

3.3.2 EVALUATION OF EXISTING CONDITIONS

B. Supporting Documents

6. All Sites – Proposed
Geotechnical Exploration



December 12, 2019

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**Re: Preliminary Geotechnical Review Services
Proposed Doherty High School
Doherty Site
Worcester, Massachusetts
LGCI Project No. 1922**

Dear Mr. Para:

Lahlaf Geotechnical Consulting, Inc. (LGCI) has performed a site visit and completed a preliminary review of the geotechnical data available for the Doherty High School (Doherty Site) in relation to the proposed Doherty High School in Worcester, Massachusetts. Our services were performed in accordance with our proposal No. 19087 dated October 14, 2019. Ms. Kathryn Crockett of Lamoureux Pagano & Associates, Inc. (LPA) authorized our services by signing our proposal on November 13, 2019.

This letter includes a summary of our field observations, a summary of the subsurface data we reviewed, our opinion about possible foundation issues during construction, and our recommendations for subsurface explorations.

1. Reviewed Documents

LGCI reviewed the following documents:

- “Custom Soil Resource Report for Worcester County, Massachusetts, Northeastern Part,” (Soil Survey Report) National Cooperative Soil Survey/National Resources Conservation Services, USDA (Map and soil description printed November 15, 2019 from <https://websoilsurvey.sc.gov.usda.gov/App/WebSoilSurvey.aspx>).
- “Surficial Materials Map of the North Worcester, Massachusetts,” prepared by Stone, J.R. and Stone, B.D. for U.S. Geological Survey, 2018, Scientific Investigation Map 3402, Quadrangle 126 – North Worcester.
- Drawings EX-1 to EX-4, titled: “Existing Conditions, Doherty Memorial High School, 299 Highland St., Worcester, MA 01602, prepared by Nitsch Engineering, Inc. dated October 28, 2019, and provided to us by LPA via e-mail on October 31, 2019.

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- Plan titled: “Site Grading & Drainage, Dr. Leo T. Doherty, Memorial High School, Worcester, Mass.” (1964 Grading Plan) Prepared by C. W. Buckley Inc., dated January 28, 1964, and provided to us by LPA via e-mail on August 23, 2019.
- Sketch showing concept plan titled: “3.3.3 - Final Evaluation of Alternatives, Preliminary Design Options, Option B.1 - New Construction on Doherty Site (Proposed Scheme), provided to us by LPA via e-mail on December 6, 2019.
- Sketches showing preliminary grading (Preliminary Grading Plans) provided t us by LPA via e-mail December 6, 2019.

2. Site Location Description

We understand that one of the sites being considered for the proposed Doherty High School is the Doherty Site located at 299 Highland Street in Worcester, Massachusetts as shown in Figure 1. The site is located at the foot of Newton Hill, a drumlin. The site is bordered by Newton Hill on the southern side, by residential properties on the eastern (Park Avenue) side, by wooded land on the western side, and by Highland Street in the northern side. The site is occupied by the existing Doherty Memorial High School. The existing school consists of several interconnected buildings terraced on the foot of Newton Hill. The site includes an athletic field on the eastern side, a parking lot on the southern side, and small parking lots and driveways leading to the terraces.

Based on the Site Plan, the ground surface at the site ranges from about El. 520 feet on Highland Street to about El. 567 feet at the rear of the southern parking lot.

Based on the historical topo maps, included in Attachment A, the site appears to have been cut within the area of the existing building and filled in the area of the existing athletic fields.

3. Project Description

We understand that the City of Worcester is considering the existing Doherty High School as one of three possible sites for the proposed Doherty High School. We understand that if the Doherty Site is selected, the proposed construction would consist of a high school building on the eastern side of the site near Parker Avenue, i.e., mostly within the existing athletic field and the southern parking lot.

Based on the Proposed Scheme, the proposed building will consist of two wings configured in a fan-shape and connected on their southern sides. Based on the Preliminary Grading Plans, we estimate that the proposed building will have a footprint of about 160,000 square feet and will be five stories high. Based on the Site Plan, the existing grades range between about El. 530 feet on the northern side and El. 565 feet on the southern side of the proposed building footprint. Based on the Proposed Scheme and the Preliminary Grading Plans, we understand that the proposed floors will be configured as follows:



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- The first floor of the proposed building will cover a portion of the proposed building footprint on the northern side and will have a finished floor elevation (FFE) of El. 525 feet. Cuts of 5 to 25 feet will be required to achieve the proposed first floor FFE. The area south of the first floor will not be excavated.
- The second and third floors of the proposed building will extend over the entire footprint of the proposed building and will have FFEs of El. 545 feet and El. 560 feet, respectively. The southern portion of the second floor will be a slab-on grade and will include a garage. Cuts ranging between 2 and 20 feet will be required to achieve the second floor FFE.
- The fourth floor of the proposed building will extend over the eastern portion of the proposed building footprint while its southern portion will be a roof. The fourth floor will have an FFE of El. 575 feet.
- The fifth floor of the proposed building will only extend over the southeastern portion of the proposed building footprint and will have an FFE of El. 590 feet.

After the proposed building is completed, the existing building will be demolished and a proposed athletic field will be provided on the western side of the site; and at-grade parking lot will also be provided between the proposed building and the proposed athletic field.

Based on the Proposed Grading Plan, the proposed exterior grade will range between about El. 550 feet and El. 560 feet on the southern side of the proposed building. The proposed grades will drop in a northerly direction and will be about El. 535 feet on the northern side. The proposed grade in the proposed at-grade parking lot will range between El. 530 feet and El. 540 feet. We understand that the proposed grade within the proposed athletic field will be around El. 530 feet. To achieve the exterior finished grades, cut of up to 25 feet will be required in the proposed at-grade parking lot and cuts of about 17 feet will be required in the proposed athletic field.

Field Observations

An LGCI representative visited the site on December 5, 2019. The purpose of our visit was to observe site features such as wet areas and other features that may impact construction. Photographs taken during our site visit are included in Attachment B.

The site was mostly covered with about one foot of snow at the time of our visit and site features were concealed by the snow.

The exposed surface visible at the time of our visit such as the parking lot on the western side of the grandstands and the concrete walkway just north of the grandstands showed no evidence of gross settlement. Cracks in the concrete slabs near the entrance were observed. We also did not observe evidence of settlement between the ground surface adjacent to the grandstands and the grandstands' foundation. It is not known whether the ground around the pile-supported



grandstands was regraded over time as a result of settlement of ground. Photographs of the site are included in Attachment B.

Summary of Existing Subsurface Data

Soil Survey Report – Based on the Soil Survey Report listed in Section 1, the soils at the site are classified primarily as Urban Land, Smoothed Udorthents, and Paxton Fine Sandy Loam. Urban Land is defined as excavated and filled land. Udorthents are defined as “made land over firm loamy basal till.” Paxton Fine Sandy Loam are defined as ground moraines, drumlins, and hills. The Soil Survey Report does not include the thickness of the A and B horizons for the Urban Land and the Udorthents. However, it includes for the Paxton Fine Sandy Loam a thickness of Horizon A of up to 8 inches, and a thickness of Horizon B of up to 18 inches. Based on the Soil Survey Report the depth to ground water is deeper than 80 inches in the Urban Land and the Udorthents, and ranges between 18 and 37 inches beneath the ground surface in the Paxton Fine Sandy Loam.

A copy of the Soil Survey Report and Map are included in Attachment C.

Surficial Geologic Map – The Surficial Geologic Map (listed in Section 1) indicates that the soils in the general vicinity of the site generally consist artificial fill, thin till, and thick till. The artificial fill is located on the eastern side of the site within the existing athletic fields. The thin till is described as non-sorted, non-stratified matrix of sand, some silt, and little clay than contains scattered pebbles, cobbles and boulders. The thin till is generally less than 10 to 15 feet thick. The thin till is generally located near the northern side of the site. The thick till is similar in composition to the thin till but is more than 10- to 15-feet thick.

The Surficial Geologic Map of the site is shown in Figure 2.

Previous Explorations – Based on the 1964 Grading Plan, ten (10) borings were advanced at the site in 1959 and seven (7) borings were advanced at the site in 1963. The logs of nine (9) of the 1959 borings (#1, #2, #3, #5 to #10) and seven (7) of the 1963 borings (#11 to #17) are shown on the 1964 Grading Plan. The logs were generally copied from faded plans and are not very legible. Also, the borings logs did not include the thickness of individual layers.

The locations of borings #1 to #6 are not shown in the 1964 Grading Plan. The locations of borings #7 to #17 are shown on the 1964 Grading Plan and were generally advanced within and around the existing building footprint. Borings #1, #2, #3, #5 to #13, and #15 extended to depths ranging between 8 and 16 feet beneath the ground surface. The depths of borings #14, #16, and #17 could not be determined.

The locations of the 1959 and 1963 borings and the enlarged boring logs are included in Attachment D.



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The borings generally indicated topsoil overlaying loose sand, overlaying dense sand. The topsoil was generally described as loam and loamy sand. The sand underlying the topsoil was generally described as a loose fine yellow sand with trace amounts of stone and gravel. Natural medium dense to very dense sand was encountered beneath the loose sand and extended to the termination depth of most borings, except for boring #11 and #13 which were terminated in clay and glacial till, respectively.

Refusal was encountered in borings #6, #9, #11, and #12 at depths of 12.5, 12, 11, 14.1 feet beneath the ground surface, respectively. Refusal was also encountered in boring #16 at a depth that appears to be 9 feet.

The legible (SPT) N-values ranged between 20 and 200 bpf, with most values greater than 40 bpf, indicating dense to very dense material. The high SPT N-values may be caused by obstructions in the soil. The 1964 Grading Plan indicates the football field west of the existing building contains a boulder deposit area.

4. Preliminary Recommendations

Please note that the review of available information summarized in this letter is not a substitute for a subsurface exploration program. The information gathered as part of this review may be incomplete and the recommendations derived therefrom are at best preliminary in nature and must be confirmed with actual subsurface explorations, laboratory testing, and geotechnical analyses.

Based on our review of the documents listed in Section 1, our understanding of the proposed construction, and our review of the previous explorations at the site, there are a few issues that we would like to highlight for consideration and discussion.

- The 1959 and the 1963 borings indicated loam and loose sand overlying natural sand. It is not known whether the loam and the loose sand were removed before the fill was placed to make the existing athletic fields. There are no records documenting whether the existing fill was placed with strict moisture, density, and gradation control. Such fill presents the risk of unpredictable settlements that may result in the poor performance of floor slabs and foundations. While the proposed grades may require removing most of the existing fill, the proposed excavations to reach the proposed FFE may not locally extend deeper than the bottom of the existing fill and the possible underlying loam and loose sand. These materials are not suitable to support the proposed building and should be entirely removed and replaced with Structural Fill.
- The natural glacial till is suitable to support the proposed building with footings and slabs placed on Structural Fill placed directly in top of the glacial till.
- Near the northern side of the site, the cuts may extend into bedrock where the glacial till is thin. Provisions should be made to include a contingency for rock blasting.



- We believe that the fill formerly placed to raise the grades within the existing athletic fields was glacial till cut from the southern side of the site. The glacial till is generally silty and the existing fill is anticipated not to meet the gradation requirements for Ordinary Fill or Structural Fill. The existing fill could be improved by processing it through a crusher with boulder and blasted rock from the site, if any, or imported blasted rock.

5. Recommendations for Subsurface Explorations

To explore for the presence of buried loam (organic soil) beneath the existing fill within the existing athletic fields and to explore for rock in deep cut areas, we recommend performing additional explorations at the site if this site is selected. The additional explorations should include at least sixteen (16) to twenty (20) soil borings, including at least six (6) borings to rock, and two (2) groundwater observation wells. The geotechnical explorations should also include at least twelve (12) test pits to explore for rock in shallow till areas.

The geotechnical explorations should be coordinated with the work of an environmental engineer to pre-characterize the site soils that will be generated during the deep cuts and that will need to be disposed of offsite.

Limitations

Our letter is based on project information provided to us at the time of this letter. If changes to the type, size, and location of the proposed structures or to the site grading are made, the recommendations contained in this letter shall not be considered valid unless the changes are reviewed, and the conclusions and recommendations modified in writing by LGCI. LGCI cannot accept responsibility for designs based solely on these preliminary recommendations.

It is not part of our scope to perform a more detailed site history; therefore, we have not explored for or researched the locations of buried utilities or other structures in the area of the proposed construction. Our scope did not include environmental services or services related to moisture, mold, or other biological contaminants in or around the site.

The recommendations in this letter are based in part on the data obtained from the review of existing subsurface data. The recommendations contained in this letter are at best preliminary in nature and must be confirmed with actual subsurface explorations, laboratory testing, and geotechnical analyses.

Our letter has been prepared in accordance with generally accepted engineering practices and in accordance with the terms and conditions set forth in our agreement. No other warranty, expressed or implied, is made. This report has been prepared for the exclusive use of Lamoureux Pagano & Associates, Inc. for the specific application to the proposed Doherty High School at the Doherty Site in Worcester, Massachusetts as conceived at this time.



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If you have any questions or need further assistance, please contact us at (978) 330-5912.

Very truly yours,

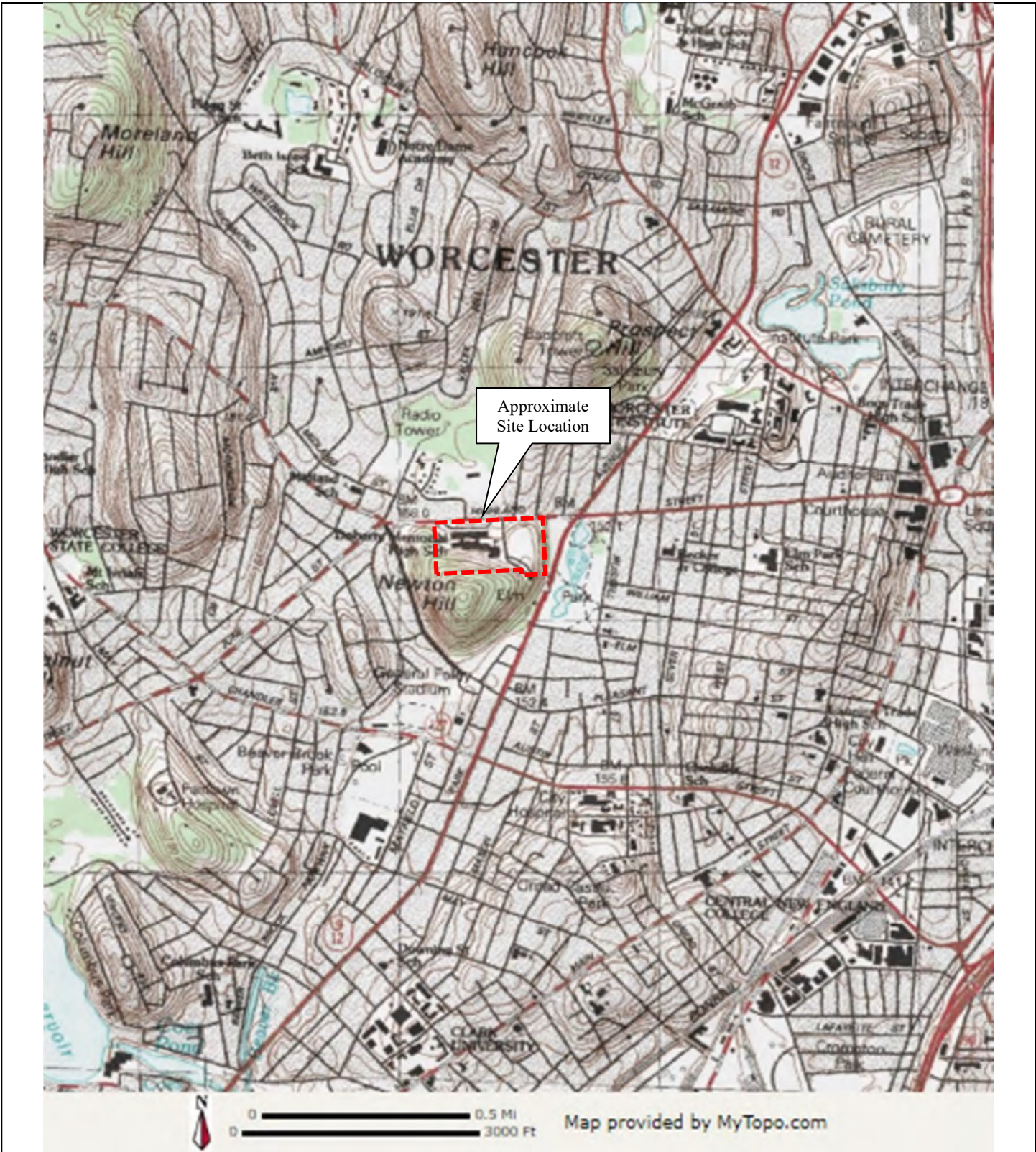
Lahlaf Geotechnical Consulting, Inc.



Abdelmadjid M. Lahlaf, Ph.D., P.E.
Principal Engineer


Attachments: Figure 1 – Site Location Map
Figure 2 – Surficial Geologic Map
Attachment A – Historical Topo Maps
Attachment B – Photographs
Attachment C – Excerpts of Soil Survey Report
Attachment D – Locations and Logs of Previous Borings

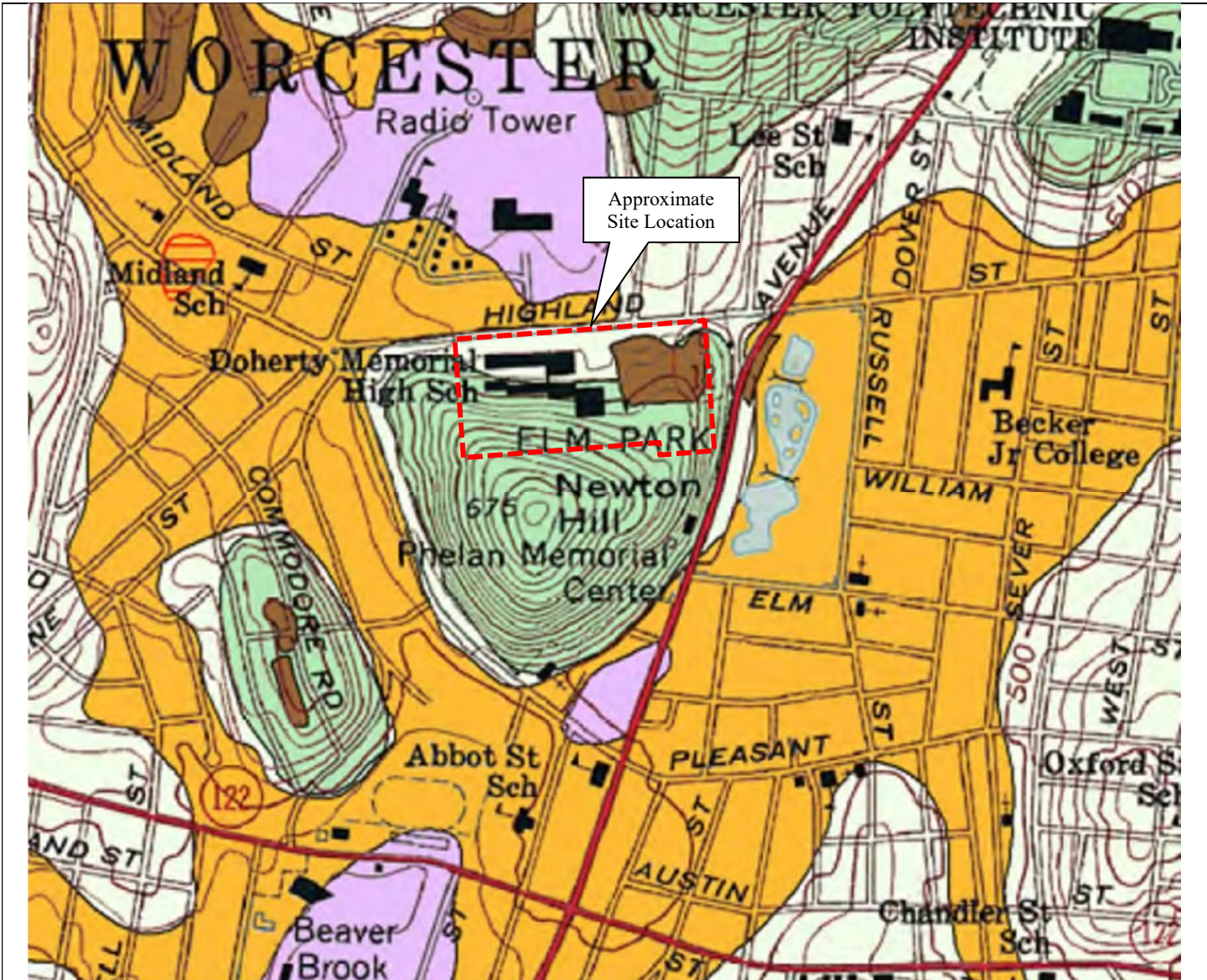




Contour Intervals: 3 meters

Figure based on USGS topographic map of Worcester, MA obtained from www.mytopo.com/maps


Client: Lamoureux Pagano & Associates, Inc.	Project: Proposed Doherty High School	Figure 1 – Site Location Map (Doherty Site)	
 LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Worcester, MA	LGCI Project No.: 1922	Date: Nov. 2019



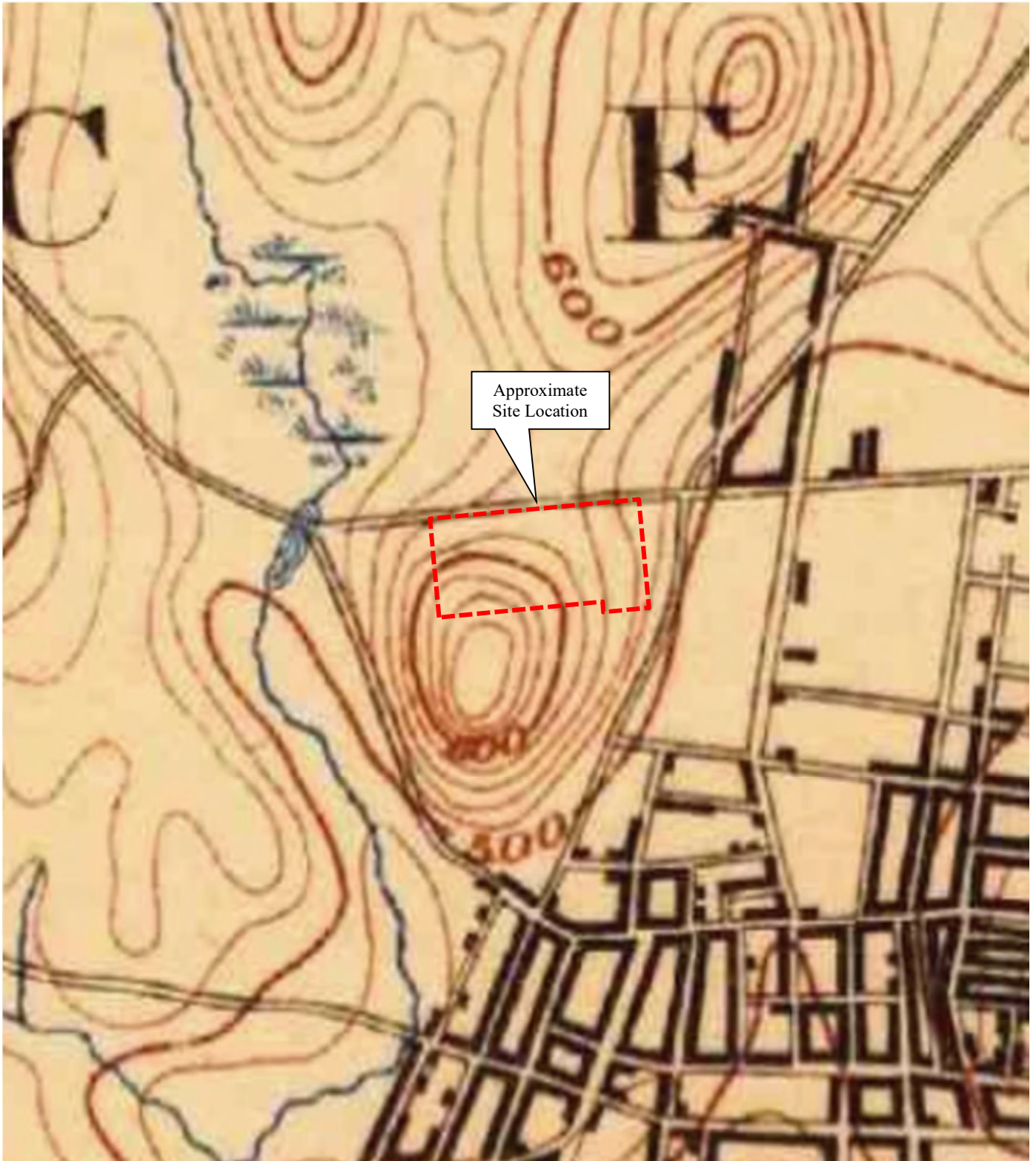
-  Artificial fill—Earth materials and manmade materials that have been artificially emplaced, primarily in highway and railroad embankments and in dams; unit may also include landfills, urban-development areas, and filled coastal wetlands
-  Thin till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebble, cobble, and boulder clasts, large surface boulders are common. Unit was mapped where till is generally less than 10 to 15 ft thick including areas of shallow bedrock. Predominantly consists of upper till of the last glaciation; loose to moderately compact, generally sandy, commonly stony. Two facies are present in some places: a looser, coarser grained ablation facies, melted out from supraglacial position, and an underlying more compact, finer grained lodgement facies deposited subglacially. In general, both ablation and lodgement facies of upper till derived from fine-grained bedrock are finer grained, more compact, less stony and have fewer surface boulders than upper till derived from coarse-grained crystalline rocks. Across Massachusetts, fine-grained bedrock sources include the red Mesozoic sedimentary rocks of the Connecticut Valley lowland, marble in the western river valleys, and fine-grained schists in upland areas.
-  Thick till—Nonsorted, nonstratified matrix of sand, some silt, and little clay containing scattered pebbles, cobbles, and boulders in the shallow subsurface; at greater depths consists of compact, nonsorted matrix of silt, very fine sand, and some clay containing scattered small gravel clasts. Mapped in areas where till is greater than 10 to 15 ft thick, mostly in drumlin landforms in which till thickness commonly exceeds 100 ft (maximum recorded thickness is 230 ft). Although upper till of late Wisconsinan age is the surface deposit, lower till of probable Illinoian age constitutes the bulk of the material in thick-till areas. Lower till is moderately to very compact and is commonly finer grained and less stony than upper till. An oxidized zone, the lower part of a soil profile formed during a period of interglacial weathering, is generally present in the upper part of the lower till. This zone commonly shows closely spaced joints that are stained with iron and manganese oxides.



Figure based on map titled: "Surficial Materials Map of the North Worcester, Massachusetts," prepared by Stone, J.R. and Stone, B.D. for U.S. Geological Survey, 2018, Scientific Investigation Map 3402, Quadrangle 126 – North Worcester.


Client: Lamoureux Pagano & Associates, Inc.	Project: Proposed Doherty High School	Figure 2 – Surficial Geologic Map (Doherty Site)	
 LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Worcester, MA	LGCI Project No.: 1922	Date: Nov. 2019

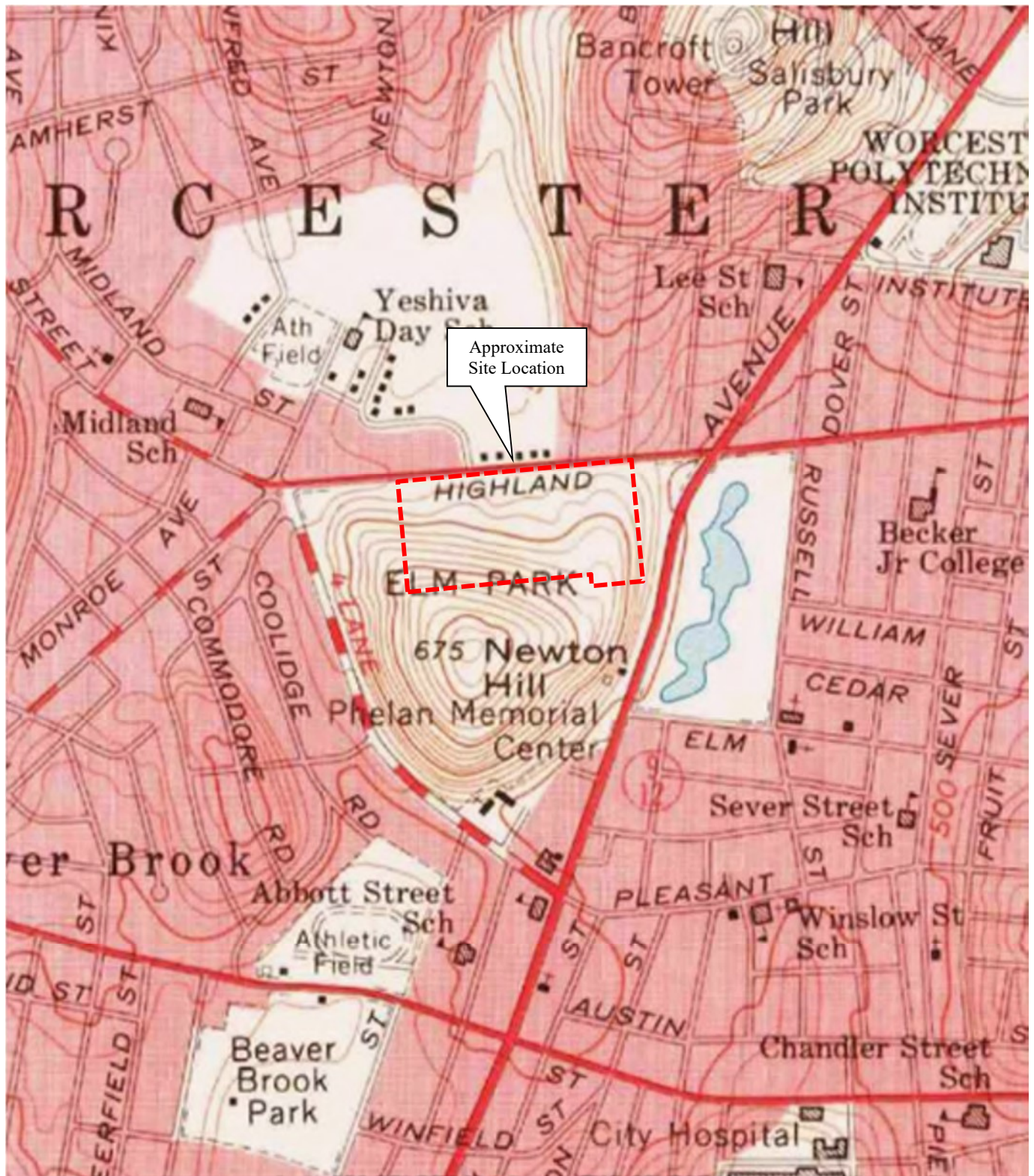
Attachment A – Historical Topo Maps



Contour Intervals: 3 meters


Figure based on USGS topographic map of Worcester, MA obtained from www.mytopo.com/maps

Client: Lamoureux Pagano & Associates, Inc.	Project: Proposed Doherty High School	Figure A1 – 1886 Historical Topo Map (Doherty Site)	
 LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Worcester, MA	LGCI Project No.: 1922	Date: Nov. 2019



Contour Intervals: 3 meters

Figure based on USGS topographic map of Worcester, MA obtained from www.mytopo.com/maps

Client: Lamoureux Pagano & Associates, Inc.	Project: Proposed Doherty High School	Figure A2 – 1960 Historical Topo Map (Doherty Site)	
 LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Worcester, MA	LGCI Project No.: 1922	Date: Nov. 2019

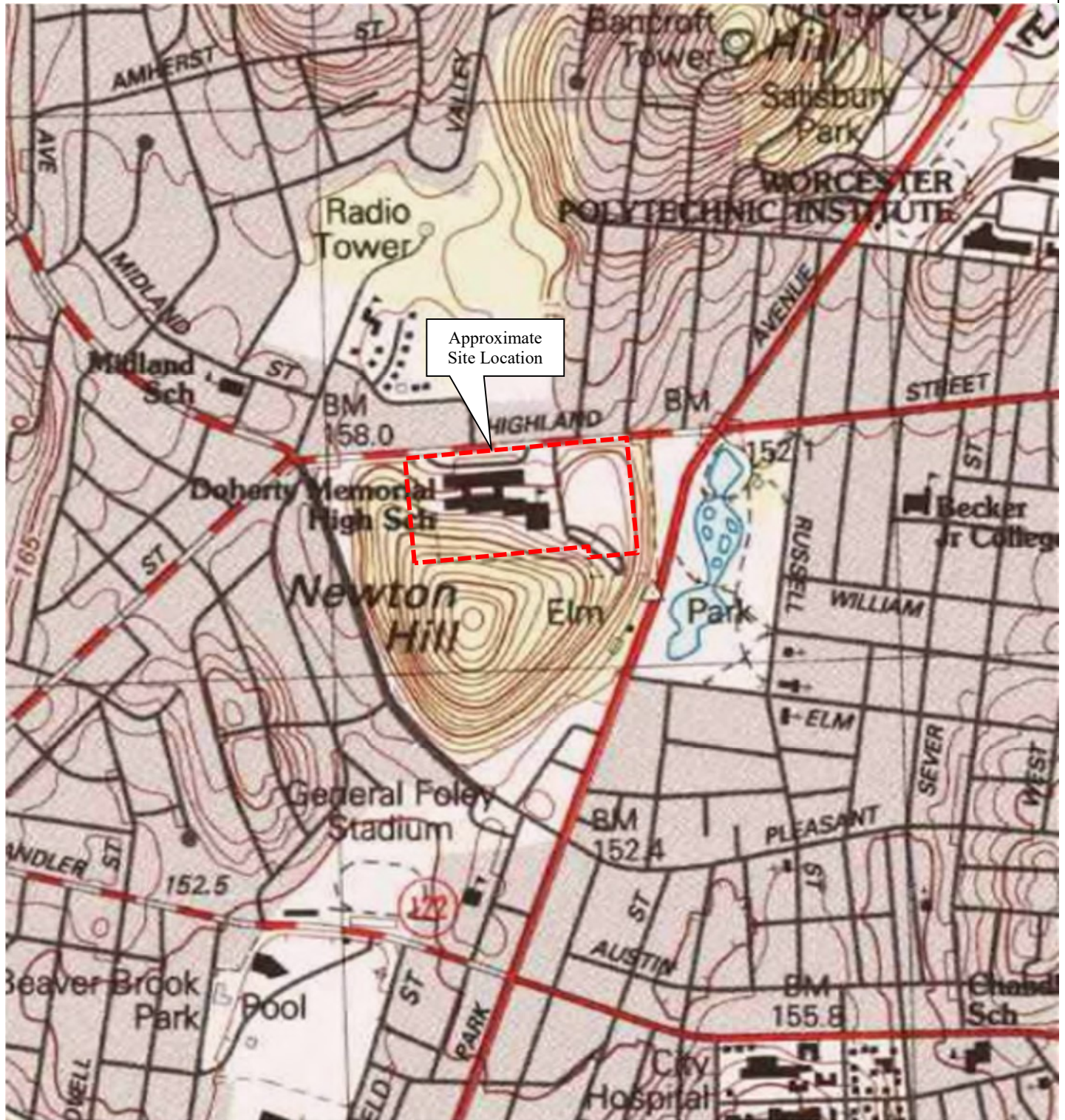



Figure based on USGS topographic map of Worcester, MA obtained from www.mytopo.com/maps

Client: Lamoureux Pagano & Associates, Inc.	Project: Proposed Doherty High School	Figure A3 – 1983 Historical Topo Map (Doherty Site)	
 LGCI Lahlaf Geotechnical Consulting, Inc.	Project Location: Worcester, MA	LGCI Project No.: 1922	Date: Nov. 2019

Attachment B – Photographs



Photo No. 1: Drop in the grade from the existing parking lot to Highland Street
(Looking north)



Photo No. 2: Asphalt condition in the existing parking lot
to the existing building



Photo No. 3: Steep rise in the grade from the parking lot to the existing wooded area South of the deexciting parking lot and building



Photo No. 4: Close up of the sharp rise in grade within the wooded area south of the existing parking lot and building



Photo No. 5: View facing north showing the flat existing athletic fields covered with snow



Photo No. 6: View facing Northeast showing the rest of the existing athletic fields



Photo No. 7: View facing northwest showing the existing athletic fields



Photo No. 8: Panoramic view of the existing athletic fields