Fluvial Geomorphology Information for NMR State of the Watershed Report

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Monitoring Stream and Floodplain Characteristics – Nine Mile Run

The shape, course, and condition of the stream provide the foundation that all other stream characteristics built upon. Fish and other in-stream biota depend on specific environments in the stream to allow protection during storms and oxygen during the hottest days of summer. Trees in the floodplain depend on infrequent, though regular, flooding to maintain competitive advantage over upland species that could otherwise grow in the floodplain. Water quality improves as stream water moves through functioning riparian zones. Therefore, modifications to stream *geomorphology* (i.e., stream shape) are one of the foundations of the Nine Mile Run restoration.

However, streams develop their shapes over decades, with most abrupt changes occurring during large rainstorms when landslides and flooding occurs. Therefore, while the restoration paid careful attention to geomorphology in its design, we do not expect to see major changes in geomorphology, as the restoration was designed to handle both large and small flows. Moreover, the last major rain event for the region, Hurricane Ivan (in 2004), occurred before the restoration was complete. Therefore, "monitoring" of the fluvial geomorphology for the first state of the watershed report will rely on historical documents to provide context.

Historic Stream Course

All streams move. Problems begin when they move too fast or begin to interfere with structures that humans value. For example, the portion of the stream below the Braddock Avenue culvert is securely cemented (at great cost). If this stream were to move, it would likely impact Braddock Avenue and the on ramp to I-376, and is the reason for the heavy use of concrete in this portion of the stream. One way to understand how much movement is "natural" and how much movement is too much is to examine the historic path of the stream.

Using historic maps, it is possible to follow changes in the path of Nine Mile Run. The oldest known mapping used for this report is 1872, from an early property atlas compiled by G. M. Hopkins and Company. Since this mapping we have a series of maps created by the federal government and the city of Pittsburgh that include Nine Mile Run. The changes in Nine Mile Run are shown below:

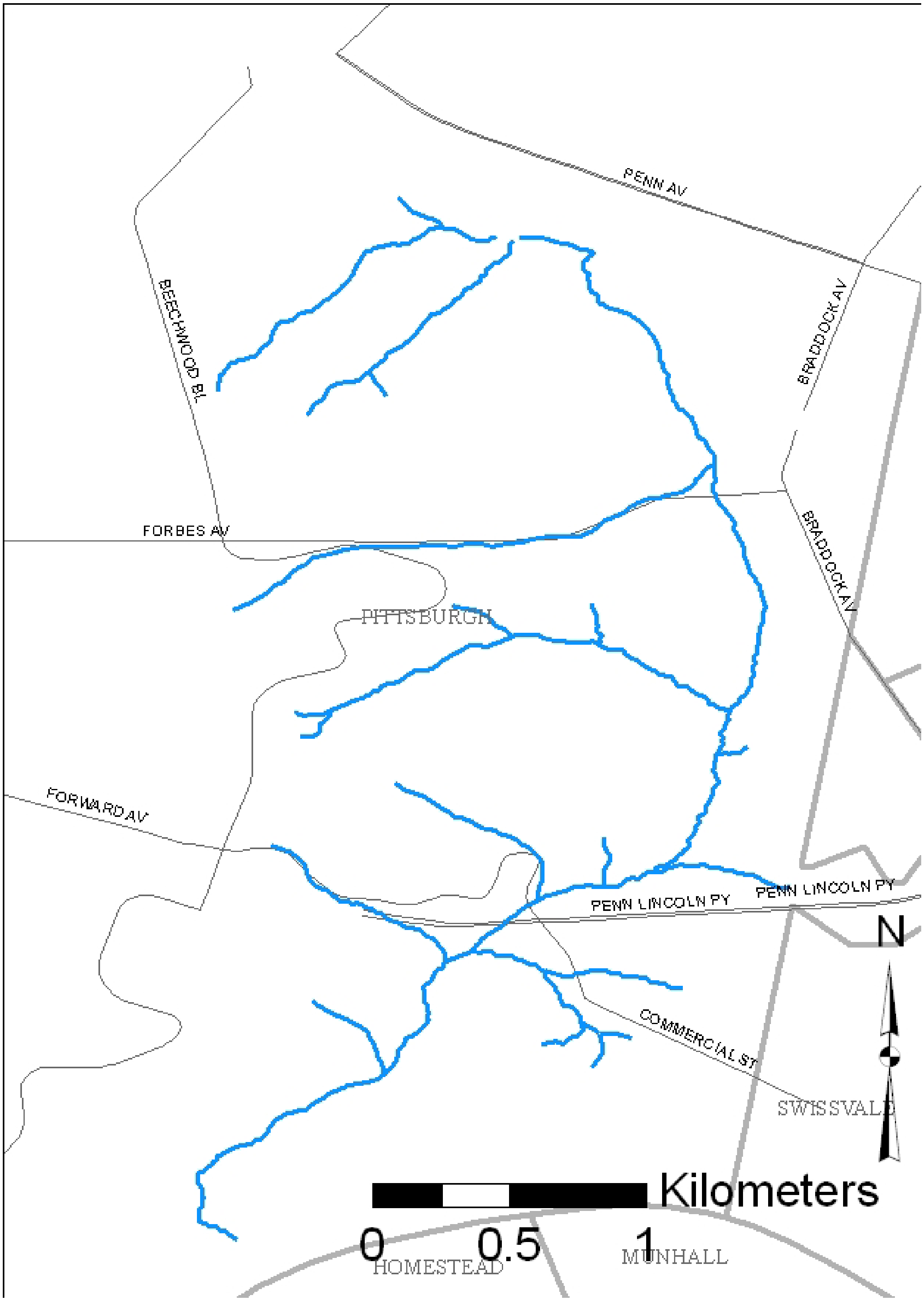


Figure 1 Stream course in 1872 traced from a property map compiled by the G. H. Hopkins Company and shown in relation to current major roads. Please note that the stream extended further east, but existing property maps ended at the county line, explaining the abrupt end of the stream at the current city line.

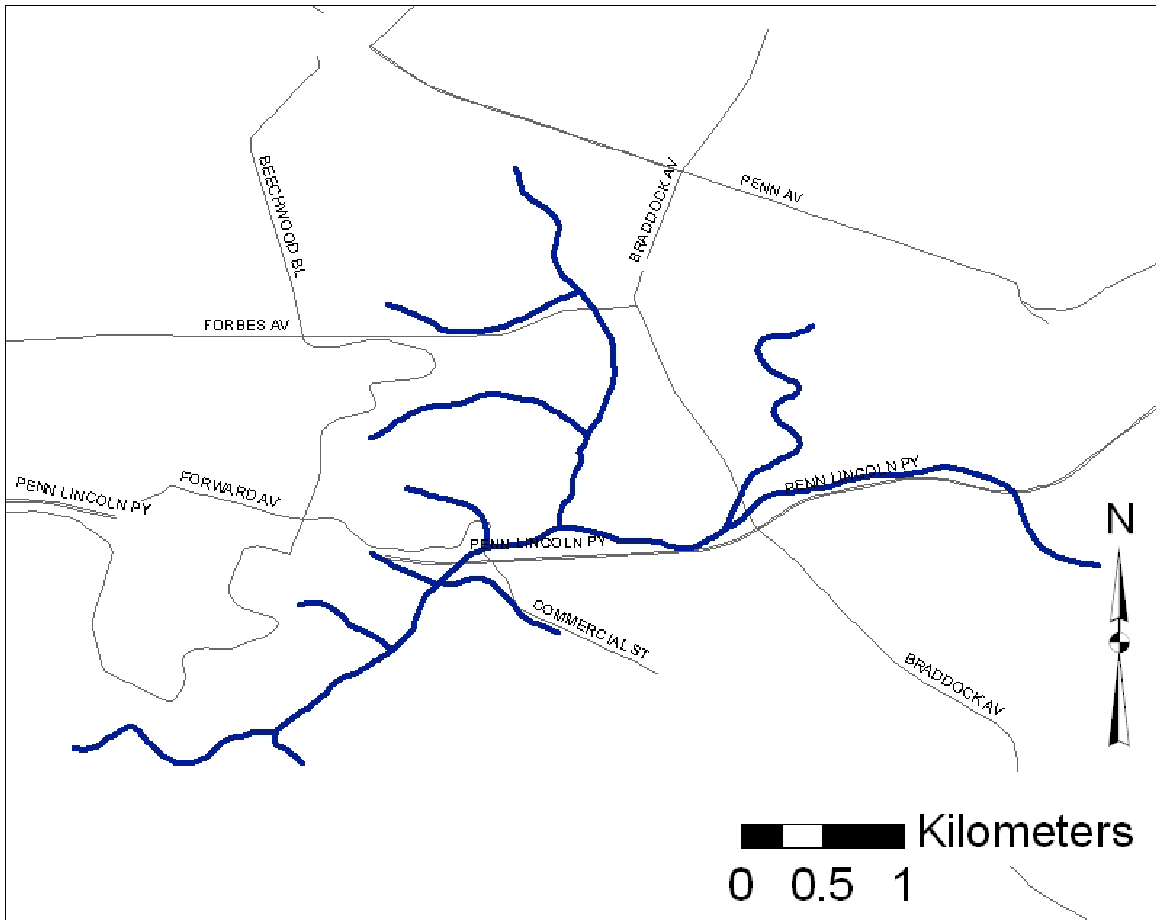


Figure 2 Map of the stream course on the 1907 US Geological Survey 15 minute topographical map.

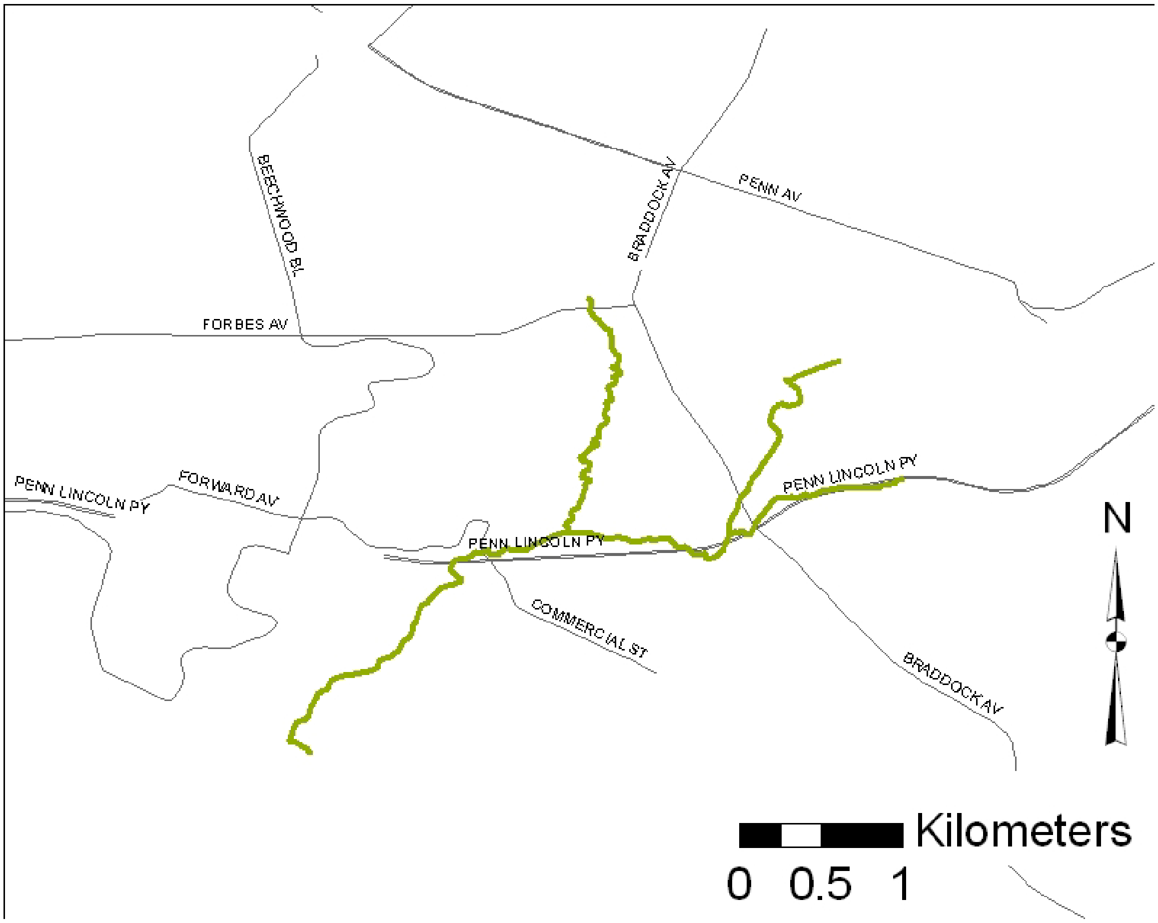


Figure 3 Map of the stream course as mapped by the 1921 City of Pittsburgh Topographical Survey

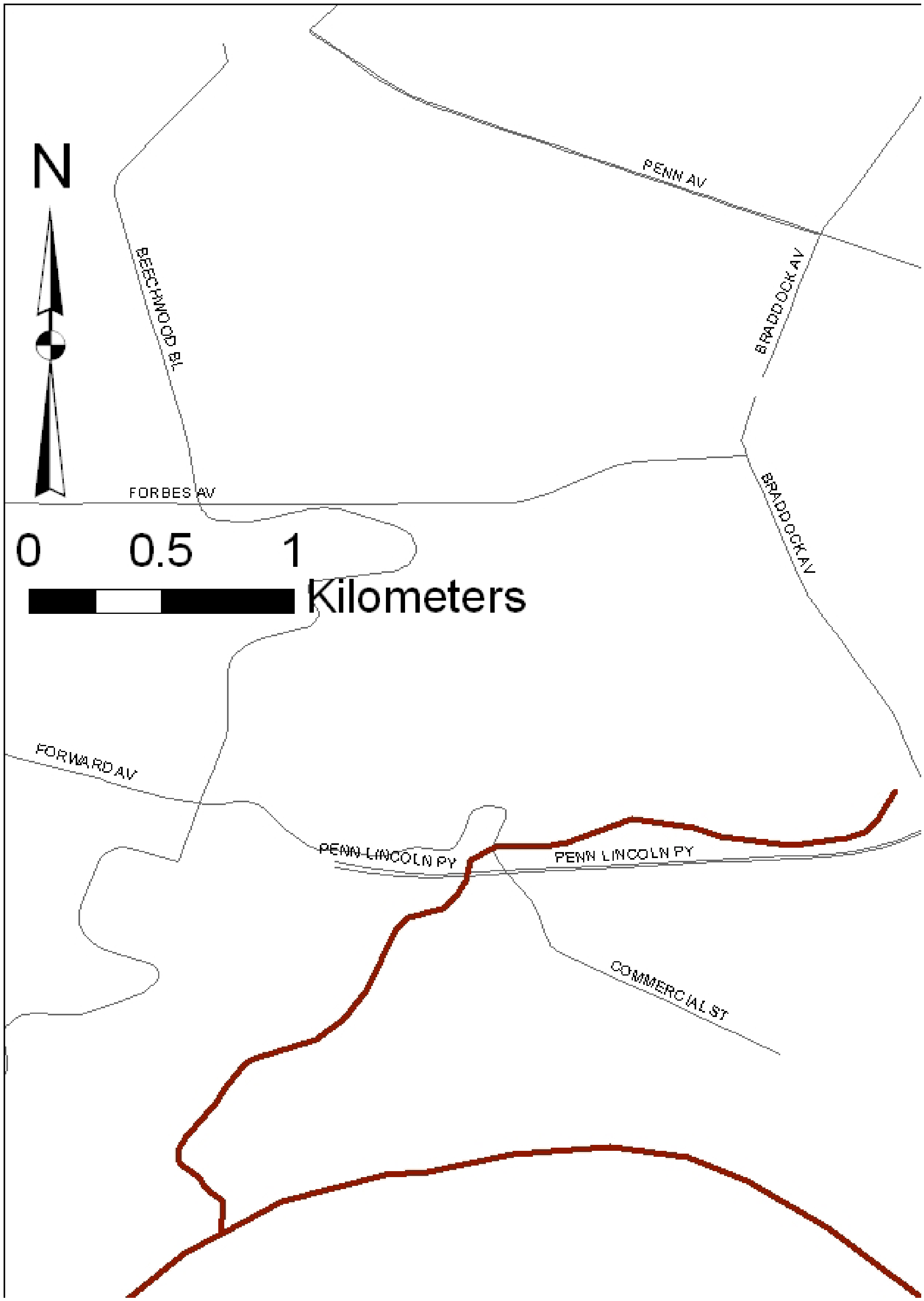


Figure 4 Map of the current stream course, as mapped in contemporary US Geological Survey publications.

Notice that as Pittsburgh has grown, Nine Mile Run has shortened. While some of this is due to the burial of streams, particularly east of Braddock Avenue, many streams, including Fern Hollow and its tributaries are much less extensive than they were even 100 years ago. Some of these streams have become ephemeral due to the large increase in impervious surfaces in the watersheds. While water used to percolate into the soil and move slowly from the ridgeline through soil and groundwater systems, it is now quickly routed to the stream through storm sewers. Therefore water that used to move slowly through ground water systems and continuously feed the stream between storms is gone and streams dry out unless rain has fallen recently.

Longitudinal Profiles

Streams not only move left and right, they also move up and down. This vertical change can pose just as many problems as lateral movement. For example, deep channels can expose buried utility lines. In addition, deep channels can cause floodplain sediments to dry, killing vegetation and reducing the ability of the stream to remove excess nutrients.

Understanding the vertical change in stream course is more difficult than understanding stream movement from side to side. Most streams follow very gentle slopes (a drop of a foot every 100 feet of length is a swift stream and, with the right type of bed material, generally what we call white water) and it is difficult to measure these changes with the human eye. And while you can see stream banks sloughing off into the stream, changes in the stream bottom are generally covered by the stream water itself. In addition, it should be re-iterated that these processes occur over the course of decades rather than years.

That said, we revisited the maps used in the first section and generated several *longitudinal profiles*. These are simply traces of stream elevation from the mouth of the stream to the last point where the stream is continually wet and flowing throughout the year (in this case the Braddock Culvert). When we compare these longitudinal profiles with each other (see figure below), several interesting adjustments are obvious. First, the dumping of slag in the lower section of the watershed has clearly raised the level of the creek. Second, in the upper creek just before the restoration began, the stream had apparently cut into the valley sediments. This adjustment likely resulted from a combination of the burial of the streams in Wilkinsburg and Edgewood and the filling of the lower valley with slag.

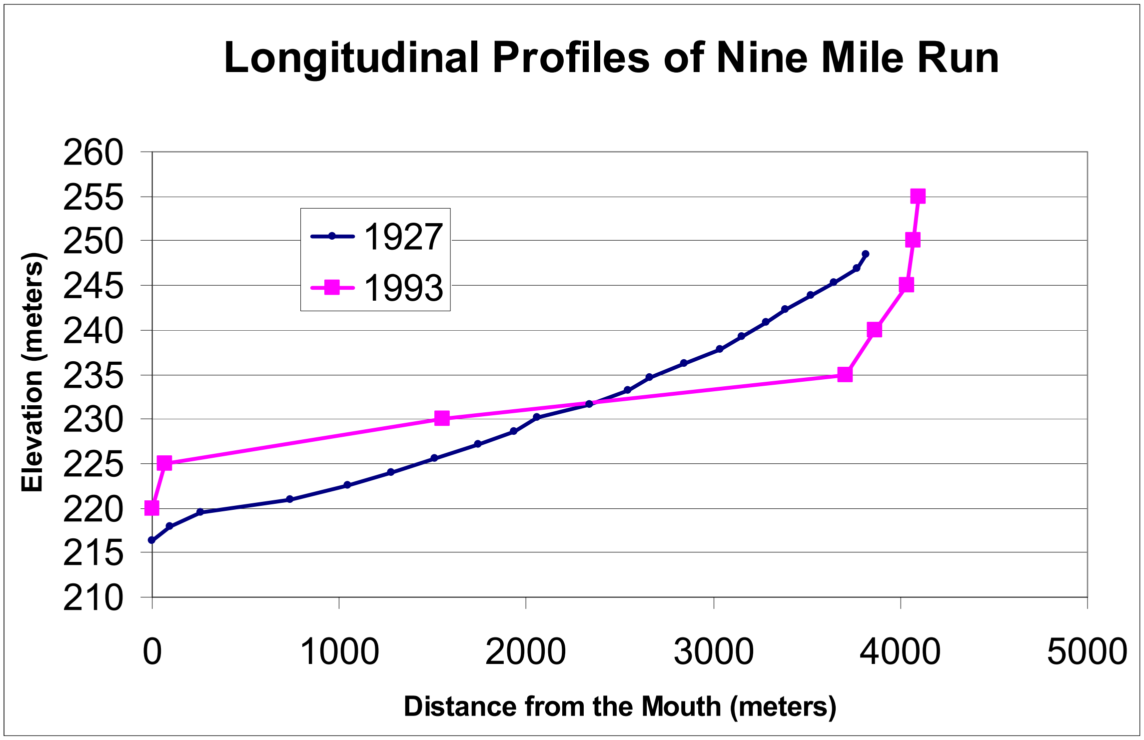
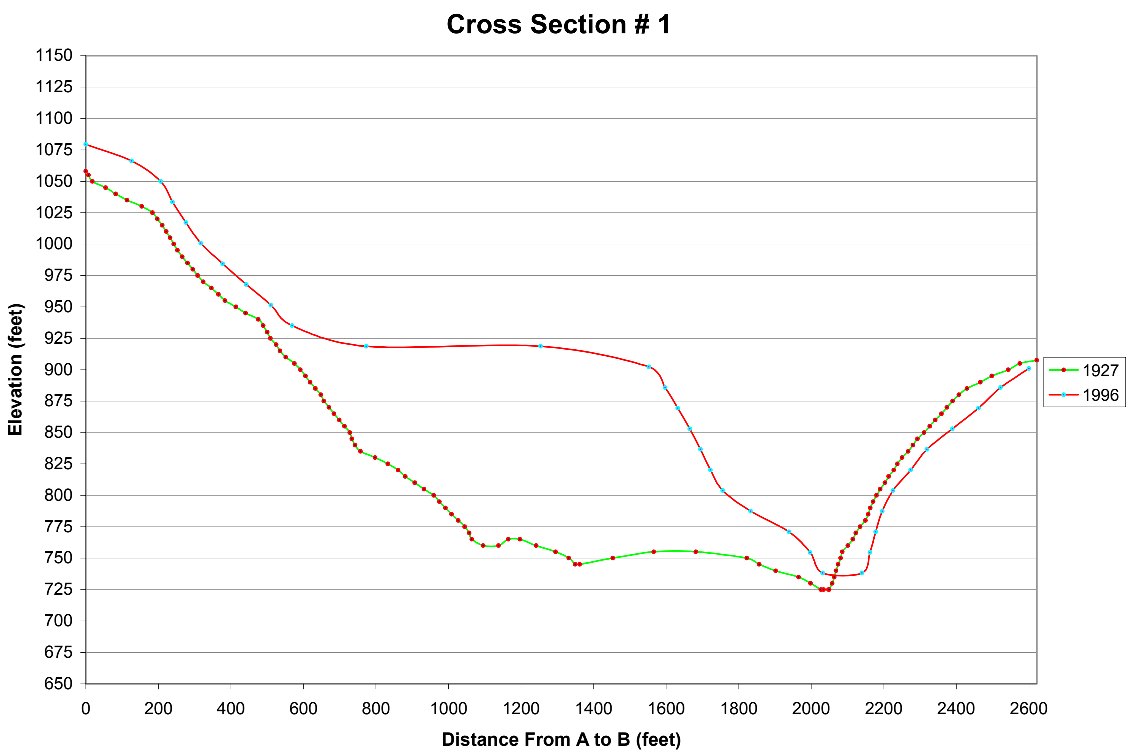
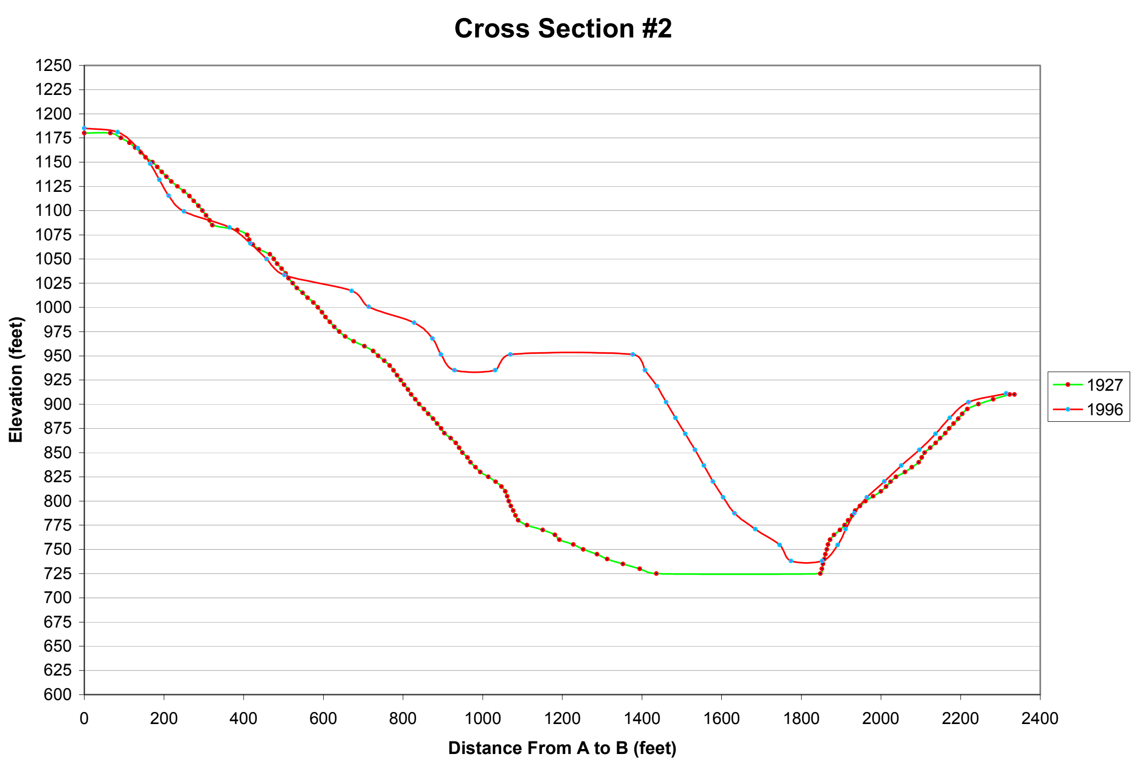


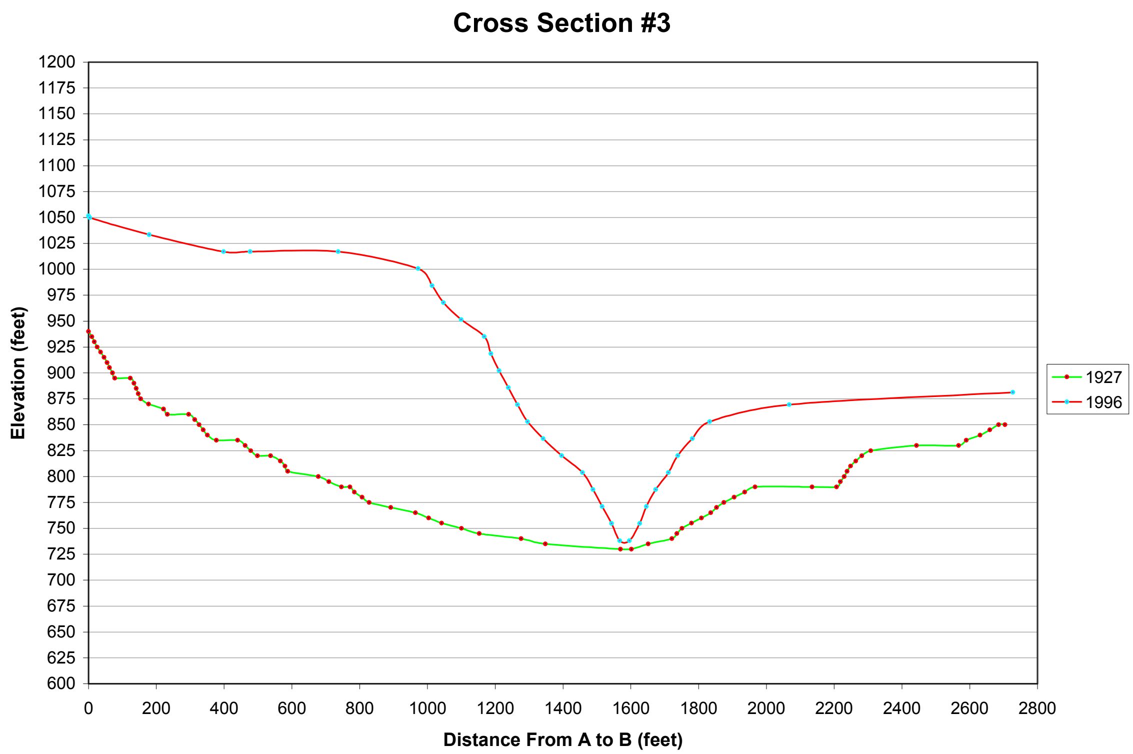
Figure 5 Map of longitudinal stream profiles from the mouth of Nine Mile Run to the Braddock Avenue Culvert in 1927 and 1993. Note the change in elevation in the lower portion of the watershed, due to the dumping of slag in that portion of the stream. Note also the apparent adjustment to the slag, changes in hydrology, etc. in the upper portion of the watershed, where the stream appears to have incised.

Slag in Lower Nine Mile Run

One of the most dramatic adjustments to Nine Mile run was the filling of the lower valley with slag, a by-product of the steel manufacture process. To understand the scale of this adjustment, we used the maps mentioned above to look at the valley cross-sections. We traced the elevations of the valley from ridge-top to ridge-top at several locations (see the map shown below). The magnitude of this sediment movement really eclipses the amount of sediment moved by the stream in the period where maps exist. Moreover, this waste disposal continues to impact Nine Mile Run and the watershed. While the made land has been put to good use, the stream will be artificially constrained for many years, and active management will likely be necessary to counteract this constraint.


Cross Section # 1
Elevation (feet)
Distance From A to B (feet)
1927
1996
1150
1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675
650
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600


Cross Section #2
Elevation (feet)
Distance From A to B (feet)
1927
1996
1250
1225
1200
1175
1150
1125
1100
1075
1050
1025
1000
975
950
925
900
875
850
825
800
775
750
725
700
675
650
625
600
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400



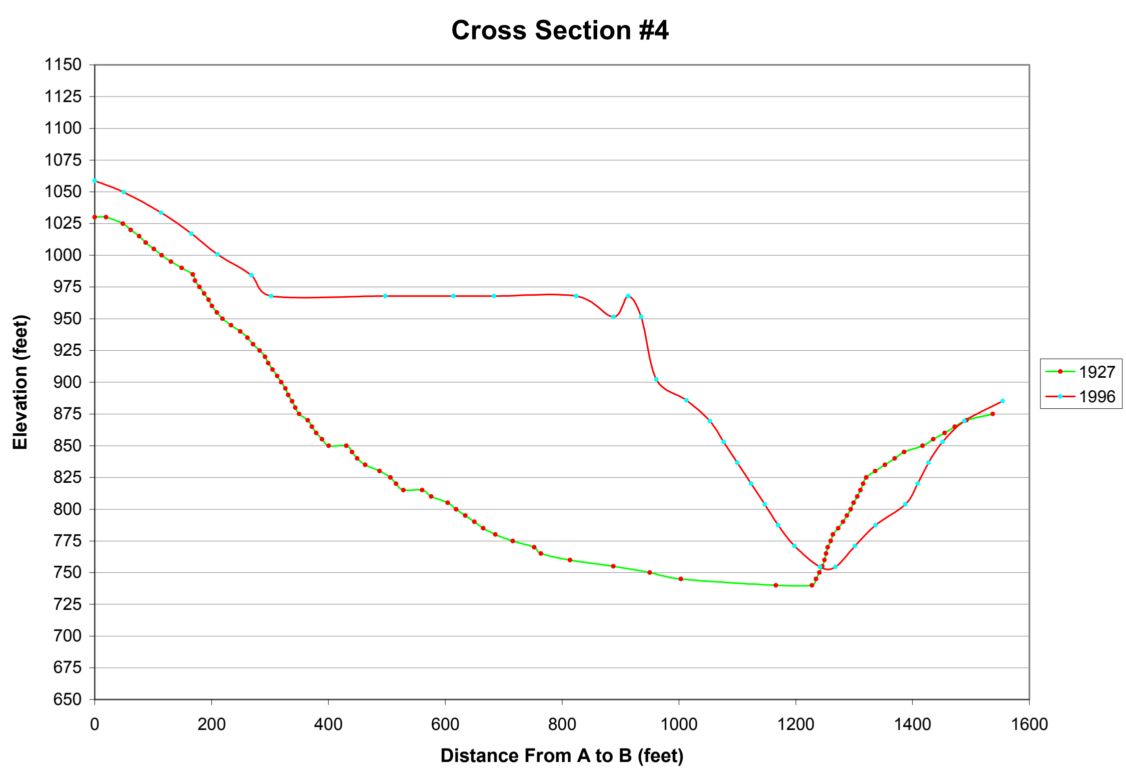


Figure 6 Series of four valley cross-sections in the slag-dump portion of Nine Mile Run showing the magnitude of this impact. (Note a map of these cross-section lines exists and will be provided asap.)