



WATER-RIGHT DOCKET

Shenandoah National Park

Docket No: 2

SKYLAND WATER SYSTEM

State Water Rights Documentation

06-10-1964: water well completion report for skyland #4 (well #2)

COMMONWEALTH OF VIRGINIA DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT DIVISION OF MINERAL RESOURCES JAMES L. CALVER, COMMISSIONER		VDMR 1033 WWCR 83
MAILING ADDRESS: Box 3667, University Sta. Charlottesville, Virginia		OFFICE ADDRESS: McCormick Road Charlottesville, Virginia
WATER WELL COMPLETION REPORT		
OWNER: National Park Service (Shenandoah)	Mailing Address: Luray, Virginia	
TENANT: Skyland #4 (Well #2)	Mailing Address: 619 Brandon Ave., SW Roanoke, Virginia	
DRILLER: Frank W. Martin Drilling Company	Mailing Address: 619 Brandon Ave., SW Roanoke, Virginia	
WELL LOCATION County Page - on county line Approx. 500 feet west (direction) of Skyline Drive at Skyland and feet miles (direction) of		
(GIVE DIRECTION AND DISTANCE IN FEET OR MILES FROM TWO REFERENCE POINTS - ROADS, TOWNS, RIVERS, ETC. - ON COUNTY HIGHWAY OR OTHER MAP)		
DATE STARTED: 5/18/64 DATE COMPLETED: 5/25/64		
TYPE OF DRILL RIG USED: Air Rotary TOTAL DEPTH 500 feet		
WATER LEVEL: Stands 81 feet below surface OR has NATURAL flow of gallons per minute.		
YIELD TEST: Method Pump		
Drawdown 351 feet		
Rate 25 gal. per min.		
Duration 24 hrs., min.		
WATER ZONES: from 64 to 65 feet		
from 99 to 100 feet		
from ? to ? feet		
WATER: Color Clear Taste None		
Odor None Temp ? °F		
WELL TO SUPPLY: (check one) Home		
Farm Town School		
Industry Other Lodges, restaurant		
WATER ANALYSIS AVAILABLE: Yes ☒ No		
DRILL CUTTINGS SAVED: Yes ☒ No		
(DRILL CUTTINGS SHOULD BE COLLECTED AT 10 FOOT INTERVALS. THESE SAMPLES MAY BE SHIPPED TO THIS OFFICE EXPRESS COLLECT. SAMPLE BAGS ARE FURNISHED FREE OF CHARGE UPON REQUEST)		
REMARKS: <i>I think this is headwaters well</i> <i>P.W.</i>		
(LOG OF WELL) OVER		

LOG

FURNISHED BY: Frank W. Martin Drilling Co. DATE: 6/10/64
Shenandoah National Park - Skyland #4 (Well #2)

DEPTH (feet)		TYPE OF ROCK OR SOIL PENETRATED (gravel, clay, etc., hardness, color, etc.)	REMARKS (water, caving, shot, screen, sample, etc.)
FROM	TO		
0	40	Boulders - dirt	
40	52	Shale rock	
52	225	Shale rock	Water at 65' and 100'
225	305	Greenstone	
305	415	Greenstone	
415	465	Greenstone	
465	500	Greenstone	Light green and gray

(Use additional forms if necessary)

Land History

(Rev. 1958)

DEPARTMENT OF THE INTERIOR NATIONAL PARK SERVICE
FIXED PROPERTY RECORD

DESCRIPTION OF PROPERTY (Include reference to the location within the Park, how the asset was acquired, name of contractor, etc.)

Location: Skyland - Central District

One Spring
 One 50,000 Gallon Concrete Reservoir - 200,000 gal. reservoir
 One Concrete Pumphouse, Bldg #17-2, 154 Sq. Ft.
 12,743 Linear Feet of Pipe
 Two Stone Masonry Drinking Fountains
 Nine Fire Hydrants

Pumping System

Constructed by OGE, Force Acct. 1938-1958

S	DATE	REFERENCE		QUANTITY			COST		
		Journal Vn.	Other	Unit	No. of Units	Accumulated Total	Direct Costs	Indirect Costs	Accumulated Costs
1	8/27/59	37-10		System	1				25,700.00
2	2/23/60	37-65						2,419.99	27,119.99
3	11/29/60	37-90				1	154.26	86.98	27,660.83
4	3/4/63	37-71					8,201.43	1,563.10	37,425.45
5	11/12/64	37-125				1	21,337.00	3,413.92	62,176.37
G.L. Acct.		General Classification			Sub-Classification		Region	State	Park or Office
300.8		Utilities			Water System		One	Wn.	NHP

LINE	DATE	REFERENCE		Unit	QUANTITY		COST		
		Journal Vow	Other		No. of Units	Completed Total	Direct Costs	Indirect Costs	Accumulated Costs
6	1/25/65	Brought Forward				1			62,176.37
7	1/25/67	37-67				1	2,515.03	402.55	65,094.85
8	5/31/65	37-116				1	3,600.00	576.00	69,270.85
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
L. Acct.	100.8	General Classification			Sub-Classification		Region	State	Park or Office
		Utility			Water System - C. Land				

Supporting Hydro Data

193-a. 6-10-25.

Gals. per min.

Daily Gage Height, in Feet, and Discr

1 Second-Foot, of Trapping Spr.

Now Now Grounds

**River
Cooks**

*- Shenandoah National Park, Va.
New

for the Year ending September 30, 1937.

Drainage Area _____ Square Miles.

Water Resources Engineers Observer.]

	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH
DAY	Gage height Discharge <i>Cals/min</i>	Gage height Discharge <i>Cals/min</i>	Gage height Discharge <i>Cals/min</i>	Gage height Discharge <i>Cals/min</i>	Gage height Discharge <i>Cals/min</i>	Gage height Discharge
1			4.0		25	
2	1.5	8.4				
3	2.0	8.4			25	
4		8.4			25	
5	1.5			20.0	22.5	
6	1.5	7.0		20.0		
7	1.5	6.0	6.0	20.0		
8	1.5			22.5	22.5	
9	1.5	6.0	7.0	20.0		
10	1.5	6.0	7.0			
11				20.0		
12	1.5	6.0		20.0	17.5	
13	1.5	6.0		20.0		
14	1.5			20.0		
15	1.5			20.0		
16	1.5	6.0		20.0		
17	25	5.0				
18		5.0				
19		5.0				
20	15.5	5.0				
21	13.5	5.0				
22	11.7					
23						
24		5.0				
25		5.0		38	55	
26				34		
27		5.0		34		
28		5.0				
29						
30	8.4	3.0		28		
31	8.4					
TOTAL,						
can						
cond-feet per square mile						
m-off, depth in inches.						
m-off in acre-feet						

[illegible]

9-192-a. 6-10-25.

Daily Gage Height, in Feet, and

Gallons per min.
arge, in Second-Feet, of

Fur Spring Weir #1

River
Creek-At in Shenandoah National Park, Va.
-Near-

for the Year Ending September 30, 19.....

Drainage Area Square Miles.

[Water Resources Engineers Observer.]

DAY	1935 ~~December~~ June		1935 ~~November~~ July		1935 ~~December~~ August		1935 ~~January~~ September		1935 ~~February~~ October		M.
	Gage height	Discharge Gals/min	Gage height	Discharge Gals/min	Gage height	Discharge Gals/min	Gage height	Discharge Gals/min	Gage height	Discharge Gals/min	
1						25				51	
2						25				47	
3				25		25		66		43	
4								66		43	
5		61		22		22		124		39	
6		47		22		22		124			
7		47		19		25		124			
8				31		22				35	
9				43		22		124		31	
10				39		22		124		31	
11				35				110		31	
12				35		19		110		31	
13		43		35		19		110			
14		43				19		103		31	
15		43		35		19				28	
16				35		19				25	
17		43		31		19					
18		39		31				103			
19		39		31		22		96			
20		39		31		39		83			
21		35				61		110			
22		35		31		66					
23				31		66					
24		31		31		66		66			
25		31		31				61			
26		31		31		66		56			
27		31		31		66		56			
28		31				66		56			
29		28		31		66					
30		28		28		66		51			
31				28		66					
TOTAL											
Mean											
Second-feet per square mile											
Run-off, depth in inches											
Run-off in acre-feet											
Maximum											

Linnell Spring

[illegible]

D 5080

March 2, 1961

Memorandum

To: Regional Director, Region One
From: Superintendent, Shenandoah
**Subject: Auxiliary Water Supply and Standby Pumping Equipment,
Skyland Developed Area**

For several years the amount of water used by the concessioner in the Skyland area has been accurately recorded. The consumption of water has increased each year as new accommodations were added to the development. Last year a total of 4,841,600 gallons was used, with very heavy loads during the summer months.

For instance, the amount used during July was 881,600 gallons. This is an average daily consumption of almost 30,000 gallons, with the weekend peaks well above 30,000 gallons. Practically all of this water is used by the concessioner in the large dining hall and the numerous lodge units.

The present source of water for the area is Furnace Spring, with flow readings varying from 15 to 75 gallons per minute. The average flow from this spring is approximately 50 GPM. During the dry period last fall, the flow dropped to 15 GPM. Should this condition occur during a peak use period, we would not be able to supply the amount of water required. (Minimum flow required to sustain operation is 20 GPM.) Such shortage would completely disrupt concessioner operations. A reliable water supply in this area is very essential for protection of the Park. During dry periods, Kettle Canyon, near Skyland, presents the greatest fire hazard of any area in the Park.

The present water system consists of a 5,000-gallon concrete clear well, concrete pump house, $\frac{7}{8}$ HP three-phase electric power pump, two 50,000-gallon underground reservoirs, approximately two miles of supply and distribution lines, and miscellaneous accessories. The electric power pump was installed in 1949, and, to date, it has given good service without major repairs. Standby electric motors are available, but the pump (Fairbanks-Morse twin piston type - 40 GPM at 180 PSI) is badly worn. This type pump is no longer manufactured, and repair parts may be difficult to obtain. Electric power for this pumping station is obtained from the remote end of a long transmission line which traverses the rugged northwest slopes of the Blue Ridge Mountain range. To date, electric service

has been good, but there are definite possibilities of prolonged power failures. Since the pump motor requires three-phase power, it would not be practical to use an auxiliary electric power unit.

In view of the above facts, we believe immediate action should be taken to increase the reliability of this water supply system.

Dr. E. Robert Hopkins, with the State Geologist, is conducting a water resources study in the Park, and the Skyland area has been given top priority. Adverse weather conditions have prevented Dr. Hopkins from completing his study of this area, but we believe it is possible to drill a production well in the vicinity of the existing pumping station.

In order to initiate and promote this badly needed project, we have prepared a PCP in the amount of \$9,600.00 for auxiliary water supply and standby pumping equipment at Skyland. The Class B estimate for this PCP is based on the assumption that a satisfactory water well can be installed near the existing pumping station. If a well cannot be developed in this area, the estimate will have to be revised.

A copy of Dr. Hopkins' study, with recommendations on the area, will be sent to you when it is complete.

We would like for this PCP to be given high priority in order that the water system may be improved before the beginning of the 1961 peak use season.

(SND) W. TAYLOR HOSKINS

E. Taylor Hoskins
Superintendent

Attachments

In duplicate

Copy to: Chief, ESBC, w/copy of attachment

Supervisory Park Engineer

JMSump/jbc



UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Region One
Richmond 20, Virginia

IN REPLY REFER TO

D5039

SHENANDOAH NATL. PARK	
JUN 13 1959	
☒	Superintendent
☒	Asst. Sup.
☒	Chief Ranger
☒	Engineer
☒	Land Architect
☒	Historian
☒	Admin. Officer

Memorandum

To: Superintendent, Shenandoah National Park

From: Regional Chief of Operations

Subject: Water Systems at Big Meadows, Panorama and Skyland

The attached copy of the concessioner's letter of August 6 discusses the park water systems in relation to the subject mentioned developments. We should like to have your comments on his statements and on the following:

Big Meadows

Two points are made which we think need basic support; the adequacy of the supply and the inadequacy of the storage facilities. We do not believe that the example of the sprinkler head is necessarily an indication that the storage capacity is too small. Any leak in excess of the minimum spring flow, if allowed to continue long enough, might deplete the available storage. You should have your engineer estimate the daily average and the maximum daily consumption for the ultimate development at Big Meadows. We believe you have meter readings and other data which may be used as a basis for such an estimate and for extending present consumption into the future. These figures can be checked against the capacity of the source and pump, and the amount of storage needed can be determined.

Panorama

With the new water system, we can get two fire streams of about 50 gpm each. With a total storage of 70,000 gallons these streams could be thrown for 10 hours which should be of more than sufficient duration. Mr. Bemiss says the supply here is adequate. Is it? What is the minimum flow of the spring? We should also like to know how much water in gpm Mr. Bemiss needed for his sprinkler system.

Skyland

The 50,000 gallon storage tank would last for 4 hours using two 100 gpm fire streams. We do not know what the minimum flow of the spring is for this supply, nor the rate at which the pump delivers. Your engineer should estimate the requirements for the ultimate development at this site also, so that there will be some factual data on which to base enlargement of the storage facilities and the need for searching for a new supply.

In reply refer to:
DSQ39

September 24, 1959

Memorandum

To: Regional Director, Region One
From: Superintendent, Shenandoah National Park
Subject: Water Systems at Big Meadows, Panorama and Skyland

This is in reply to Mr. Smith's memorandum of September 16, forwarding a copy of the concessioner's letter of August 6 discussing the Park water systems in relation to the subject mentioned developments. Our comments and the information requested are as follows:

W8

Big Meadows

We agree that the points needing basic support are the adequacy of the supply and the inadequacy of the storage facilities. At the present time, we have a 50,000 gallon reservoir at this location. The source of water is Lewis Spring, and the electric pump has a maximum capacity of 46 g. p. m. There is installed in the pump-house a gasoline stand-by pump which will deliver approximately 20 g. p. m. in case of emergency.

The minimum flow of Lewis Spring was recorded on September 17, 1957 when the out-put was 38.6 g. p. m. Some other recent observations are given below:

August 16, 1957	-	47.2 g. p. m.
December 20, 1957	-	196.0 g. p. m.
February 20, 1959	-	186.0 g. p. m.
March 20, 1959	-	166.0 g. p. m.
May 11, 1959	-	156.0 g. p. m.
July 31, 1959	-	64.8 g. p. m.

During August of this year, the total water consumption at Big Meadows was 1,087,400 gallons, or a daily average of 35,077 gallons. These figures are from actual meter readings. However, the use during week-ends was noted at approximately 40,000 gallons per day. Of the total amount, the concessioner facilities used 618,900 gallons, and the Park activities consumed 468,500 gallons.

Panorama

The minimum flow of the source spring was recorded on September 16, 1957 when the out-put was 5.0 g. p. m. Some other readings follow:

August 16, 1957	-	7.5 g. p. m.
December 19, 1957	-	6.8 g. p. m.
February 20, 1958	-	10.0 g. p. m.
October 22, 1958	-	14.0 g. p. m.
March 20, 1959	-	27.6 g. p. m.
May 11, 1959	-	18.8 g. p. m.

There are two other unused springs in the vicinity having a combined out-put approximately equal to the source spring which could be used for additional supply if desired.

The above data and field survey information were furnished to the Public Health Service and EDC personnel for use in the design of the system. As you know, the new water system at Panorama was completed this past summer, but the facilities there were not operated, so we have no actual experience on its performance. It is understood that there may be some loss of water from the source, and this will be investigated and corrected as far as possible by our Park maintenance forces before next season.

As to the amount of water needed by the concessioner for the sprinkler system, we have asked Mr. Davis to get the information for us from his architects. As soon as the data is available, we will furnish it to you.

Skyland

The minimum flow of the supply spring was recorded on September 17, 1957 when the out-put was 14.0 g. p. m. Some other recent readings were:

August 16, 1957	-	17.5 g. p. m.
December 20, 1957	-	99.2 g. p. m.
February 20, 1959	-	51.8 g. p. m.
March 20, 1959	-	99.2 g. p. m.
May 11, 1959	-	99.2 g. p. m.
July 31, 1959	-	24.5 g. p. m.
August 18, 1959	-	21.6 g. p. m.
August 31, 1959	-	18.8 g. p. m.

The electric pump will deliver a maximum of 46 g. p. m. We have no stand-by pumping equipment at Skyland, but it may be possible to install a gasoline unit in the pump house for emergency operation by re-arranging the existing pumping plant.

Last month, the total water consumption at Skyland was 920,900 gallons, or a daily average of about 30,000 gallons. Peak-day use has been approximately 36,000 gallons.

As near as we can determine from the Master Plan and from the concessioner, it appears that the ultimate development at Skyland will result in an expansion of 50% greater than at present. Using this as a basis, the ultimate daily average would be 45,000 gallons, and the peak-day use would be 54,000 gallons.

When sufficient water is available, our present pump could deliver something over 60,000 gallons per day. However, it will be seen that with a possible minimum spring flow of 14.0 g. p. m., only 20,000 gallons of water per day could be supplied. As previously reported, we have had a few instances in recent years, when the consumption at Skyland exceeded the out-put from the source, and we were facing the prospect of hauling water on an emergency basis to supply the demand. Fortunately, we were able to get by with the reserve amount in the reservoir. However, it seems to us that even under present circumstances, additional sources of water are urgently needed.

We hope that the foregoing will supply the information desired by Mr. Smith. As indicated earlier, we will furnish the data concerning the Panorama sprinkler system as soon as we get it from the concessioner.

If there is other information we can provide, please let us know.

R. Taylor Hopkins
Superintendent

In duplicate

WWZ/mtv

660-05

UNITED STATES
DEPARTMENT OF THE INTERIOR
SHENANDOAH NATIONAL PARK
LURAY, VIRGINIA

June 17, 1935

Mr. O. C. Taylor, Deputy Chief Engineer,
National Park Service,
Washington, D. C.

Dear Mr. Taylor:

I am transmitting herewith drawing No. NPS - SHN 6016,
showing a proposed water development for a portion of Skyland.

All that is proposed at present is the construction of a
50,000 gal. reservoir at Raggy Spring - which is located on
the north side of the present entrance road, and at an elevation of 3616 - and approximately 1000 feet of two inch pipe
leading to Field Cabin, which is now being used as a comfort
station.

The proposed installation can be incorporated in the
final design of the Skyland water system, and by extension,
will furnish all of the lower part of Skyland, except on
days of heavy usage and in unusually dry seasons. Throughout
the fall and spring, this system should supply all of
Skyland's needs, by confining its activities to the lower
section.

I feel that it is imperative to make this installation
at once, so as to provide an adequate quantity of water to
operate Field Cabin independently of Mr. Follocks system,
which is pumped from Furnace Spring.

I will appreciate approval of this project so that we
can get the installation under way and completed in time to
serve our needs the latter part of July.

Sincerely yours,

J. R. Lassiter,
Engineer in Charge

JRL/tta

cc: Director
Mr. Peterson

Skyland Water Supply - Consists of
two springs (Furnace & Keggy Springs)
and two wells. Not clear whether
water of two springs and well 2 are
chlorinated but well 4 (1 & 3 are not holes)
is chlorinated. System, Keggy Spring
may not be used any more.

National Park Service
Contract No. 14-10-0137-0169

Final Report #2
SKYLAND AREA
Shenandoah National Park

On June 30, 1961 the drilling of three test holes was completed at Skyland; one of these test holes was converted into a water well. On May 18, 1964 the Frank W. Martin Drilling Company began drilling the second Skyland water well at the site referred to as "Proposed Well No. 1" in the Skyland Addendum, December 27, 1963. During drilling operations, field examination of the drill cuttings by geologists from the Division of Mineral Resources resulted in the recommendation that the new well be terminated at a depth of 500 feet.

Geology

As mapped and noted in previous reports by this Division, three major rock units occur in the Skyland Area; the Pedlar (lower, or oldest), Swift Run, and the Catoclin (upper, or youngest) formations. Of these, it was determined that only the Swift Run Formation possesses primary as well as secondary permeability, the Pedlar and Catoclin formations having only secondary (cleavage and fracture) permeability. It was requested by Park officials that the well sites be located on the developed (west) side of Skyline Drive where the water is to be used and where the reservoir is located. As this is the "recharge" side for the formations that are inclined to the southeast, it was considered necessary to locate the second water well near the Skyline Drive. It was also necessary to recommend the entire thickness of the primary aquifer (Swift Run Formation) be penetrated, this depth being estimated as 600 feet. An additional 100 feet of drilling was recommended to obtain water from any fractures in the upper portion of the Pedlar Formation. As subsurface dip of the formations often varies from measured surface outcrops, the recommended total depth was 700 feet, plus or minus 100 feet.

- 2 -

Well Drilling

It was anticipated that 10 to 15 gallons per minute could be obtained from the Swift Run Formation, and possibly an additional 5 to 10 gallons per minute from water-filled fractures in the Pedlar Formation. Incomplete driller's reports do not indicate whether aquifers other than those penetrated at 64 and 99 feet below ground level were encountered, and much hydrologic and some sample data were not obtained from the lower half of the well. Part of the difficulty in obtaining this data is attributable to the driller's unfamiliarity with the rock types to be drilled, his inexperience with drilling deeper than 400 feet, and he had improper equipment to accomplish deep drilling. After some delay, additional equipment was obtained and the well drilled to 500 feet; it is doubtful that drilling could have been continued to the contracted depth. Field examination of the drill cuttings on May 24, 1964, revealed the subsurface dip of the formations is less than that of measured outcrops to the west, and the top of the Pedlar Formation was reached at approximately 365 feet rather than 600 feet as expected. It was therefore recommended that the upper 135 feet of the Pedlar Formation be drilled, and drilling terminated at 500 feet.

Quantity of Water

Because adequate test-pumping equipment was not immediately available, the pump test was not conducted until June 9, 1964. At that time a 24-hour test was made with a final yield of 25 gallons per minute; no water-level recovery data was kept by the driller. Although a tested discharge of 25 gallons per minute was recorded, drawdown data make it questionable if a sustained yield of 25 gallons per minute can be maintained throughout the summer months. After 20-2/3 hours of the test the drawdown curve began a sharp decline from which it never recovered or stabilized; the reason no further decline of the curve was measured during the final 2 1/3 hours of the test is because the pumping level had reached the bottom of the air line, below which no water levels could be

- 3 -

measured. How far the pumping level would have declined if the pump intake was lower, the airline longer, and the test continued another 24 hours is unknown. Small aquifer zones throughout the Swift Run Formation, and possibly one or two small fractures in the Pedlar Formation, furnish water to the hole; it is possible these aquifers will adequately recharge the well to stabilize the pumping level at around 450 feet with a sustained yield of 15 to 20 gallons per minute.

Quality of Water

Water samples from the well were collected by Park officials on June 22, 1964, and submitted to this Division for partial chemical analysis. The water is slightly acidic (pH 6.8), and no turbidity was noted; the remainder of the analysis is as follows (in parts per million):

Total Hardness	30.0	Phosphate	0.80
Calcium Hardness	10.0	Iron	0.20
Sulfate	15.0	Nitrate	0.03
Silica	1.0	Manganese	0.00

Provided the bacteria tests are negative, the water is of good quality. The only chemical treatment that might be considered beneficial would be for the reduction of the iron content; United States Public Health Service acceptable limit is 0.25 parts per million. As the amounts of some mineral constituents in water from new wells sometimes is reduced after the well has been pumped for a few weeks, iron treatment should be deferred until after the well has been in regular production for a month and a new iron analysis made.

Recommendations

In the concluding paragraph of the December 27, 1963, Skyland Addendum it was recommended that two wells be drilled and the data used to select the location for a third; 1500 feet of drilling depth was approved for these wells.

- 4 -

Inasmuch as a sufficient quantity of water was apparently obtained at the first site, Park officials decided no further drilling was necessary. Because of the possibility that the new well will not produce 25 gallons per minute under sustained pumping during the summer months, it may be necessary to obtain additional water. If so, all data from the existing two wells and two test holes at Skyland should be re-evaluated before further drilling is undertaken.

Enclosed are copies of the Water Well Completion Report form, pump-test data sheets, drawdown curve, and geologic log. This well, labeled Skyland #4 (Well #2), has been recorded in the permanent repositories maintained by this Division as Page County Well #83, Well Repository #1033.

Virginia Division of Mineral Resources
Charlottesville, Virginia
March 12, 1965

**Addendum
Skyland Area
Shenandoah National Park**

**National Park Service
Contract No. 14-10-0137-0150**

Additional geohydrologic investigations were conducted in the Skyland Area at the request of Shenandoah National Park Officials (R. T. Hoskins' letter, September 27, 1963) who consider the present water supply inadequate for planned future expansion. The locale of this investigation is the portion of Skyland west of the Skyline Drive between the north and south entrances to the Area.

Geology

The three rock units that occur in the Skyland Area are the Pedlar, Swift Run, and Catoclin formations that have been described in a previous report on the Area (Virginia Division of Mineral Resources - March 16, 1961). The areal distribution of the formations is shown on the accompanying geologic map. The Swift Run formation is the only one of these rock units that possesses primary as well as secondary permeability.

Drilling Recommendations

Proposed Well No. 1 is located 450 feet north of the southern entrance to Skyland, and approximately 50 feet east of the Swift Run - Catoclin contact. The well should penetrate 50 feet of weathered

material and greenstone of the Catoclin formation, and encounter the upper contacts of the Swift Run and Pedlar formations at approximately 50 and 600 feet, respectively. The hole should terminate 100 feet in the Pedlar formation in order to explore the permeability of the lower Swift Run metasediments and fracture openings in the upper Pedlar granodiorite. As subsurface dips and formation thicknesses are often different from measured surface exposures, the total depth may vary 100 feet plus or minus from the anticipated 700 feet.

The site for proposed Well No. 2 is approximately 350 feet west of the three test holes drilled in 1961. This location is in a west-plunging draw that is underlain by the uppermost part of the Pedlar granodiorite. Although this formation has virtually no primary permeability and in general is not well fractured, most fractures present are near the top of the formation. This, together with relatively good recharge, may be conducive to a moderate yield from a well less than 200 feet deep. Other factors considered in the selection of this site were the nearness of existing roads, electric power, and water mains.

Whereas proposed well numbers 1 and 2 have a combined estimated footage of approximately 900 feet, the remainder of the 1500 feet allotted for drilling (Proposed Water Well Drilling Cost Estimate - J. M. Stump, September 26, 1963) will be used for proposed Well No. 3. The drilling site for this well will be selected

following completion and evaluation of all data from proposed well
numbers 1 and 2.

Virginia Division of Mineral Resources
Charlottesville, Virginia
December 27, 1963

WATER SYSTEMS - SHENANDOAH NATIONAL PARK

Dec. 1959

General

Water supply systems have been developed in fifteen separate areas in Shenandoah National Park. Additional systems will be required as new areas are opened and the Skyline Drive is extended. Some of these are little more than a developed spring, a drinking fountain and connection pipe line.

Where practical, gravity supply systems are developed and at other points pumping plants are installed. The present system may be classified as follows:

<u>Group</u>	<u>Gravity Supply</u>	<u>Pumped Supply</u>
1	Serving Park Operator, Public and Government.	
	Panorama Swift Run Gap Elk Wallow Dickey Ridge	Starland Big Meadows
2	Serving Public & Govern- ment only.	
	Sexton Knoll Hazed Mountain Hughes River Gap Naked Creek Parking Area Bald Face Mountain South River Picnic Grounds Pass Mountain Clear Spring	Lewis Mountain

Charge for Water Service

This report deals with the water systems which jointly serve the National Park Service and the park operators (Group 1) where the cost of water service furnished is prorated on the basis of use.

Cost and utilization information has been estimated based upon limited data accumulated over the period November 1, 1958 — November 30, 1959. As more complete data is obtained any necessary change in the rates can be made. Most of these installations have been equipped with water meters for measuring the output of the system and the individual consumption.

At certain developed areas where the park operator conducts operations and where park visitors, other than patrons of the park operator, assemble, the

WATER SYSTEM - SHENANDOAH NATIONAL PARK

Reference W-2

Investment

May 1958

Panorama - 1957 CCC jobs 119-120

20,000 gal. concrete tank 18'x18'x9'	\$900.00	
Spring development - 3 springs	850.00	
Wier Recorder House	300.00	
500 ft. 4" terra cotta pipe at spring @ 20¢	100.00	
1200 ft. 3" C.I. pipe @ \$1.10	1,450.00	
1000 ft. 1½" galv. W.I. pipe @ 40¢	400.00	
Water meters, 2 - 3/4"	75.00	
1 - 1½"		
		<u>\$4,055.00</u>

Skyland - 1956-57 WPA job 9.

50,000 gal. concrete tank 53" dia. x 8' deep buried	\$2,500.00	
Spring development	550.00	
Pump house 14' x 16' - 2 story	1,285.00	
Pump equipment - 380 ft. head		
45 GPM - 2 Cyl.-reciprocating pump (F-M)		
7½ HP motor, 2 phase, 220 volt		
Automatic control, 2300 ft. #10/2 parkway control cable		
Electric heater, chlorinator	1,615.00	
3500 ft. 6" C.I. pipe @ \$1.26	\$4,410.00	
2500 ft. 4" C.I. pipe @ .94	2,350.00	
3000 ft. 3/4" galv. W.I. pipe @ .30	900.00	7,660.00
30 building entrance services	280.00	
20 pressure reducing valves	140.00	
Water meters 1 - 2½"	100.00	
1 - 1½"	40.00	140.00
6 Fire Hydrants 4 @ \$100	\$400.00	
		<u>\$15,950.00</u>

Water System - Operating Costs - Shenandoah National Park.

December 1939.

Description of System	Shenandoah		Mt. Washington		Great Smoky Mts.		Elk Mt.		Mud Run		Total		Unit Charge Per H. Gal.
	Int.	Dist.	Int.	Dist.	Int.	Dist.	Int.	Dist.	Int.	Dist.	Int.	Dist.	
Investment (Int. & Dist.)	\$4,000		\$15,000		\$17,500		\$1,445		\$6,100		\$19,187		
Depreciation Rate													
Int.	80%	20	61%	16%	1,310	151	680	84	5,450	171	232	12	104
Dist.	85%	25	67%	17%	1,500	232	70	2	1,740	55	17,405	485	
Int.	2,500	45	4,115	82	4,115	82	685	14	1,740	208	1,550	41	
Dist.	100		486		566		50				478		
Annual Operating Costs													
Electric Energy		25		324		580		20		50		75	54
Labor		25		100		100		20		50		75	24
Total Annual Costs		150		500		500		20		50		75	64
Annual Water Output H. Gal.	2,500		4,500		8,000		1,500		1,000		1,500		234

Average Unit Cost - \$4.540 - \$0.25 per H. Gal.
19,500

SKYLAND AREA
Shenandoah National Park

The three major rock units exposed in the vicinity of Skyland are the Pedlar, Swift Run, and Catoctin formations described in a previous Skyland report (Va. Div. of Mineral Resources, March 16, 1961). On the east side of Skyland drive between Milesposts 43 and 44 the strike of these formations is approximately N 5° E and the dip, 11° E.

The Swift Run formation is the only one of the three rock units that possesses primary permeability, and the lateral exposure of this formation is greatest near the Skyline Drive about 4000 feet south of the south entrance to Skyland. The width of the exposure decreases to the south and to the north. A minor structural feature is indicated and this probably accounts for the relatively low, flat, seep area east of Timber Hollow Overlook. The perennial surface water and topographic conditions here provide greater recharge to a larger drainage area than is present on the west side of Skyline Drive.

Test hole No. 1, located about 2000 feet east of Timber Hollow Overlook, has an estimated total depth of 200 to 250 feet. The test hole will begin in the Catoctin, penetrate approximately 100 feet of Swift Run, and terminate 20 feet in the Pedlar formation. The final location for test hole No. 2 is dependent upon examination of drilling data from test hole No. 1, but is tentatively located approximately 1900 feet northeast of test hole No. 1. Test hole No. 2 will begin in the Catoctin, penetrate approximately 120 feet of Swift Run, and terminate 20 feet in the Pedlar formation. The estimated depth of this hole is 250 to 300 feet.

VIRGINIA DIVISION OF MINERAL RESOURCES
Charlottesville, Virginia
December 28, 1962

National Park Service
Contract No. 14-10-0137-109

SKYLAND AREA
Final Report

Drilling of the three proposed wells at Skyland was begun on June 13, 1961, by the Valley Drilling Corporation, Mr. O. L. Payne, driller.

In brief, the results were as follows:

Well No. 1

Location: approximately 200 feet southwest of Skyland
pumphouse
Total depth: 70.1 feet
Casing depth: 29 feet
Final yield: 7 gallons per minute

Well No. 2

Location: approximately 130 feet southeast of Well No. 1
Total depth: 233 feet
Casing depth: 51 feet 4 inches
Drilling yield: 55 gallons per minute
Pumping capacity: 40 to 50 gallons per minute

Well No. 3

Location: approximately 90 feet north of Well No. 2,
location moved in field from that shown on
Skyland report of March 17, 1961.
Total depth: 162 feet
Casing depth: 43 feet 8 inches
Final yield: 3 gallons per minute

Well No. 2 should be developed as the producing well with a regulated yield of between 40 and 50 gallons per minute. The water enters Well No. 2 from multiple fractures in the lower quartzitic portion of the Swift Run formation. Some of these fractures also provide channel-ways for the water to Furnace Springs. Wells No. 1 and No. 3 have a low yield because of a lack of fractures or the fractures are "tight" and will not permit the ready flow of water.

The quality of water from the production well (No. 2) will be determined in the near future by the Public Health Service.

The Furniss Spring Project is located at the head of Dry Run and, similar to the Lewis Spring Project, is on the edge of a large area of talus formation. The general layout plan and detail of structures for this project are shown on PLATES VI and VII. The 100 feet of collecting gallery shown on the sketch rests on a solid rock ledge with receptacles B, C, D and E, located on clay from 15 to 20 feet higher in elevation. Receptacle G encloses the original Furniss Spring the main supply of which bubbles up through the sand in the bottom of the receptacle with some coming in from the sides. The flow collected by receptacles B, C, D and E might be called seepage as it consists of a number of small underground streams coming out close together at an elevation 10 to 15 feet higher than the bed rock on which the collecting gallery rests. In order to collect these flows a wall, which is a part of the receptacle, was constructed in front of the flow and the footing of the wall extended up to and in under the supply. On this base was laid two layers of tile pipe cemented together and covered with large stones followed by crushed stone and sealed with a 4-inch concrete slab. The flow from these receptacles is taken to the main 8-inch tile line in the collecting gallery. Each of the receptacles carry an extra 4-inch tile line to take care of the overflow. An area of talus formation from 10 to 15 feet deep lies between receptacles B, C, D, E and the bed rock on which the cut-off wall of the collecting gallery is located. Water was seeping through this formation following the bed rock at the base of the talus formation and through a height of about 3 feet above the base. Therefore, in order to collect this flow, the 100 feet of collecting gallery was constructed, detail shown by section M-M. It consists of a cut-off wall set on rock and the concrete footing gradually worked back to the break or point of seepage. An 8-inch tile pipe, covered first with large stones and then smaller stones, is used to collect the flow. The entire gallery is covered with a concrete slab to protect it and to keep out surface waters. The flow is collected in a chamber from which a 4-inch pipe feeds the pumping reservoir and an 8-inch pipe takes care of the overflow.

780

FURNISS SPRING PROJECT
WATER SUPPLY for SKYL.

PLATE VI

FURNISS SPRING PROJECT
WATER SUPPLY for SKYLAND

PLATE VI

Receptacles "B, C, D and E" (see detail)

Receptacle "G" (see detail)

11' of 4" closed tile

22' of 4" closed tile

21' of 4" closed tile

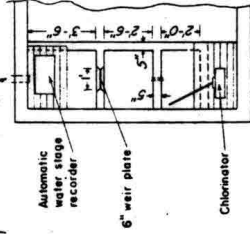
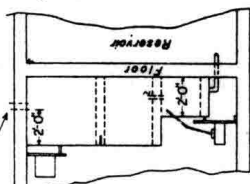
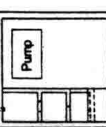
34' of 4" closed tile

8" conc. slab on bottom
and 4" conc. slab on
top of ditch8" conc. out-off
wall 2'-0" high4" closed tile
overflow

4" closed tile

Cut-off wall
2'-0" highCollecting chamber
(see detail)

GENERAL LAYOUT PLAN

Detail of flow measurement, purification, and
distribution equipmentNote: Reinforced concrete used
on all installations
Earth fill depth up to 4 ft.
covers all installations12' x 12' concrete
basin containing
pump, automatic
recorder, 6" weir
and reservoir
(see detail)

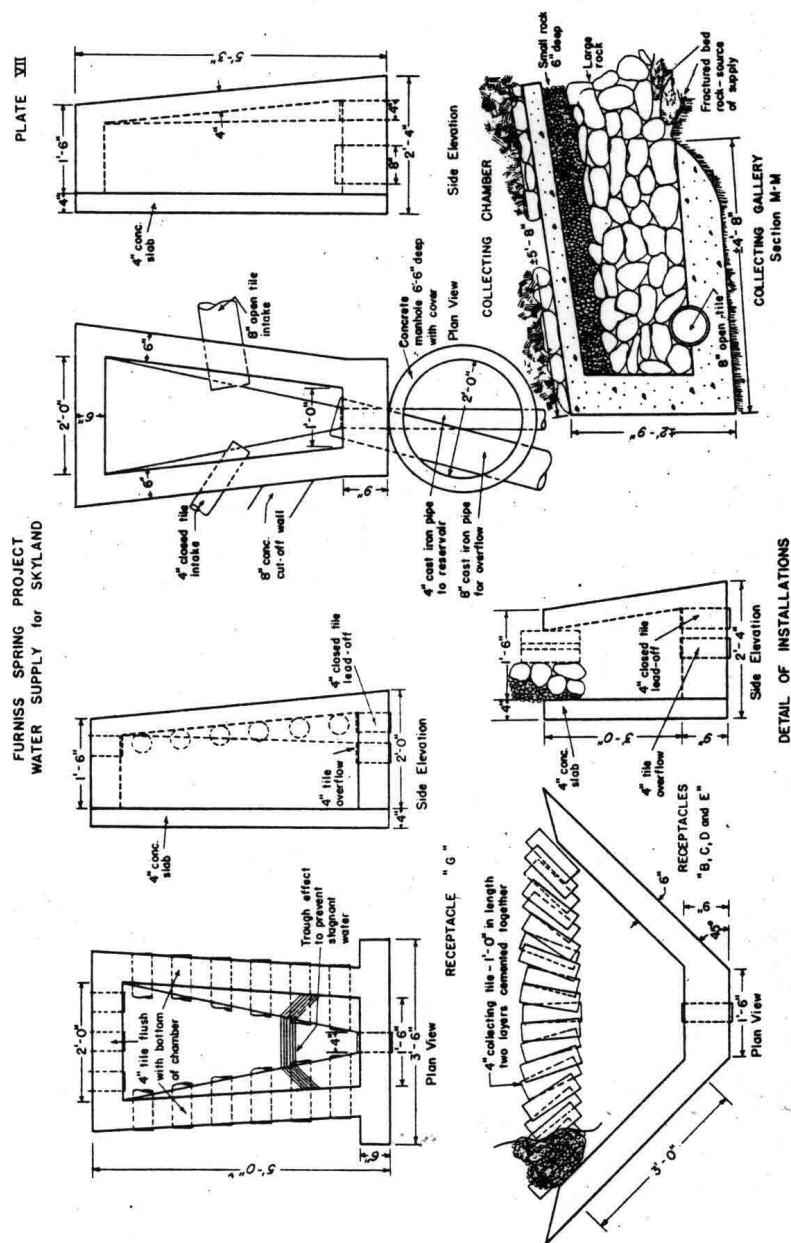


PLATE VII

Furniss Spring - Weir No. 1

Location.-- 50 feet above riding trail, 200 feet northeast of old Skyland road, about one-fourth mile northeast of Skyland resort and 1,700 feet west of Stony Man.

Establishment.-- Established June 5, 1934.

Equipment.-- A 6-inch 90 degree V-notch weir installed in a concrete spring box. (See photographs). Flow from weir is caught in concrete receptacle and directed through 3-inch pipe line to supply tank for pumping to Skyland.

Records of flow.-- June 5, 1934 to May 31, 1935; record continued after May 31, 1935.

Elevation.-- Mean sea level elevation 3,432 feet.

Remarks.-- Gage read several times a week. Measurements of flow made by volumetric method. Flow from Furniss Spring Weir No. 2 is included in this record.

Average.-- Average discharge shown on form 9-192a is not the mean discharge for the month but the average discharge for the number of days on which discharge is recorded.

Furniss Spring - Weir No. 2

Location.-- 70 feet south of Furniss Spring Weir No. 1 about one-fourth mile northeast of Skyland resort and 1,700 feet west of Stony Man.

Establishment.-- Established June 4, 1934.

Equipment.-- A 6-inch 90 degree V-notch weir installed in a small concrete spring box (See photographs). Flow from this weir is caught in a concrete receptacle and directed through 2-inch pipe line to spring box at Furniss Spring Weir No. 1.

Records of flow.-- June 4, 1934 to May 31, 1935; record continued after May 31, 1935.

Elevation.-- Mean sea level elevation 3,439 feet.

Remarks.-- Gage read several times a week. Measurements of flow made by volumetric method.

Average.-- Average discharge shown on form 9-192a is not the mean discharge for the month but the average discharge for the number of days on which discharge is recorded.

Trapping Spring - Pow Wow Grounds

Location.-- On western edge of Pow Wow grounds about 800 feet west of Skyline Drive, 1,000 feet south of Bushy Top peak and three-fourths mile northwest of CCC Camp No. 1.

Establishment.-- Established April 4, 1935.

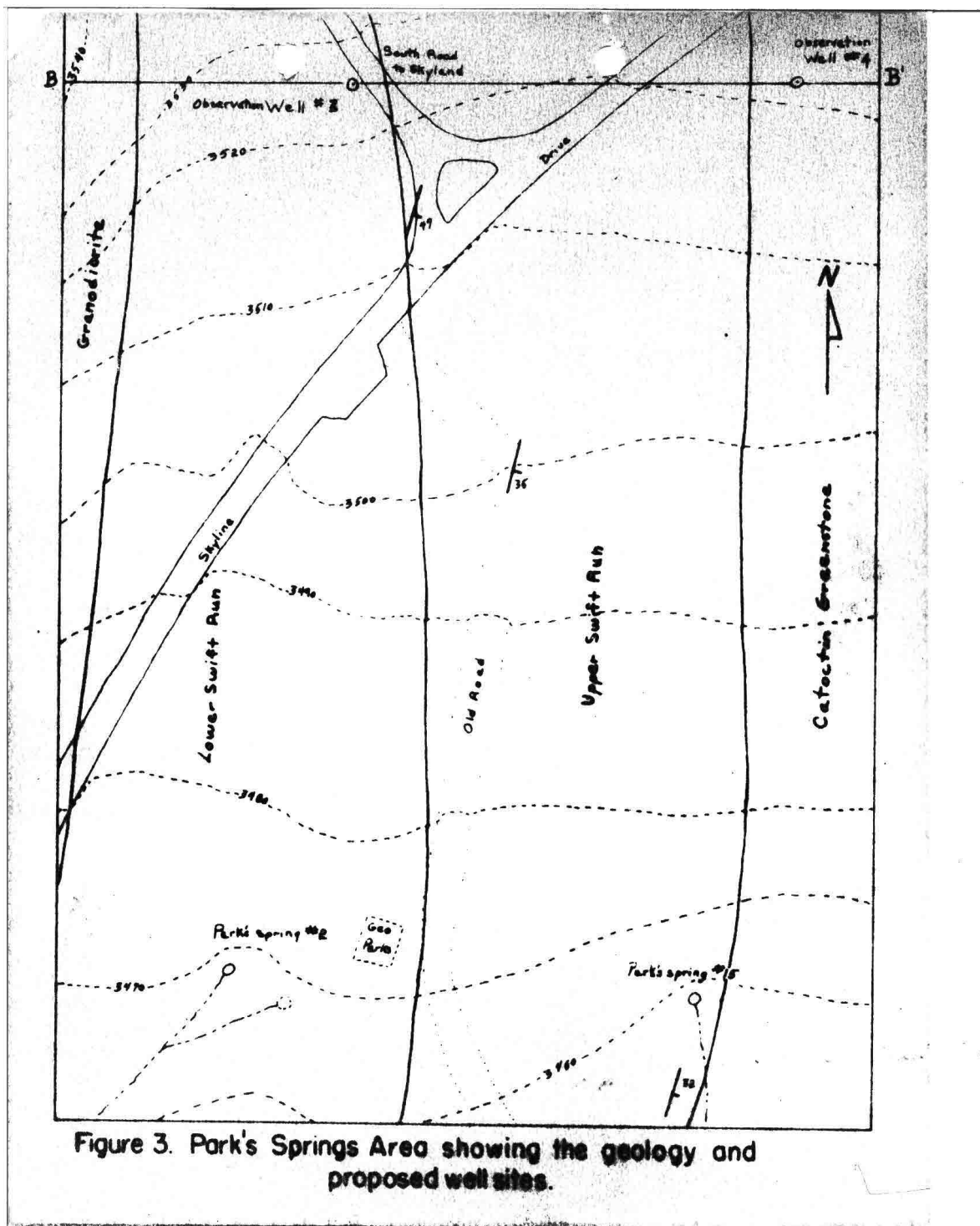
Equipment.-- A 4-inch 90 degree V-notch weir installed in 5 foot square concrete spring box with cut-off wall. (See sketch and photographs).

Records of flow.-- April 4, 1935 to May 31, 1935; record continued after May 31, 1935.

Elevation.-- Mean sea level elevation 3,450 feet.

Remarks.-- Gage read several times a week. Measurements of flow made by volumetric method.

Average.-- Average discharge shown on form 9-192a is not the mean discharge for the month but the average discharge for the number of days on which discharge is recorded.



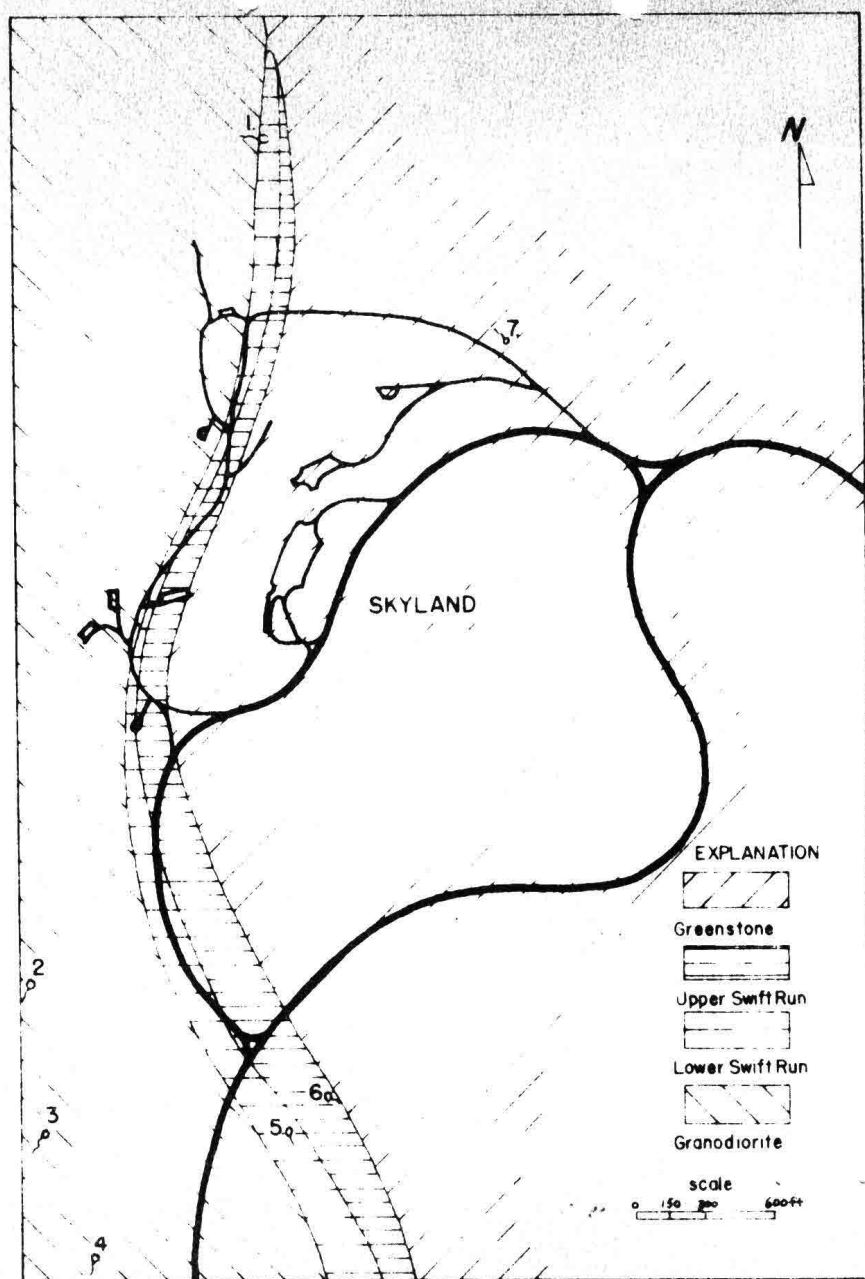


Figure 1. Geology of Skyland and vicinity showing springs. 1 Furnace spring, 2 Spring No 50, 3 Trapping spring, 4 Spring No. 1, 5 Park's spring No 2, 6 Park's spring No. 15, 7 Keggy spring

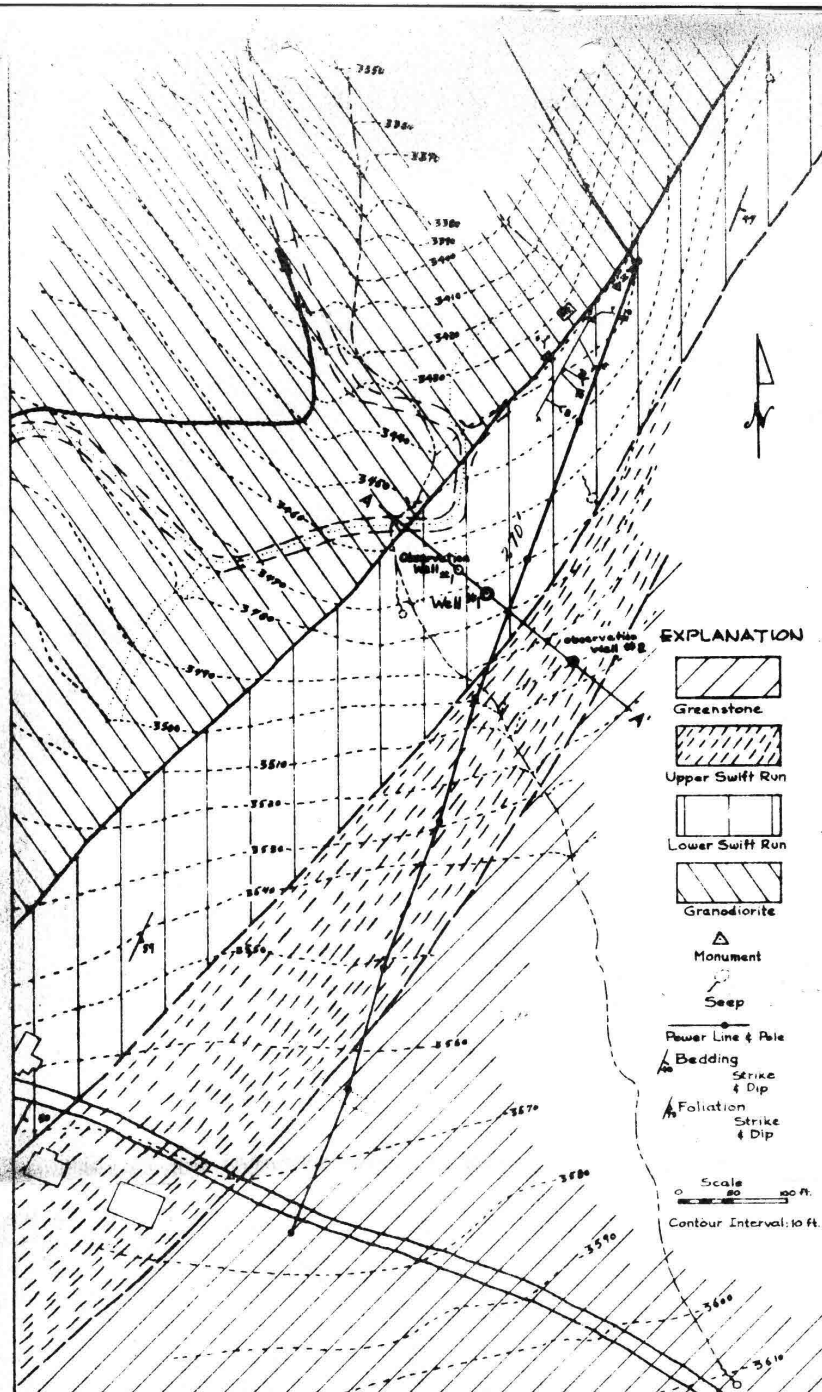


Figure 2. Furnace Spring Area showing the geology and proposed well sites.

Docket Information

Number of Documents in Docket 43

Documents Dated from 6/12/1935 to 12/15/1966

Docket Compiled: 6/17/2011