GROUND WATER QUALITY IN STANLY COUNTY, NORTH CAROLINA

By

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GROUND WATER CIRCULAR NO. 15

NORTH CAROLINA

DEPARTMENT OF WATER AND AIR RESOURCES

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AUGUST 1970

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INTRODUCTION

On Tuesday, July 9, 1968, an article entitled "26 Stanly County Wells Polluted" appeared in The News and Observer calling attention to poor water quality in the streams and some wells in Stanly County. This news item resulted in a special study of the ground-water to ascertain the existence, source, and extent of any bacteriological pollution which might be detrimental to the environmental health of Stanly County residents.

The assistance of well owners, local and state officials, and various government agencies is gratefully acknowledged. Particular thanks is offered to Dr. Leiby, Mr. Claywell and Mr. Clark of the Stanly County Health Department.

GEOGRAPHY AND GEOLOGY

Stanly County occupies 399 square miles of the south-central Piedmont in North Carolina (fig. 7). The annual mean temperature is about 60°F (Fahrenheit), and the annual precipitation averages about 48 inches.

The topography of Stanly County is characterized by rolling hills and steep stream valleys. Contours are used to portray the topography of Stanly County in Fig. 1. The Uwharrie Mountains are in the east-central portion of Stanly County, having a maximum elevation of 936 feet above mean sea level at Morrow Mountain. Lowest elevations, about 250 feet, are in the southeastern corner of the county at the confluence of the Rocky and Yadkin-Pee Dee Rivers.

The geologic units that crop out in Stanly County are of Paleozoic or Precambrian age and are presented in Fig. 2. Except for rhyolite flows, these units are of sedimentary origin and consist mainly of sand, silt and clay that has been metamorphosed into shale and graywacke. These units from oldest to youngest are: The laminated argillite unit, the tuffaceous argillite unit and the upper volcanic unit. Geophysical logs of 15 wells are listed in table 1 and are shown in Fig. 3, 4, and 5. They show the various geophysical characteristics of the argillite units.

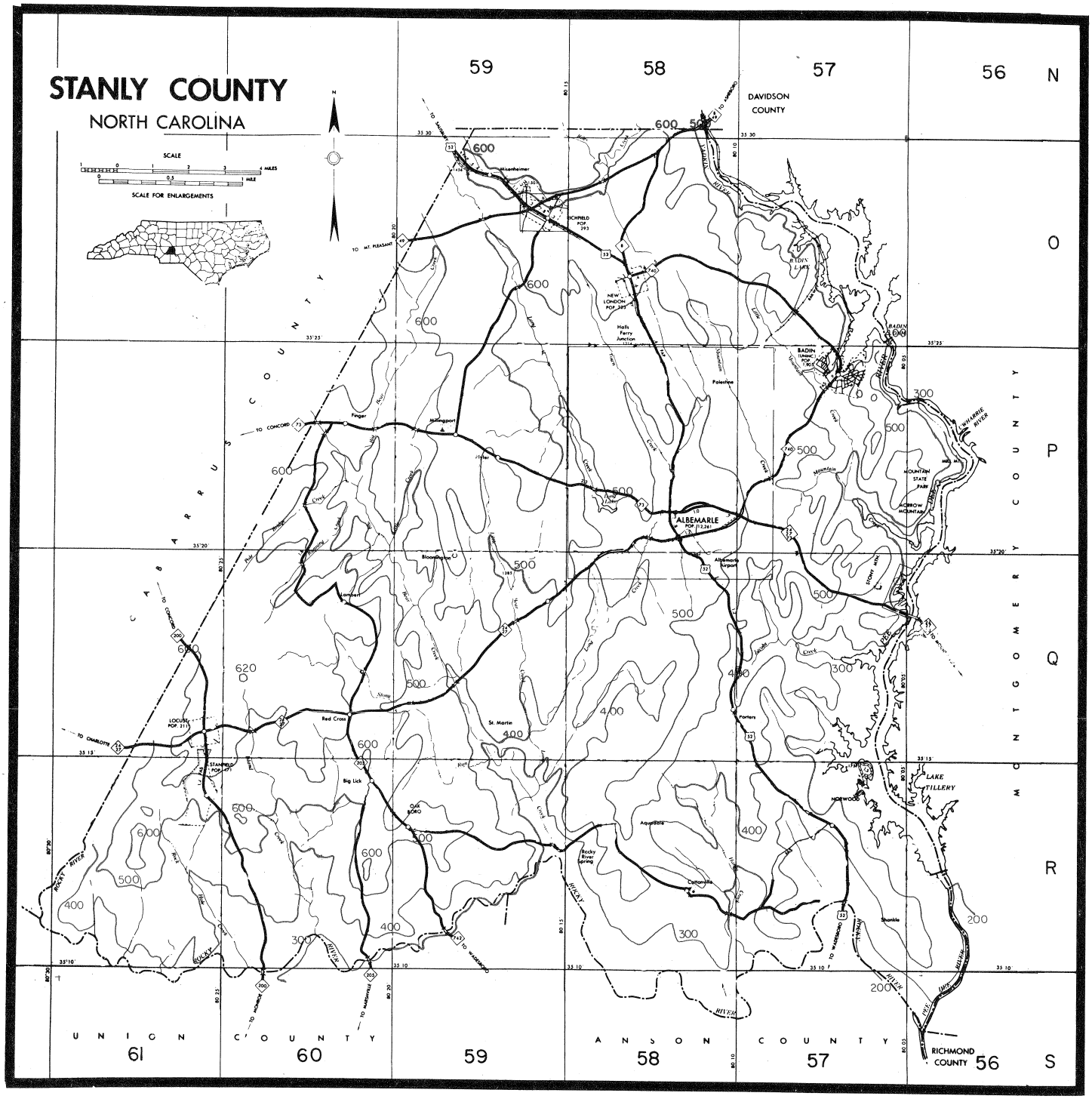


Figure I.- Topographic map of Stanly County

EXPLANATION

STRUCTURE

Syncline

Anticline

GEOLOGY

Paleozoic and Precambrian (?)

Carolina Volcanic Sedimentary Group

- uv Upper volcanic unit
- Ta Tuffaceous argillite unit
- La Laminated argillite unit

BASE MAP ADAPTED FROM N.C. HIGHWAY COMMISSION. GEOLOGY FROM THE MONROE AREA REPORT AND STATE GEOLOGIC MAPS.

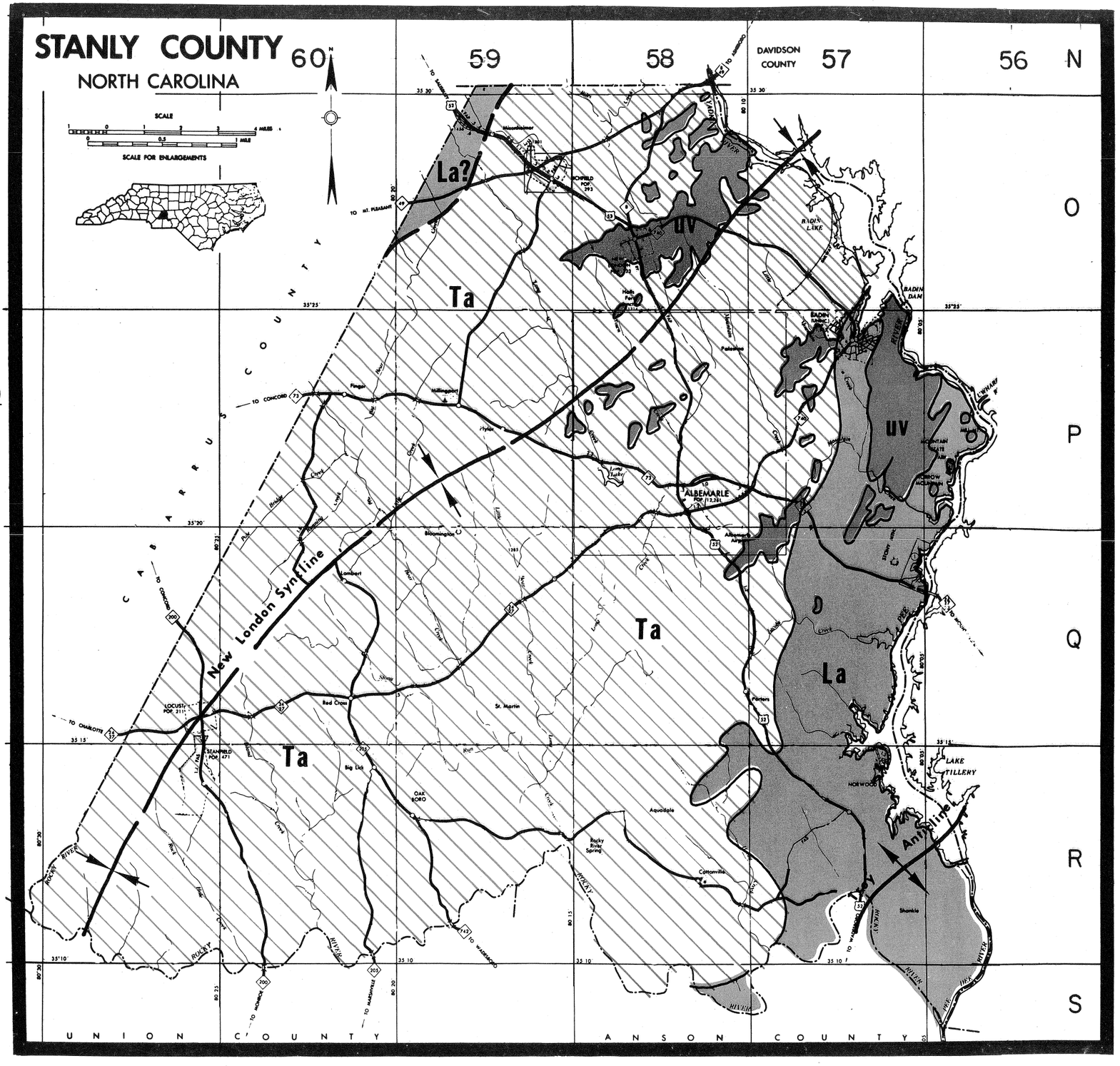


Figure 2.- Geologic map of Stanly County.

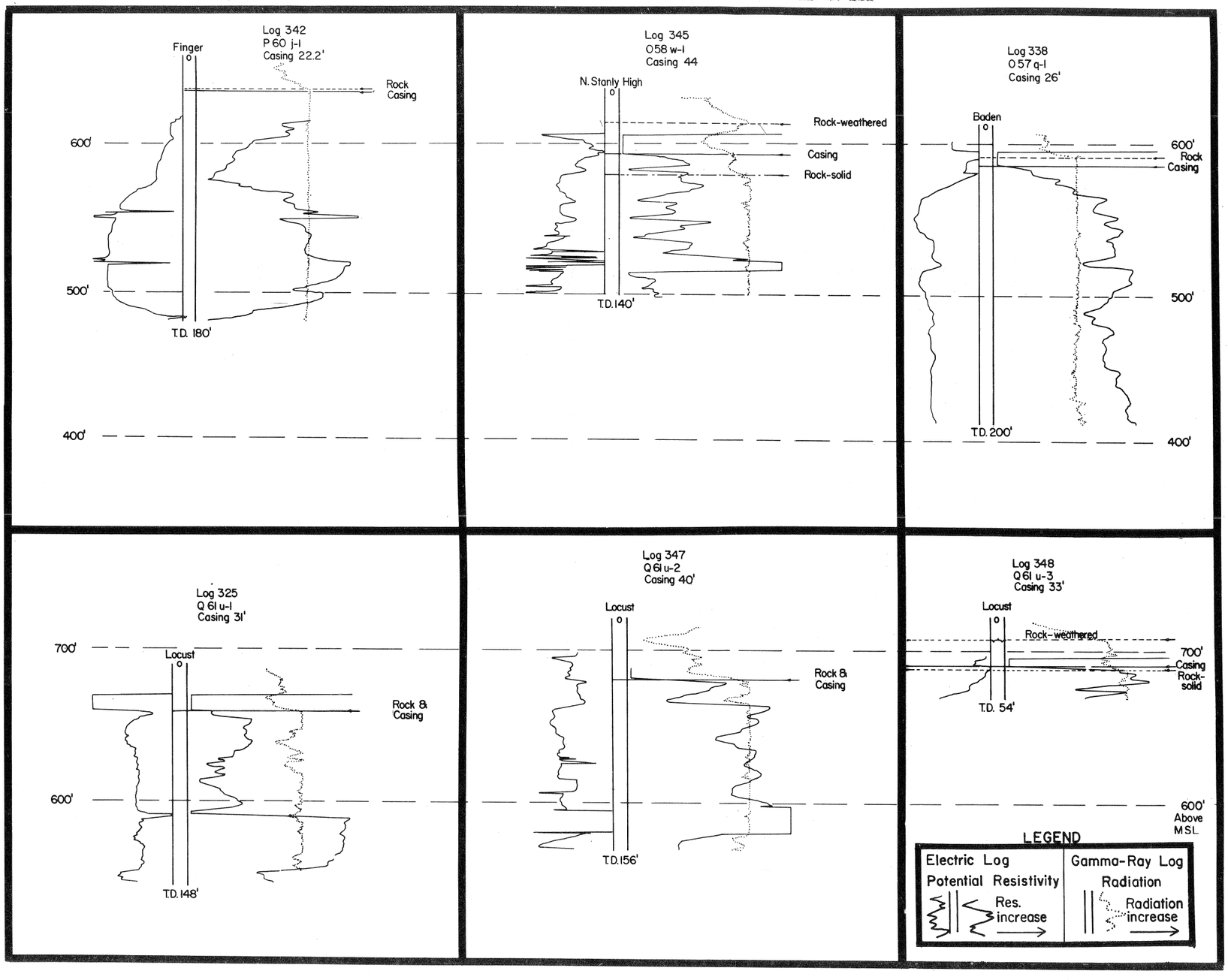


Figure 3.- Geophysical logs of selected wells in Stanly County

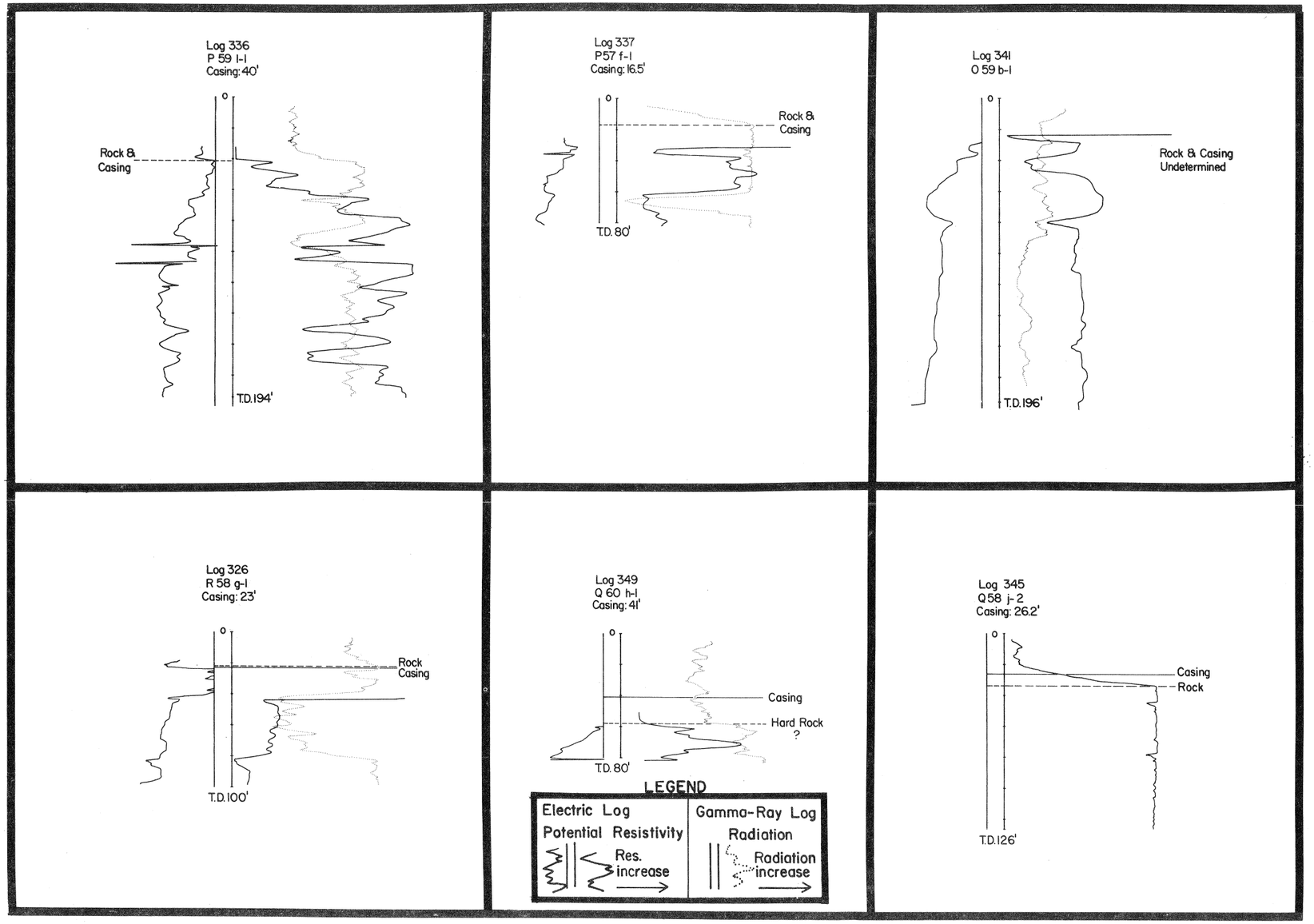


Figure 4.- Geophysical logs of selected wells in Stanly County

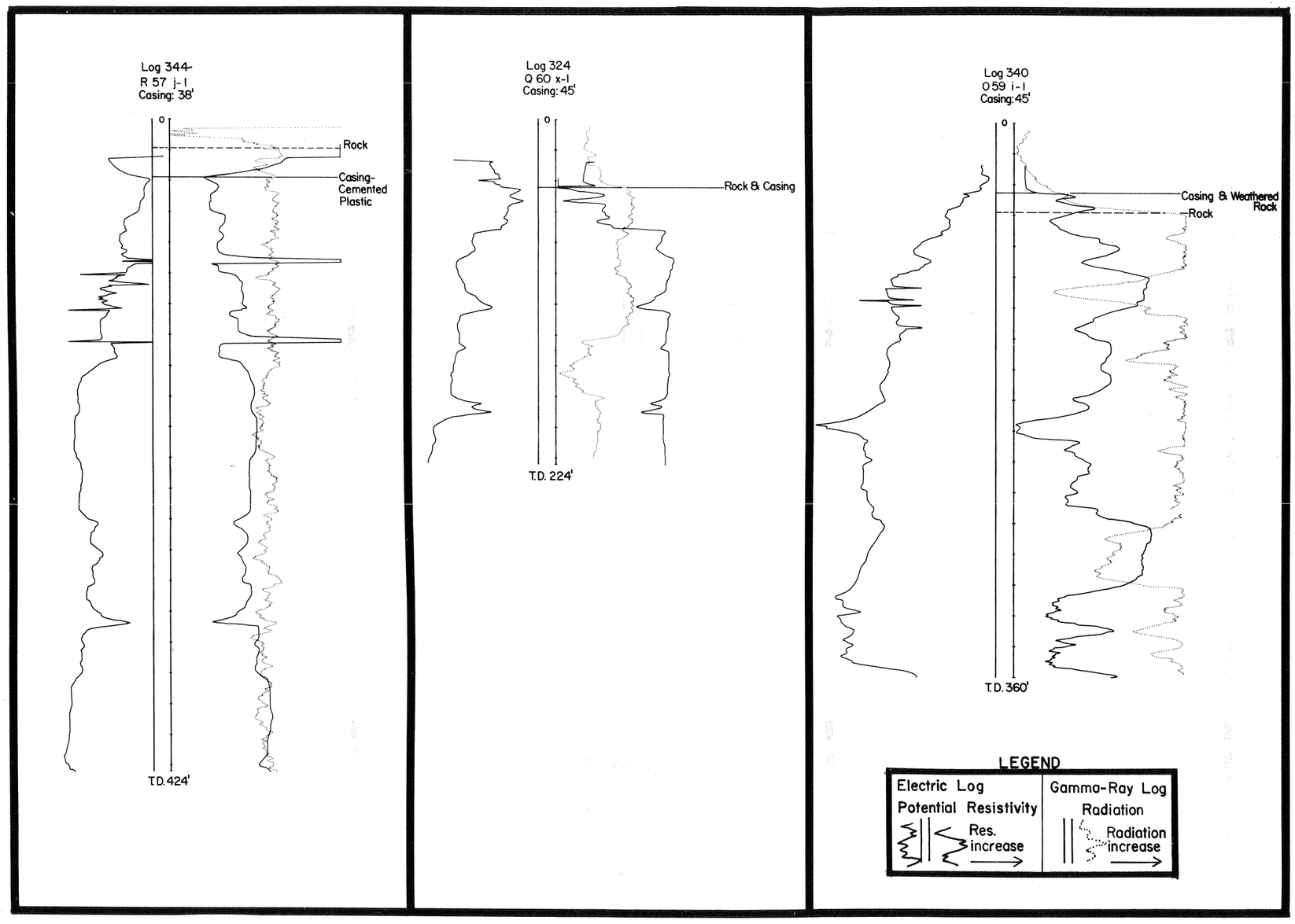


Figure 5. - Geophysical logs of selected wells in Stanly County

The laminated argillite unit, the oldest rock present, crops out in eastern Stanly County. It is composed of thin layers of silt and clay that have been slightly metamorphosed into shale. Fresh outcrops of this unit may be identified by cream colored laminae that give the gray shale a banded appearance. Subsurface identification of this unit may be made by noting the uniform intensity of gamma radiation shown by the gamma-ray log of well R 57 j-1 in figure 5. This unit weathers to a red and yellow silty clay. Ground water in this unit occurs in bedding planes, joints, cleavage planes and fractures. Reported well yields in this unit range from 1,500 gpd (gallons per day) to over 180,000 gpd.

The tuffaceous argillite unit unconformably overlies the laminated argillite and covers the western two-thirds of Stanly County. This unit is graywacke, shale, and felsic and mafic tuffs and breccias. Graywacke outcrops along the center of the New London syncline in the New London area and grades into tuffaceous shale to the east, west, and south. Recently exposed rock is bluish-black to gray and weathers into a brownish-red sandy soil. In this unit, ground water moves along cleavage planes, bedding planes, joints, fractures and quartz veins. Reported well yields in this unit range from 7,000 gpd to 188,000 gpd, with an average yield of about 19,000 gpd. Largest yields are obtained from wells drilled in valleys and draws.

The upper volcanic unit unconformably overlies both the tuffaceous and laminated argillites. This unit is subdivided into rhyolite, basaltic tuff, and andesitic tuff. The rhyolite is characterized by flow banding, conchoidal fractures, and resistance to weathering. It is well jointed and has a thickness of over 300 feet at Morrow Mountain. The basaltic tuff is primarily basalt and is approximately 260 feet thick about two miles south-south-east of Badin Community. The andesitic tuff is primarily composed of lithic-crystal tuff and occasional scoriaceous fragments (Conley 1962). It has an exposed thickness of over 100 feet about one mile east of New London. The upper volcanic unit weathers into a red or brown clay and often contains large rock fragments. Ground-water is available in joints and fractures but very few wells are drilled in this unit because of its steep slopes. No yields are reported for this unit.

WATER RESOURCES

Water enters at the surface and moves downward until it reaches the zone of saturation, in which all openings are filled with water. The top of the zone of saturation is called the water table and is determined by measuring the level at which water stands in a well. Water levels were measured in wells and a water table contour map of Stanly County was compiled as shown in Fig. 6. Comparison of water-table and topographic maps of Stanly County show that the water table is a subdued replica of the topography. The water-table map also shows that the direction of movement of the ground water is towards draws and stream valleys. Recharge and discharge cause fluctuation in the water-table contour surface, and water levels are highest in September and lowest during January in Stanly County.

Wells furnish water for nearly 60 percent of the population in Stanly County. Over 1,000,000 gpd of ground water is used in Stanly County for domestic, school, industrial, and municipal water supplies. Yields are reported for 33 wells in table 2. (see Fig. 7) These wells yield from 1,000 gpd to over 250,000 gpd and have an average yield of about 45,000 gpd.

Two major streams border Stanly County, the Yadkin-Pee Dee River forms the eastern County boundary and Rocky River forms the southern County boundary. The Yadkin-Pee Dee River has a 6,870 square mile drainage basin and two major reservoirs in Stanly County. Badin Lake in the north-east has a storage capacity of 139,000 acre feet of water which furnished both Badin and Albemarle with municipal water supplies. Lake Tillery in the south-east has a storage capacity of 23,600 acre feet and provides Norwood with municipal water. Since the construction of these dams, the flow of the Yadkin-Pee Dee has been controlled and averages about 5,700 cfs (cubic feet per second). The Rocky River has a drainage basin of about 1,230 square miles and an average flow of about 1,280 cfs.

WATER QUALITY

Precipitation absorbs both dissolved gases and solids by falling through the air and acquires additional solids and micro-organisms upon contact with the earths surface. Temperature, length of contact time, and biological activity are a few of the many factors controlling quality and quantity of dissolved minerals in water. Analyses of ground water normally include only the dissolved mineral constituents because micro-organisms are usually removed or die before reaching the water table. Therefore, in ground water investigations, a high

Figure 6.– Water-table contour map of Stanly County, Fall of 1968.

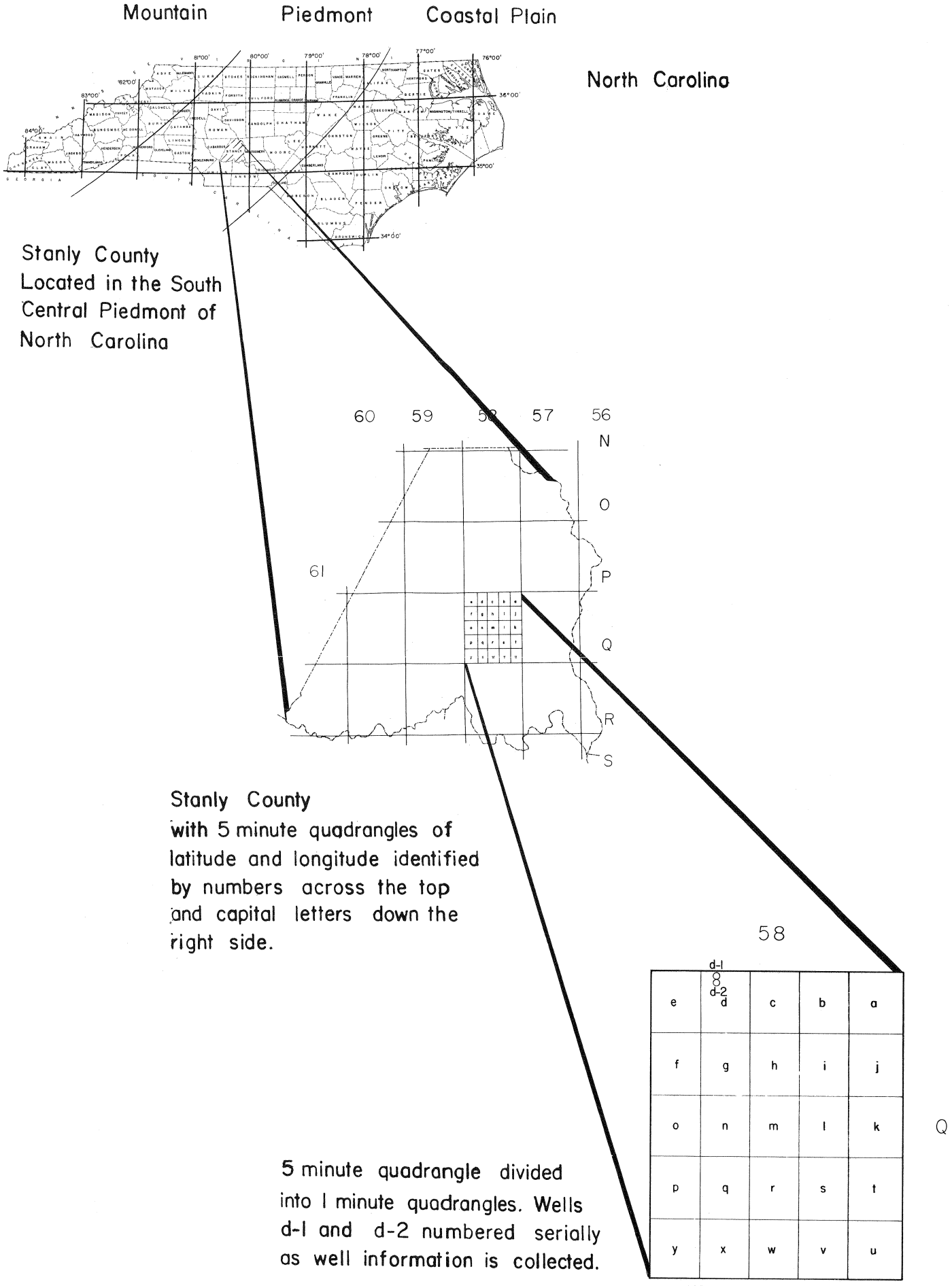


FIGURE 7.- NORTH CAROLINA WELL-NUMBERING GRID SYSTEM.

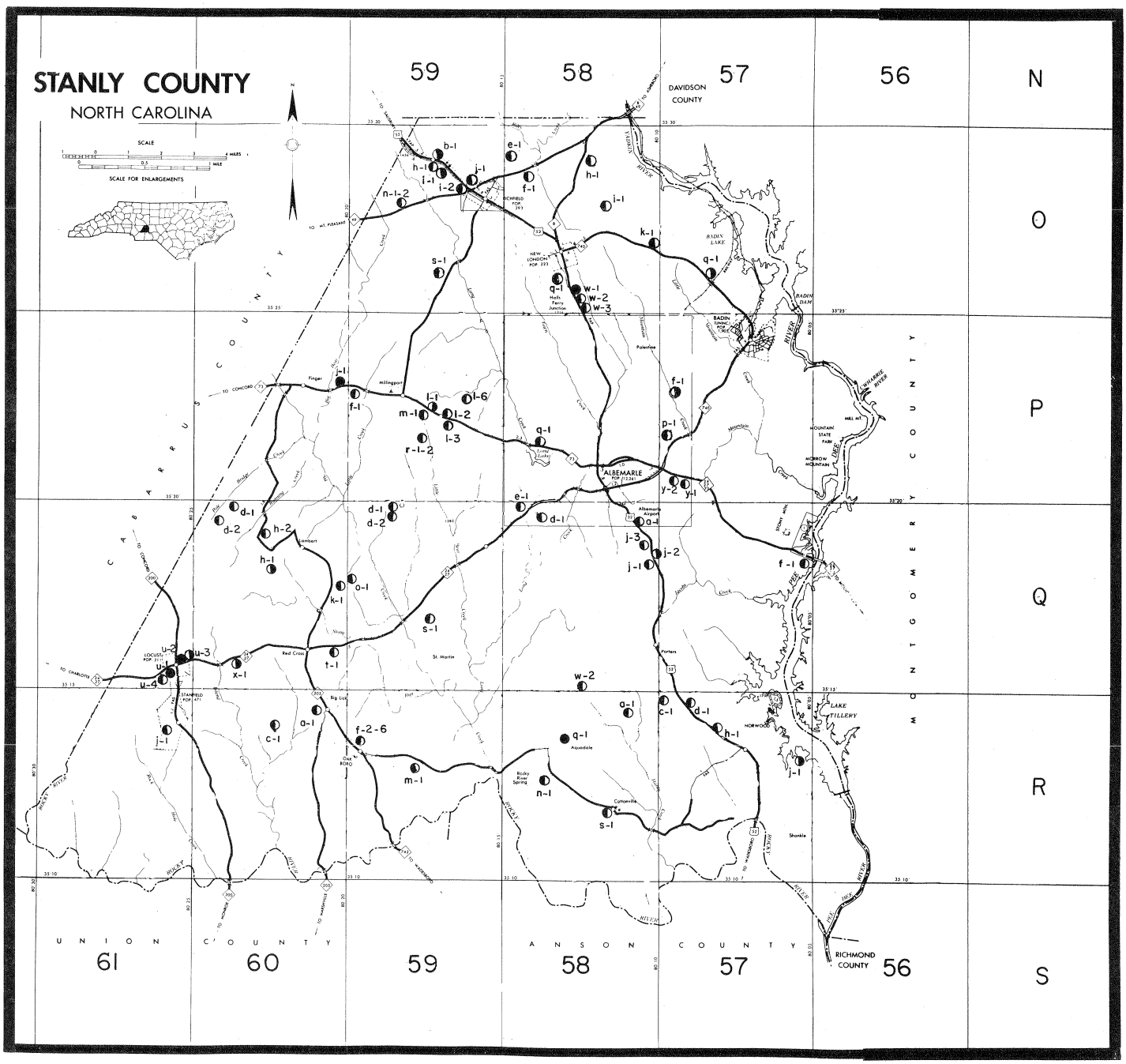
nitrate content combined with high chloride content is often used as an indicator of pollution. No such combination was found in the 62 analyses of Stanly County well-water shown in table 2. The well locations are shown in Fig. 8.

This ground water investigation includes analyses for fecal bacteria in 43 wells and five dissolved mineral analyses of surface water from the two major streams in Stanly County. Of the 43 wells analyzed for bacteria, only two contained fecal material. Well P 59 1-2 about four miles west of Albemarle contained 16 fecal bacterial colonies per 100 ml (milliliters), and well Q 61 u-2 in Locust contained 38 colonies per 100 ml.

In both of these wells, poor construction allows open avenues to pollution. Inspection of well P 59 1-2 showed no sanitary seal which allows pollutants to enter the top of the well. Additional analyses of three nearby wells show no bacteria present in the ground water. Examination of well Q 61 u-2 included electric and gamma-ray logging of both this well and adjacent well Q 61 u-3, which is about 85 feet away. Logs of these wells appear in figure 3 and they show that neither well casing is set into firm rock. The casing of well u-2 is set on top of the rock. The casing in well u-3 does not extend far enough to reach rock, which may be one of the reasons this well was abandoned. Pollutants, apparently, were entering well u-3 above the water table and were penetrating the zone of saturation by flowing down the casing. Polluted water in the zone of saturation was moving to well u-2 on top of firm rock and was entering the well underneath the casing. Upon filling well u-3 with concrete and sterilizing well u-2, no bacteria have been present in well u-2 at the date of this report.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study and previous studies show that ground water of suitable quantity and quality for domestic and other water needs is available throughout Stanly County. The ground-water supply of the County is not polluted, however, pollution of individual wells has occurred as a result of poor construction and improper finishing of wells. Poorly constructed and finished wells are numerous in the county. There is no evidence that the Rocky and Yadkin Rivers are a source of ground-water pollution.



◑ = Geophysical log ● = Both of above ◐ = Chemical analyses

Figure 8.- Map showing location of wells having chemical analyses and geophysical logs in Stanly County.

On the basis of this study, the following recommendations are offered:

1. Existing wells should be checked and possible improvements made to reduce or prevent potential pollution.
2. Wells should be located as far as possible from potential sources of pollution.
3. Drilling and pump contractors should comply with State regulations on sterilization and sanitary seals for wells.
4. Buried wells should be prohibited.
5. A minimum of 20 feet of leak-proof casing should be installed in all wells.
6. The well casing should be set at a depth of five feet in unweathered rock and cemented in place.
7. Abandoned wells should be filled and sealed with cement.

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Table 1. - Geophysical logs of selected drilled wells in Stanly County

Well	Owner	Depth (feet)	Casing		Water level (feet)	Yield (gpm)	Topography
			Diameter (inches)	Depth (feet)			
0 57 q-1	P. Dulin	203	-	-	-	5	Slope
0 58 w-1	N. Stanly High School	142	6	44	20	100	Flat
0 59 b-1	Pfeiffer College	200	6	-	-	-	Slope
0 59 i-1	.....do.....	360	6	45	-	-	Hill
P 57 f-1	Girl Scout Camp	83	6	16.5	32	-	Hill
P 59 l-1	L. Lowder	195	4	40	5	13	Slope
P 60 j-1	W. Cody	181	6	22.2	43	50-60	Hill
Q 58 j-2	P. Poplin	127	4	26.2	-	-	Hill
Q 60 h-1	_____	82	6	41	35	10	Slope
Q 60 x-1	Providence Church	224	6	45	-	-	Slope
Q 61 u-1	B. McIntire	148	4	31	30	10	Flat
Q 61 u-2	L. Honeycutt	158	4	-	21	-	Slope
Q 61 u-3	.....do.....	54	4	-	14	-	Hill
R 57 j-1	W. Kendricks	423	6	38	-	-	Flat
R 58 g-1	Aquadale School	100	6	23	-	-	Hill

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	0 58 e-1	0 58 f-1	0 58 h-1	0 58 i-1	0 58 k-1	0 58 q-1	0 58 w-1	0 58 w-2
Silica (SiO_2)	-	-	-	-	-	-	-	-
Aluminum (Al)	-	-	-	-	-	-	-	-
Iron (Fe)	0.13	0.10	0.25	0.16	0.0	5.10	0.27	0.15
Manganese (Mn)	0.15	1.20	-	0.20	-	0.12	-	0.0
Copper (cu)	0.04	0	-	0	-	0	-	0
Zinc (Zn)	1.10	0.05	-	0.10	-	0	-	0.08
Calcium (Ca)	-	-	77	-	19	-	38	-
Magnesium (Mg)	-	-	22	-	4.9	-	4.6	-
Sodium (Na)	-	-	23	-	9.8	-	7.2	-
Potassium (K)	-	-	0.50	-	0.50	-	0.50	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	-	-	243	-	86	-	143	-
Sulfate (SO_4)	-	-	15	-	1.4	0	5.6	-
Chloride (Cl)	5.0	110	82	2.0	6.0	6.0	2.6	3.0
Fluoride (F)	0.3	0.1	-	0.1	-	-	-	0.0
Nitrate (NO_3)	0.2	0.2	0	0.1	9.5	0.3	2.1	1.9
Phosphate (PO_4)	0	0	-	0.15	-	0.11	-	0.07
Total hardness (as $CaCO_3$)	80	200	284	98	68	46	114	54
Dissolved Solids	-	-	-	-	-	-	-	-
Other Constituents	a	a		a		a		a
Ph	6.8	7.0	7.3	7.3	7.1	6.7	7.8	7.0
Specific conductance (micromhos at 25°C)	215	705	607	280	178	170	248	170
Temperature, F	60.5	62	-	61.0	-	68.0	-	69.0
Color, apparent	-	-	-	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	0	0	-	0	-	0	-	0
Depth (feet)	100	109	128	-	96	-	142	-
Casing diam. (inches)	-	4	4	4	4	4	6	4
Casing depth (feet)	-	21	16	-	18	-	44	-
Topography	-	-	Slope	Flat	Hill	Slope	Flat	Hill
Water Level, (feet below surface)	-	-	15	-	50	-	20	-
Yield (gpm)	-	6	-	12	5	-	100	-
Owner	Parker Men. Ch	Fisher	C. Arey	P & J Fish-House	Maner		North Stanly High	C. Ayres

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	0 58 w-3	0 59 h-1	0 59 i-2	0 59 j-1	0 59 n-1	0 59 n-2	0 59 s-1	0 59 p-1
Silica (SiO_2)	-	-	-	-	34	-	-	-
Aluminum (Al)	-	-	-	-	-	-	-	-
Iron (Fe)	0.14	0.69	1.60	0.05	2.70	0.71	0.44	1.80
Manganese (Mn)	-	-	21	-	30	6.8	7.7	-
Copper (cu)	0.00	0.00	-	0.00	-	-	-	0.10
Zinc (Zn)	1.15	0.69	-	0.00	-	-	-	0.46
Calcium (Ca)	-	-	108	-	75	10	12	-
Magnesium (Mg)	-	-	21	-	30	6.8	7.7	-
Sodium (Na)	-	-	26	-	-	15	7.0	-
Potassium (K)	-	-	0.70	-	0.50	1.80	0.10	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	-	-	216	-	200	28	52	-
Sulfate (SO_4)	-	-	111	-	132	21	4.8	-
Chloride (Cl)	2.0	9.0	78	33	66	23	13	33
Fluoride (F)	0.00	0.00	-	0.00	-	-	-	0.00
Nitrate (NO_3)	1.5	3.1	0.00	-	15	8.8	0.00	0.5
Phosphate (PO_4)	0.07	0.00	-	0.00	0.00	-		
Total hardness (as $CaCO_3$)	42	38	356	200	312	54	62	164
Dissolved Solids	-	-	-	-	-	-	-	-
Other Constituents	a	a		a				a
Ph	7.5	6.3	6.9	7.0	6.9	6.3	6.1	6.4
Specific conductance (micromhos at 25°C)	160	155	750	380	-	-	158	460
Temperature, F	65	-	61	-	-	-	82	61
Color, apparent	-	-	-	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	0.00	0.00	-	0.00	-	-	-	0.00
Depth (feet)	-	-	90	-	101	45	70	80
Casing diam. (inches)	4	-	4	-	6	48	4	-
Casing depth (feet)	-	-	-	-	36	-	20	-
Topography	Flat	Flat	Slop		Hill	Hill	Hill	Flat
Water Level, (feet below surface)	-	-	10	-	30	40	35	-
Yield (gpm)	-	-	5-10	-	65	1	10	-
Owner	K. Barbe	United Meth. Ch	B. Burrage	J. Moss	R. Van-denberg	R. Van-derberg	Brooks	Shoemate

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	P 57 7-1	P 57 y-2	P 58 q-1	P 59 f-1	P 59 1-2	P 59 1-3	P 59 1-6	P 59 m-1
Silica (SiO_2)	-	-	-	-	-	-	-	-
Aluminum (Al)	-	-	-	-	-	-	-	-
Iron (Fe)	0.62	0.65	0.10	0.05	0.10	0.13	0.06	0.17
Manganese (Mn)	-	-	-	-	-	4.1	29	-
Copper (cu)	0.00	0.04	0.00	0.00	0.00	-	-	0.00
Zinc (Zn)	2.70	0.23	0.08	0.07	0.07	-	-	0.00
Calcium (Ca)	-	-	-	-	-	6.4	44	-
Magnesium (Mg)	-	-	-	-	-	4.1	29	-
Sodium (Na)	-	-	-	-	-	8.2	18	-
Potassium (K)	-	-	-	-	-	0.30	0.40	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	-	-	-	-	-	51	235	-
Sulfate (SO_4)	-	-	-	-	-	4.6	10	-
Chloride (Cl)	7.0	7.0	12	4.0	4.0	2.5	56	6.0
Fluoride (F)	0.00	0.20	0.00	0.00	0.10	-	-	0.20
Nitrate (NO_3)	0.5	0.00	2.9	1.4	2.2	1.7	7.2	2.9
Phosphate (PO_4)	0.00	0.00	0.00	0.48	0.08	-	-	0.00
Total hardness (as $CaCO_3$)	78	132	94	20	28	23	230	114
Dissolved Solids	-	-	-	-	-	-	-	-
Other Constituents	a	a	a	a	a	a	a	a
Ph	5.2	5.1	6.8	6.8	6.2	6.4	6.8	6.8
Specific conductance (micromhos at 25°C)	200	320	260	85	105	115	532	28
Temperature, F	61.7	61.7	61.0	64	60.5			60
Color, apparent	-	-	-	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	0.00	0.00	0.00	0.00	16.	-	-	0.00
Depth (feet)	-	-	145	200	110	102	400	65
Casing diam. (inches)	6	4	6	6	6	4	6	4
Casing depth (feet)	-	-	-	-	80	31	-	20
Topography	Slope	Slope	Hill	Hill	-	Flat	Valley	Valley
Water Level, (feet below surface)	-	-	-	-	-	30	32	-
Yield (gpm)	-	-	9	-	-	5	200	9
Owner	Turner	Dennis	Pickler	Hatley	Lowder	Honeycut	Lowder	Morris

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	P 59 r-1	P 59 r-2	P 60 j-1	Q 56 f-1	Q 58 a-1	Q 58 d-1	Q 58 e-1	Q 58 j-1
Silica (SiO_2)	-	-	20	-	-	-	-	-
Aluminum (Al)	-	-	0.00	-	-	-	-	-
Iron (Fe)	0.10	0.08	0.46	0.13	0.43	0.10	0.23	1.80
Manganese (Mn)	0.13		-	1.50	0.00	1.40	0.10	0.49
Copper (cu)	0.20	-	0.00	0.05	0.00	0.00	0.00	0.00
Zinc (Zn)	0.15	-	1.50	1.40	0.20	0.35	0.06	0.08
Calcium (Ca)	-	26	47	-	-	-	-	-
Magnesium (Mg)	-	6.3	6.5	-	-	-	-	-
Sodium (Na)	-	52	10	-	-	-	-	-
Potassium (K)	-	0.01	0.40	-	-	-	-	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	-	85	136	-	-	-	-	-
Sulfate (SO_4)	-	4.6	20	-	-	-	-	-
Chloride (Cl)	99	24	18	8.0	9.0	22	11	9.0
Fluoride (F)	0.2	-	0.1	0.1	0.1	0.2	0.2	0.2
Nitrate (NO_3)	0.00	7.7	4.8	0.00	1.4	0.00	0.00	0.00
Phosphate (PO_4)	0.00		0.00	0.00	0.00	0.00	0.00	0.23
Total hardness (as $CaCO_3$)	270	90	145	164	62	128	146	98
Dissolved Solids	-	-	211	-	-	-	-	-
Other Constituents	a	-	a	a	a	a	a	a
Ph	6.8	6.8	6.5	5.5	6.6	7.1	6.9	6.9
Specific conductance (micromhos at 25°C)	820	243	323	260	180	-	400	250
Temperature, F	68	-	62	75.2	66.2	-	67.1	62.6
Color, apparent	-	-	5	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	0.00	-	0.00	0.00	0.00	0.00	0.00	0.00
Depth (feet)	188	189	181	-	-	-	60	-
Casing diam. (inches)	4	4	6	4	4	6	4	4
Casing depth (feet)	48	37	22.2	-	-	-	-	-
Topography	Slope	Hill	Hill	Slope	-	Draw	Slope	Slope
Water Level, (feet below surface)	40	43	-	-	-	-	-	-
Yield (gpm)	10	3.5	50-60	-	-	10	-	10
Owner	J. Herlocker	T. Herlocker	W. Cody	E. Almond	J. Trull	B. Long	M. Jenson	Marbry's Hotel

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	Q 58 j-3	Q 58 w-2	Q 59 d-1	Q 59 d-2	Q 59 O-1	Q 59 s-1	Q 60 d-1	Q 60 d-2
Silica (SiO_2)	-	-	-	-	-	-	-	-
Aluminum (Al)	-	-	-	-	-	-	-	-
Iron (Fe)	2.60	0.06	0.07	0.19	0.00	0.10	0.06	0.10
Manganese (Mn)	0.15	-	0.00	0.00	0.00	-	0.00	0.00
Copper (cu)	0.00	-	0.10	0.08	0.05	-	0.00	0.05
Zinc (Zn)	0.18	-	0.29	0.08	0.00	-	0.00	0.99
Calcium (Ca)	-	27	-	-	-	16	-	-
Magnesium (Mg)	-	16	-	-	-	4.8	-	-
Sodium (Na)	-	13	-	-	-	15	-	-
Potassium (K)	-	0.40	-	-	-	2.60	-	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	-	127	-	-	-	36	-	-
Sulfate (SO_4)	-	8	-	-	-	15	-	-
Chloride (Cl)	15	20	2.00	7.00	4.00	20	16	11
Fluoride (F)	0.1	-	0.1	0.2	0.00	-	0.00	0.00
Nitrate (NO3)	0.00	13	0.5	2.5	1.4	8.6	0.00	4.1
Phosphate (PO_4)	0.00	-	0.53	0.17	0.15	-	0.08	0.08
Total hardness (as $CaCO_3$)	176	130	10	46	10	60	124	48
Dissolved Solids	-	-	-	-	-	-	-	-
Other Constituents	a		a	a	a		a	a
Ph	5.7	7.0	6.2	6.6	5.8	6.0	6.8	6.2
Specific conductance (micromhos at 25°C)	460	313	62	165	62	240	325	155
Temperature, F	62.6	-	60.5	61	62	-	64	61
Color, apparent	-	-	-	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	0.00	-	0.00	0.00	0.00	-	0.00	0.00
Depth (feet)	-	40	115	100	83	82	215	100
Casing diam. (inches)	4	4	6	4	6	4	6	6
Casing depth (feet)	-	22	40	-	33	21	-	-
Topography	Hill	Hill	Hill	Slope	-	Slope	Slope	Slope
Water Level, (feet below surface)	-	0	-	-	-	1.55	-	-
Yield (gpm)	10	20	8	-	22	25	-	-
Owner	Poplin P.	Russel F.	Honeycutt D.	Bowers, L.	Gilbert, E.	Bowers, D.	Mission Bpt. Ch.	Hatley, R.

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	Q 60 h-2	Q 60 k-1	Q 60 t-1	Q 61 u-1	Q 61 u-2	Q 61 u-4	R 57 d-1	R 57 e-1
Silica (SiO_2)	-	-	-	-	-	-	-	-
Aluminum (Al)	-	-	-	-	-	-	-	-
Iron (Fe)	0.64	0.00	0.36	20.00	0.20	0.03	0.00	0.16
Manganese (Mn)	-	0.00	0.79	-	0.53	0.00	0.00	0.00
Copper (cu)	-	0.00	0.00	0.00	0.15	0.00	0.00	0.04
Zinc (Zn)	-	0.00	0.00	0.51	1.50	0.07	0.00	0.16
Calcium (Ca)	133	-	-	-	-	-	-	-
Magnesium (Mg)	27	-	-	-	-	-	-	-
Sodium (Na)	47.0	-	-	-	-	-	-	-
Potassium (K)	0.60	-	-	-	-	-	-	-
Lithium (Li)	-	-	-	-	-	-	-	-
Bicarbonate (HCO_3)	223	-	-	-	-	-	-	-
Sulfate (SO_4)	11.0	-	-	-	-	-	-	-
Chloride (Cl)	249	6.0	75	86	34	11	9.0	11
Fluoride (F)	-	0.00	0.1	0.00	0.1	0.1	0.2	0.2
Nitrate (NO_3)	0.1	4.0	0.00	0.6	2.7	1.5	4.5	0.1
Phosphate (PO_4)	-	0.25	0.05	0.00	0.00	0.00	0.00	0.00
Total hardness (as $CaCO_3$)	433	18	216	62	92	110	120	108
Dissolved Solids	-	-	-	-	-	-	-	-
Other Constituents		a	a	a	a	a	a	a
Ph	7.0	5.8	6.7	6.0	6.0	6.8	5.9	5.3
Specific conductance (micromhos at 25°C)	1190	80	580	430	300	280	260	260
Temperature, F	-	-	-	64.4	64.4	65.3	62.6	66.2
Color, apparent	-	-	-	-	-	-	-	-
Fecal Bacteria (colonies per 100 ml)	-	0.00	0.00	0.00	38	0.00	0.00	0.00
Depth (feet)	50	78	-	148	158	-	163	55
Casing diam. (inches)	6	6	-	4	4	-	6	4
Casing depth (feet)	-	7	-	31	-	-	32	20
Topography	Hill	Slope	Flat	Flat	Slope	-	Hill	Hill
Water Level, (feet below surface)	18	-	-	30	21	-	32	-
Yield (gpm)	5	10	-	10	-	-	18	-
Owner	G. Almond	G. Barbee	W. Stanly High Sch	B. McIntire	L. Honeycutt	B. Barbee	Flanning's	C. Harris

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	R 57 h-1	R 58 a-1	R 58 g-1	R 58 n-1	R 58 s-1	R 59 f-2	R 59 f-3	R 59 f-4
Silica (SiO_2)	-	-	-	-	-	29	24	29
Aluminum (Al)	-	-	-	-	-	-	-	0.1
Iron (Fe)	0.05	4.70	2.20	0.23	0.04	0.99b	1.20b	2.60
Manganese (Mn)	0.00	0.19	0.26	0.05	-	0.48	0.82	0.60
Copper (cu)	0.00	0.00	0.00	0.00	0.08	-	-	-
Zinc (Zn)	1.70	0.05	0.13	0.09	-	-	-	-
Calcium (Ca)	-	-	-	-	52	61	65	63
Magnesium (Mg)	0.00	0.19	0.26	0.05	-	0.48	0.82	0.60
Sodium (Na)	-	-	-	-	19	18	20	18
Potassium (K)	-	-	-	-	2.40	0.40	0.40	0.20
Lithium (Li)	-	-	-	-	-	-	-	0.1
Bicarbonate (HCO_3)	-	-	-	-	339	145	157	166
Sulfate (SO_4)	-	-	-	-	14.0	64.0	41.0	55.0
Chloride (Cl)	28	10	8.00	18	33	25	54	40
Fluoride (F)	0.00	0.3	0.2	0.1	-	0.1	0.1	0.2
Nitrate (NO_3)	11.0	0.00	0.5	2.0	9.0	0.00	0.00	0.00
Phosphate (PO_4)	0.00	0.08	0.05	0.05	-	-	-	-
Total hardness (as $CaCO_3$)	94	60	78	208	316	186	208	217
Dissolved Solids	-	-	-	-	-	290	328	308
Other Constituents	a	a	a	-	a	a	a	a
Ph	5.5	5.6	5.4	5.4	7.0	7.2	7.3	7.3
Specific conductance (micromhos at 25°C)	260	180	240	220	635	431	496	503
Temperature, F	62.6	61.7	6.17	68.	-	-	-	63
Color, apparent	-	-	-	-	-	2	2	5
Fecal Bacteria (colonies per 100 ml)	0.00	0.00	0.00	0.00	-	-	-	-
Depth (feet)	-	115	100	-	68.5	120	115	200
Casing diam. (inches)	6	6	6	6	4	8	8	6
Casing depth (feet)	-	30-40	23	-	22	-	-	-
Topography	Hill	Hill	Hill	Hill	Hill	-	-	-
Water Level, (feet below surface)	-	30.86	-	-	-	-	-	-
Yield (gpm)	-	30	-	-	10	60	60	80
Owner 5	Smith	Elton Hudson	Aquadale School	Von Swaringer	Billy Mabrey	Oakboro No. 1	Oakboro No. 2	Oakboro No. 3

Table 2 - Chemical and physical analyses of water and well data from selected wells in Stanly County (Analyses by Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources: results in parts per million except for pH and as noted.)

Well Numbers	R 59 f-5	R 59 f-6	R 59 m-1	R 60 a-1	R 60 c-1	R 61 j-1		
Silica (SiO_2)	31	17	-	-	-	-		
Aluminum (Al)	0.1	-	-	-	-	-		
Iron (Fe)	1.10	0.06	0.31	0.00	1.20	0.09		
Manganese (Mn)	0.40		0.19	0.00	0.05	0.00		
Copper (cu)	-	-	0.00	0.00	0.08	0.00		
Zinc (Zn)	-	-	0.09	0.09	0.14	0.11		
Calcium (Ca)	63	29	-	-	-	-		
Magnesium (Mg)	8.4	5.8	-	-	-	-		
Sodium (Na)	23	13	-	-	-	-		
Potassium (K)	0.30	0.20	-	-	-	-		
Lithium (Li)	0.1	-	-	-	-	-		
Bicarbonate (HCO_3)	161	106	-	-	-	-		
Sulfate (SO_4)	55	9.6	-	-	-	-		
Chloride (Cl)	34	16	3.0	44	119	13		
Fluoride (F)	0.20	-	0.20	0.00	0.10	0.00		
Nitrate (NO_3)	0.6	1.5	0.00	1.5	0.7	8.2		
Phosphate (PO_4)	0.20	-	0.20	0.00	0.00	0.00		
Total hardness (as $CaCO_3$)	193	97	68	170	200	72		
Dissolved Solids	304	-	-	-	-	-		
Other Constituents			a	a	a	a		
Ph	7.4	7.4	6.8	7.4	6.8	6.5		
Specific conductance (micromhos at 25°C)	478	-	195	520	700	220		
Temperature, F	63	-	63.5	65.3	-	63.5		
Color, apparent	5	-	-	-	-	-		
Fecal Bacteria (colonies per 100 ml)	-	-	0.00	0.00	0.00	0.00		
Depth (feet)	330	150	40	-	-	-		
Casing diam. (inches)	6	6	-	-	-	-		
Casing depth (feet)	22	30.7	-	-	-	-		
Topography	Slope	Slope	Slope	Draw	-	Flat		
Water Level, (feet below surface)	-	-	-	-	-	-		
Yield (gpm)	55	100	-	-	-	-		
Owner	Oakboro No. 4	Oakboro No. 5	Ray Morgan	G. Honeycutt	J. M. Furr	Stanfield School		

Table 3 - Chemical and physical analysis of selected surface waters Stanly County (Analysis by North Carolina Department of Water and Air Resources and the United States Geological Survey for the Department of Water and Air Resources. Results in parts per million except pH and as noted.)

	Rocky River near Norwood	Pee Dee-Yadkin River South of Co.	Lake Badin at Albermarle	Lake Badin at Badin	Lake Tillery at Norwood
Silica	15	11.01	10	4.7	9.8
Aluminum (al)					
Iron (Fe)	0.08	0.03	0.08	0.02	0
Manganese (Mn)			0	0	
Copper (Cu)					
Zinc (Zn)					
Calcium (Ca)	11	5.5	4.6	4.1	0
Magnesium (Mg)	4.0	1.5	1.4	1.2	1.4
Sodium (Na)	72	9.9	5.7	4.5	5.2
Potassium (K)	5.4	2.0	1.4	1.5	1.1
Lithium (Li)					
Bicarbonate (HCO_3)	122	31	26	20	18
Sulfate (SO_4)	20	5.9	5.2	5.8	6.7
Chloride (Cl)	58	8.5	3.5	3.5	3.5
Fluoride (F)	0.2	0.1	0.1	.0	0.1
Nitrate (NO_3)	3.2	1.7	0.3	0.8	0.7
Phosphate (PO_4)	1.30	0.11			
Total Hardness as $CaCO_3$	45	20	17	15	13
Dissolved Solids	265	66	73	49	47
Ph	7.1-8.1	6.7-7.5	7.2	7.5	7.0
Specific Conductance in micromhos at 25°C	429	92	65.3	59.5	54.3
Temperature, °F					
Color, apparent	29	16	17	16	16