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GEOLOGIC INVESTIGATION AT THE SITE OF
the POST OFFICE BUILDING
WELCH, WEST VIRGINIA

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GEOLOGIC INVESTIGATION AT THE SITE OF THE POST OFFICE BUILDING, WELCH, WEST VIRGINIA

By Harold H. Hawkins

INTRODUCTION

Statement of Problem: Cracking in the interior and exterior walls of the post office building at Welch, West Virginia, developed in the summer of 1947. This cracking appeared about two months after the patching of similar cracks that had developed in 1946. The Public Buildings Administration was requested to investigate the damage. They, in turn, requested the Geological Survey and the Bureau of Mines to furnish representatives to work with their engineer in determining the cause of the cracking. The press gave widespread publicity to the cracking of walls in the post office and other buildings in Welch.

This report explains how the investigation was conducted, describes topographic, geologic, and mining conditions found during the field examination, and draws conclusions based on the facts observed.

History of Investigation: On behalf of the Engineering Geology Branch of the U. S. Geological Survey, the writer, accompanied by Mr. P. L. Hein, Construction Engineer, Public Buildings Administration, left Washington August 18, 1947. They spent August 19 and 20 in Welch, returning to Washington August 21. Upon their arrival at the post office, Mrs. Ann H. Wetherby, Postmaster, called in Messrs. L. E. Rogers, Mayor; L. A. Osborn, City Engineer: M. K. Ankeny, Mining Engineer, Mt. Hope District office, U. S. Bureau of Mines; and John Zeleskey, Federal Coal Mine Inspector, Welch office, U. S. Bureau of Mines. The Mayor and City Engineer then

conducted the group on a tour of inspection in the post office and to other buildings in the vicinity to point out cracks that had developed.

Cracks were observed in several buildings, all downhill from and within a radius of 300 feet from the post office. The cracks observed in these buildings were said to have developed within the preceding 6 months except those in the Appalachian Electric Power Company building, which were said to have opened about 3 or 4 years ago and to have become larger during the past 6 months. There is a large crack in the west exterior wall of a commercial building at the southeast corner of Mercer and Railroad Streets, about 250 feet south of the post office. The exterior east wall and plate glass window of a building on the southwest corner of Wyoming and Bank Streets are cracked. Cracking, which may or may not be of the same origin, shows near the northeast corner of the McDowell County National Bank building on the northwest corner of Wyoming and Bank Streets. The east-west walls of the Appalachian Electric Power Company building next door to the post office, are badly cracked. Larger cracks are in the interior walls, located midway of the length of the building. One crack begins about 5 feet above the ground and widens progressively toward the roof. An index to the photographs of cracked walls included in this report is shown in figure 1. Figure 2 shows the lower end of the crack last described. A displacement in the sidewalk and curbing back of the Appalachian Electric Power Company building on Mercer Street is shown diagrammatically in figure 3.

Opposite the post office on the north side of Sudduth Street is a brick building that is used as an annex of the Ellwood Hotel. The west wall of this building is cracked so badly that it is in danger of falling. Some windows are held in place only by contact with the sill at two

diagonally opposite corners, leaving gaps of as much as 2 or 3 inches between the window and sill. The south elevation of this building is shown in figure 4.

In 1946 several cracks developed in both interior and exterior walls of the post office; these were patched in May 1947. In July and August 1947 some of these cracks reopened and new ones developed. Several interior-wall cracks may be seen on the second floor of the post office. Two east-west interior walls in room A, a basement room, developed cracks extending diagonally downward from the ceiling, as shown in figures 5 and 6. These cracks are more or less parallel. The under side of the concrete first floor is cracked in a north-south direction from one wall to the other; the crack is midway between two first-floor reinforced-concrete sills. The tops of the diagonal wall cracks begin at the ends of the floor crack. Large cracks in the outside walls of the post office building are illustrated in figures 7 and 8. The cracking and movement in two directions, shown in figure 8, is near the northwest corner of the post office, the ground level of which is lower than any other corner of the building.

The Exeter Nos. 3 and 4 Mines, Kingston Pocahontas Coal Company, Hemphill, McDowell County, West Virginia, the property of which adjoins Welch on the west, were visited by Messrs. Ankeny and Zeleskey to obtain information on the latest mining activity.

Attempts were made to obtain logs of wells in the vicinity of the post office from Messrs. E. P. and H. R. Pauley, local well drillers. The writer talked also with the acting manager of the Appalachian Electric Power Company concerning a water well in front of the Company's building. This well furnishes water for air-conditioning of the Power Company building. None of these well logs have been received.

Outcrops of rocks in and near Welch were examined. Monthly precipitation records for the period January 1935 to July 1947 (table 1) were obtained from the U. S. Coal and Coke Company's voluntary weather station at Gary, West Virginia, which is about 5 miles south of Welch.

TABLE 1

PRECIPITATION RECORD FOR GARY, WEST VIRGINIA
(in inches)

	1935	1936	1937	1938	1939	1940	1941	1942	1943
Jan.	5.39	4.77	6.41	2.98	2.51	0.94	2.37	1.62	3.53
Feb.	3.20	2.75	3.16	2.52	4.81	2.78	1.44	1.21	1.85
Mar.	7.80	3.94	1.86	4.08	3.30	1.99	3.25	4.10	4.79
Apr.	5.08	3.99	2.86	2.98	2.65	3.87	2.74	0.67	3.06
May	7.73	1.77	2.07	5.24	2.49	3.83	1.07	4.01	3.87
June	3.58	2.45	4.50	5.71	4.23	5.36	5.19	8.15	3.39
July	5.09	7.90	5.94	6.71	8.31	8.28	7.08	5.94	4.93
Aug.	3.75	4.16	6.97	4.83	1.70	6.50	3.84	3.57	1.43
Sept.	3.14	3.40	0.91	3.72	0.59	2.06	4.13	2.48	1.28
Oct.	2.29	3.03	6.91	0.45	1.18	0.77	2.50	3.12	2.65
Nov.	3.45	1.59	0.84	2.27	0.87	1.28	1.78	2.59	1.56
Dec.	1.27	4.09	1.87	2.10	2.27	1.72	2.17	5.84	1.87
	51.77	43.84	44.30	43.59	34.91	39.39	37.56	43.30	34.19

	1944	1945	1946	1947
Jan.	2.22	2.40	5.02	7.44
Feb.	5.76	4.88	2.64	1.23
Mar.	5.59	3.78	3.71	2.50
Apr.	3.44	3.30	4.02	1.73
May	1.96	5.19	5.56	2.17
June	2.25	3.40	4.09	2.97
July	3.67	5.83	3.16	3.14
Aug.	2.41	2.56	3.00	
Sept.	2.19	6.64	1.65	
Oct.	3.98	1.16	2.05	
Nov.	2.33	4.19	1.31	
Dec.	3.78	2.70	1.98	
	39.58	46.03	38.19	

TOPOGRAPHY

Welch is in the southern part of West Virginia, about 30 miles northwest of Bluefield and about 60 miles south of Charleston. It is in a part of the Appalachian Plateau physiographic province that is characterized by mature plateaus of moderate to strong relief. The relief within the city limits of Welch is more than 550 feet. The local topography is shown on the Welch, West Virginia-Virginia quadrangle topographic map. Tug Fork, a tributary of Big Sandy River which empties into the Ohio River, flows in a north-northwest direction along the west side of the city in a deep, narrow valley. Elkhorn Creek flows south and southwest through Welch in a deep, narrow valley, and empties into Tug Fork near the business district. Browns Creek flows in a westerly direction near the northern limits of Welch and empties into Tug Fork; its valley is similar to the two mentioned above.

The main business section of Welch is in the valleys of Tug Fork and Elkhorn Creek and extends above these valleys onto the nose of a hill, the long axis of which trends northward (fig. 9). The Norfolk and Western Railroad tracks lie mostly in the valleys of Elkhorn Creek and Tug Fork. At the base of the nose of the hill is the railroad station, where the altitude is 1,303 feet above sea level. Above the station on the nose of the hill is the county courthouse, the altitude of which is 1,335 feet at a linear distance of about 200 feet from the station. Across Wyoming Street from the courthouse is the post office. The altitude in front of the post office is about 1,318 feet; at the rear of the post office, a distance of about 100 feet, it is approximately 1,306 feet, or 12 feet lower. Figure 10 shows the southern end of the nose of the hill on which

the courthouse stands, and also shows the land surface beyond the courthouse which rises toward the north. The railroad station is about 200 feet to the right of the foreground shown in this picture on Bank Street.

GEOLOGY

Rocks underlying Welch are sandstones, shales, and coal of Pennsylvanian age. Weathered exposures of these rocks may be seen in outcrops on the hillside east of the courthouse, on a vacant lot near the intersection of Wyoming and Mercer Streets (fig. 11), along the south bank of Browns Creek in the northern part of town, and along the west bank of Tug Fork west of town. It is believed that these outcrops occur higher in the geologic section than the rocks on which the post office stands. However, it is reasonable to assume that rocks of similar characteristics, i. e., alternating sandstones and shales, in both thick and thin beds, immediately underlie the post office foundations. Being near the surface, they are no doubt weathered. The exact thickness of the sandstones and shales beneath the post office, their lithologic or physical characters, and the specific type of rock on which the footings rest cannot be ascertained from surface observations.

Two beds of coal, Pocahontas No. 3 and Pocahontas No. 4, are being mined west of town. The lower coal, Pocahontas No. 3, is 360 feet below the surface and averages 48 inches in thickness. Sixty feet above it is the Pocahontas No. 4 coal bed, which averages 50 inches in thickness. The coal dips N 70°W at approximately 79 feet per mile. There is no evidence that coal has been mined from beneath Welch, as determined by Messrs. Ankeny and Zeleskey. The Kingston Pocahontas Coal Company discontinued mining operations upon reaching their eastern boundary line, which is shown in figure 9.

An attempt was made to investigate the possibility that subsurface water was responsible for the movement that caused the cracks. Logs of nearby wells were not obtainable, and statements concerning water levels were conflicting. The acting manager of the Appalachian Electric Power Company stated that water stood at a depth of about 85 feet below the surface in the well in front of his building. Someone else stated that when the well was first drilled water stood nearer the surface. There is a water well on the east side of the courthouse building, where the ground altitude is about 16 feet higher than the post office. Conflicting statements were obtained concerning water seeping into basements of buildings in the vicinity of the post office. Thus, because of the contradictory statements, it was not possible to evaluate the effect of subsurface water.

CONCLUSIONS

Cracking of the walls of the Welch post office is believed to have been caused by movement that was generally downward, but probably had a westerly (lateral) component due to the slope of the ground surface and the dip of the rocks. The cause of the movement is not entirely discernible. It may be subsidence, caused by compaction of the natural foundation materials under the weight of the structure. On the other hand, the movement may be due to slipping caused by wetting of clays or shale beds underlying the footings of the structure. The contract for the construction of the building specified that all footings were to rest on solid rock and that test pits and borings were to be dug to determine the elevation of the solid rock. These pits and borings were made but there is no proof that they extended into the solid rock to determine its thickness. Inasmuch as some of the sandstone is thin-bedded and layers of shale are interbedded with the sandstone, it is quite possible that the footings are resting on

one of the thin sandstone beds. It is also possible that if the footings are resting on shale and not sandstone, movement could be caused by slipping when the shale is wet. Statements were made by local residents that the footings along the front of the post Office were placed on sandstone and that those in the rear were not.

If movement has been due to slipping it is then necessary to account for the origin of the water that lubricated the shale. If percolating water is the fundamental agent causing the movement, it will be necessary to intercept the water as one means of stopping further damage to the building. Certainly the seepage underground of rainfall, runoff from buildings and streets, and leakage from underground drains would provide some water. Rainfall records, dating back to before the post office was constructed, do not indicate excessive amounts of precipitation. One possible source of an excessive amount of water is the unusually heavy snowfall that remained on the ground many days during February 1947.

The possibility of subsidence due to coal mining operations is eliminated because no coal was mined from beneath Welch and all recent mining stopped at the coal company's property line west of town. Pillar-and-room method of mining was used, and contrary to usual practice, when mining was discontinued near the property line the pillars were left standing.

It is recommended that in order to aid in determining the cause of the movement two core holes be drilled, one near the northeast corner of the post office and another near the northwest corner. Cores and

samples from these holes will show the sequence and physical nature of the rocks beneath the post office and also determine the dry and moist zones below the surface and the depth to the water table.

/ss/ Harold H. Hawkins

Harold H. Hawkins, Geologist
August 26, 1947

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Editor's note: Mr. Hawkins' recommendation that two core holes be drilled was followed. The holes were drilled September 5-11, 1947. The following brief report by R. W. Richards discusses the geologic significance of the drill cores.

November 3, 1947

Geologic Report on Core Drilling at Welch, West Virginia, Post Office

by R. W. Richards

An examination was made of the cores and samples from the test holes drilled September 5-11, 1947, at the post office site in Welch, West Virginia. As far as the bedrock is concerned it would afford a substantial support for the footings of the building. However, a total of 4.94 feet of the 91.0 feet of bedrock in the hole drilled near the northeast corner, and 6.91 feet of the 94.67 feet of bedrock in the hole near the northwest corner, was not recovered. The loss of material in the two upper rock units was approximately twice as great in the northwest hole as in the northeast hole. The unrecovered bedrock footage is thought to have consisted mainly of soft, very fine, sandy shale such as was seen washing out at intervals in the drilling water until the surface flow was lost. Whether the material washed out represented the entire unrecovered footage is not known.

The apparently westerly dipping bedrock section revealed by the cores recovered from the 100-foot holes drilled near the northeast and northwest corners of the post office may be summarized as follows:

	Average thickness (feet)	Material washed out (percent)	
(Overburden, unconsolidated material)	7.0		
		N.E. Hole	N.W. Hole
1. Sandstone, soft, fractured, gray with brown to gray shaly streaks that were washed out by the drilling water and not recovered...	9.	13.9	22.4
2. Clay shale, light to dark gray, soft, grading to sandstone in northwest well.....	8.5	7.9	19.5
3. *Sandstone, compact and strong, gray.....	43.	1.3	1.98
4.**Clay shale, light to dark gray, soft, with 4 feet of sandstone 5 feet below the top in the northwest hole.....	28.	8.8	7.4
5. Coal, hard, brittle (presumably the source of the gas found in the northwest hole).....	0.33		
6. Sandstone, gray.....	4.0		

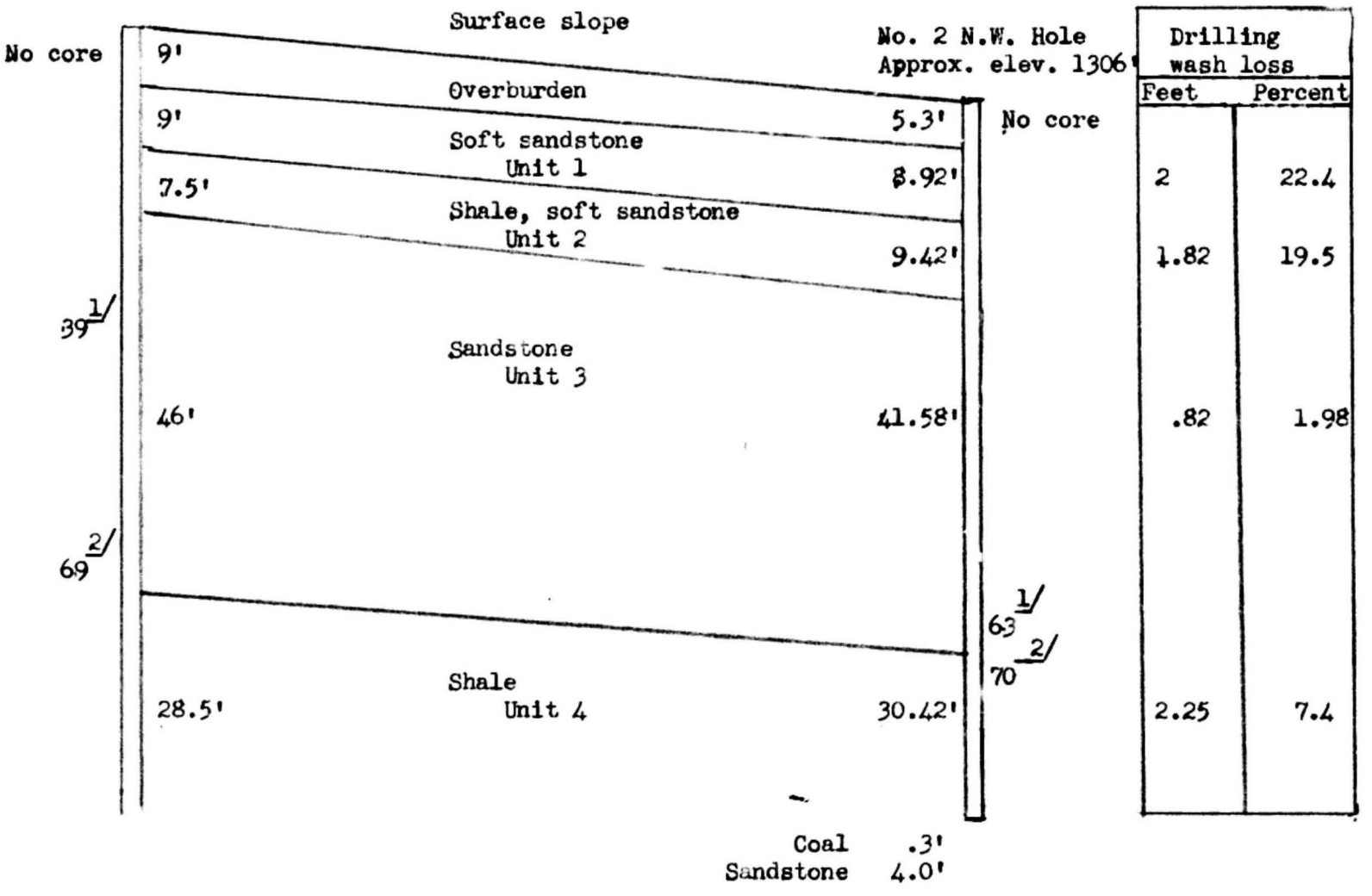
* Drilling water returned to the surface until the holes passed the middle of this unit.

**Water level, about 12 hours after drilling, is near the top of this unit.

Inasmuch as the Post Office building is reported to have shown no signs of cracking for several years subsequent to completion in 1936, it could be assumed that the footings were located on Unit 1 of the

Diagrammátic Cross Section

Drilling wash loss	
Feet	Percent
1.25	13.9
.59	7.9
.59	1.3
2.51	8.8



Drilling wash loss	
Feet	Percent
2	22.4
1.82	19.5
.82	1.98
2.25	7.4

1/ Drilling circulation lost
2/ Water level about 12 hours after drilling

bedrock section rather than in the overburden above that unit. It seems reasonable to suspect that the cracking of the walls may be the result of water having entered the bedrock section, wetting the soft shaly streaks, and facilitating possible down-dip slippage. This water may have come from clogging of the subdrainage system, from broken mains in the vicinity, from precipitation that has percolated downward through the upper layers of rocks, or by any combination of these.

Suggestions concerning remedial work: If the footings of the buildings are actually on Rock Unit 1 and the softer shaly portions are being washed out by water:

Source of water	Remedy
a) Backed up by clogged subdrains	Restore proper drainage
b) Escaping from broken pipes in the vicinity	Locate leaks and repair pipes
c) Entering from the high east side or the north side of the building	Provide additional subdrainage, and cover the open space between the north curb with a cement apron

If, however, the building is not actually footed on Unit 1 of the rock section, but rests upon some portion of the overburden (a condition which can be determined by pitting) it will then be necessary to crib up or grout any existing gaps between the footings and Rock Unit 1; in addition some of the steps suggested above should possibly be undertaken.

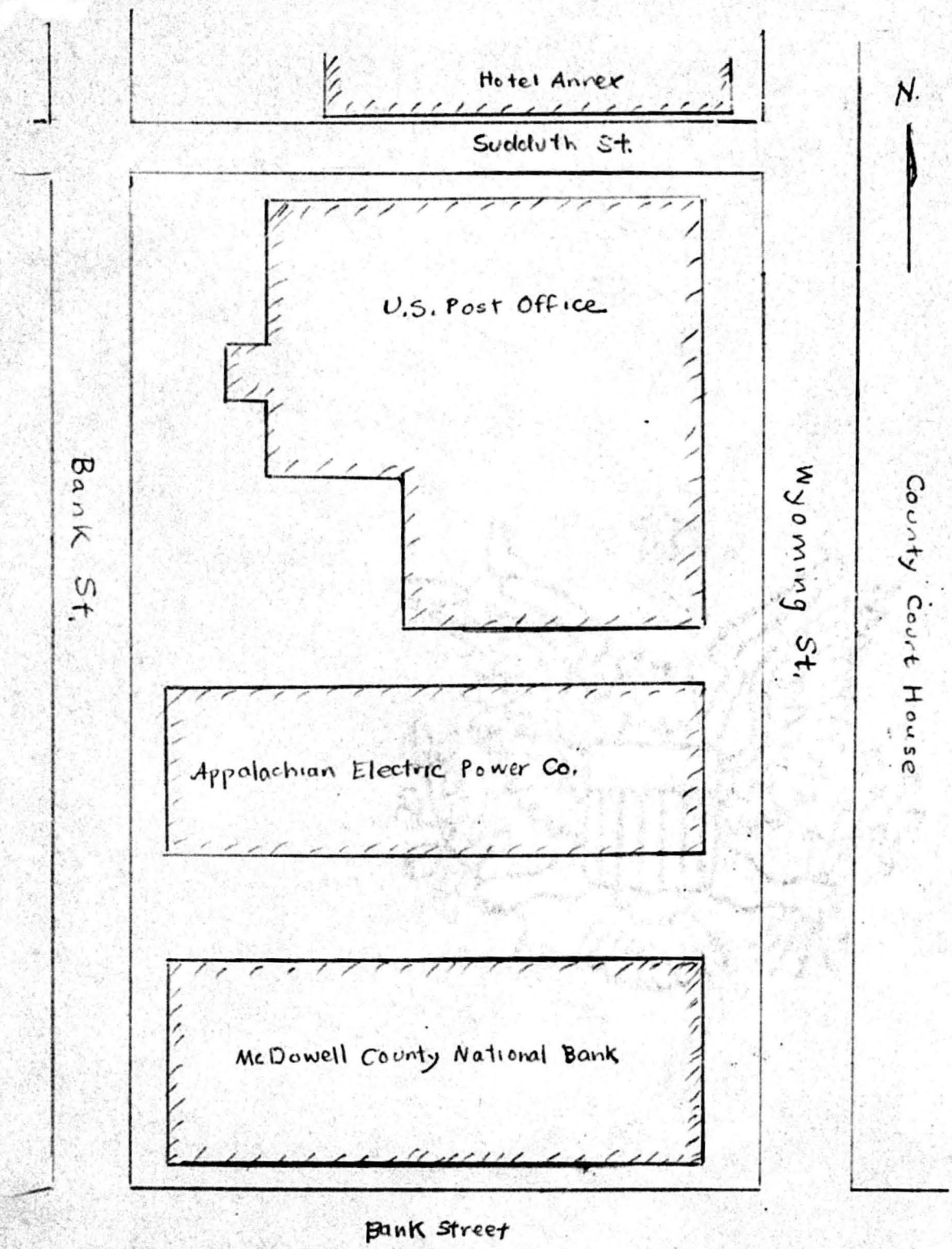
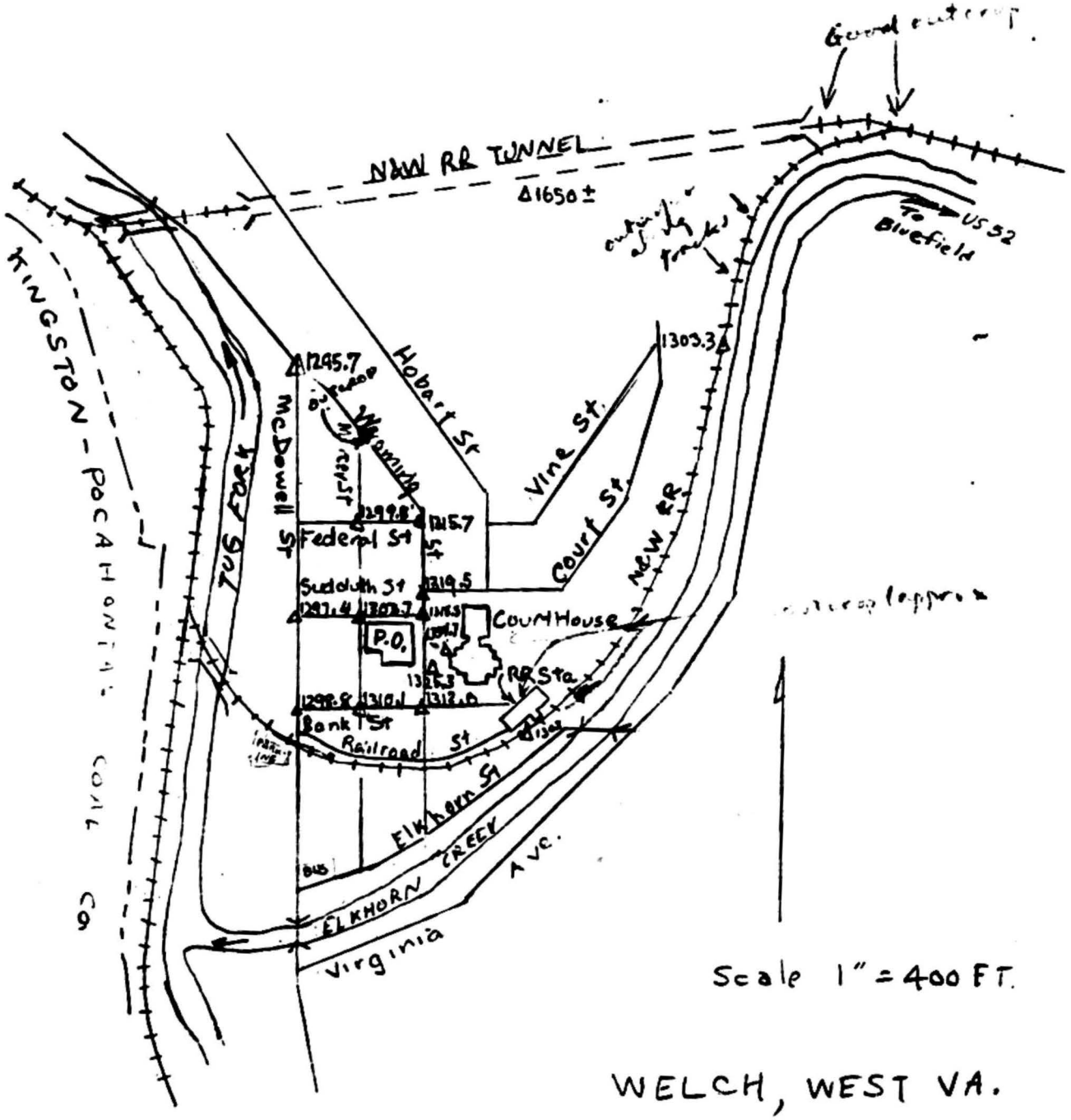


Fig 1, Hawkins report.
Location of Bldgs in Welch, W.Va.


NEW RR TUNNEL
41650±
To US 52
Bluefield
KINGSTON - POCAHONTAS COAL CO
TUG FORK
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Hobart St
Vine St.
Court St.
NEW RR
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COURTHOUSE
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Bank St
Railroad St
ELKHORN CREEK
ELKHORN AVE.
Virginia
Scale 1" = 400 FT.
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