Pleistocene Lake Monongahela and the Carmichaels Formation in Southwest Pennsylvania

Pittsburgh Geological Society Field Trip

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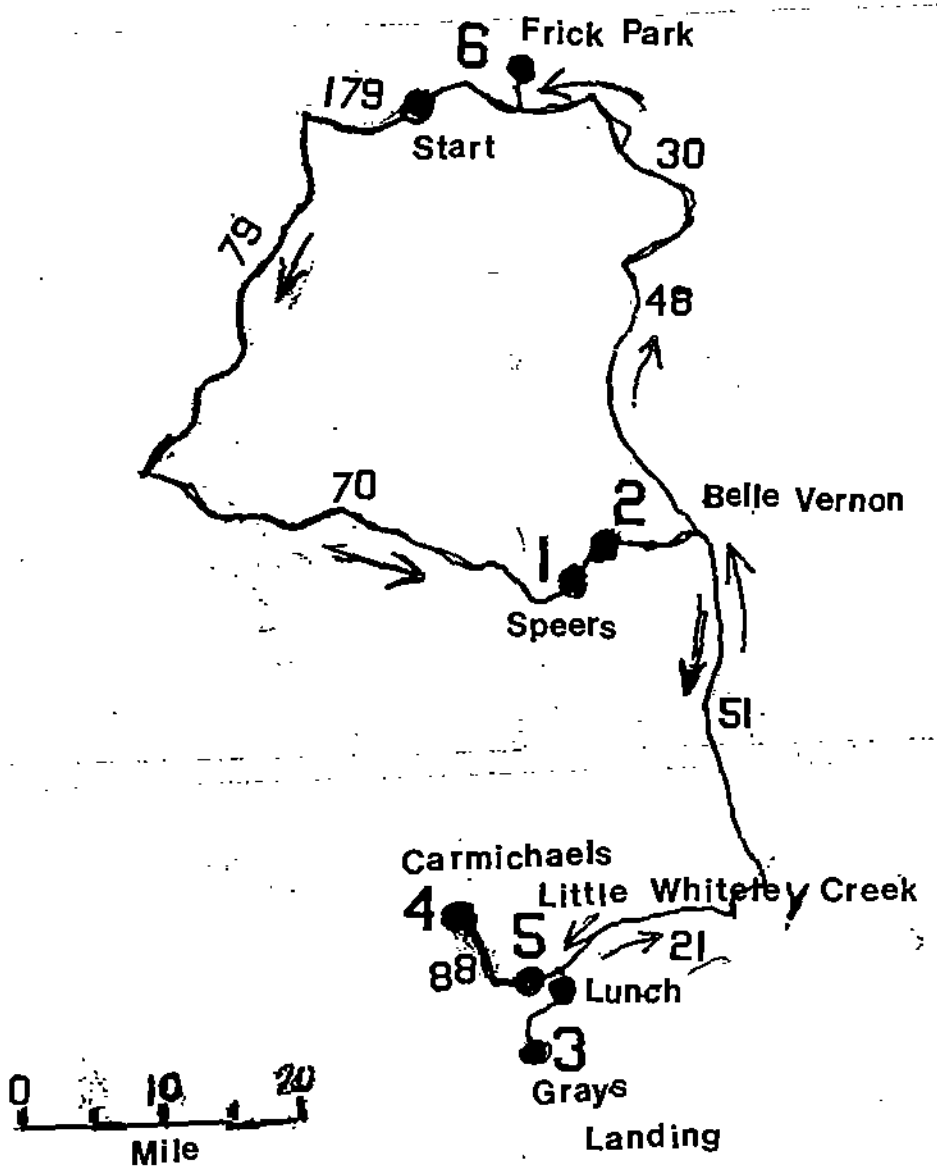
Jack Donahue, University of Pittsburgh

Brian Kirchner, University of Pittsburgh

Sketch map of field trip route showing stops and road numbers.



Introduction

The Carmichaels Formation is a Pleistocene unit of lacustrine clay, silt, and sand matrix containing subangular to well-rounded, cobble- to boulder-sized, typically sandstone clasts. The Carmichaels was deposited at the bottom of Lake Monongahela, a standing body of water formed by the glacial damming of the pre-Pleistocene Pittsburgh River system, the drainage of which included those of the modern Monongahela, Allegheny and Beaver Rivers (Figures 1a, 1b and 2). The unit occurs as a series of terraces along these rivers and their tributaries in western Pennsylvania and northern West Virginia. Carmichaels Formation terraces within the Monongahela River's drainage basin can be grouped by elevation into two distinct levels which have been interpreted as representing two different glacial damming events: ~900-970 ft representing Illinoian glaciation, and ~1000-1100 ft pre-Illinoian (Figures 3 and 4) (Marine, 1997; Jacobson, et al., 1988; White, 1896). These age constraints are tenuous, based primarily on correlation with outwash gravel trains and drift and on measurement of remanent paleomagnetism in Carmichaels sediments at widely scattered localities; they will most likely require revision based on the results of future studies. In addition, a lower terrace, not composed of the Carmichaels Formation, occurs at ~920-970 ft. and is interpreted as being Wisconsinan in age (Marine, 1997; White, 1896).

This field trip will focus on several representative Carmichaels Formation terraces within the Monongahela River drainage between Pittsburgh and Masontown, along with one stop at the non-Carmichaels Wisconsinan terrace. The terrace geomorphology, Carmichaels sedimentology, and some ideas concerning the origin of the Carmichaels Formation, particularly its clasts, will be discussed.

Stop 1: Speers/Charleroi

The northeast and northwest sides of the parking lot of the Charleroi Job Center expose sediments of a 920-foot Carmichaels terrace (Illinoian). The unit here is a silty clayey sand, ranging in color from reddish-orange to tan. Clay occurs primarily as coatings around sand and silt grains (rather than as discrete pure clay horizons). Faint laminations can be seen within the deposit on some fresh surfaces. A notable feature here is the presence of abundant subangular to well-rounded sandstone clasts. These range in size from small cobbles to medium boulders, and in lithology from sandy siltstone to coarse-grained conglomeratic sandstone. Initial study of the clasts suggests derivation from multiple bedrock units. Matrix and clasts are continually washing into the parking lot, illustrating the mobility of the Carmichaels Formation under modern climate conditions.

Stop 2: Belle Vernon Cemetery, North Belle Vernon, PA

This stop illustrates one use of the Carmichaels terrace surfaces. Unless a new grave site has been prepared, we will look at the dump pile for excavations on one edge of the cemetery grounds. Note that we have a relatively flat surface here and that grave site excavation is quite easy. At the dump site we can see the different sedimentary facies that occur in the Carmichaels Formation. These range from a sandy reddish clay that is relatively plastic to a reddish-orange silty clayey sand facies. Note the abundance of sandstone clasts of variable size throughout the dump pile. The source of the reddish clay is still an open question since it is found not only along the Monongahela and Youghiogheny drainage basins but also along the lower Allegheny drainage basin. The red clay could be derived from the Upper Pennsylvanian and Permian bedrock units located to the south, especially in West Virginia, but these units would not serve as a source for the Allegheny drainage. Another possible source is soils developed during the interglacial intervals during the lower Pleistocene.

Stop 3: Grays Landing, PA

This stop illustrates the lower Wisconsinan terrace located along both the Monongahela and Youghiogheny drainages. Although we don't have a radiocarbon date from this terrace, it probably formed during middle or late Wisconsinan time when glacial outwash from the Allegheny River blocked the Monongahela drainage. A great thickness of gravel and sand located not only in the Allegheny and Ohio River channels but also at elevations of 40 to 50 feet above the present channels. It appears likely that during times of glacial melting, both the Monongahela and Youghiogheny Rivers were temporarily dammed, resulting in ponding and deposition of the lower terrace. Although we will only look at exposures at river level, the entire terrace is composed of crudely laminated, grayish brown silts and clays. No reddish clay or rounded sandstone clasts have been found in these sediments. Corps of Engineers borings do document the presence of relatively thick gravel deposits at the base of this sequence.

Stop 4: Carmichaels, PA

The vicinity of the town of Carmichaels is the type locality for the Carmichaels Formation. We Will not see any exposures of the Carmichaels at this locality; in fact, this is one of the frustrating aspects of doing field work on this unit. In many cases, unless you find building excavation, road work or an excavated but unfilled grave site, you will not see the Carmichaels exposed. The main reason to stop here is to view the extensive flat horizontal surface that is typical for the Carmichaels terraces and which makes the terraces such attractive locations for building. Although we have not tried the method very often, a hand auger can be used to check for the presence of the Carmichaels at localities like this. Figure 2 shows the presence of a meandering pattern for the Carmichaels in this area. During lower Pleistocene time, the rivers forming the major drainage basin in western Pennsylvania had a meander pattern situated at ca. 1000 feet above sea level and a northern drainage outlet through the present-day Beaver River. Rapid downcutting concurrent with the development of the present-day Ohio River resulted in bedrock river channels with straighter courses that cut through and below the early Pleistocene meander pattern.

Stop 5: Little Whiteley Creek

We will view this locality from across Little Whiteley Creek. This is because of present high water conditions and also because we don't want to disturb this "outcrop." The creek has downcut through the Carmichaels Formation, exposing ca. 10 feet of the unit. The Carmichaels at this locality contains rounded sandstone clasts and consists of reddish silty plastic clay. Branches, leaves, and small tree trunks are buried at the bottom of the unit; these appear quite recent and we suspect that at least a small amount of mass movement has occurred here with the Carmichaels plowing down bushes and small trees that were growing along the creek valley slopes. A much older-looking branch occurs at the top of the unit. Samples of wood from the top and bottom have been sent to the AMS radiocarbon dating facility at the University of Arizona, Tucson and we should have dates available in July. AMS dating at this facility extends back to 48,000 years BP and, if our interpretation is correct, the upper wood should be dead while the lower wood will have a Holocene date.

Stop 6: Frick Park, Pittsburgh

The tennis courts, and part of the neighborhood on the east side of Braddock Avenue, are built on a 920-foot Carmichaels terrace. This terrace is being incised by the gully behind the tennis courts along which the Biddle Trail runs; no Carmichaels has been observed in situ at this location, but several deposits of remobilized Carmichaels sediment can be seen along the trail. Watch for small pockets of reddish-orange, highly plastic silty clay. In addition, much of the slope between the trail and the top of the gully is covered with a thin veneer of slope wash containing abundant red-orange clay and silt.

The second notable feature at this stop is the presence of abundant subangular to well-rounded sandstone and siltstone clasts along the gully walls and in the gully bottom.

Both of these features provide an excellent example of the mobility of the Carmichaels Formation; it especially illustrates the idea that the clasts are able to be transported without the aid of running streams. This widens the field of possible explanations for original transport of the clasts into Lake Monongahela.

References Cited

Jacobson, R., 11987, Pedological studies at Grays Landing terrace, Fayette County, Pennsylvania: U.S. Geological Survey Open-File Report; p. 87-128

Jacobson, R.B., Elston, D.P., and Heaton, J.W., 1988, Stratigraphy and magnetic polarity of the high terrace remnants in the Upper Ohio and Monongahela Rivers in West Virginia, Pennsylvania, and Ohio: Quaternary Research, v. 29, p. 216-232

Leverett, F., 1934, Glacial deposits outside the Wisconsin terminal moraine in Pennsylvania: Pennsylvania Geological Survey, Bulletin G7, P. 90-119.

Marine, J.T., 1997, Terrace deposits associated with ancient Lake Monongahela in the lower Allegheny drainage, western Pennsylvania: unpub. M.S. thesis, University of Pittsburgh, Pittsburgh, PA, 182 p.

Morgan, S.A., 1994, Depositional facies associated with Lake Monongahela: unpub. M.S. thesis, West Virginia University

Stout, W., Ver Steeg, K., and Lamb, G.F., 1943, Geology of water in Ohio, 4th Series: Ohio Geological Survey Bulletin 44

White, I.C., 1896, Origin of the high terrace deposits of the Monongahela River; reprinted in Hennen, R.V. and Reger, D.B., 1913, Marion, Monongalia and Taylor County Report; West Virginia Geological Survey County Report, p. 67-75

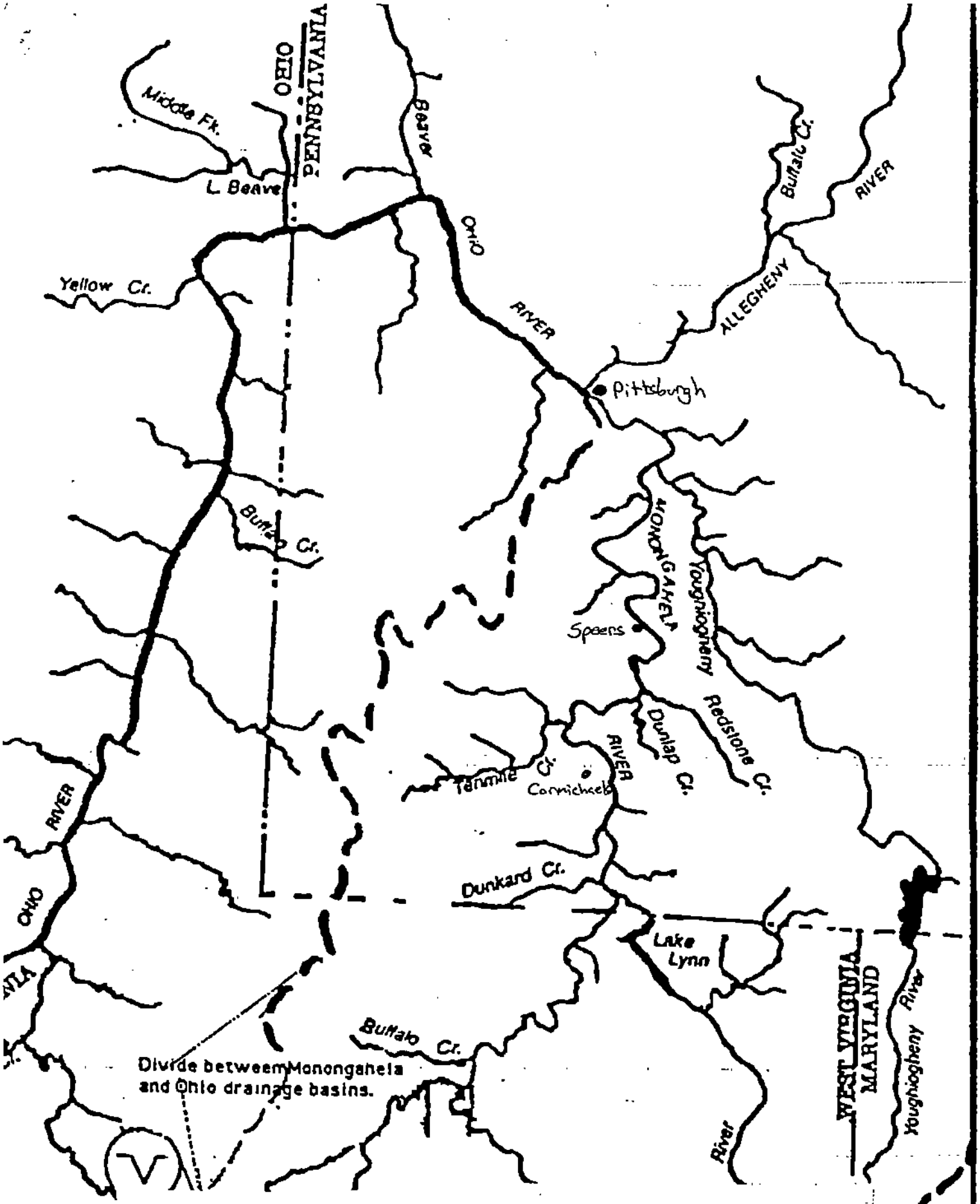


Figure 1a: Map of modern Monongahela, Allegheny, Beaver, and upper Ohio Rivers (after White, 1896 and Morgan, 1994)

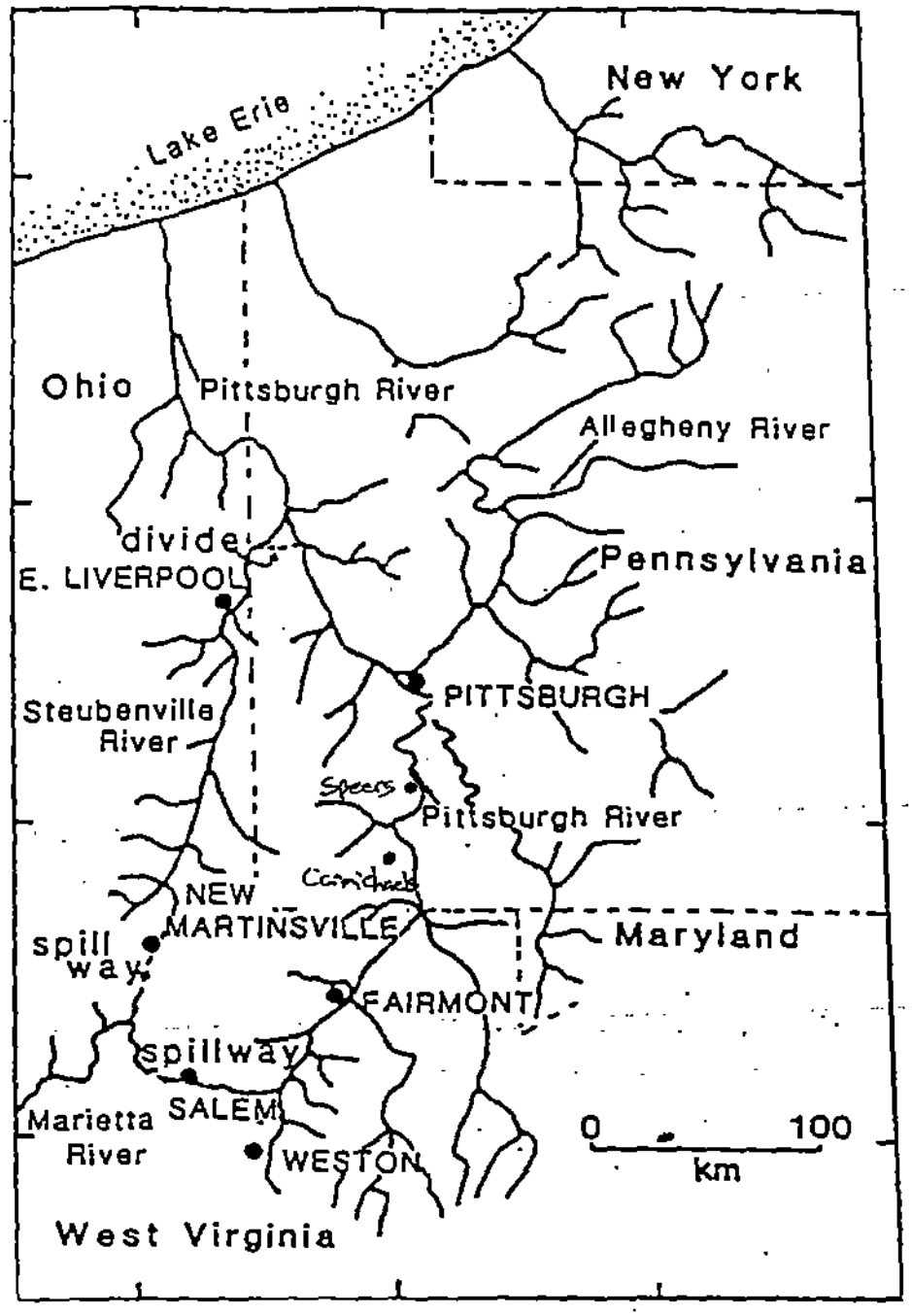
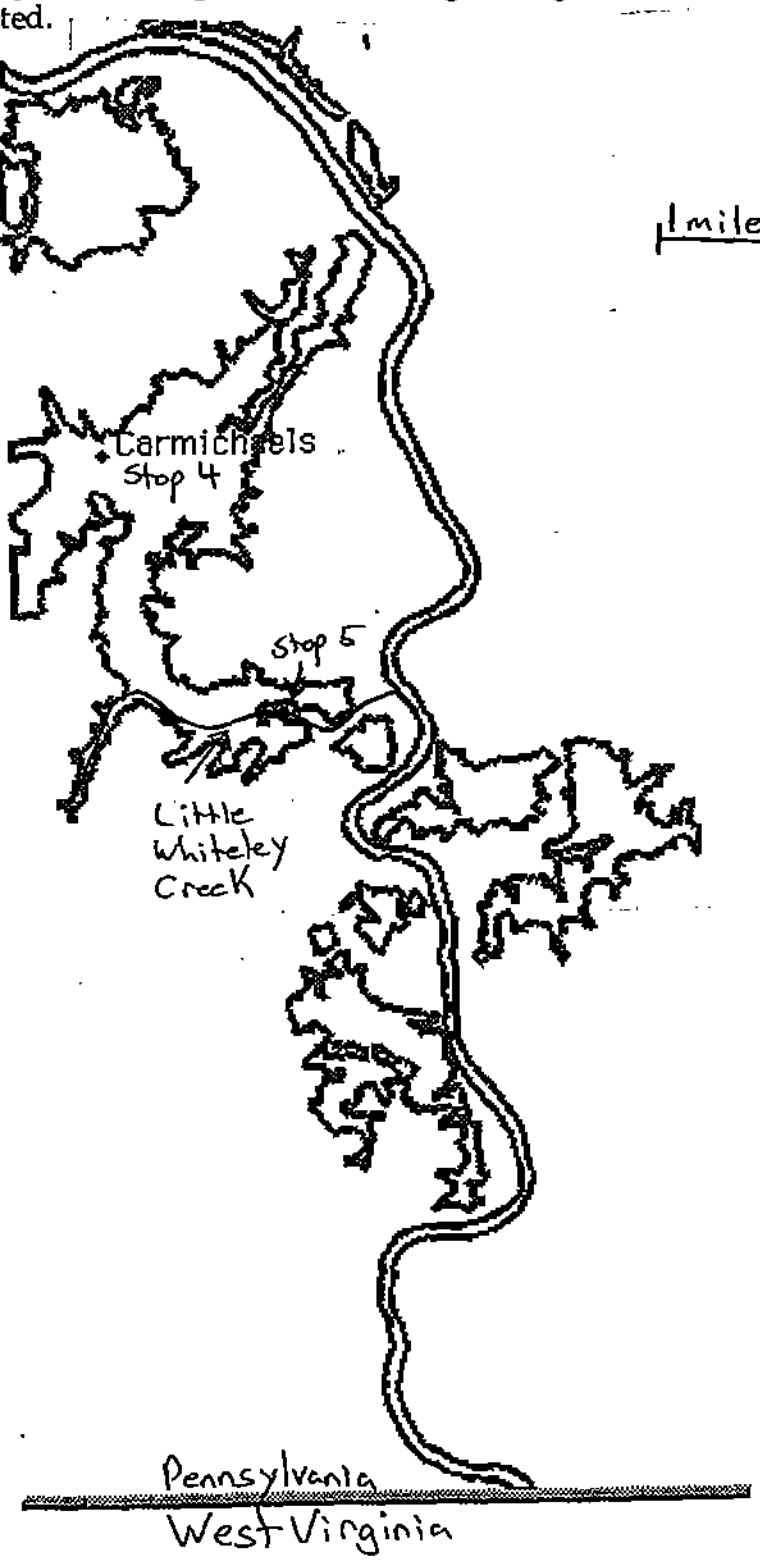


Figure 1b: Map of preglacial drainage in western Pennsylvania showing location of ancient Pittsburgh River system (after Jacobson, 1987; Stout, et al., 1943; and Leverett, 1934).

Figure 2: Map showing course of modern Monongahela River and outlines of 1000-foot Carmichaels Formation terrace remnants; just north of the West Virginia state line in the vicinity of Stops 3, 4 and 5. Terraces roughly mark the location of Lake Monongahela along the ancient Monongahela River course during lower Pleistocene time; note greater degree of meandering compared to modern course. At the time of terrace deposition, downcutting through drainage divides (and resulting increase in gradient and straightening of river course) had not yet been completed.



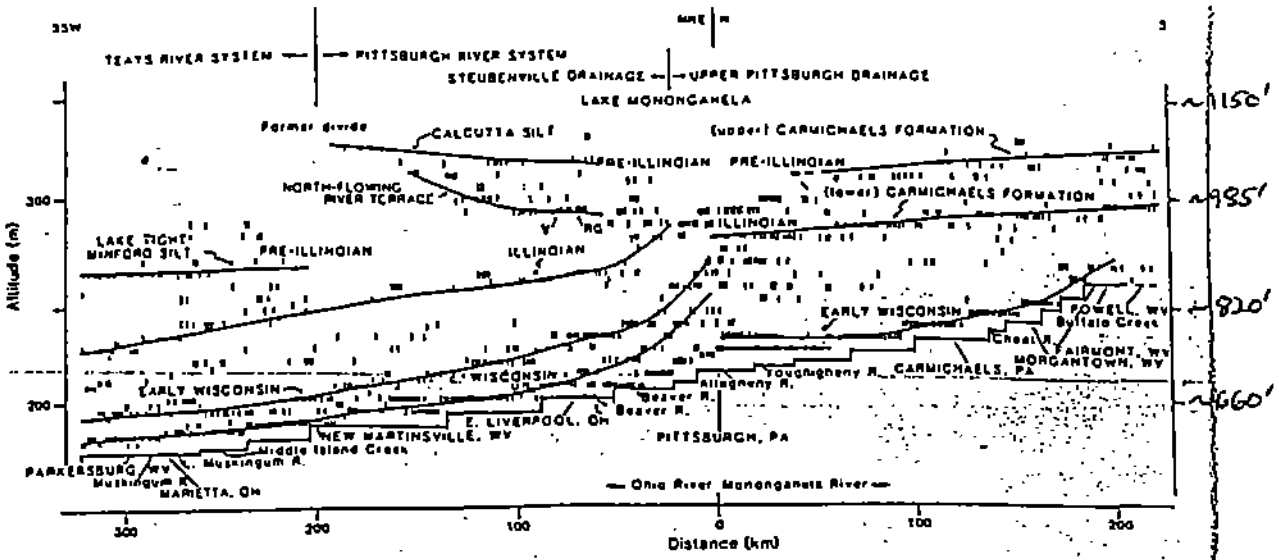


FIG. 3 Summary of slackwater and alluvial terrace altitudes along the modern Ohio and Monongahela Rivers from Parkersburg, West Virginia, to Powell, West Virginia, by way of Pittsburgh, Pennsylvania. The figure is explained in text. Data are synthesized from sources cited in text and the following soil surveys: Marion and Monongalia Counties (Wright *et al.*, 1982), Ohio, Hancock, and Brooke Counties (Ellyson *et al.*, 1974), Marshall County (Kunkle *et al.*, 1960), and Wood and Wirt Counties (Ellyson *et al.*, 1970) in West Virginia; Monroe County (Hayhurst *et al.*, 1974), Belmont County (Rubel *et al.*, 1981), Washington County (Lessig *et al.*, 1977), and Columbiana County (Lessig *et al.*, 1968) in Ohio; Lawrence and Beaver Counties (Smith, 1982), Allegheny County (Newbury *et al.*, 1981), and Westmoreland County (Taylor *et al.*, 1968) in Pennsylvania. V, Vulcan Terrace; RG, Riverview Greenhouse Terrace of Lessig (1961a). From Jacobson, et al., 1988

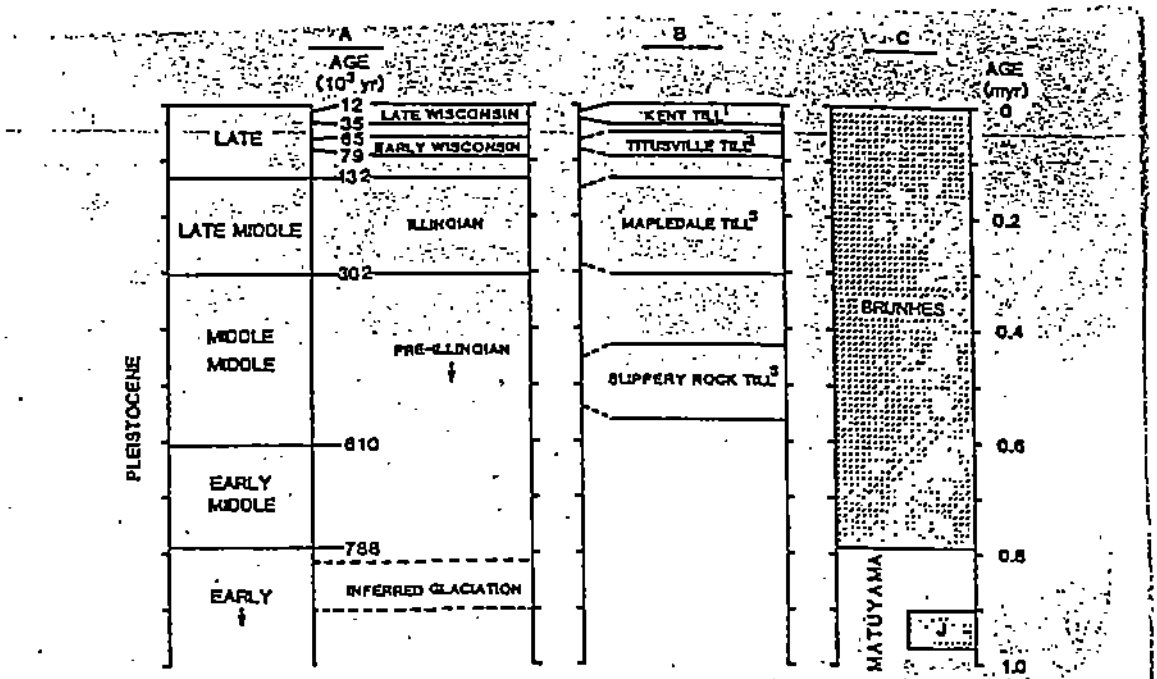
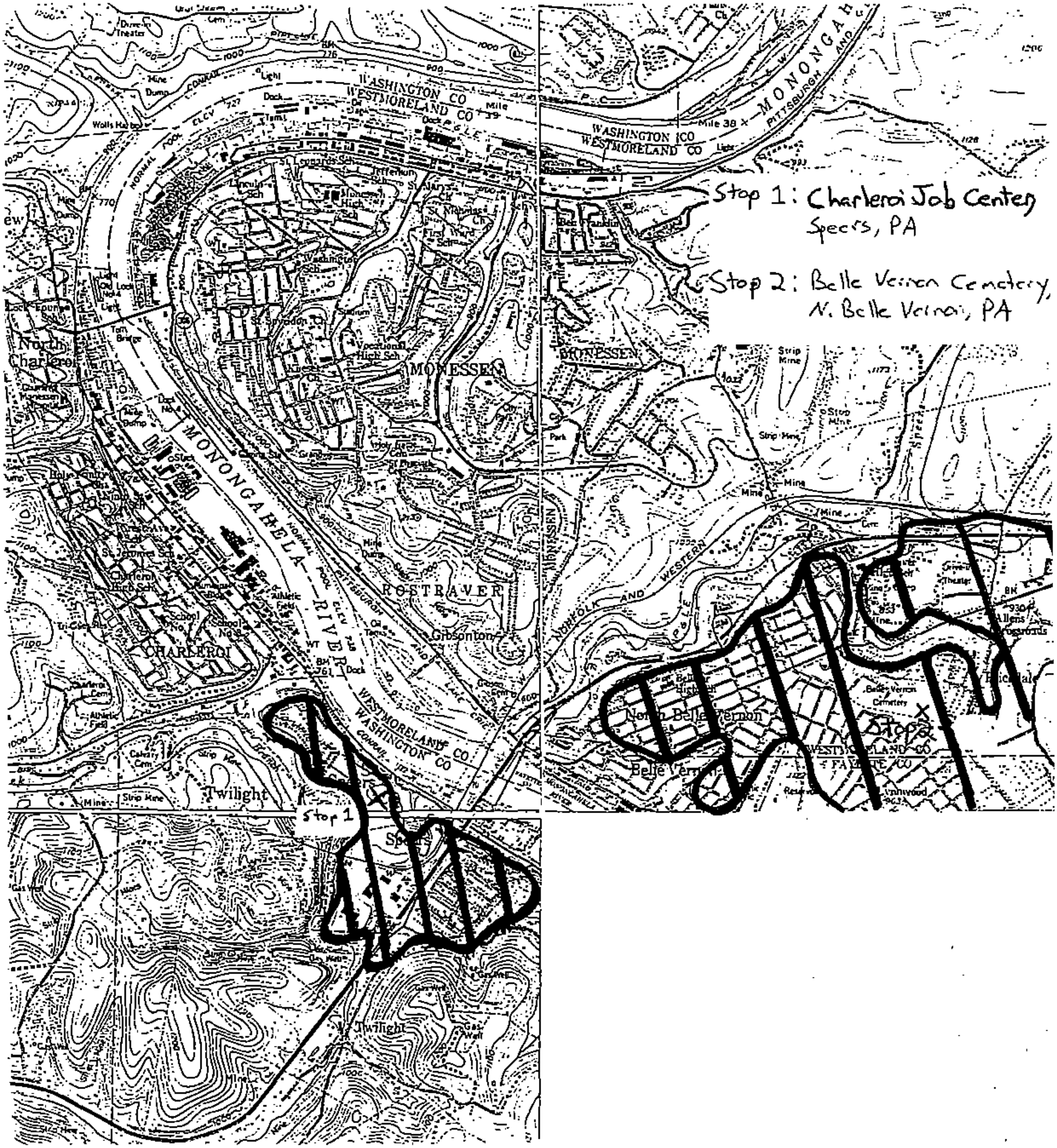


FIG. 4 Summary of Pleistocene till stratigraphy and paleomagnetic time scale. The Pleistocene stratigraphic column and ages in column A are from Richmond and Fullerton (1986; Chart 1). Column B is a summary of till stratigraphy of the Ontario–Erie lobe of northwestern Pennsylvania and northeastern Ohio (Fullerton, 1986). [1]From White (1960): the Kent Till is the basal late Wisconsin till in a multi-till sequence. [2]From White and Totten (1965) and White *et al.* (1969). [3]From White (1969) and White *et al.* (1969). Column C is the paleomagnetic time scale with ages assigned by Richmond and Fullerton (1986; Chart 1). J denotes the Jaramillo Normal-Polarity Subchron.

From Jacobson, et al., 1988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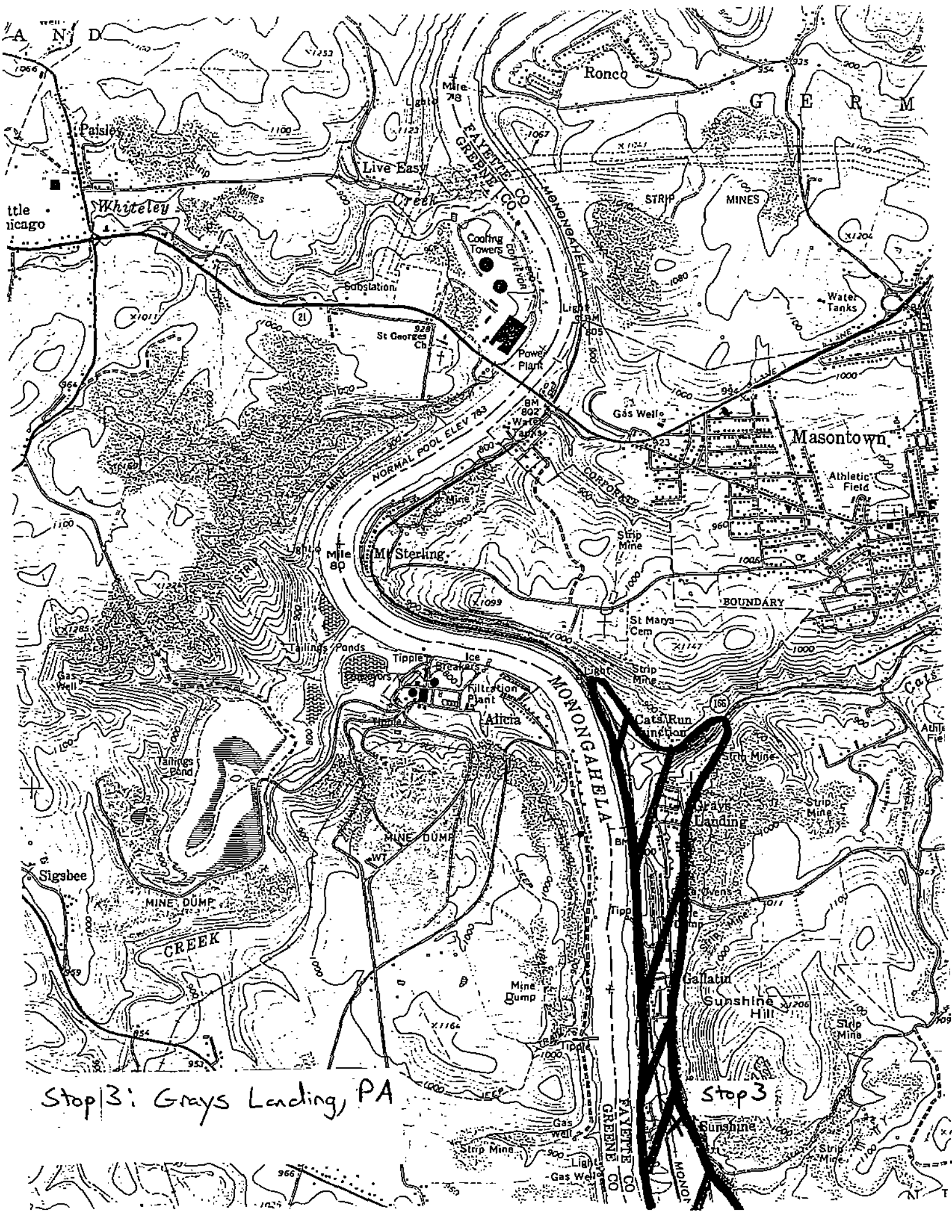
Speers, PA
Stop 2: Belle Vernon Cemetery,
N. Belle Vernon, PA
Stop 1
Stop 2
MONONGAHELA RIVER
WASHINGTON CO
WESTMORELAND CO
MONESSEN
ROSTRAVER
CHARLEROI
North Charleroi
Gibsonton
North Belle Vernon
Belle Vernon
Twilight
FAYETTE CO


Paisley
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FAYETTE CO
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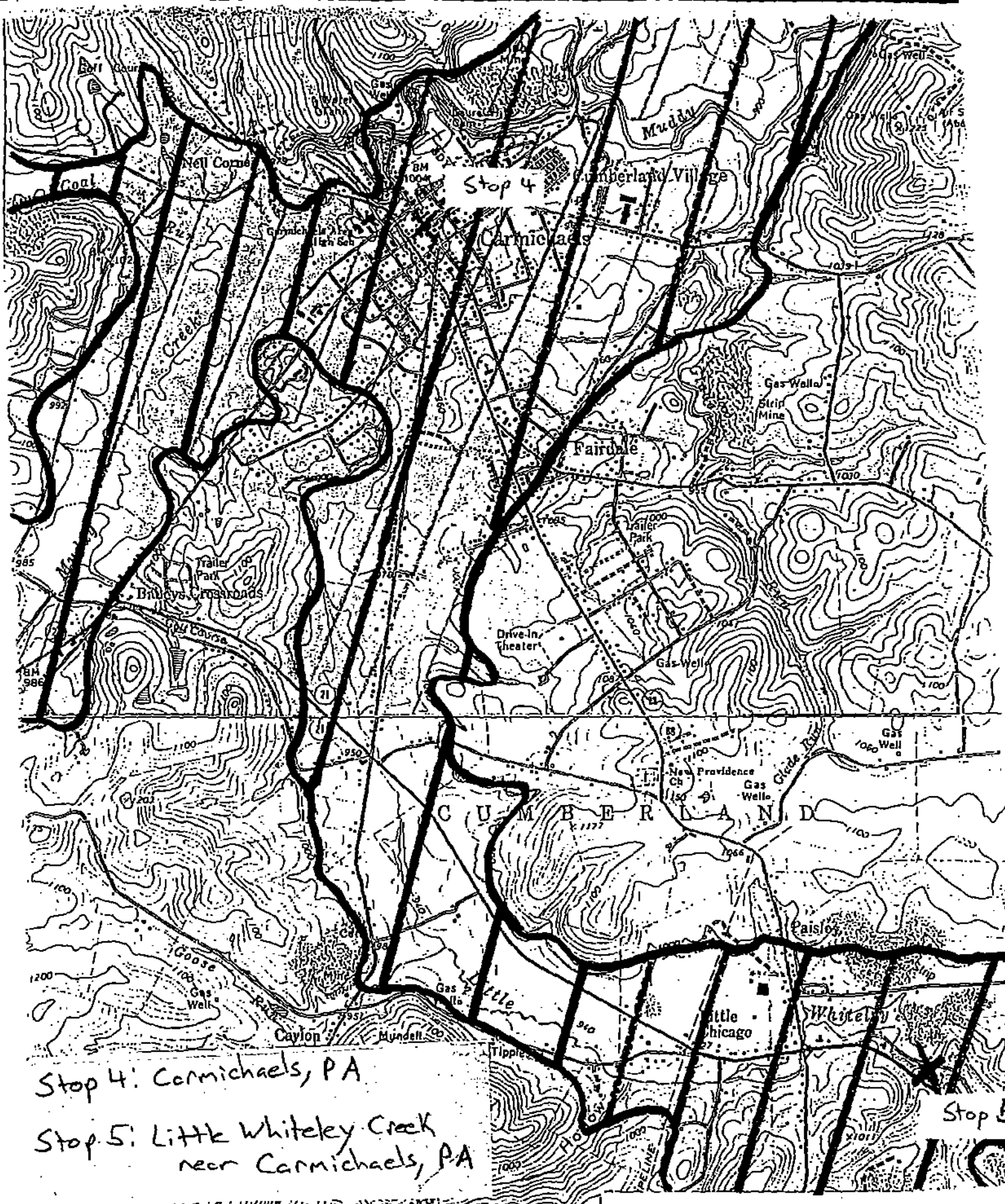
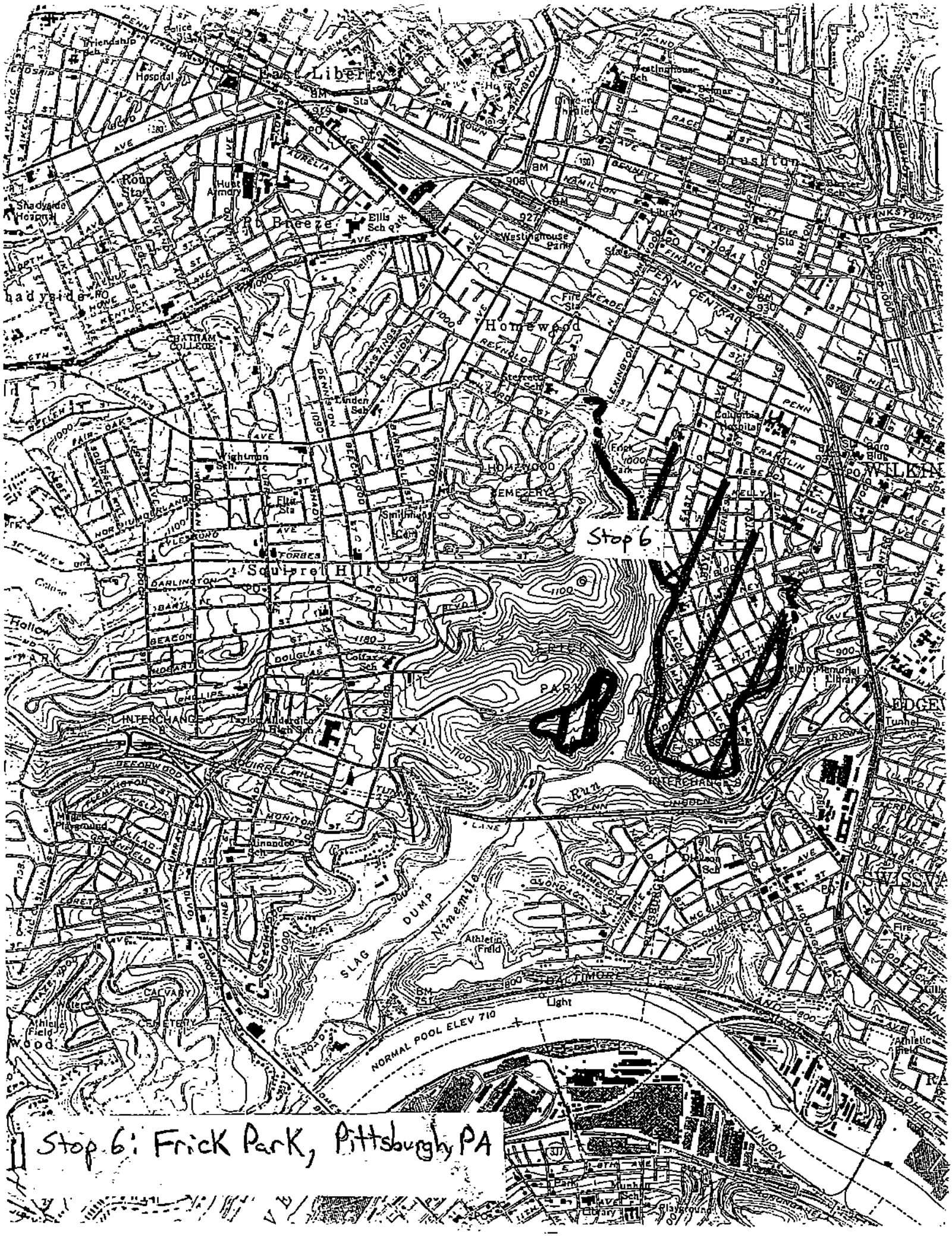
CONVEYOR
Substation
Light
Water Tanks
St Georges Ch
928
Power Plant
BM 802 Water Tanks
NORMAL POOL ELEV 783
Gas Well
Masontown
Athletic Field
CORTORSTEP
Strip Mine
Mile 80
Mt Sterling
BOUNDARY
St Marys Cem
Tailings Ponds
Tipple
Ice Breakers
Conveyors
Filtration Plant
Alicia
Cats Run
Tailings Pond
Gas Well
MINE DUMP
Sigsbee
CREEK
Grays Landing
Gallatin
Sunshine Hill
Mine Dump
Tipple
Sunshine
Gas well
Strip Mine
Light
Gas Well
FAYETTE CO
GREENE CO
MONONGAHELA
Stop 3
Stop 3: Grays Landing, PA



Stop 4: Carmichaels, PA

Stop 5: Little Whiteley Creek near Carmichaels, PA


Stop 6
Stop 6: Frick Park, Pittsburgh, PA