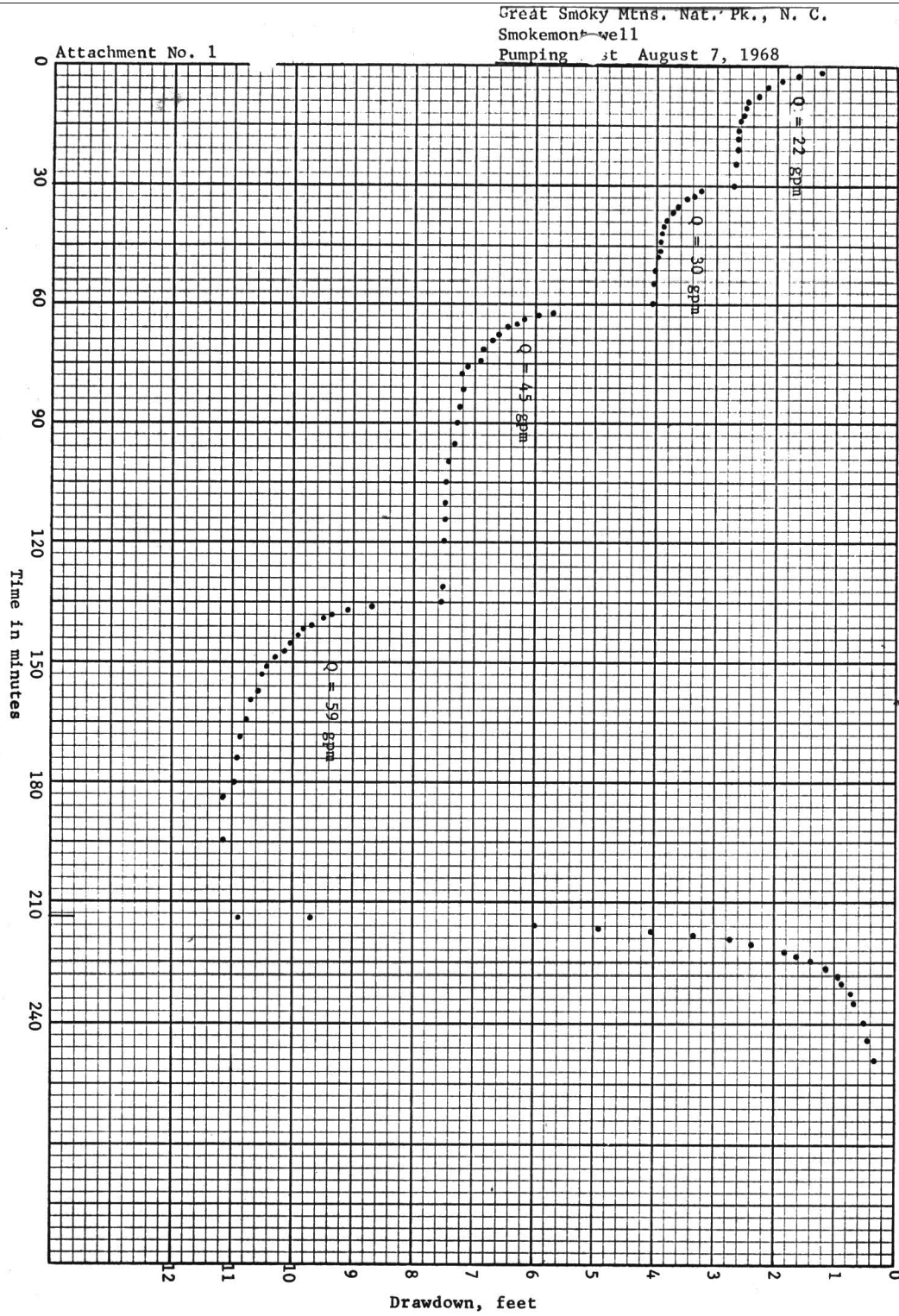
*Ed - it was nice to see you again. I hope you can
come down to N.C. with Dick sometime -*

*Best regards,
Raph*

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NO. 315-R. 10 DIVISIONS PER INCH BOTH WAYS. 70 BY 100 DIVISIONS.



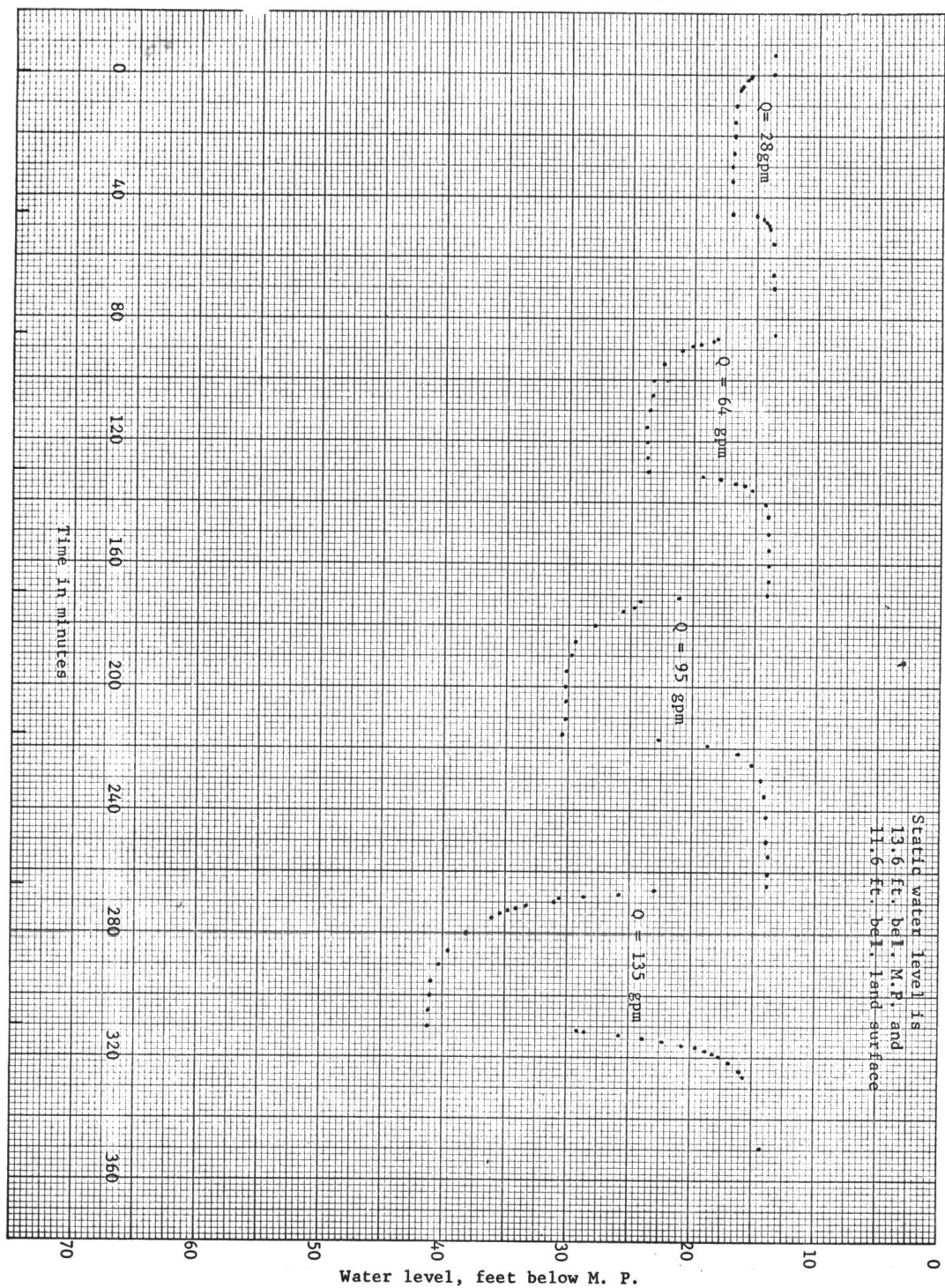
Attachment No. 2

Great Smoky Mtns. Nat. Pk., N.C., Smokemont well
Pumping Test April 22, 1969

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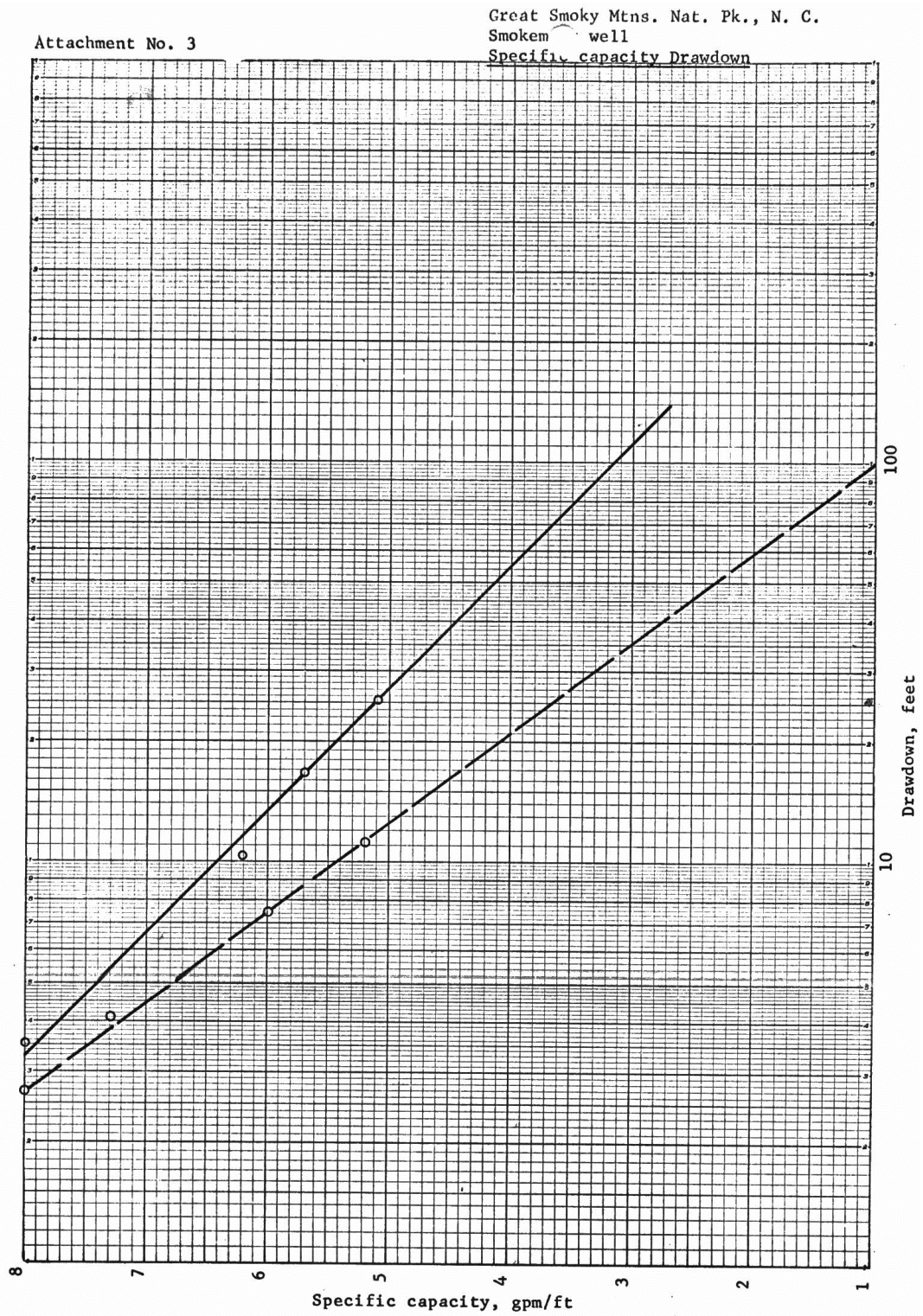
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NO. 31.287. 10 DIVISIONS PER INCH (270 DIVISIONS) BY THREE 3 1/2-INCH CYCLES RATIO RULING.

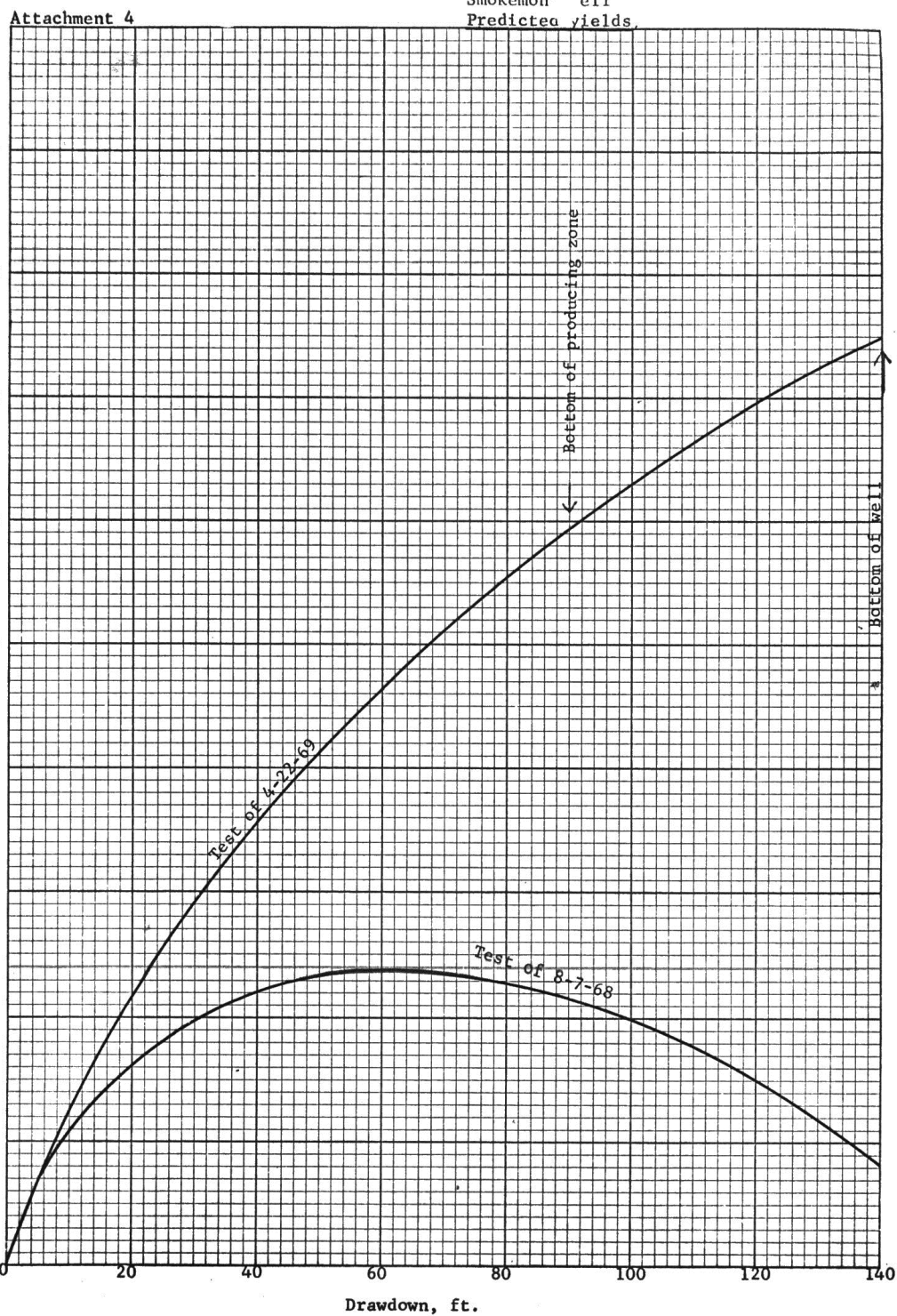


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NO. 31.190. 10 DIVISIONS PER INCH BOTH WAYS. 70 x 100 DIVISIONS.

Yield, gpm

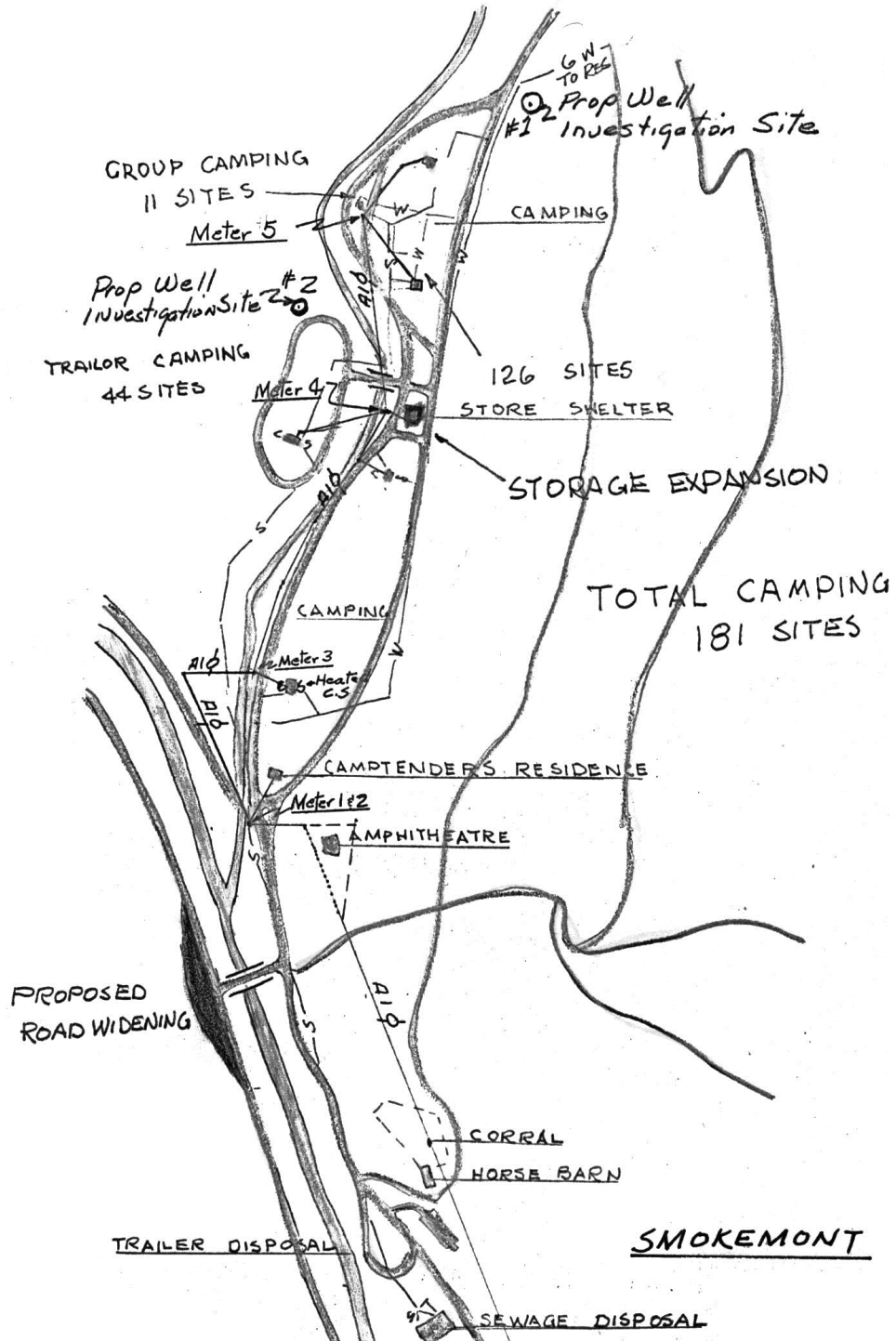


SMOKEMONT

Situation: The existing Smokemont area consists of 170 campground sites (plus 11 group camping sites), a campground store, seasonal quarters, and a horse concession. The water supply for this area is taken from an open stream and apparently is adequate now that a supplemental supply from another creek has been developed. However, with the anticipated expansion of the campground area by another 100 sites (scheduled by the Job Corps in the 1969 F.Y. program), it is questionable that the existing supply will be adequate. At the present time (based on actual meter readings) the area consumption amounts to 25,000-30,000 gallons per day.

Proposed: That we drill a deep well or combination of wells that will supply up to 50 g.p.m. If we are able to obtain a good capacity well in an acceptable location, we will either use it as a supplement to the existing system or use it as the ultimate supply, if desirable.

Progress to date: We have requested wage rates for this work and are hopeful that we can get a contract out for this investigation by mid-May 1966. The actual depth and location to be based on recommendations by U.S.G.S. geologists.



Smokemont Campground

Based on hydrogeologic criteria, a well site was selected in Smokemont Campground at the north end of the group camping area (fig. 6). This well was the first of two wells drilled at the campground during June 9 to July 11, 1966. A geologic log of the well, drilled in alluvium and the Thunderhead Sandstone, follows:

- 0-22 ft, Alluvium ranging from sand to boulders. The well was cased to 25 ft.
- 22-35 ft, Quartzite, mica gneiss, and mica schist; the well yielding about 5 gpm.
- 35-65 ft, Quartzite and mica schist, the well yielding about 13 gpm.
- 65-85 ft, Quartzite and mica schist, drilling terminated at 85 ft as no water occurred in the preceding 25 ft of drilling.

The static water level was 9.1 ft. A test pump installed at 70 ft was operated at maximum discharge for about 1 minute and thereafter at the discharge rates shown on the accompanying chart (fig. 7). At the end of the 8-hour test period, discharge was constant at 14.4 gpm. The specific capacity of the well is 0.26 gallons per minute per foot of draw-down. Although not providing the total amount of water required at the campground, this well will serve nearly 30 percent of it.

The water is qualitatively excellent, requiring no treatment or restrictions for public use. Results of laboratory analyses of chemical quality are given in table 8.

The second well site selected at Smokemont Campground is about 100 ft. west of the camp tender's residence at the south end of the campground. A geologic log of the well, drilled in alluvium and the Thunderhead Sandstone, follows:

- 0-25 ft, Alluvium ranging from sand to boulders. The well was cased to 28 ft.
- 25-45 ft, Gray quartzite, mica gneiss, and mica schist; little water.
- 45-65 ft, Quartzite, layered gneiss, mica schist; no water.
- 65-100 ft, Quartzite, layered gneiss, and mica schist. Drilling was continued from 65 ft. to 100 ft. as a test.

The small yield of this second well, as indicated by the air return, was deemed insufficient to justify further development or testing.

An estimated minimum of two additional wells will be required to furnish the water requirements of the campground if further development of ground-water resources at this locality is planned.

As indicated by data in table 1, adequate supplies of surface water are available to satisfy any foreseeable future need, either from Bradley Fork, Oconaluftee River or tributary streams.

Water of excellent chemical quality is now being obtained from Carver Branch tributary (primary supply) and Carver Branch (supplemental supply). Dissolved constituents are shown in tables 9, 10. Based on tentative data shown in table 1, the combined yield of these two streams totals about 100 gallons per minute, except at intervals exceeding 5 years. Even at rarer intervals (say 10 or 20 years) the combined surface- and ground-water supplies may be adequate to satisfy the projected demand of 50 gallons per minute.

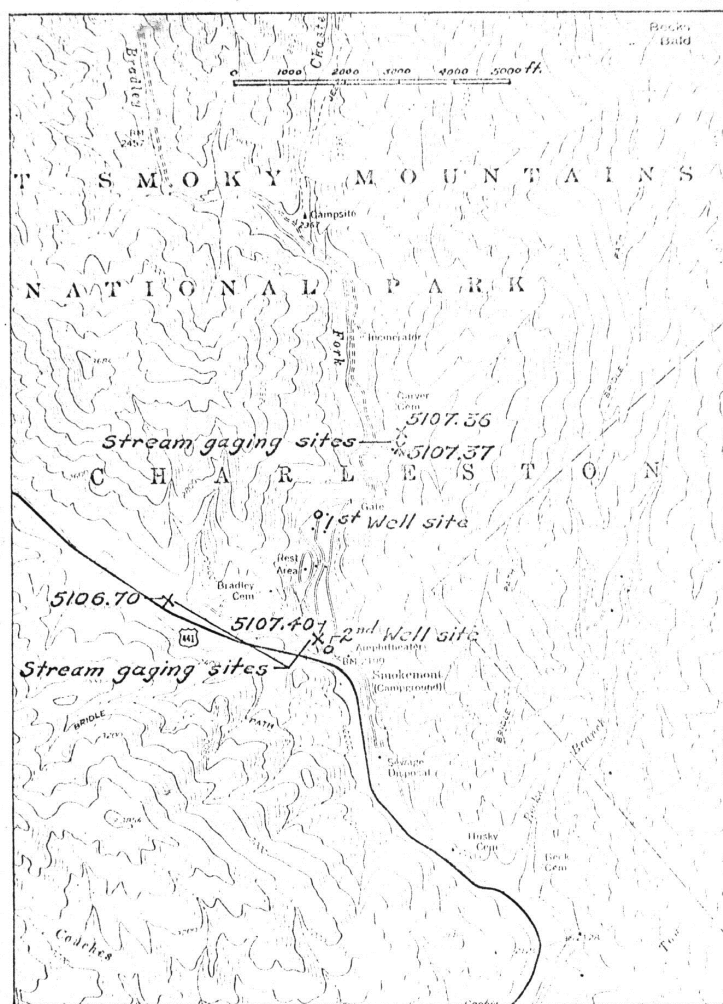
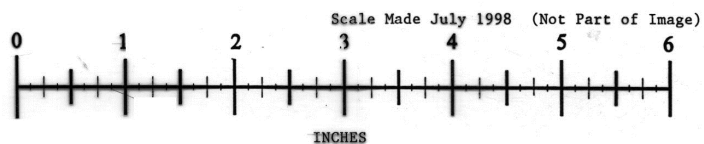
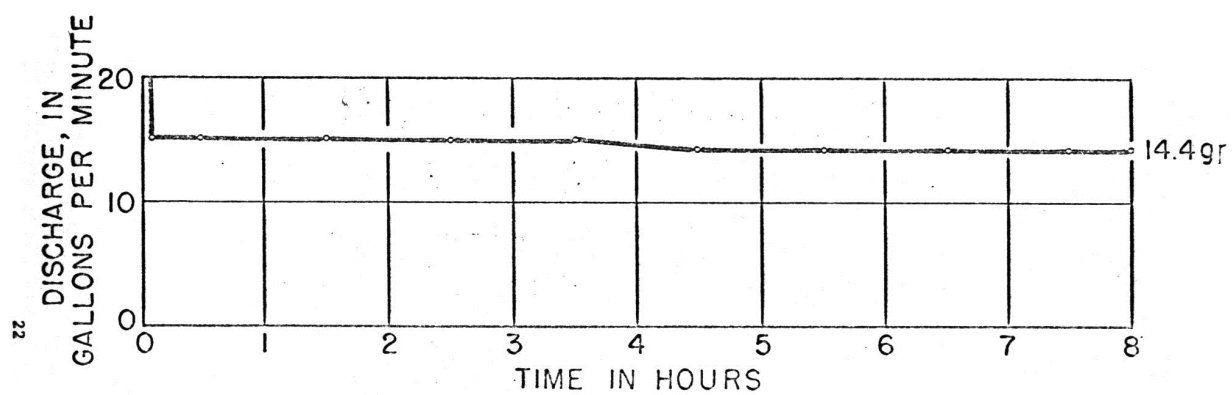


Figure 6.--Map of the Smokemont campground area.





Smokemont Campground
June 16, 1966
Depth, 85 feet
Static water level, 9.1 feet; Pump, 70 feet
Specific capacity, 0.24 gallons per foot of drawdown

Figure 7.-- Discharge of the first well at Smokemont Campground during the pumping test.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER ANALYSIS

Table 8. Chemical
quality of water from
first Smokemont Camp-
ground well.

W.R. Lab. No. NC 46150

Location <u>Smokemont Campground, 6 miles north of Cherokee, N. C.</u>			
Source <u>Great Smoky Mountains National Park, N. C. Drilled, cased 25 ft.</u>			
Depth: <u>85 ft.</u> Drilled: <u>6-16-66.</u> Collected well head. Owner: <u>NPS, Gatlinburg, Tenn.</u>			
Use: <u>Public Supply. WBF: Metamorphic complex. WL: static 9.1' below lip of casing.</u>			
Yield: <u>14.4 gpm pump mens. Prod. intervals from 25 to 55. Sampled after pump. 8 hrs.</u>			
Date of collection <u>June 16, 1966</u>			
Gage height (ft.)	Discharge (sec. ft.)	Temp. (°F)	<u>56</u>
(Parts per million)			
Silica (SiO ₂).....	<u>11</u>	Carbonate (CO ₃).....	<u>0</u>
Aluminum (Al).....	<u>.0</u>	Bicarbonate (HCO ₃).....	<u>12</u>
Iron (Fe).....	<u>.07</u>	Sulfate (SO ₄).....	<u>2.0</u>
Manganese (Mn).....	<u>.01</u>	Chloride (Cl).....	<u>1.4</u>
Calcium (Ca).....	<u>1.9</u>	Fluoride (F).....	<u>.1</u>
Magnesium (Mg).....	<u>.1</u>	Nitrate (NO ₃).....	<u>.1</u>
Sodium (Na).....	<u>1.5</u>	Phosphate (PO ₄).....	<u>.05</u>
Potassium (K).....	<u>.6</u>	.....	
Lithium (Li).....		.....	
(Parts per million)			
Dissolved solids:			
Sum.....	<u>25</u>	ABS.....	
Residue upon evapo- ration @ 180°C.....	<u>28</u>	Color.....	<u>2</u>
Hardness as CaCO ₃	<u>6</u>	.....	
Noncarbonate.....	<u>0</u>	.....	
pH.....	<u>6.2</u>	Specific conductance (micromhos at 25°C).....	<u>22</u>

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER ANALYSIS

Table 9. Chemical
quality of water from
Carver Branch.

W.R. Lab. No. NC 46746

3-5107.36

Location <u>nr. Smokemont - Smoky Mt. Nat. Park.</u>			
Source <u>Carver Branch. Coll. at intake. Supplemental supply stream for Smoke-</u> <u>mont Camp.</u>			
<u>Q = 0.28. Time: 1430. Air Temp: 68 °</u>			
Date of collection <u>July 27, 1966</u>			
Gage height(ft.) _____		Discharge(sec.ft.) <u>0.28</u> Temp.(°F) <u>60</u>	
(Parts per million)			
Silica (SiO ₂).....	7.4	Carbonate (CO ₃).....	0
Aluminum (Al).....		Bicarbonate (HCO ₃).....	10
Iron (Fe).....	.00 <u>1/</u>	Sulfate (SO ₄).....	1.4
Manganese (Mn).....		Chloride (Cl).....	1.0
Calcium (Ca).....	1.1	Fluoride (F).....	.0
Magnesium (Mg).....	.2	Nitrate (NO ₃).....	.1
Sodium (Na).....	1.4	Phosphate (PO ₄).....	.07
Potassium (K).....	.4	.....	
Lithium (Li).....		.....	
(Parts per million)			
Dissolved solids:			
Sum.....	18	ABS.....	.00
Residue upon evapo- ration @ 180°C.....	18	Color.....	5
Hardness as CaCO ₃	4	.....	
Noncarbonate.....	0	.....	
pH.....	6.7	Specific conductance (micromhos at 25°C).....	16

1/ In solution when analyzed.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER ANALYSIS

Table 10. Chemical
quality of water from
Carver Branch tributary.

3-5107.37

W.R. Lab. No. NC 46745

Location <u>nr. Smokemont, N. C. - Smoky Mtn. Nat. Park</u>			
Source <u>Carver Branch Tributary - Coll. above intake - primary supply station</u> <u>for Smokemont Campground.</u>			
Time: <u>1515.</u> Q = <u>27.5</u> gal/min. Air Temp: <u>74</u>			
Date of collection <u>July 27, 1966</u>			
Gage height(ft.) _____		Discharge(sec.ft.) <u>0.06</u>	Temp.(°F) <u>59</u>
(Parts per million)			
Silica (SiO ₂).....	<u>8.0</u>	Carbonate (CO ₃).....	<u>0</u>
Aluminum (Al).....		Bicarbonate (HCO ₃).....	<u>9</u>
Iron (Fe).....	<u>.00</u> <u>1/</u>	Sulfate (SO ₄).....	<u>.4</u>
Manganese (Mn).....		Chloride (Cl).....	<u>.2</u>
Calcium (Ca).....	<u>1.0</u>	Fluoride (F).....	<u>.0</u>
Magnesium (Mg).....	<u>.1</u>	Nitrate (NO ₃).....	<u>.2</u>
Sodium (Na).....	<u>1.3</u>	Phosphate (PO ₄).....	<u>.00</u>
Potassium (K).....	<u>.4</u>	.....	
Lithium (Li).....		.....	
(Parts per million)			
Dissolved solids:		ABS.....	<u>.00</u>
Sum.....	<u>16</u>	Color.....	<u>5</u>
Residue upon evapo- ration @ 180°C.....	<u>21</u>	.....	
Hardness as CaCO ₃	<u>3</u>	.....	
Noncarbonate.....	<u>0</u>	.....	
pH.....	<u>6.5</u>	Specific conductance (micromhos at 25°C).....	<u>14</u>

1/ In solution when analyzed.

Handwritten: 08-12-1969
A. R. Cogg.

Handwritten: EWR
8/14
[Signature]

L54 WSC-MW

August 12, 1969

Memorandum

To: Chief, Design and Construction, P.S.C.
Attention: Mecislavas Rumbaitis

From: Supervisory Hydraulic Engineer, WSC

Subject: Test Well at Smokemont Campground, Great Smoky

As requested by Mr. Rumbaitis of your office, we are transmitting the final report on the test well drilled at Smokemont Campground during 1968. Please file the report in Water Rights Docket No. 28 for record purposes.

(Sgd.) Richard W. Ketcham

Richard W. Ketcham

Enclosure

cc:
Chief, Division of Water Resources w/enc.
WSC-MW
Mr. Ketcham

RWKetcham:nsw 8/12/69

Smokemont Campground

As a part of the cooperative program between the U. S. National Park Service and the U. S. Geological Survey, a proposed well site was selected in June 1968 near the Smokemont Campground in Swain County, N. C.

The campground offers tent and trailer camp sites with drinking water and toilet facilities for about 150 families. The National Park Service plans to double the present facilities and estimates that 50 gpm (gallons per minute) will be required to meet future needs. The source of the existing water supply for the campground is a tributary to Bradley Fork of the Oconaluftee River, but it is inadequate to meet the needs of the planned increase in the facilities.

In an effort to obtain additional water for the expansion of the campground, a well was drilled at the site in June 1968 (fig. 3.1). The site is about 750 feet north of a gate, which is on the north side of the campground, about 150 feet south of a fork in the road, the east fork of which leads to the source of the present water supply, and on the east side of the Bradley Fork of the Oconaluftee River.

The Smokemont Campground is situated on a hillside about 10 feet above the Bradley Fork stream bed at an altitude of about 2300 feet above mean sea level. Flood plains occur along Bradley Fork both upstream and downstream from the site, but the valley is narrow and the valley walls are steep at the site.

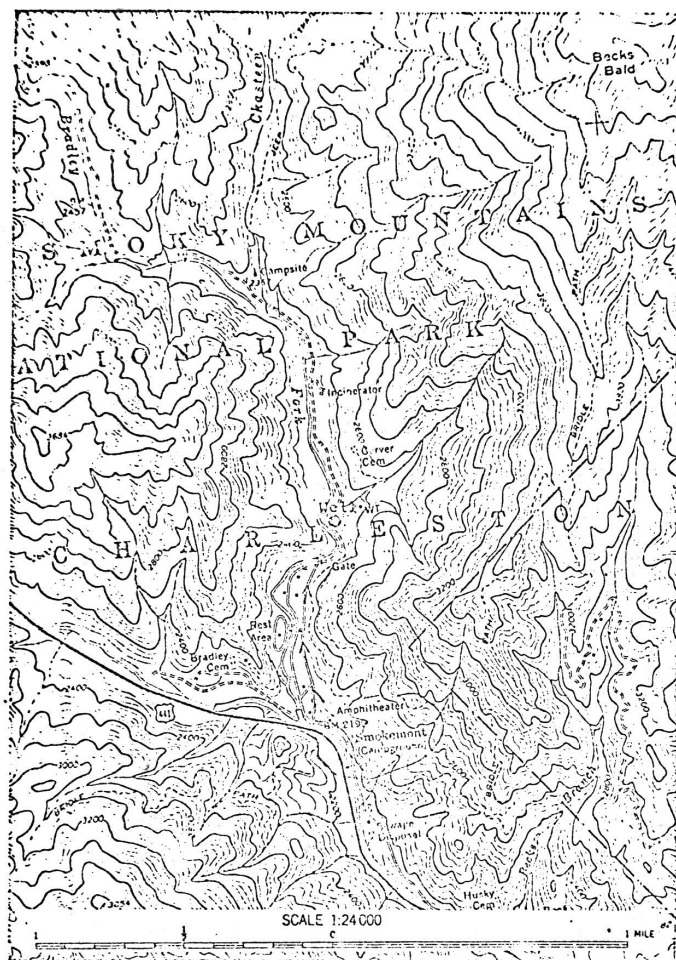
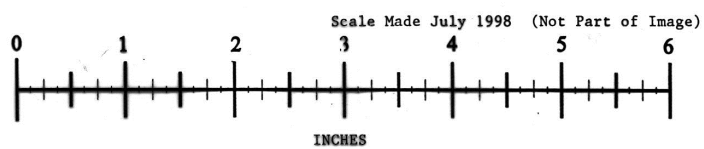


Figure-3.1.--Location of well at Smokemont Campground.



Smokemont Campground is underlain by alluvial sand and gravel. The alluvium is underlain by the Thunderhead Sandstone of the Great Smoky Group in the Ocoee Series. The Thunderhead Sandstone consists mainly of coarse-grained feldspathic quartz sandstone or arkose, interbedded with thinner layers of pebble conglomerate, subgraywacke, and dark-gray or black slate or phyllite. Joint or fracture systems are well developed in the area and have produced paths more susceptible to erosion for the stream channels to follow. The water-yielding characteristics of these rocks depend on the degree to which fractures are open to the movement of ground water. The fractures generally yield water at shallow depths. Below depths of about 150 feet the fractures decrease in size and number, hence are less capable of yielding significant quantities of water.

A six-inch well was drilled to a depth of 150 feet on June 10-11, 1968, then cased to a diameter of eight inches at this site. A log of the well follows:

<u>Depth</u>	<u>Description</u>
0 - 17 feet	Alluvium; sand and gravel.
17 - 32	Partially weathered feldspathic sandstone, surface casing set at 23 feet.
32 - 65	Feldspathic sandstone, yield about 30 gpm at 45 feet, red at first, turning muddy, gradually clearing.
65 - 110	Dark gray dense sandstone, yield 60 gpm at a depth of 100 feet.
110 - 150	Mica schist, increase in yield below 100 feet.

At the time of completion, the static water level was 15.0 feet below the top of the casing, or 13.0 feet below the land surface.

On July 9, 1968, a three horsepower submergible test pump was installed in the well at a depth of 140 feet. The well was pumped for about one hour while the discharge valve was being calibrated. After the water level had recovered, the well was tested at several different rates, after being pumped for about 5-1/2 hours, however, mechanical trouble with the pumping system made it necessary to pull the pump and postpone the test.

On August 7, the pump, having been repaired, was again installed in the well at a depth of 140 feet. The well was pumped 15 minutes to calibrate the discharge valve, the water level was allowed to recover for 25 minutes to its static level, and the well was tested at several different rates ranging from 22 gpm to 59 gpm for a total of about 3-1/2 hours. Figure 3.2 is a graph showing the drawdown in the well related to time since pumping began. The well was pumped at 22 gpm in the first step, 30 gpm in the second step, 45 gpm in the third step, and 58 gpm in the fourth step. During each step the water level declined rapidly at first in response to the increased pumping rate, then declined slowly. It was not until the fourth step, pumping at 58 gpm, that the water level declined about one foot below the bottom of the casing. After 195 minutes of pumping the discharge valve was opened fully in an attempt to increase the pumping rate. (In pumping the well before the rate of about 100 gpm was attained.) However, because the pump was already using all the power produced by the generator, the pumping rate could not be increased and the pump was stopped and the recovery of the water level was measured.

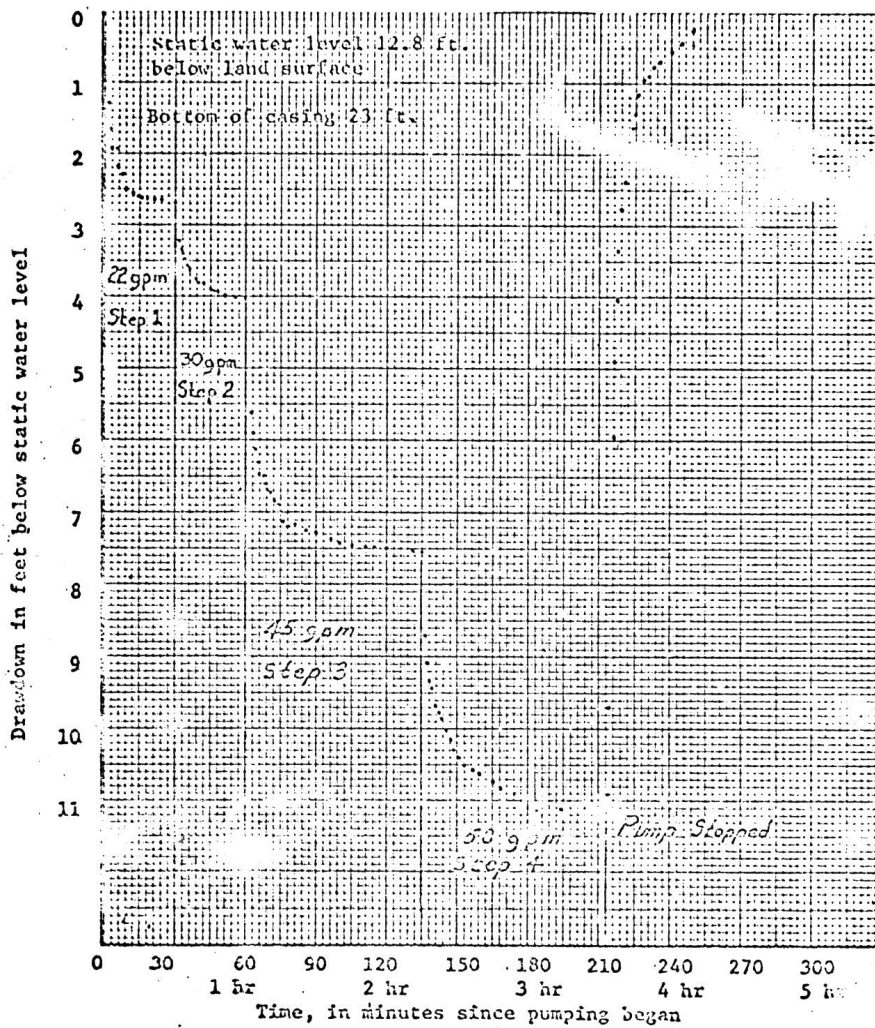


Figure 3.2.--Smokemont pumping test, August 7, 1968.

The specific capacity of the well ranged from 8.3 gpm per foot at a pumping rate of 22 gpm, to 3.7 gpm per foot of drawdown at a pumping rate of 58 gpm. The drawdown in the well reached the bottom of the casing while pumping at 58 gpm. At higher pumping rates dewatering of the rock fractures will occur. In view of the decrease in specific capacity each time the pumping rate increased, it probably is not desirable to pump the well at rates in excess of 60 gpm for extended periods.

Samples of the water at the beginning and at the end of the test were analyzed by the U. S. Geological Survey laboratory in Raleigh, North Carolina. The results are shown in tables 3.1 and 3.2. The water is of excellent quality except that it is slightly acidic and may be somewhat corrosive to metal.

Analysis of the drawdown data collected during the first step of the test suggests that the fractures supplying the well are recharged nearby. It is probable that Bradley Fork is the source of the recharge. and, if so, it might be desirable to consider chlorinating the water from this well.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER ANALYSIS

W.R. Lab. No. NC 50089

Location Smokemont Campground, 8 miles north of Cherokee, N. C. -County: Swain			
Source Drilled well. Depth: 150 ft. Date drilled: June 1968. Collected at discharge pipe. Owner: Great Smoky Mountains National Park, Gatlinburg, Tenn.			
Use: Public supply. Water-bearing formation: Gneiss. Water level: static 13 ft. below land surface. Yield: 5 gpm. Appearance when collected: Cloudy.			
Producing interval: 23 to 20 ft.			
Date of collection July 9, 1968			
Gage height(ft.)		Discharge(sec.ft.)	
		Temp.(°C) 13	
(in milligrams per liter)			
Silica (SiO ₂).....	13	Carbonate (CO ₃).....	0
Aluminum (Al).....		Bicarbonate (HCO ₃).....	18
Iron (Fe).....	.13	Sulfate (SO ₄).....	1.6
Manganese (Mn).....		Chloride (Cl).....	.7
Calcium (Ca).....	2.4	Fluoride (F).....	.1
Magnesium (Mg).....	.5	Nitrate (NO ₃).....	.2
Sodium (Na).....	3.0	Phosphate (PO ₄).....	.02
Potassium (K).....	2.2	.....	
Lithium (Li).....		.....	
(in milligrams per liter)			
.....	33	ABS.....	
.....	32	Color.....	5
.....	8	.....	
Noncarbonate.....	0	.....	
.....	6.4	Specific conductance (microhm at 25°C).....	34

Table 3.1.--Chemical analysis of water sampled at beginning of test.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
WATER ANALYSIS

W.R. Lab. No. NC 50155

Location Smokemont Campground, 8 miles north of Cherokee, N. C. - County: Swain			
Source Drilled well. Drilled: 1968. Owner: Great Smoky Mountains National Park, Gatlinburg, Tenn. Use: Public supply. Water-bearing formation: Crystalline rock. Water level: 26 ft (pumping) below top of casing. Yield: 50 gpm.			
Appearance when collected: Clear. Producing intervals: 23 to 80 ft. Sampled after pumping 3 hours.			
Date of collection August 7, 1968			
Gage height (ft.)		Discharge (sec. ft.)	Temp. (°C) 12
(in milligrams per liter)			
Silica (SiO ₂).....	13	Carbonate (CO ₃).....	0
Aluminum (Al).....	.1	Bicarbonate (HCO ₃).....	14
Iron (Fe).....	.10	Sulfate (SO ₄).....	1.6
Manganese (Mn).....	.01	Chloride (Cl).....	.5
Calcium (Ca).....	2.9	Fluoride (F).....	.1
Magnesium (Mg).....	.3	Nitrate (NO ₃).....	.1
Sodium (Na).....	2.4	Phosphate (PO ₄).....	.15
Potassium (K).....	.6	.....	
Lithium (Li).....		.....	
(in milligrams per liter)			
Unfiltered solids:		ABS.....	
Total.....	29	Color.....	0
Residue upon evapo- ration @ 100°C.....	33	.....	
Hardness as CaCO ₃	8	.....	
Non-carbonate.....	0	.....	
.....	6.0	Specific conductance (microhms at 25°C).....	27

Table 3.2.--Chemical analysis of water sample at end of test.

Other Supporting Information

PROPOSED SITES FOR WATER RESOURCES INVESTIGATION

1. Park Headquarters
2. Green Mountain (Foothills Parkway)
3. Newfound Gap
4. Cades Cove
5. Deep Creek
6. Smokemont
7. Abrams Creek
8. Twin Creeks
9. Collins Creek
10. Metcalf Bottoms
11. Cataloochee
12. Elkmont
13. Cosby
14. Chimneys
15. Rocky Mountain (Foothills Parkway)
16. Webb Mountain (Foothills Parkway)
17. Little Greenbrier
18. Greenbrier
19. Sinks
20. Towstring
21. Indian Camp Creek
22. Tremont Ranger Station
23. Round Bottom Campground
24. Balsam Mountain Campground
25. Main Oconaluftee Residential Area
26. Old Oconaluftee Residence Area (Ravensford)
27. Big Creek Ranger Station
28. Cataloochee Ranger Station
29. Cataloochee Maintenance Area
30. Twentymile Ranger Station
31. Cherokee Orchard
32. Sugarlands

(09/28/67)

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : Gerald Rowe, Chief of Maintenance
Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

DATE: September 7, 1967

FROM : W. M. McMaster, USGS, WRD
Knoxville, Tennessee

SUBJECT: Summary of work plans for study of water resources of Great Smoky Mountains
National Park, North Carolina and Tennessee Districts

As I promised you on August 11, I am sending you our plans for the study of water resources of Great Smoky Mountains National Park that have been modified as a result of a meeting between North Carolina and Tennessee U. S. Geological Survey personnel July 6-7, 1967.

W. M. McMaster
W. M. McMaster
Hydrologist

cc: Edward J. Kennedy, Chief, Tenn. District
Ralph C. Heath, Chief, N. C. District



5010-108

Buy U.S. Savings Bonds Regularly on the Payroll Savings Plan

Summary of work plans for study of water resources of Great Smoky Mountains
National Park, North Carolina and Tennessee Districts

Sept. 7, 1967

At a meeting in Knoxville during July 6-7, 1967, North Carolina and Tennessee personnel discussed modification of plans in the study of water resources of the Great Smoky Mountains National Park. Those who attended the meeting were: Ralph C. Heath, North Carolina District Chief; Edward J. Kennedy, Tennessee District Chief; D. R. Rima, Assistant District Chief for Tennessee; Nat Thomas, G. C. Goddard, and E. F. Hubbard of North Carolina; and W. M. McMaster of Tennessee.

At the meeting it was agreed that the effort in both districts should be combined under leadership of one individual; McMaster was delegated project leadership. McMaster will be responsible for ground water interpretive aspects of the study and Hubbard will be responsible for surface water interpretive aspects.

The final product will be a hydrologic atlas of the Smokies area, published by the Geological Survey, that will consist of the 1:125,000 base map upon which will be delineated ground water and surface water information. Ground water occurrence and availability will be shown as a series of patterns, each defining a range between a minimum, a maximum, and an average of expected well yields within the area covered by the pattern. These areas are expected to be established by topographic criteria, geologic location, estimated soil thickness, and background information provided by test wells drilled during the course of the study. If a test well appears capable of yielding the desired quantity of water for water supply at the drilling site, a pumping test will be run.

Surface water information will be indicated by isopleths of minimum flow in cubic feet per second per square mile at the 2-year 7-day recurrence interval, based on a series of low-flow measurements made during the course of the study, at a total of about 100 sites throughout the Park distributed so as to define variations in flow with location and altitude. It is hoped that these sites can be measured a total of 6-8 times following periods of about 7 days of no rainfall.

Ground water and surface water chemical quality will be described, based on results of analysis of water from test wells and samples collected from streams. A series of coliform analyses of stream water is planned to define possible areas of contamination.

An explanatory text and supplementary illustrations will be included. The atlas is expected to provide the NPS engineer a basis for planning future developments of any kind in the Park for which knowledge of water resources is required.

Consideration will be given to popular-type brochure for distribution to Park visitors, describing and illustrating the occurrence of water in the area and its role in shaping the mountains.

Test drilling and reporting will continue to be handled by the District in which the site is located.

Plans are to complete the text of the final report by May 1969 for transmission through final review prior to publication. However, if insufficient opportunities to collect low-flow measurements occurs during the remaining time through November 1968, it is hoped that supplementary funds will be available from NPS to make additional measurements during the following year.

725-9-17-65-

LS4 SER(OLW)

SEP 14 1965

[Handwritten signature]
ARC
WAZ 9/17

Memorandum

To: Superintendent, Great Smoky Mountains
From: Acting Assistant Regional Director, Operations,
Southeast Region
Subject: Water Resources Investigations, Great Smoky Mountains
National Park

We will be glad to assist you in developing a detailed water resources study at Great Smoky Mountains National Park during the 1966 fiscal year as requested in your memorandum of August 23. The results produced from such a study should provide us with the basis for a full and most effective development of all water resources located within the Park boundaries. It is evident that new sources of water are needed to meet the demands of future and existing Park facilities.

We believe the investigative work should include the following:
(1) The first and most pressing problem involves the need to expand several water supply systems in order to provide more water to take care of a greater number of Park visitors and increased Park uses. This requires an evaluation of the probable capacity of the present sources of supply and the locating of possible new sources of water supply of acceptable quality for increased demands of the future and (2) The second phase of the project (extending over a period of several years) would be to conduct surface and ground water studies throughout the Park in order to obtain a general knowledge of all water resources. With such information at hand, the Park staff will be able to plan efficiently for new or expanded developments.

An over-ceiling item was included in the 1966 F.Y. Regional Water Resources Program in the amount of \$26,000 to initiate a study of domestic water supply needs and test well drilling work at the Park. Mr. E. W. Reed, Chief, Water Resources, has recently advised that at present the Washington Office reserve contains sufficient funds to finance this study.

We agree a meeting and field reconnaissance should be held at the Park between representatives of the U. S. Geological Survey, the Regional Office and the Park staff to properly formulate a logical approach to this water resources project. In early October, we will take the necessary action to firm up a satisfactory date for the meeting with all those concerned.

(SIGNED)

W. Mikell

cc:

~~Director, w/c of inc.~~

Chief, RODOC (2), w/c of inc.



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Great Smoky Mountains National Park
Gatlinburg, Tennessee 37738

Y REFER TO:
L54

August 23, 1965

EAST REGION	
AUG 26 1965	
Regional Director	
Asst. Reg. Dir. (A)	26
Asst. Reg. Dir. (CA)	
Asst. to Reg. Dir. (PA)	
Asst. to Reg. Dir. (DI)	
Resource Studies Asst.	

X *Paul Water*
Main

Memorandum

To: Regional Director, Southeast Region

From: Superintendent, Great Smoky Mountains *lost Lile*

Subject: Water Resources Investigations, Great Smoky Mountains National Park

Over the past couple of years, continued increases in demands on the numerous surface water supplies have gradually developed into a problem that needs immediate attention. While it is recognized that in the past we have shown little or no interest in water resources investigations, it now appears that well supplies may not only be a desirability but a necessity. During periods of prolonged drouth such as we are now experiencing in the Park, the surface supplies diminish to the point of nearly drying up, and supplemental supplies of low quality water are heavily treated and pumped into the supply lines.

During USPHS Engineer Henderson's recent trip to the Park, we had occasion to closely observe several of our major supplies. For example, we found that the Ash Hopper Branch gravity supply that ordinarily supplies headquarters was providing 19 gallons per minute (actual meter readings) over a period of a week. The consumption at this time was metered at 35,000 to 37,000 gallons per day and so, needless to say, we had to pump a supplemental supply out of a branch of Fighting Creek which runs through the residential area. We actually were only able to obtain a maximum of 15 gallons per minute from this supply. Incidentally, this creek pumping station is only a couple of hundred feet from the first domestic user and less than 1,000 feet from our major development area which definitely does not allow the desired chlorine retention time for safe water treatment. Also, when you realize that our actual usage exceeded an average of 25 gallons per minute and all available water in the system amounted to 34 gallons per minute, it is easy to see there is little margin for any emergency whether it be a leak in the line, any type of fire drawdown or allowance for any consideration of lawn sprinkling. If either of these supplies decrease further, we do have several alternatives in order to retain a minimum supply on hand.

By metering, we have determined that we are wasting 13,000 gallons per day through our Visitor Center dehumidifier system. This is quite a luxury and one that needs some study as to the possibility of re-circulation of this water. If our present supply should decrease any further, we would of course have to shut down the dehumidifier system which would have rather detrimental effects on artifacts storage as well as causing the Visitor Center to be rather uncomfortable.

Further checks on other major supplies in the Park showed similar conditions but none as critical as that that exists in the Headquarters area. If at all possible, and if it can be worked into your Water Resources Investigation program as an emergency measure, we would like to suggest the programming of an exploratory well for this fall. While we have little information on the characteristics of wells in this area, Mr. Henderson felt that a well programmed for 100-foot depth with rotary drill method (possible heavy river boulder sub-surface) should provide a plentiful supply for the area. On this basis, it appears that funds in the construction amount of \$2,500 would be needed to drill, case and test the well.

In an August 19 telephone conversation between Hydraulic Engineer Vick of your office and Chief of Maintenance Rowe, Mr. Vick had mentioned that he had put an over-ceiling item in his 1966 F.Y. Water Resources budget in the amount of \$24,000 to initiate a study of Park domestic water supply needs. We support this program whole-heartedly and hope that a necessary field inspection involving personnel from the USGS, the Regional Office, and the Park can be set up for the month of November. / /

As suggested to Mr. Vick in the abovementioned telephone call, the following listing is a tentative priority list of well investigations which we would like to see programmed:

1. Headquarters -- As soon as possible.
2. Green Mountain Picnic Area, Foothills Parkway -- 1967 F.Y.
3. Cades Cove -- 1967 F.Y.
4. Cataloochee -- 1967 F.Y.
5. Rocky Mountain -- 1967 F.Y.
6. Chilhowee, Foothills Parkway -- 1968 F.Y.

7. Cades Cove -- 1968 F.Y.
8. Deep Creek -- 1968 F.Y.
9. Smokemont -- 1968 F.Y.
10. Chimneys -- 1969 F.Y.
11. Elkmont -- 1969 F.Y.
12. Cosby -- 1969 F.Y.
13. Webb Mountain, Foothills Parkway -- 1969 F.Y.



George W. Fry

Form 10-174
(June 1963)UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

FACE SHEET FOR COMPLETION REPORT

Park Great Smoky Mountains National Park	Region Southeast	Work Order No. 14X1035
Location in Park Smokemont Campground and Headquarters Area	State(s) North Carolina and Tennessee	Year Programmed 1963
	County or Counties Swain and Sevier	PCP No. U-227
☐ Contract and/or ☒ Day Labor		Master Plan No. NP-GSM 3161
Work Order Title Sanitary Disposal Stations for Travel Trailers (2)		Master Plan Corrected By ----
		As Built Drawings By ----
		Date Started September 1963
		Date Completed June 1964
DESCRIPTION OF FIXED ASSETS (For completion by employee in charge of project)		TOTAL COSTS (For completion by FFO)
Utilities, Water Systems 100.8-1		
Smokemont:		)
Intake, 500 gallon storage, chlorinator,		)
850 L.F. supply and distribution line,		) 2,320.00
4 outlet valves		)
Headquarters:		)
31 L.F. distribution spur, 2 outlet valves		) 348.00
Utilities, Sewer Systems 100.8-2		
Smokemont:		)
Drain and apron, 32 L.F. lateral		) 580.00
Headquarters:		)
Drain and apron, 15 L.F. lateral, 750 gallon septic tank and drain field		) 580.00
TOTAL		\$ 3,828.00

DISTRIBUTION		THE FIXED ASSET DESCRIBED ABOVE HAS BEEN COMPLETED IN ACCORDANCE WITH APPROVED DRAWINGS, SPECIFICATIONS, AND AUTHORIZED CHANGES	
No.	To	Submitted By: <u>James A. Stites</u>	Title: <u>Supvy. Civil Engineer</u> Date: <u>11-16-64</u>
Orig. 1	DIRECTOR	Approved By: <u>Robert H. Sharp</u>	Title: <u>Acting Superintendent</u> Date: <u>11-20-64</u>
1	SEEO	COSTS VERIFIED BY: <u>Joseph G. W. Patton</u>	Title: <u>Accounting Officer</u> Date: <u>11-19-64</u>
1	EODC		

SANITARY DISPOSAL STATIONS FOR TRAVEL TRAILERS (2)
Smokemont Campground
Headquarters Area
Work Order No. B-57 GSM

Maintenance personnel accomplished the construction of this project under the supervision of a Foreman III (B&U) and the Maintenance Supervisor as a day labor project. Similar facilities were installed at Smokemont and at Headquarters.

Smokemont Disposal Station

This portion of the project consists of a 4" sanitary drain with bronze cover, connected to the Smokemont campground sewer main (to disposal plant), cast into a concrete slab to receive the trailer sewage. A water supply with hose to flush the trailer sanitary system and to wash down the disposal facility is included. It proved most economical to provide a small separate water supply system to serve the disposal station, horse concession and sewage disposal plant. Personnel constructed a water intake structure across a small stream sufficiently above the elevation of the outlet facilities to provide a gravity-flow system. To make the water safe for drinking, and to provide for a maximum drawdown, maintenance personnel installed a hypochlorinator with concrete block structure on the intake line, and a 500 gallon steel storage tank.

Distribution of potable water was made to the disposal station, to the Smokemont horse concession with a 25' spur, and to the Smokemont sewage treatment facilities with a 150' spur. Consonant with Park practices, personnel constructed and installed signs which provide directional information to the disposal station, and a sign at the site with instructions for proper usage.

This portion of the project was started in the late fall season, and delay was encountered due to inclement winter weather.

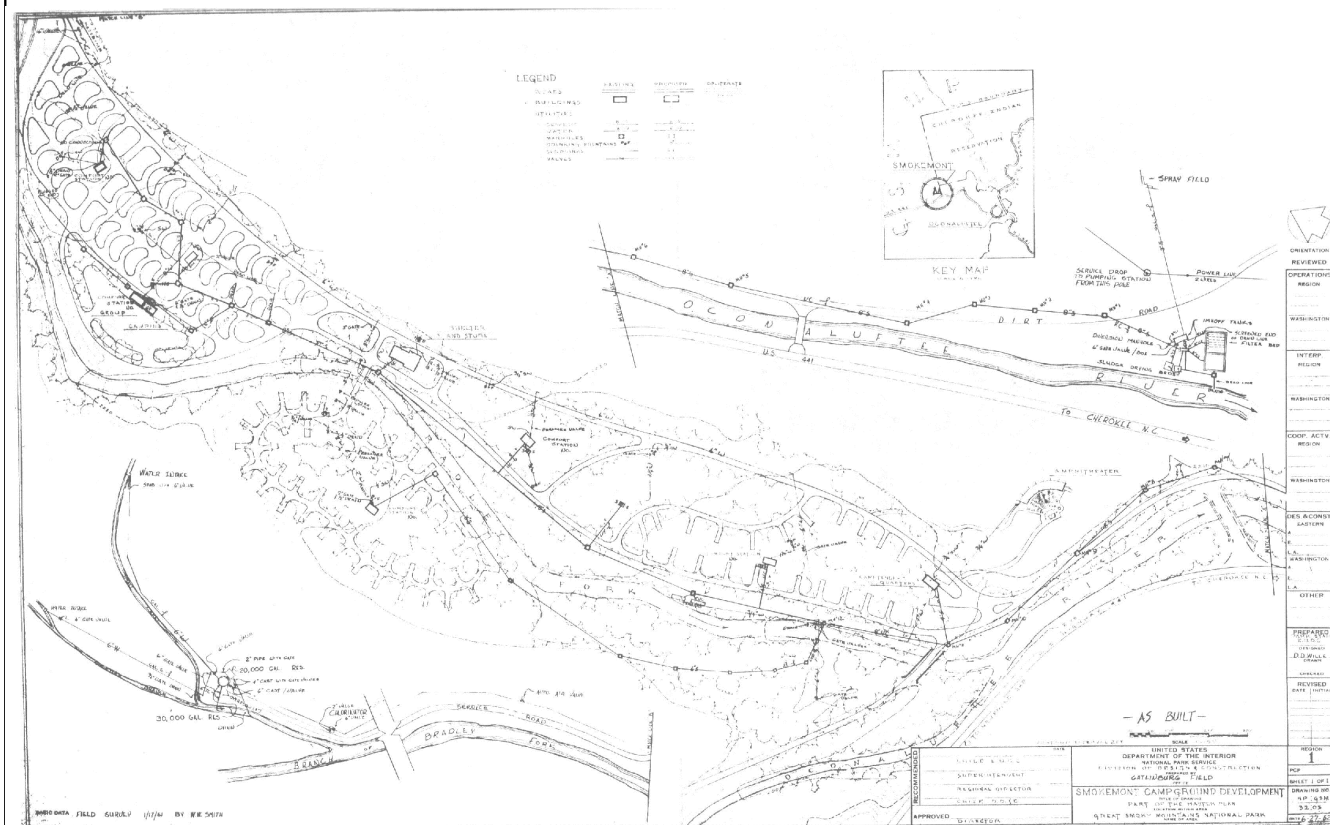
Headquarters Disposal Station

This portion provides a visitor use facility essentially the same as that at Smokemont. Water supply is provided by a 25' spur from the Headquarters area supply system water main. Sewage disposal is provided by a 750 gallon septic tank and disposal field. Work on this portion of the project was begun in May and completed in June with no unusual delays in progress.

Finding of the Facts and Explanation
for Day Labor Work

In the interest of visitor services and public health, it is advantageous to provide facilities for sanitary disposal of travel trailer wastes. This project was performed in cooperation with the Mobile Homes Manufacturers Association to provide adequate facilities in this Park.

The primary reasons for performing this work as a day labor project were its size and informality. It would not support the cost of detailed planning inherent in contract procedures. The amount of work in the project was insufficient to be advantageous to contractors.



Docket Information

Number of Documents in Docket 41

Documents Dated from 11/16/1964 to 3/11/1970

Docket Compiled: 6/2/2016