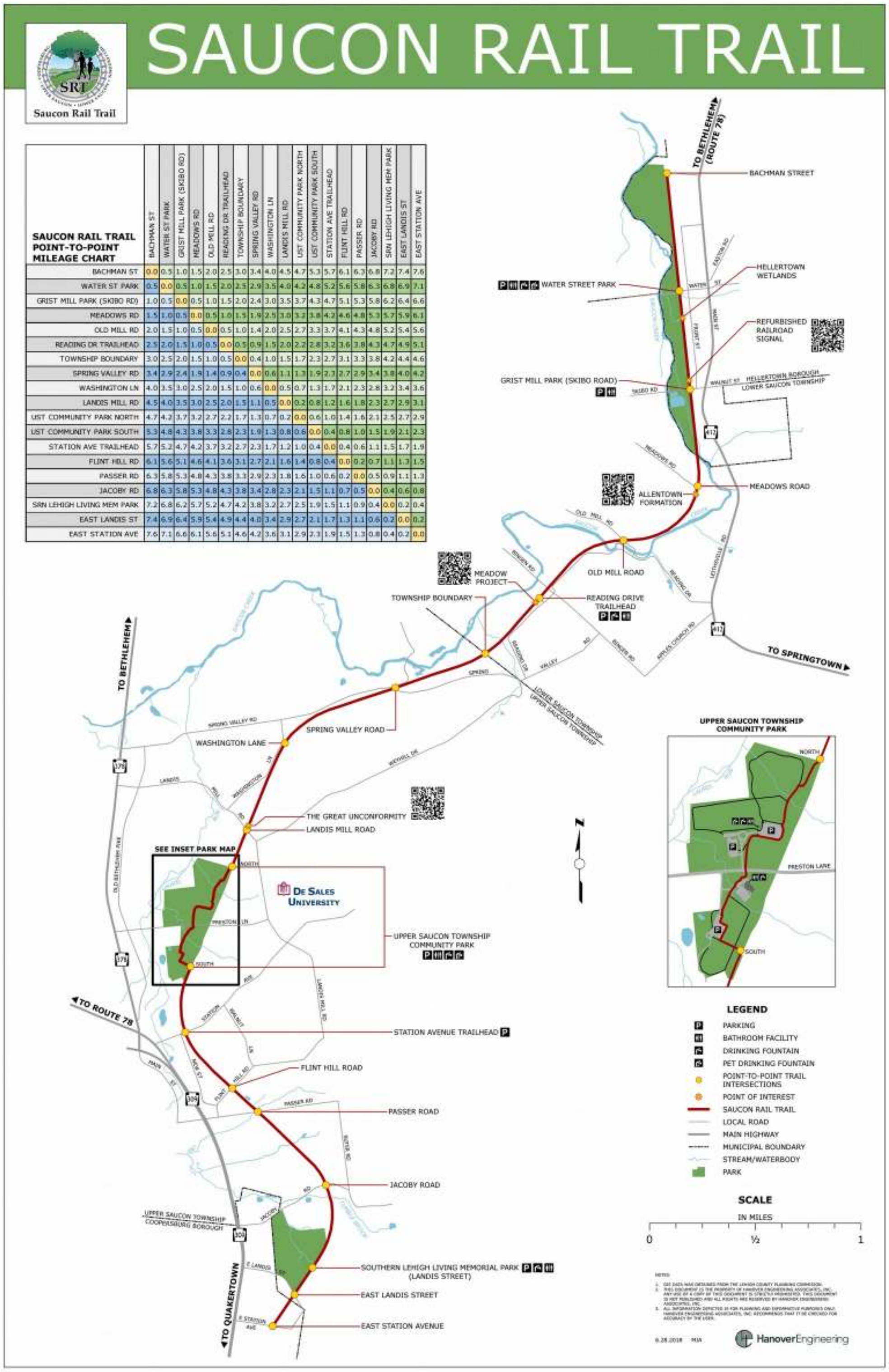
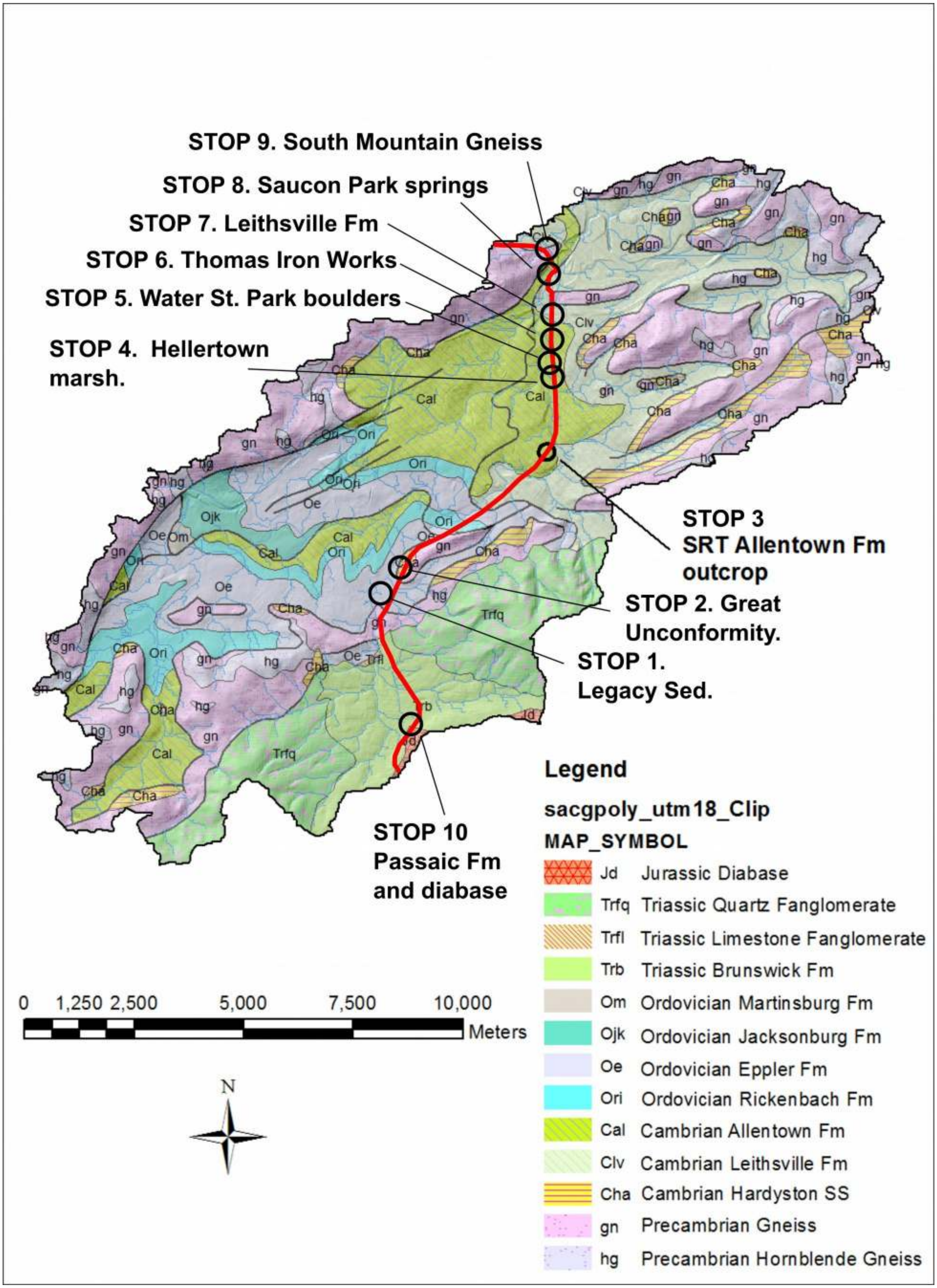
FCOPG Geo-Bike Tour

04 October, 2018

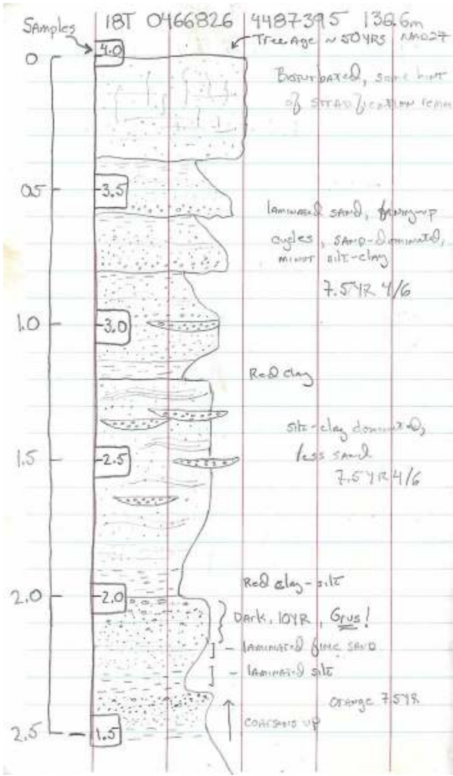
Frank J Pazzaglia, Lehigh University




STOP 9. South Mountain Gneiss
STOP 8. Saucon Park springs
STOP 7. Leithsville Fm
STOP 6. Thomas Iron Works
STOP 5. Water St. Park boulders
STOP 4. Hellertown marsh.
STOP 3 SRT Allentown Fm outcrop
STOP 2. Great Unconformity.
STOP 1. Legacy Sed.
STOP 10 Passaic Fm and diabase
Legend
sacgpoly_utm18_Clip
MAP_SYMBOL
Jd Jurassic Diabase
Trfq Triassic Quartz Fanglomerate
Trfl Triassic Limestone Fanglomerate
Trb Triassic Brunswick Fm
Om Ordovician Martinsburg Fm
Ojk Ordovician Jacksonburg Fm
Oe Ordovician Eppler Fm
Ori Ordovician Rickenbach Fm
Cal Cambrian Allentown Fm
Clv Cambrian Leithsville Fm
Cha Cambrian Hardyston SS
gn Precambrian Gneiss
hg Precambrian Hornblende Gneiss
0 1,250 2,500 5,000 7,500 10,000
Meters
N

KM	MILES	
0.00	0.00	Start From South Parking lot of Upper Saucon park. Head west to gravel pad behind storage shed at corner of soccer field.
0.2	0.12	Leave bike at storage shed, take trail into woods to the high embankment of Laurel Run. **STOP 1.** Legacy sediments along tributary of Saucon Creek. This tributary of Saucon Creek was used, historically, as an impoundments for the Landis Mill site ~ 2 km downstream, as well as a sink for runoff generated by nearby iron mines. The result of these activities was historic aggradation and widening of the floodplain due to the trapping of fine-grained sediment. The Laurel Run channel was raised 2-3 meters by this aggradation in the past 100-200 years, and much more recently has deeply incised back do to near its pre-human impacted elevation. The physical sedimentology of the aggradation and degradation of the channel are well exposed in the embankment at this stop.

STOP 1 as it looked in the summer of 2009. Note the removal of the large tree stump since that time.



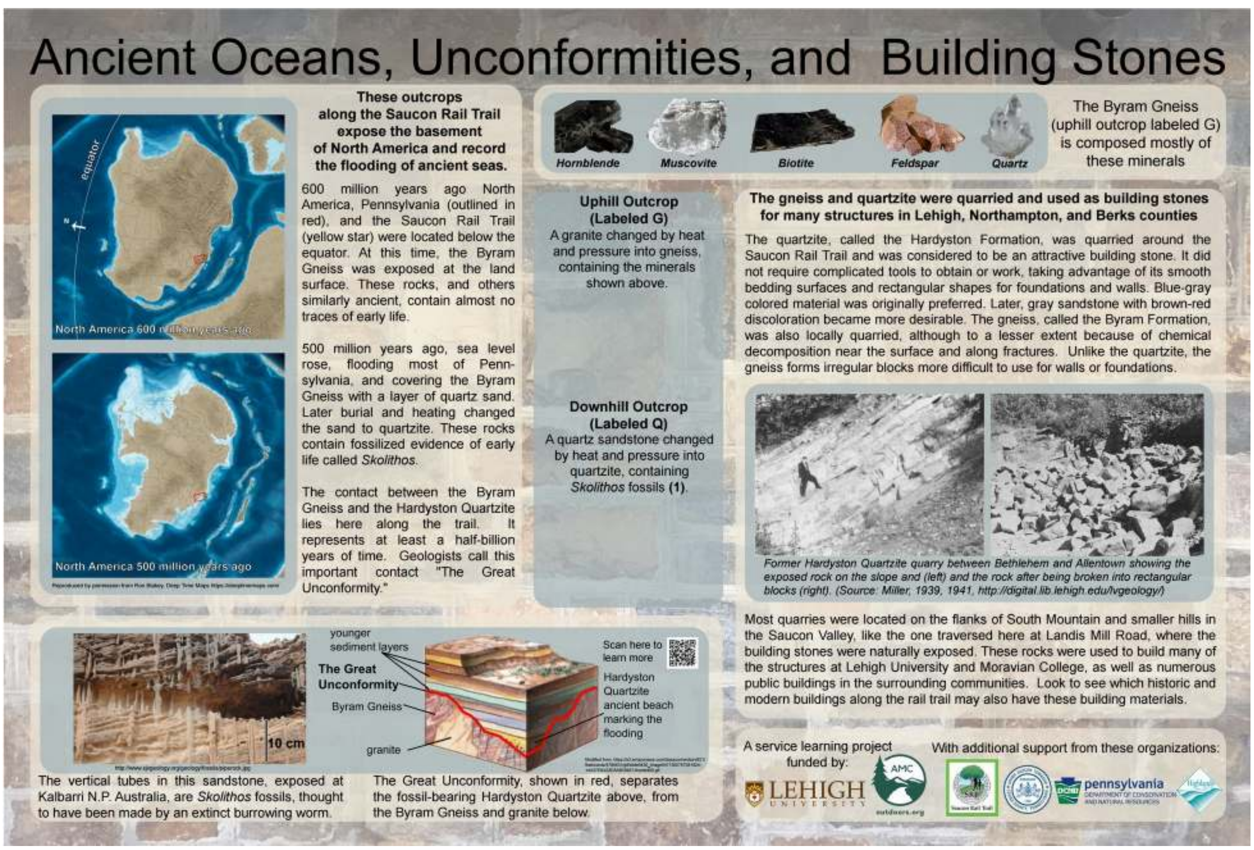
Photos from STOP 1 showing the stratigraphy and characteristics of the base of the deposit where a yellow, leaf-rich horizon buries a black, organic rich, wetland deposit. The wetland deposit in turn lies on top of indurated sand and gravel. Elsewhere in the mid-Atlantic region, the wetland deposit is 14C dated to be mostly ~ 3500-4000 yrs old. That is true too for Saucon Creek and will be displayed at STOP 4. The sand and gravel below the wetland deposit is taken to be LGM or early Holocene in age.

0.2 0.12 Return to bikes, retrace route to parking lot.

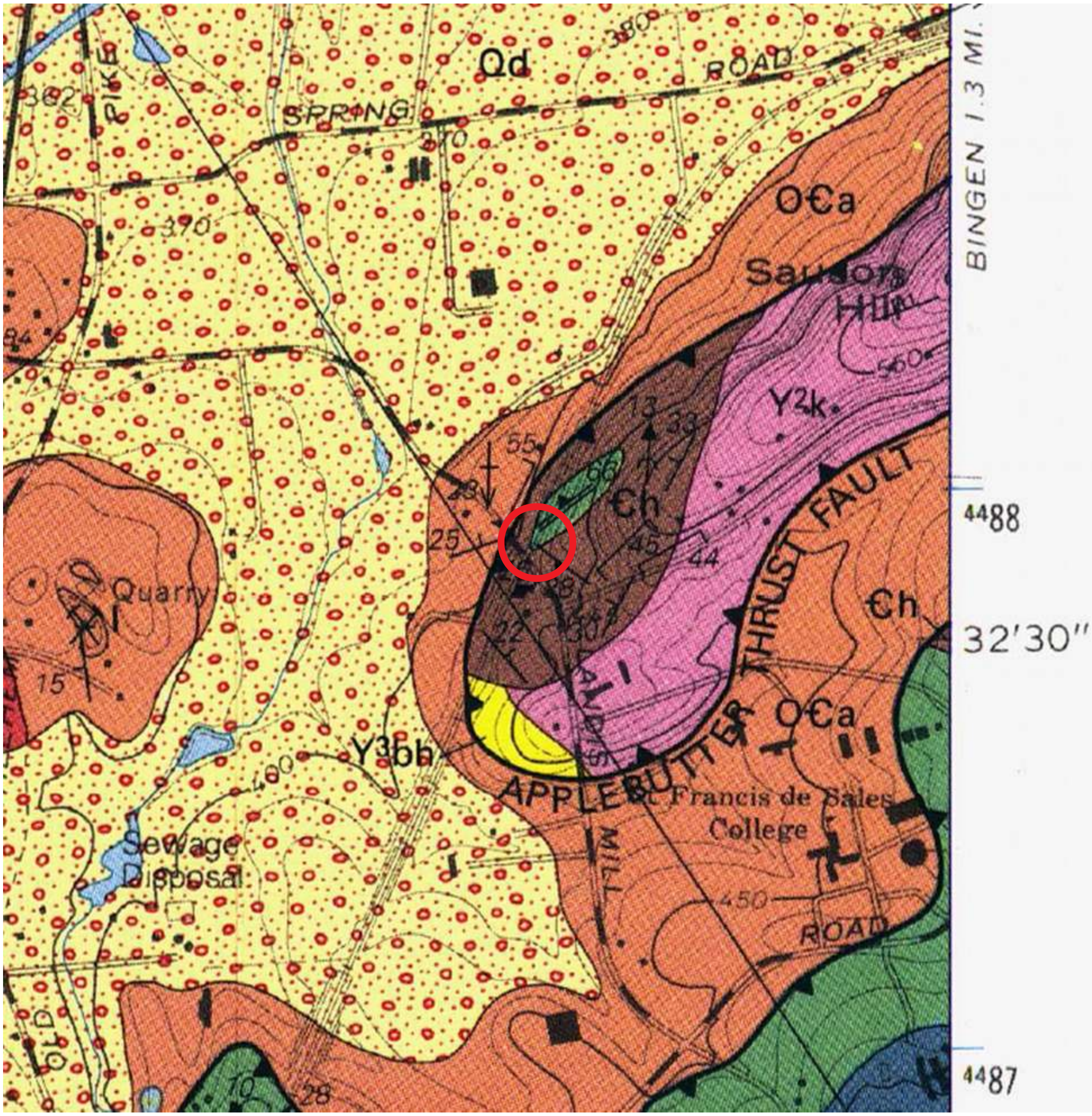
0.4 0.25 Depart parking lot through east entrance, cross park entrance road and access paved trail. Follow outline of parking lot to the east, then north.

0.88 0.55 Bear right, ascend hill, and pass onto SRT gravel trail heading north.

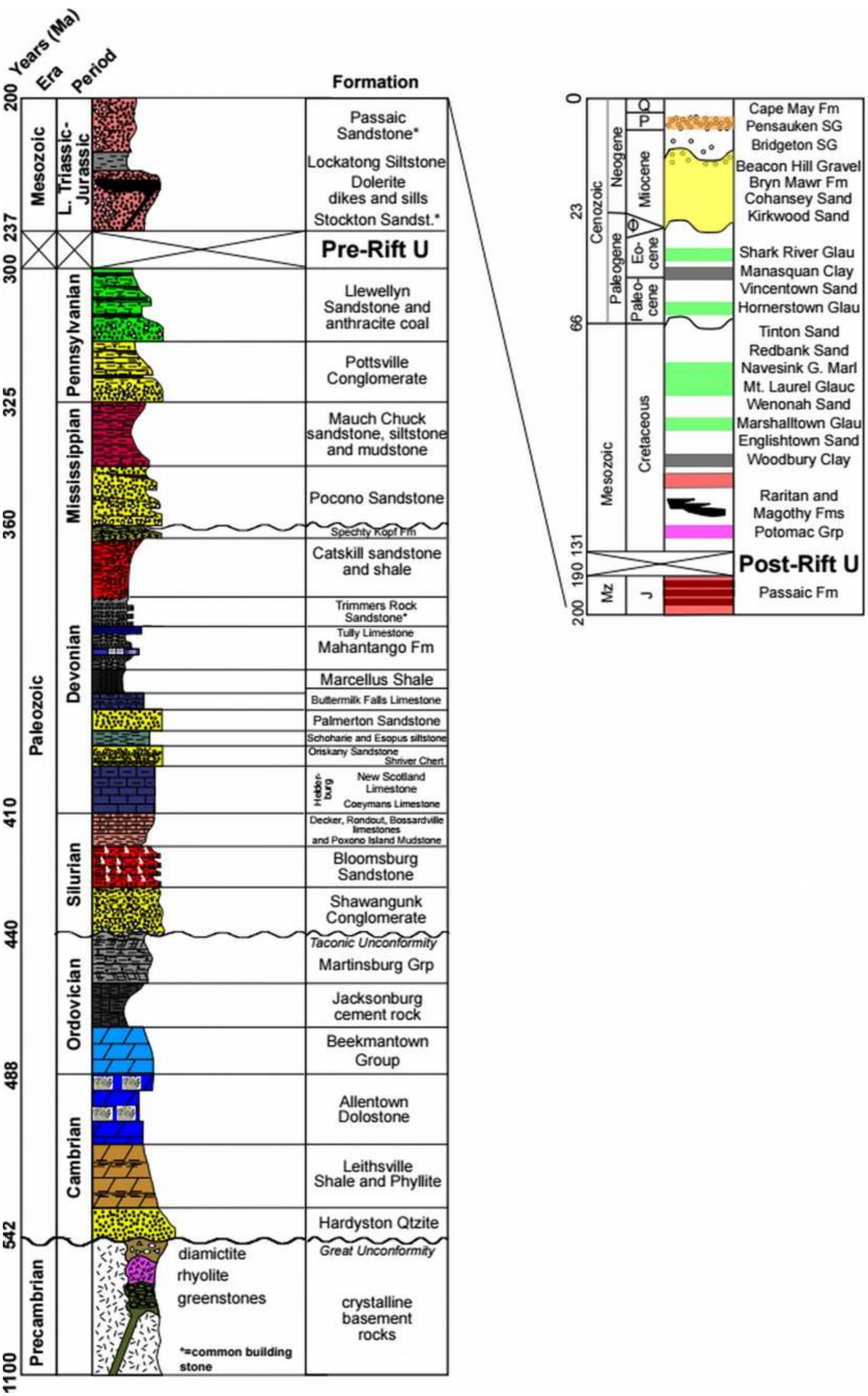
1.35 0.84 Cross Landis Mill Road and park at **STOP 2**. Ancient Oceans, Unconformities, and Building Stones of the Lehigh Valley. The goal of this stop is to touch the Great Unconformity that separates the crystalline, Grenville-age (~1.1 Ga) rocks of the Blue Ridge – Reading Prong, from the Paleozoic sedimentary cover, here represented by the Hardyston Quartzite. The Grenville rocks of the Reading Prong consist mostly of a hornblende-bearing orthogneiss consisting of microperthite, quartz, and oligoclase. There are lesser bodies of a more mafic hornblende-clinopyroxene orthogneiss and alaskite (leucogranites). It is the alaskite that is mapped here at this outcrop. The Hardystone quartzite here and locally contains facies of coarse-grained arkose as well as finer-grained quartz arenites. *Skolithos* may or may not be present in the Hardyston here, but it is present locally. This is an excellent opportunity to discuss the flooding of North America in the early Paleozoic as well as the tectonic and erosional events that have uplifted and exposed this structural level throughout the Lehigh and Saucon Valley. Both the crystalline rocks and Hardyston Quartzite were mined as important local building materials.

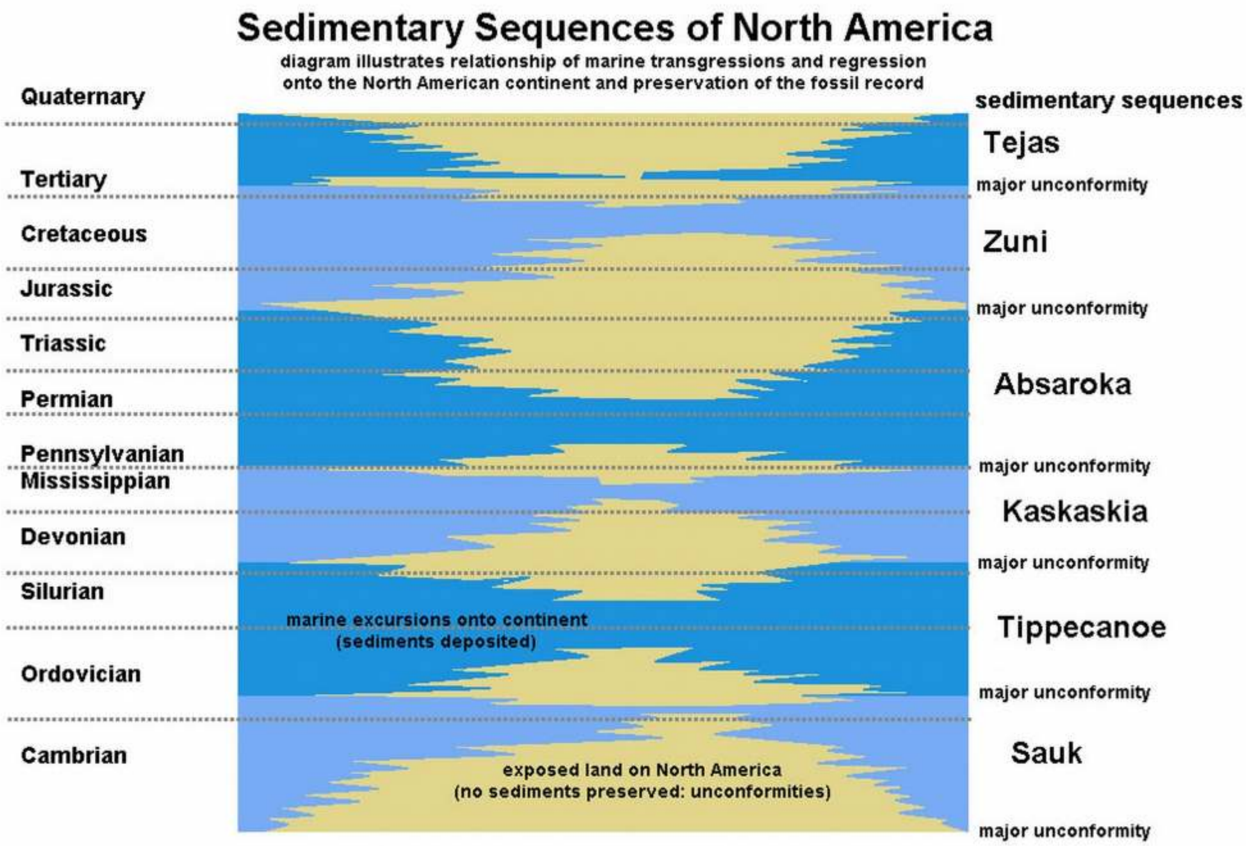


Interpretive sign at STOP 2.



Part of the Allentown East quadrangle, USGS GQ-1804 showing the geology at STOP 2 (red circle). Note that the map interpretation has the crystalline rocks protruding to the surface along the crest of a small anticlinal fold.


Years (Ma)
Era
Period
Formation
200
237
300
325
360
410
440
488
542
1100
Mesozoic
L. Triassic-Jurassic
Paleozoic
Pennsylvanian
Mississippian
Devonian
Silurian
Ordovician
Cambrian
Precambrian
Passaic Sandstone*
Lockatong Siltstone
Dolerite dikes and sills
Stockton Sandst.*
Pre-Rift U
Llewellyn Sandstone and anthracite coal
Pottsville Conglomerate
Mauch Chuck sandstone, siltstone and mudstone
Pocono Sandstone
Spechty Kopf Fm
Catskill sandstone and shale
Trimmers Rock Sandstone*
Tully Limestone
Mahantango Fm
Marcellus Shale
Buttermilk Falls Limestone
Palmerton Sandstone
Schoharie and Esopus siltstone
Oriskany Sandstone
Shriver Chert
Helderburg
New Scotland Limestone
Coeymans Limestone
Decker, Rondout, Bossardville limestones and Poxono Island Mudstone
Bloomsburg Sandstone
Shawangunk Conglomerate
Taconic Unconformity
Martinsburg Grp
Jacksonburg cement rock
Beekmantown Group
Allentown Dolostone
Leithsville Shale and Phyllite
Hardyston Qtzite
Great Unconformity
diamictite
rhyolite
greenstones
crystalline basement rocks
*=common building stone
0
23
66
131
190
200
Cenozoic
Mesozoic
Mz
Neogene
Paleogene
Q
P
Miocene
O
Eo-cene
Paleo-cene
Cretaceous
J
Cape May Fm
Pensauken SG
Bridgeton SG
Beacon Hill Gravel
Bryn Mawr Fm
Cohansey Sand
Kirkwood Sand
Shark River Glau
Manasquan Clay
Vincentown Sand
Hornerstown Glau
Tinton Sand
Redbank Sand
Navesink G. Marl
Mt. Laurel Glauc
Wenonah Sand
Marshalltown Glau
Englishtown Sand
Woodbury Clay
Raritan and Magothy Fms
Potomac Grp
Post-Rift U
Passaic Fm



Sloss sequences showing the flooding and emergence of North America in the Phanerozoic. https://serc.carleton.edu/integrate/teaching_materials/coastlines/student_materials/889

1.35 0.84 Return to trail, continue north.

3.03 1.88 Cross Spring Valley Road

3.94 2.44 Cross outflow from springs that emerge in the center of the small community of Spring Valley to the east of this location.

4.35 2.70 Reading Road access to SRT.

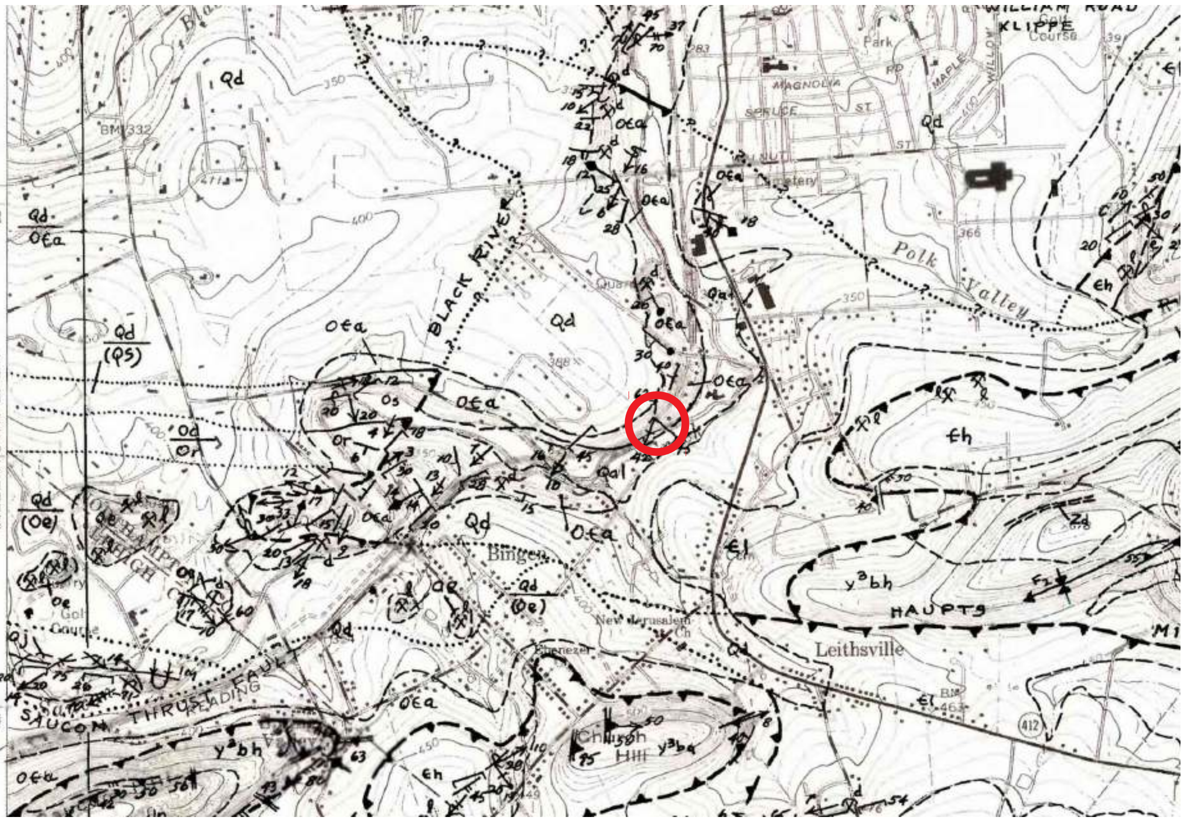
4.47 2.77 Cross over Bingen Street and traverse cuts of outcrops of Allentown Fm Dolostone that are poorly-exposed and overgrown.

5.0 3.10 Cross Saucon Creek.

5.17 3.21 Old Mill Road and Erhart's Mill Historic District. From Wikipedia, https://en.wikipedia.org/wiki/Ehrhart%27s_Mill_Historic_District, Ehrhart's Mill Historic District is a national historic district located along Saucon Creek at Lower Saucon Township, Northampton County, Pennsylvania. The district includes 9 contributing buildings, 2 contributing sites, and 4 contributing structures associated with a 19th and early 20th century grist mill. The buildings include a small barn, the stone grist mill (destroyed), and three stone or brick vernacular houses. The mill is a three-story, five level stone building with a slate covered gambrel roof. The most prominent structure is an iron Pratt truss bridge built in 1867, and known as County Bridge #16. The mill was destroyed by fire. For more information, see also: https://www.nps.gov/nr/travel/delaware/ehr.htm.

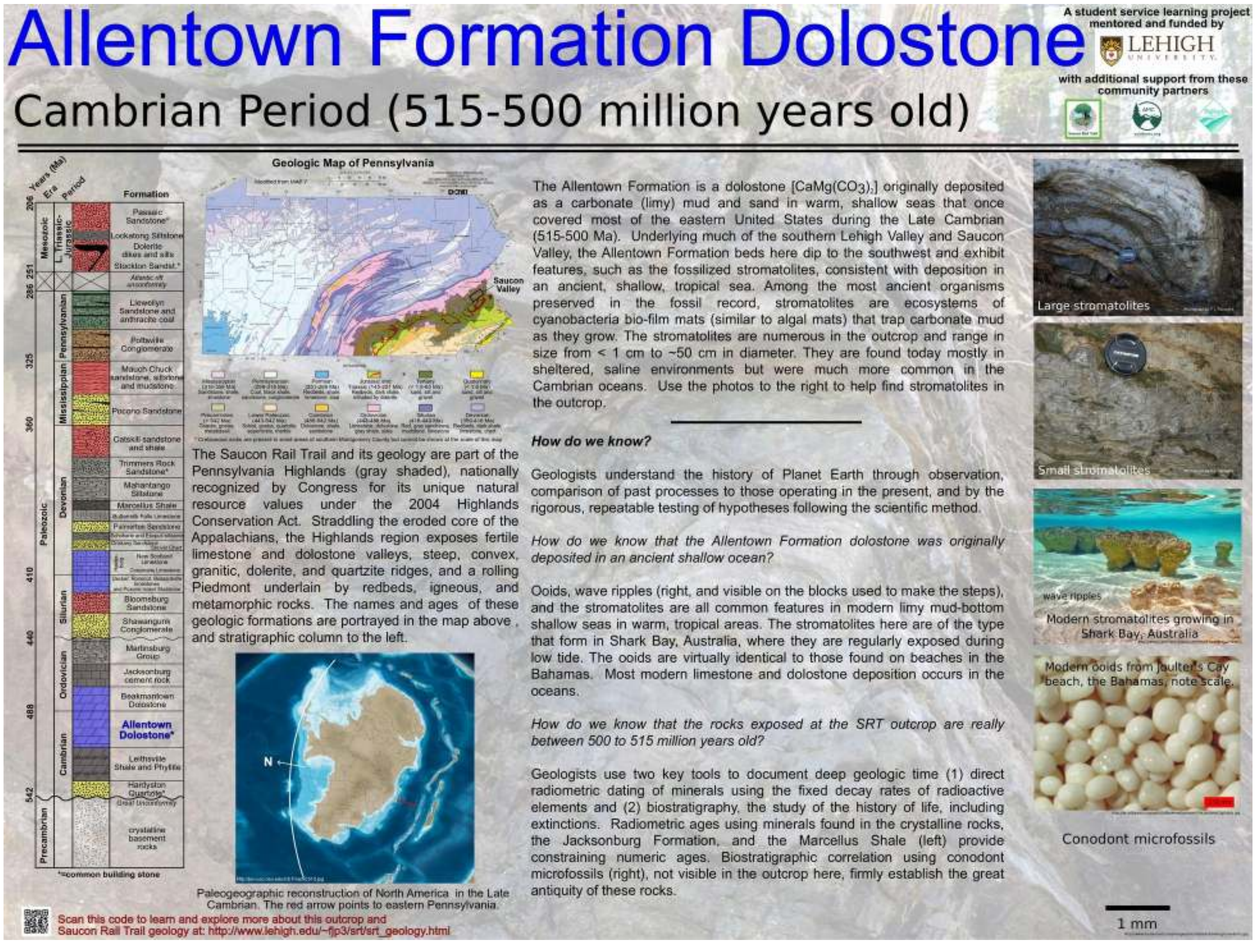
Photos of Erharts Mill (destroyed) and the Old Mill Bridge (still standing).

5.76 3.57 Allentown Fm and **STOP 3.** The purpose of this stop is to observe the stratigraphy, texture, and fossils of the Allentown Dolostone on an outcrop that has been cleaned for public display along the SRT. Excellent examples of several different types of stromatolites as well as oolites are visible in these beds. The overall stratigraphy is consistent with stacked shallowing upward cycles, interpreted as deposition on a production-dominated, slowly-subsiding carbonate shelf, also influenced by eustatic change.



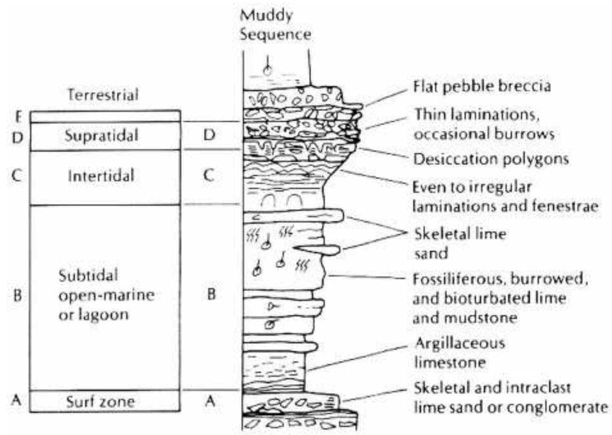
Part of the Hellertown quadrangle, USGS OFR 96-546 showing the geology at STOP 3 (red).

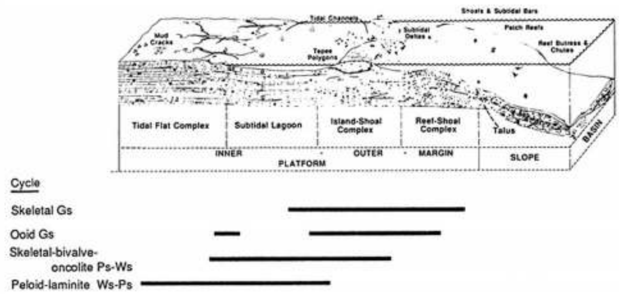
Lehigh student power washing the outcrop in 2014.



Interpretive sign at STOP 3.

Photos of different types of stromatolites exposed at STOP 3.





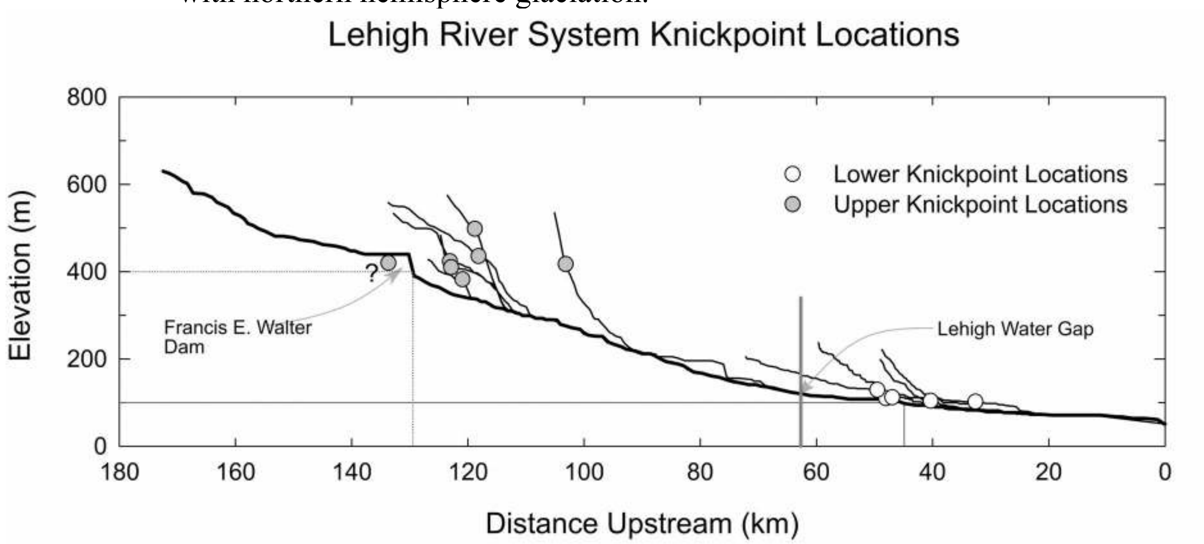
https://www.geol.umd.edu/~jmerck/geol342/lectures/15.html http://www.kgs.ku.edu/Publications/Bulletins/233/Crevello/

(Left) Schematic of shallowing up carbonate facies model and (right) spatial distribution of facies on a carbonate shelf.

5.76 3.57 Return to trail, continue north.

5.94 3.68 Cross Meadows Road.

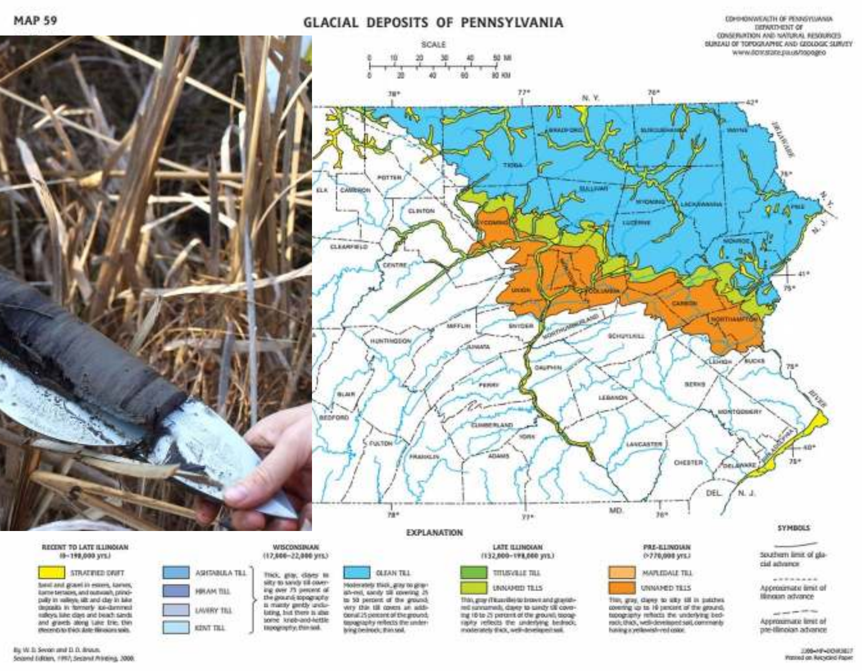
6.17 3.83 Cross Saucon Creek, note low diversion dam in channel to right. This dam diverts flow into a mill race that feeds the Hellertown Grist Mill ~ 1 km to the north. The fact that such short distances translate into head drops of ~ 2 m speaks to the steepness of mid-Atlantic streams. The elevation of Saucon Creek at this location is about 290 ft (83.4 m), which places it well within a knickzone that extends up to ~ 100 m on all tributaries of the Lehigh and Delaware Rivers. Preliminary analysis of the celerity of this knickpoint migration upstream suggests that it is early Pleistocene in age, responding to a major epeirogenic base level fall before or coincident with the first major glacio-eustatic drawdowns associated with northern hemisphere glaciation.



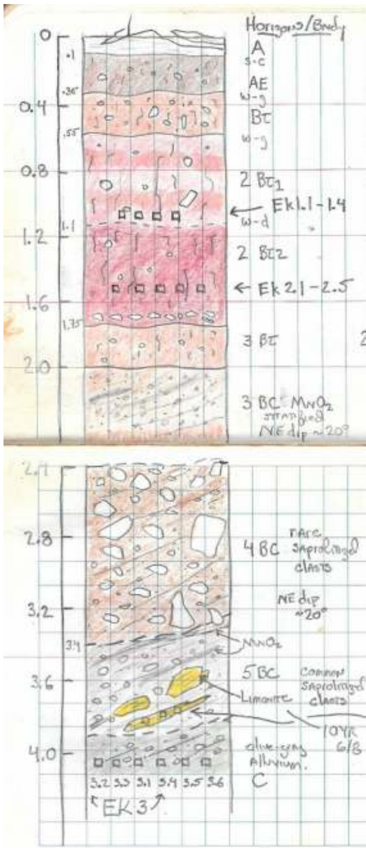
6.3 3.91 Cross the mill race

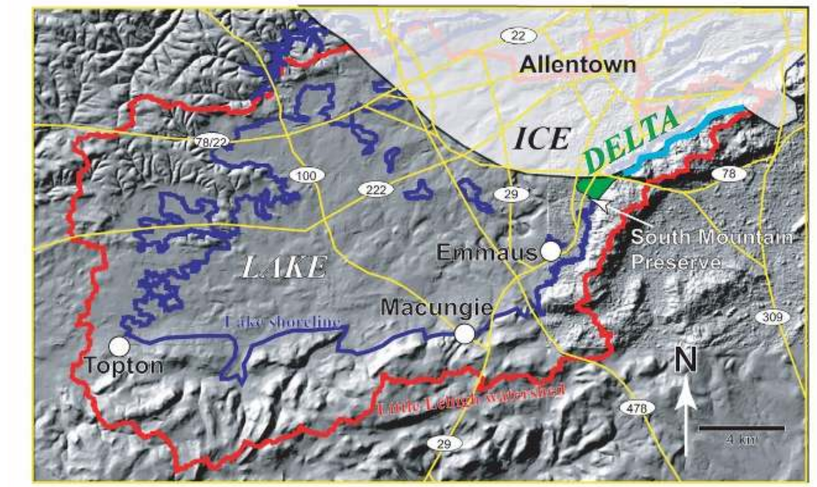
6.69 4.15 Cross Walnut Street, Historic Grist Mill to the left.

7.23 4.48 Hellertown Marsh and **STOP 4.** The Hellertown marsh is a remnant of a much larger wetland that once filled the valley bottom of Saucon Creek, and probably representative of similar wetlands that filled the valley bottoms of most mid-Atlantic streams prior to colonization,farming, and damming of the rivers for water power. The marsh sits atop ~ 1m of legacy sediments like those viewed at STOP 1. A core that has been pushed through these sediments pushed down through the former pre-colonial wetland, that black layer visible at STOP 1. The base of the core has been radiocarbon dated to 3540+/-30 ybp (UGAMS# 6125; Nov, 2009). The interpretive sign at this stop speaks of the marsh sitting on top of glacial deposits ~850 ka. That is generally true, although those deposits are unevenly distributed and because of poor exposures in the Saucon Valley, we are inferring an age from regional stratigraphic relationships. We do know that a pre-Illinoian ice sheet advanced from the NE to SE passing over this part of the Saucon Valley, building a terminus at what is now Emmaus, PA. At that location on the other side of South Mountain, a kame delta is exposed in a former gravel pit. That delta fed a proglacial lake that resulted from the daming of the Little Lehigh River and Saucon Creek. Silty sediments exposed in that kame ~ 4 m below the surface are paleomagnetically reversed, meaning that the pre-Illinoian ice must be older than 780 ka.

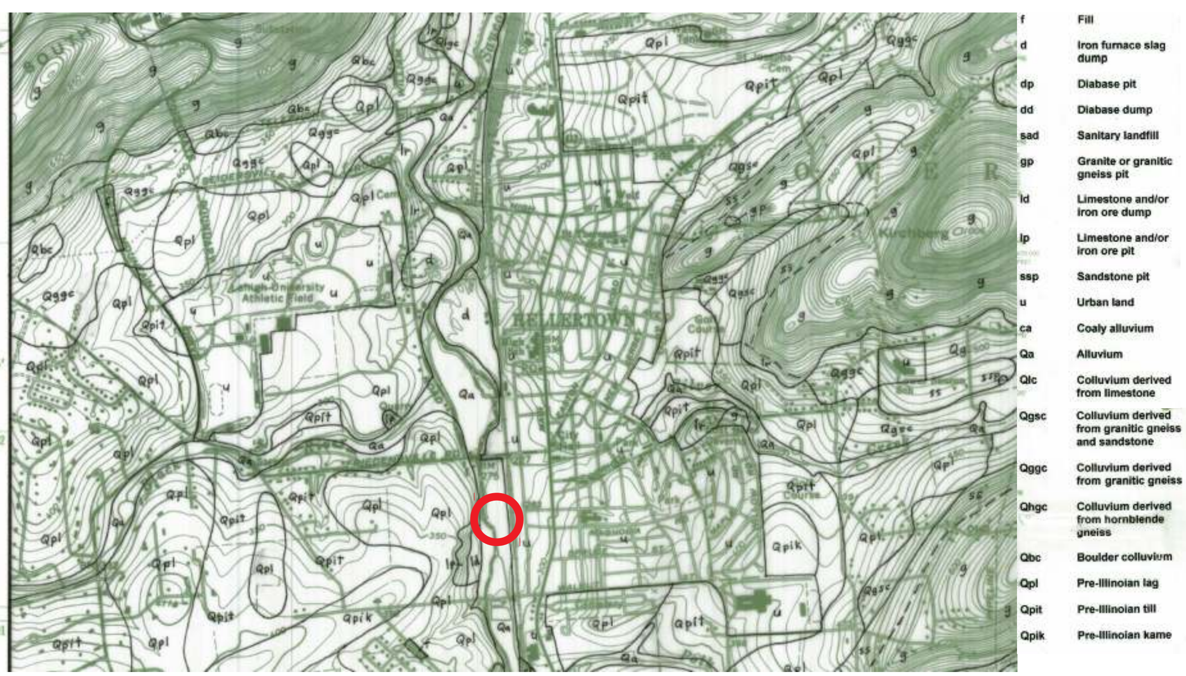


(Above) Photo of the Russian core sample through the Hellertown marsh, dated at ~3500 ybp. (Right) The extent of glaciation in eastern Pennsylvania. The Saucon Valley is located in the orange, pre-Illinoian deposits.





(Left) Stratigraphic section through the Emmaus kame delta showing the location of paleomagnetic samples. Samples EK-3 have predominantly reversed polarity. (Top) Map showing the extent of the lake that resulted from the damming of the Little Lehigh drainage. The Saucon Valley lies beneath the words "South Mountain Preserve" and would have also presumably been dammed by the lob of ice that is protruding through the Saucon water gap.

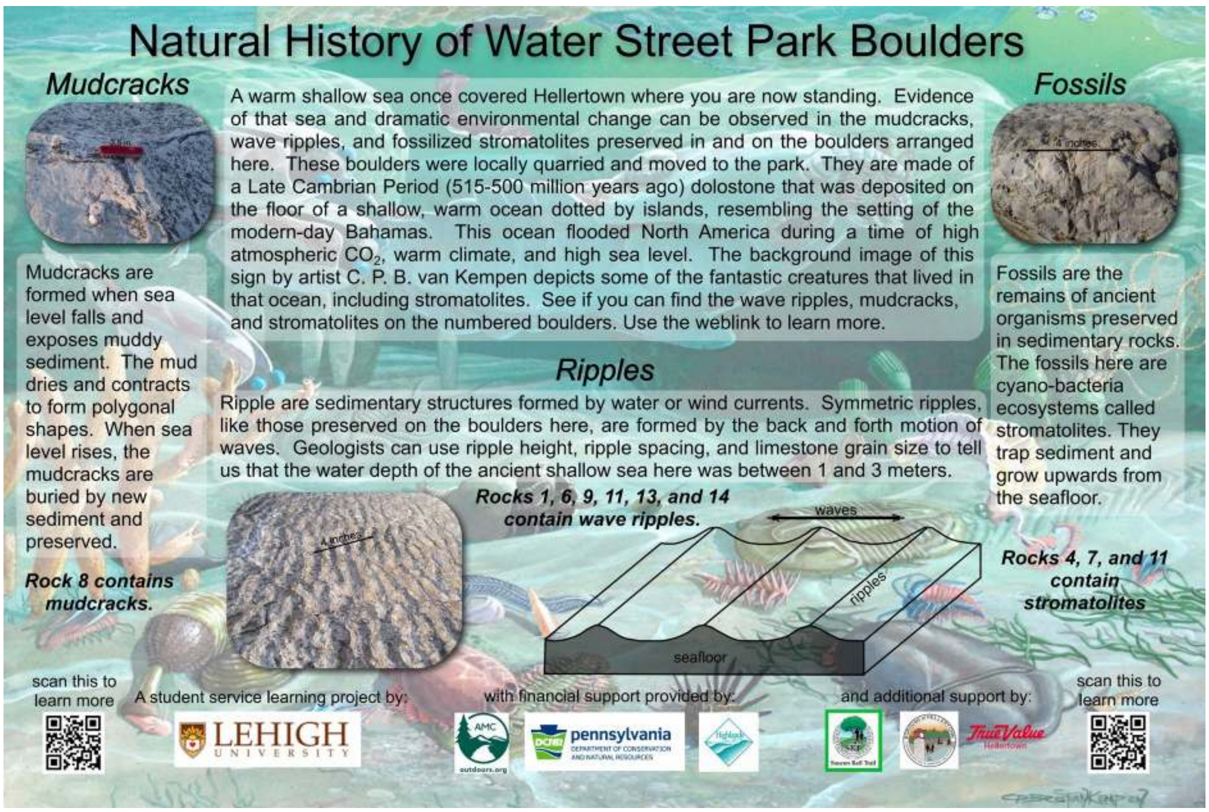


Part of the Surficial Geologic Map of the Hellertown Quadrangle, PA Geologic Survey OF 96-44. STOP 4 is located with the red circle.

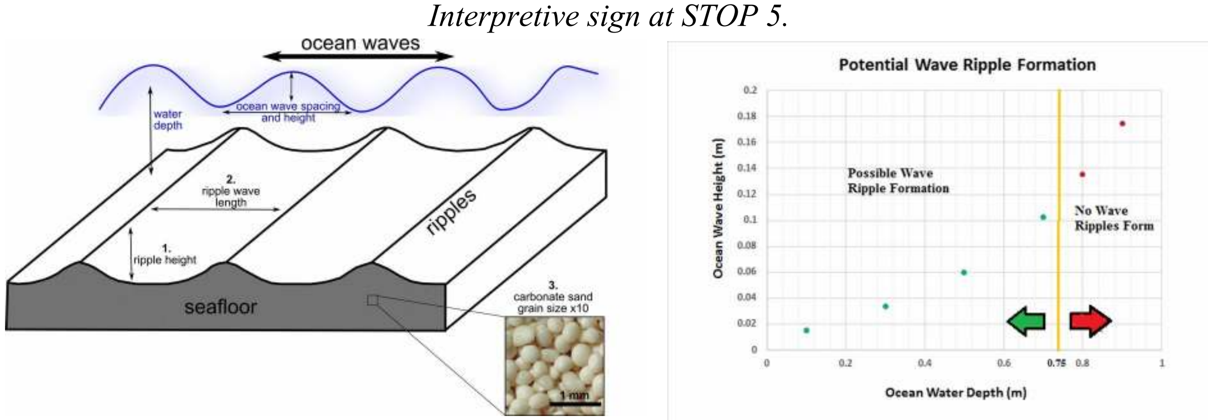
7.23 4.48 Continue north on the SRT.

7.46 4.63 Cross Water Street.

7.51 4.66 Water Street Park Boulders and **STOP 5**. The purpose of this stop is to observe the sedimentary structures, namely mudcracks and wave ripples, that are well-preserved on boulders of Allentown Dolostone. Not all boulders are dolostone and here and throughout Water Street Park, there are examples of many of the rocks exposed from South Mountain to the Newark Basin. A paleocurrent analysis of the wave ripples shows that they were created at ~0.5 m water depths, by waves that were ~ 2 to 10 cm high.



Interpretive sign at STOP 5.

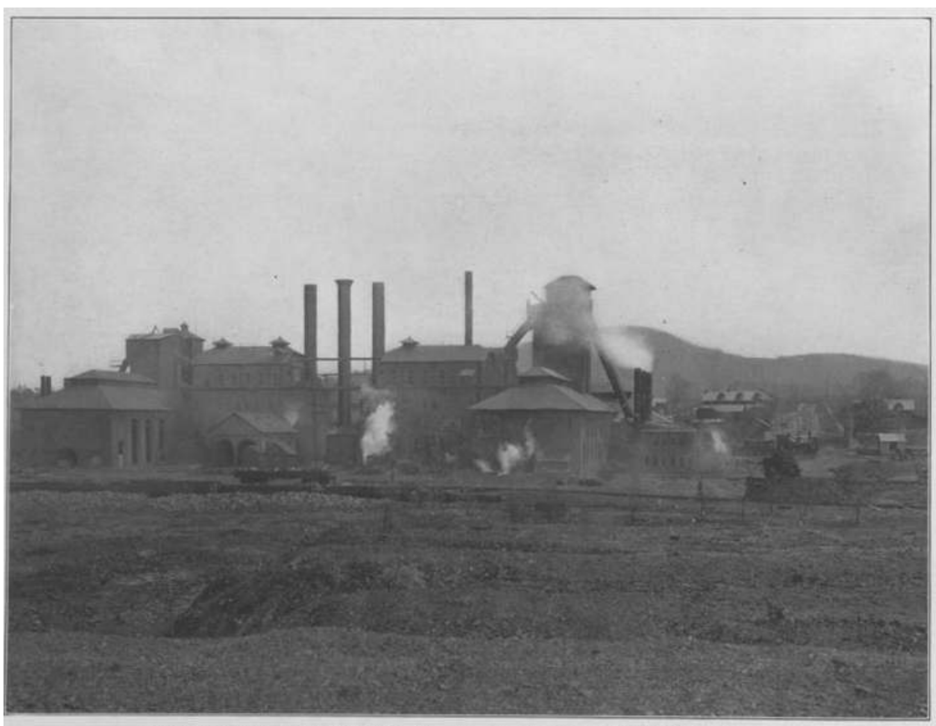


(Left) Description of oscillation ripples and (Right) phase space of allowable wave heights and water depths given the wave ripple spacing and grain size of the dolostone.

7.51 4.66 Continue north on the SRT.

7.84 4.86 Entrance at left to optional mountain bike path to Thomas Iron Works

8.25 5.12 Park bench, Thomas Iron works off to left. This is **STOP 6**. The concrete foundations of the Thomas Iron works preserved here, are a testament to the long and early history of iron mining and steel production in the Saucon and Lehigh Valleys. These iron works were established in 1866 by Jacob Riegel of the Saucon Iron Company, and purchased by the Thomas Iron Company in 1884. Over 350 people were employed when the furnaces were in full blast. The iron ore came from many local, low grade, residual and bog iron sources, the most important of which were located in the Polk Valley watershed SE of Hellertown. The iron ore here is residual in nature, part of a deep saprolite that formed at the structural contact between Precambrian crystalline rocks and the Leithsville Fm. Acidic ground water carrying dissolved iron from the crystalline rocks is buffered by the dolostone in the Leithsville Fm, changes pH, and precipitates the dissolved iron into masses of goetite and hematite. The saprolite hosting these ironstone ores is surprisingly deep, exceeding 200 m in the axis of Polk Valley (known from water wells), and speaks to the degree of chemical weathering in the pre-Quaternary Pennsylvania landscape. The Wharton mine was the major producer in the Saucon valley, opening in 1872 and worked until 1910. Over its life, it produced about 200,000 tons of ore that was on average, 43% iron, 19% silica, 4.2% alumina, 2% manganese, 0.4% phosphorus, and 7% moisture. Pig iron was produced from this ore at this site until 1920, and the buildings were demolished in 1924. Slag piles remain on the site as hills dumped on the Saucon floodplain.



SAUCON PLANT, HELLERTOWN, PA. FRONT VIEW OF FURNACES Nos. 11 AND 10.

http://digital.lib.lehigh.edu/cdm4beyond_viewer.phpCISOPTR=5668&ptr=5685&searchworks=cat10

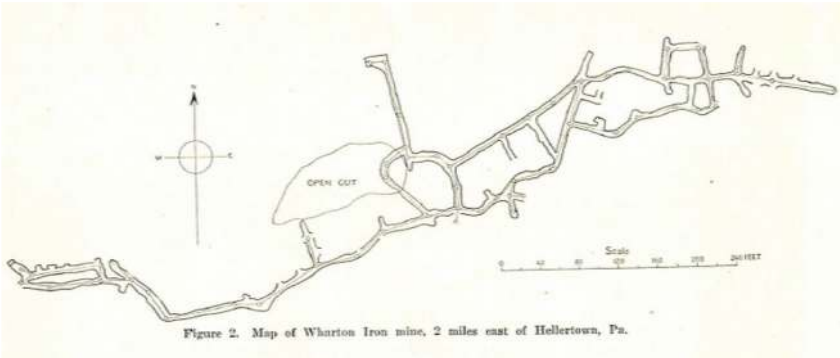
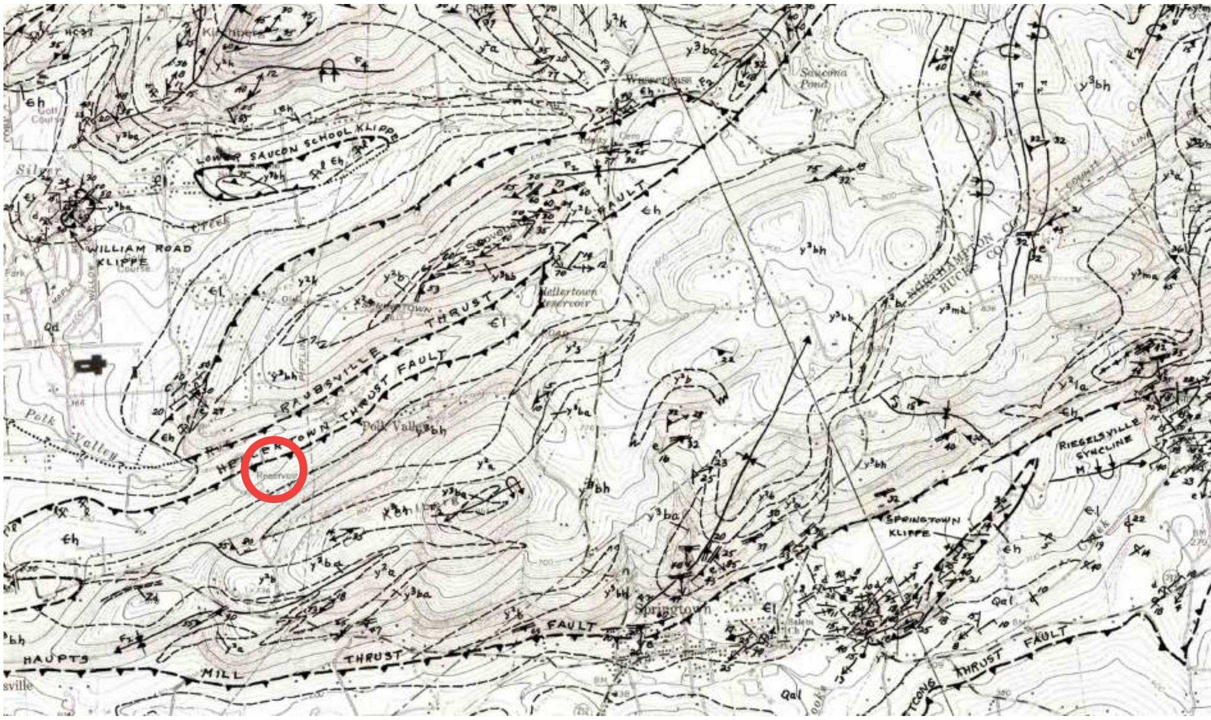


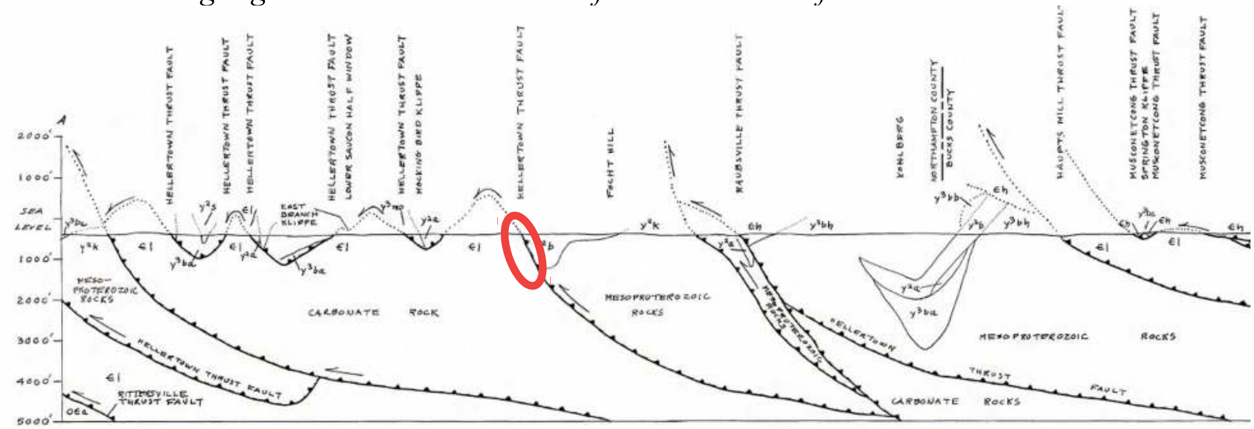
Figure 2. Map of Wharton Iron mine, 2 miles east of Hellertown, Pa.

(Left) From the PA Geologic Survey Atlas of the Allentown Quadrange, Atlas 206, Miller, 1925. (Right) Photo of a goetite (?) dendrite from the Wharton mine.
http://digital.lib.lehigh.edu/cdm4/beyond_viewer.php?CISOPTR=5624&ptr=5685&searchworks=cat10

Scanned photo of the Wharton mine during operation. (from the Hellertown Borough Authority photo archives).



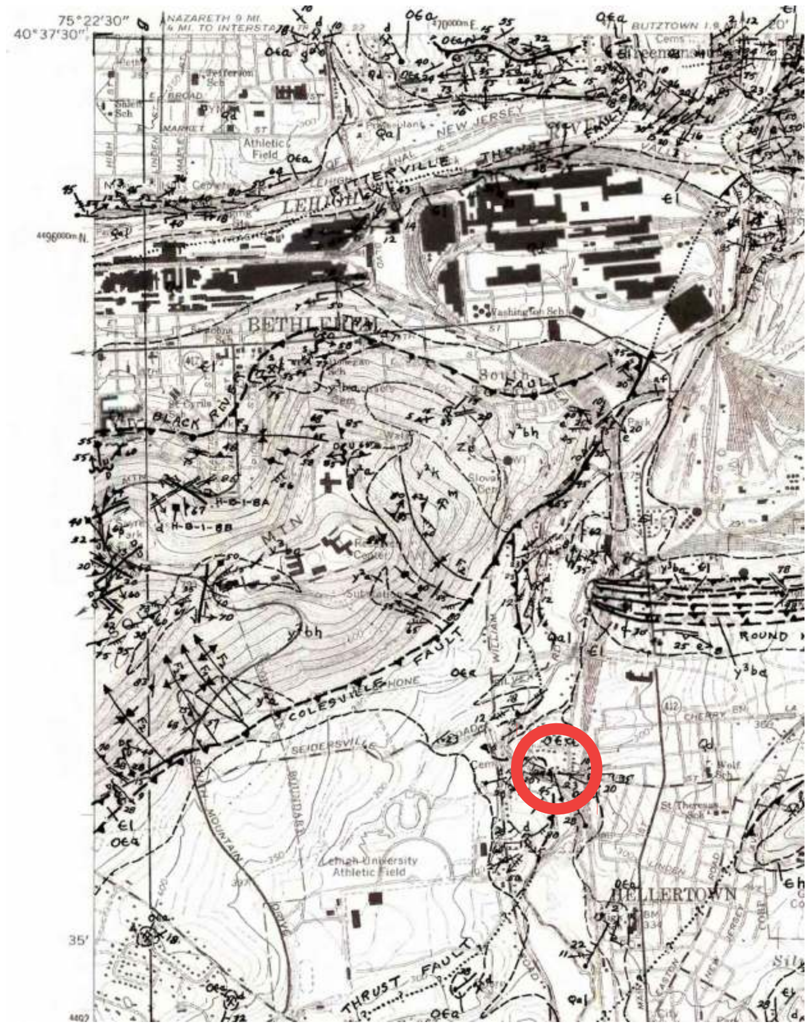
Part of the Hellertown quadrangle, USGS OFR 96-546 showing the geology for the Polk Valley and surrounding region. The red circle is the former location of the Wharton Iron Mine.

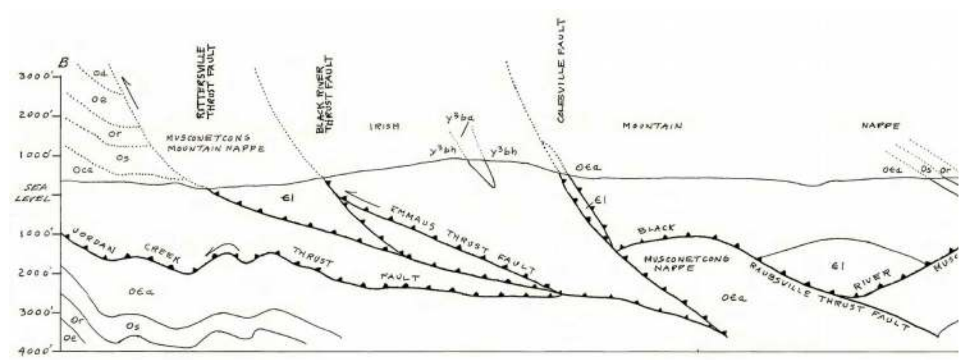


Cross-section line from NW to SE across the Polk Valley showing the inferred structural interpretation of Drake, 1996 (USGS OFR 96-546). The Wharton Mine residual iron ore would have been located in the area of the red ellipse.

8.25	5.12	Continue north on the SRT.
8.38	5.20	Turn right, off trail, then left onto Whitaker Street.
8.5	5.27	Turn left on Clark Street
8.54	5.29	Turn right onto rail trail behind Blindermans Recylcing. Follow overgrown trail to the bridge overpass.

8.9 5.52 Bridge under High Street, Allentown to Leithsville Fm transition, park bikes, this is **STOP 7**. The purpose of this stop is to see the contact between the Allentown Dolostone and the underlying Leithsville Fm, typically thought of as a shale, but here shown to be an interbedded sandy dolostone and phyllite. The beds dip south, away from South Mountain and consistent with their position in the hanging wall syncline of a north-vergent thrust thought to underlie all of the Saucon Valley.





(Previous page) Part of the Hellertown quadrangle, USGS OFR 96-546 map and cross-section showing the location of STOP 7 (red circle) and Drake's (1996) interpretation for thrust faulting in the Reading Prong part of the Saucon Valley. An unresolved feature of Drake's maps are thrust faults that place younger rocks over older rocks. Curiously, this arrangement of rocks does not require a thrust fault. It can be explained more parsimoniously by the normal stratigraphic order of units as well as by normal faults, which do place younger rocks over older rocks.

8.9 5.52 Return to bikes and head south, retracing route back to Clark Street.

9.28 5.75 Intersection of Clark and Whitaker, turn left and ascend hill

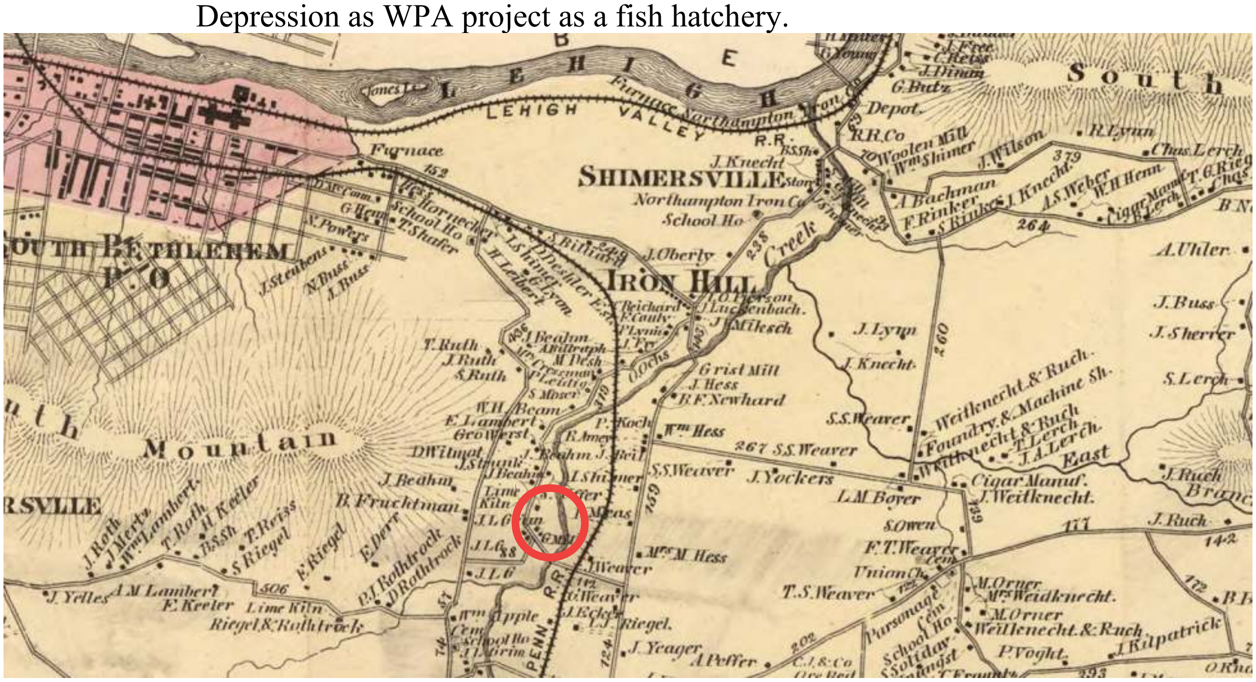
9.58 5.94 Turn left onto High Street.

9.81 6.08 Turn right on Ravenna Street.

10.42 6.46 Left on Silvex, watch for traffic.

10.53 6.53 Stay right into Saucon Park.

10.76 6.67 Turn right into parking lot, this is **STOP 8**. The purpose of this stop is to observe a series of wetlands and springs that emerge from the floodplain of Saucon Creek, as the carbonate aquifer of the Allentown Dolostone and Leithsville Fm narrows in the watergap between, and probably floored by crystalline rocks of the Reading Prong. This site also offers an opportunity to explore the remnants of the mill race of the former Gran grist mill that was re-purposed during the Great Depression as WPA project as a fish hatchery.



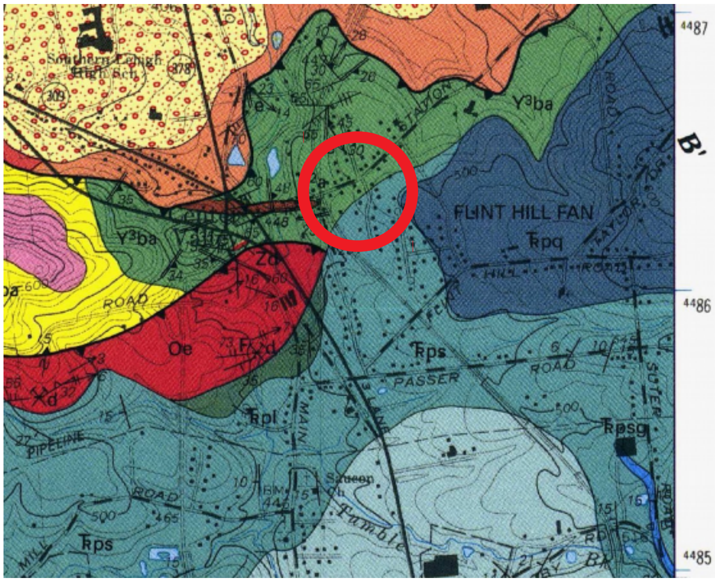
Part of the Northampton County Lower Saucon Township Atlas of 1974 showing the location of STOP 8, including the grist mill.

Oblique north-oriented aerial view of the Saucon water gap showing Saucon park in the foreground, including the former mill race that now directs the flow from the springs to Saucon Creek. STOP 8 is shown by the red circle. Image from GoogleEarth. Scale changes across this view.

10.76	6.67	Use a break in the parking bumpers at the eastern edge of the parking lot to descend into the park, and then turn left to follow the paved, but bumpy sidewalk that parallels the mill race.
10.84	6.72	Site of old mill, old mill race, springs, and re-purposed fish hatchery. Note that the walls are constructed of Hardystone Quartzite.
11.06	6.86	Cross Saucon Creek. Note the water level as you cross in comparison to the water level of a bankfull event, captured in the photo below taken on 28 Sept, 2018.


View (left) upstream and (right) downstream of Saucon Creek during a bankfull discharge.

11.2	6.94	Bear right off of sidewalk into parking lot, right turn onto Dearborn Ave.
11.51	7.14	Left turn onto Auburn Street and proceed to coarse gravel at end of road.
11.73	7.27	Ascend onto the Bethlehem Greenway, the extension of the SRT. Note former railroad tower, now the home of a nesting pair of Bald Eagles.
12.4	7.69	Small outcrops of Precambrian Reading Prong rocks on the let side of the trail. This is **STOP 9.** The outcrops here show how shallow the crystalline rocks are to the surface here, supporting the interpretation of them riding in the footwall of a north-vergent thrust sheet. You can compare the mineralogy of this outcrop to other crystalline rocks seen along the SRT. You can also compare and contrast different models for the structural geology of the Reading Prong. The prevailing model presented during this tour follows that of the USGS mapper Avery Drake who favored a thin, folded crystalline trust sheet over the earlier ideas of Benjamin Miller and others who favored a basement rooted structure bound by high-angle reverse faults.
12.4	7.69	After visiting the outcrop, return to bikes, turn around, and head south on the SRT, retracing steps back to Water Street Park in Hellertown.
16.71	10.36	Water Street Park Pavilion and **LUNCH**.
24.22	15.02	Upper Saucon Park parking lot. Turn right on paved trail. Proceed under Preston Lane, pass Upper Saucon Library and stay straight on gravel, then paved trail. Ascend hill to panel at entrance back to the SRT.
25.27	15.67	Access gravel rail trail after library
25.34	15.71	Overgrown stone quarries in Precambrian rocks on the left.
25.82	16.01	Cross Station Ave. In ~200 m the SRT passes from Precambrian crystalline rocks to the Passaic Formation of the Newark Basin (called Brunswick Fm on the Allentown East geologic map). There is no border fault at this location and the contact, presumably an onlap of the basin sediments over the crystalline rocks, is not exposed.



Part of the Allentown East quadrangle, USGS GQ-1804 showing the geologywhere the trail crosses into the Newark Basin (red circle). Note the paleo-alluvial Flint Hill fan that must have been sourced in a much higher footwall of the border fault, which is now buried by the fan and inter-fan Passaic Fm.

26.38 16.36 Cross Flint Hill Road.

26.65 16.52 Cross Passer Road

27.21 16.87 Cross Lutron.

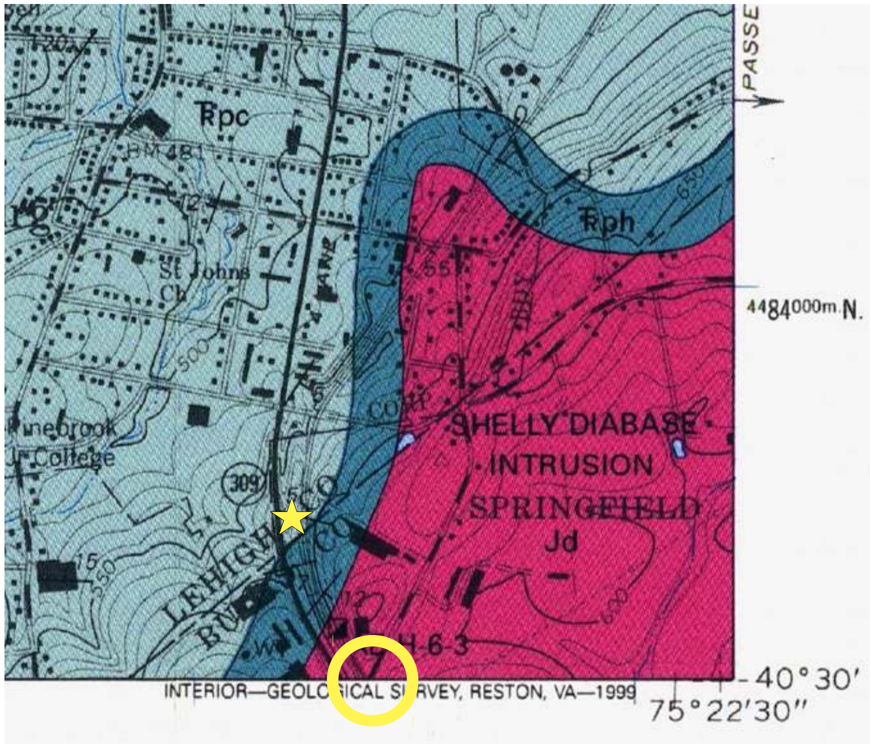
27.52 17.06 Cross over Tumble Brook, a tributary to Saucon Creek. The hills in background (to the SE) are underlain by a diabase intrusion onto the Newark Basin sediments.

28.1 17.42 Entrance to Living Memorial Park on the right.

28.34 17.57 Cross Landis Street.

28.64 17.76 Arrive at Station Ave. Turn left, then make a quick right onto Springfield. Follow Springfield Street to the final stop.

29.75 18.45 Bridge over Newark Basin outcrops including diabase, hornfels, and interbedded Passaic Formation red and green sandstone, shale, and paleosols. STOP 10 is in the railroad cut below and north of the bridge. NOTE: There is no easy access to this site and it is frequently flooded. There are plans in the near future to rehabilitate and open this part of the SRT. To the NW of this bridge, and sandwiched between the RR cut and Rt 309 is the former location of a dinosaur trackway. No prints remain after having been illegally removed by fossil hunters.



Part of the Allentown East quadrangle, USGS GQ-1804 showing the geology at STOP 10. The yellow circle is the stop and star marks the location of the former trackway.

29.75 18.45 Return to bikes and retrace route back to Upper Saucon Park.

34.79 21.57 Arrive at Upper Saucon Park. End of Geo-Bike Tour.

THANKS FOR COMING. ENJOY THE REST OF THE FIELD CONFERENCE!!