

J2241-01-01  
October 3, 2011

Mr. Lance Trevallion  
Building Commissioner  
Town of Wilbraham  
240 Springfield Street  
Wilbraham, Massachusetts 01095

Re: Geotechnical Engineering Recommendations  
Wilbraham Fire Station Addition  
Wilbraham, Massachusetts

Dear Mr. Trevallion:

We are pleased to provide this report summarizing our geotechnical recommendations associated with the proposed additions to the Wilbraham Fire Department building, located at 2770 Boston Road in Wilbraham, Massachusetts. A Site Locus is provided as Figure 1. A Site Plan is provided as Figure 2.

Our geotechnical study is based upon four soil borings. Our services consisted of the full-time observation of the borings, review of the logs and soil samples, engineering analyses, and preparation of this report. This report is subject to the attached limitations.

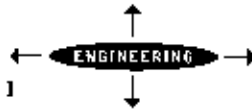
## PROJECT DESCRIPTION

We understand that the project consists of demolishing three existing additions to the main fire station building and constructing three additions, totaling approximately 6,700 square feet to the north, east and west sides. At this time, we understand that the additions will be a one story, slab-on grade structure. Maximum column loads are expected to be less than 50 kips.

The ground surface in the area of the proposed addition is generally covered with asphalt, and is flat at between elevation 263 and 264 feet. We understand that the portion of the building to remain has a slab elevation of 264.33 feet, and that the slab elevations for the new structures will match existing. Therefore, cuts and fills to form the building pad should be less than two feet.

## SUBSURFACE EXPLORATIONS

Subsurface explorations consisted of four soil borings (WF-1/1A and WF-4) performed on September 9, 2011 by Seaboard Drilling of Chicopee, Massachusetts. The borings were located near the footprint of the proposed addition and extended to depths between 27 and 37 feet below ground surface. Boring WF-1 encountered drilling refusal on concrete located



immediately below the asphalt layer. This boring (WF 1A) was offset 20 feet to the north and drilling continued. The borings were performed using hollow stem auger drilling techniques. An O'Reilly, Talbot & Okun Associates, Inc. (OTO) engineer observed and logged each boring. Boring locations are shown on Figure 2. Boring logs are attached.

In general, soil samples were collected at the ground surface and every five feet thereafter, using a split spoon sampler. Standard Penetration Tests (SPT) were performed by driving a 2-inch outside diameter split-spoon sampler 24 inches into the soil, using a 140 pound hammer free falling 30 inches (American Society for Testing and Materials Test Method D1586-99 "Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils"). The number of blows required to advance the split-spoon each 6-inch interval is recorded. The total blows required to drive the sampler the middle 12 inches of the 24-inch drive is the standard penetration resistance or N value. After drilling, each borehole was backfilled with soil cuttings and capped with cement.

## **SUBSURFACE CONDITIONS**

Subsurface conditions were interpreted based upon soils borings and are generally favorable for the proposed construction. Conditions are described below.

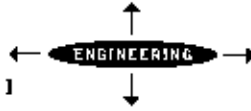
Between 1.5 and 4 inches of asphalt was present at the ground surface in each of the borings. Immediately below the asphalt layer in boring WF-1A, a concrete slab reinforced with woven wire mesh was encountered. The slab was penetrated to a depth of 12 inches, prior to offsetting the boring 20 feet to the north. Concrete was not encountered in the offset boring, WF-1.

In each boring, between five and twelve feet of loose to dense, granular fill was observed at the ground surface. The fill consisted of fine or medium sand with trace amounts of gravel, coarse sand, and silt. Beneath the fill layer in boring WF-3, trace fibrous organics and roots were observed between 10 to 14 feet, indicating that the site had been filled. The surficial granular fill layer was underlain by native, medium dense to dense, granular soils. These soils either consisted of fine sand with trace amounts of gravel, medium and coarse sand, and silt, or medium sand with trace amounts of gravel, fine sand, coarse sand, and silt. The borings were terminated in this layer, at a depth of between 27 and 37 feet below ground surface.

Groundwater was not encountered at the time of drilling. Therefore, groundwater is not expected to impact the proposed construction.

## **DESIGN RECOMMENDATIONS**

Based upon the subsurface conditions encountered, the significant geotechnical issues consist of building foundations and the presence of fill. The following recommendations are provided for the assumed construction described above.



Between five and 12 feet of fill was observed in the site borings. This fill predominately consisted of suitable materials, fine to medium sand with some gravel. The fill contained only insignificant amounts of silt, clay, organics, debris or other unsuitable materials. The fill was mostly medium dense to dense, with some loose layers or zones.

Based upon our observations, the granular fill was likely placed in a controlled manner to level the site for the existing fire station. Most of the fill appears to have been compacted during placement. However, some loose zones are present. Based upon the proposed construction, which consists of a relatively light, single-story structure, the fill can remain in place provided it is compacted to treat any localized loose zones. Therefore, we recommend that the entire footprint of the proposed additions be thoroughly proof compacted by at least six passes with an 8,000 pound (minimum static weight) vibratory drum loader. In addition, all footing subgrades should be proof compacted using a vibratory plate compactor.

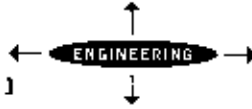
#### Foundations

The proposed building can be founded on normal spread footing foundations bearing on the medium dense native soils or compacted engineered fills. As described above, footing subgrades should be densified prior to placement of footing concrete. Provided these recommendations are followed, a maximum allowable bearing pressure of 4,000 pounds per square foot may be used for the design of footings.

We estimate that settlement of footings and slabs bearing on the medium dense native soils, proof-compacted existing soils, or new compacted fill should be small and largely elastic in nature. Maximum settlements should be less than 1 inch and should occur relatively quickly after load application (during construction). Assuming the existing building does not settle in the future, the structural engineer should conservatively assume ½ inch of settlement between the existing building and the addition.

We recommend that exterior footings be embedded a minimum of 48 inches below the lowest adjacent grade for frost protection. Strip footings beneath the bearing walls should be at least 18 inches wide. Isolated column footings should be at least 24 inches wide. All other applicable requirements of the Massachusetts State Building Code (MSBC) should be followed.

If winter construction occurs, footings should not be placed on frozen soils. Footing excavations should be free of loose or disturbed materials. Any boulders or cobbles larger than 4 inches in diameter should be removed from within one foot of the bottom of the footings and replaced with sand and gravel fill. As recommended above, the footing subgrades should be densified with at least three passes with a vibrating plate compactor. If loose materials are present in the excavations, they shall be recompacted to form a firm, dense, bearing surface.



### Earthquake Considerations

Earthquake loadings must be considered under requirements in Section 1613 and 1806 of the 8th Edition (February 2011) Massachusetts State Building Code (MSBC). The 8<sup>th</sup> Edition of the MSBC is based upon the International Building Code 2009 (IBC 2009) with Massachusetts amendments.

Section 1613 covers lateral forces imposed on structures from earthquake shaking. Per table 1604.10, the maximum considered earthquake spectral response accelerations at short periods ( $S_s$ ) and at 1 sec ( $S_1$ ) for Wilbraham, Massachusetts were determined to be 0.23 and 0.065, respectively. Based upon preliminary data, the site Class was determined to be Class D. The site classification is based upon the nature of subsurface soils. Procedures for the site specific determination of site Classification are provided in Section 1613.5.4 of the 2009 IBC. The site coefficients  $F_a$  and  $F_v$  were determined according to Tables 1613.5.3(1) and 1613.5.3(2) using both the  $S_s$  and  $S_1$  values and the Site Class. For this site,  $F_a$  and  $F_v$  were determined to be 1.6 and 2.4, respectively.

Section 1806.4 relates to the liquefaction potential of the underlying soils. The liquefaction potential was evaluated for the site soils encountered below the water table. Based upon the observed density of the granular soils at the site, they would not be subject to liquefaction under the design earthquake.

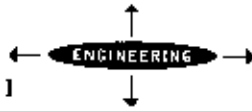
### Concrete Slabs

We recommend that the building slabs be supported on at least 12 inches of imported, compacted sand and gravel. The subgrade within the footprint of the proposed building should be stripped of topsoil, asphalt or concrete, and densified to treat any loose areas that are present. The subgrade should also be free of large boulders or cobbles. The Sand and Gravel fill beneath the concrete slabs should meet the grain size distribution characteristics outlined in Table 1. Fill supporting slabs should be placed in accordance with the recommendations for compaction provided below.

### Earthwork Considerations

We anticipate that earthwork for this project will include excavations for footings, the proof-compaction of existing site soils, the compaction of fill beneath footings, and cuts and fills to form the building floorslab.

Two fill types are recommended: Sand and Gravel for use within 12 inches beneath floor slabs and footings, and Granular Fill for use at depths greater than 12 inches beneath floor slabs, and as miscellaneous fill, if needed. Grain size distribution requirements are presented in Table 1. The near surface granular soils found on Site may be suitable for re-use as fill. If the contractor elects to use the on-site material as fill, we recommend he collect a representative sample in a test pit and perform grain size distribution analysis to obtain approval by the engineer prior to the start of construction.



**Table 1**  
**Grain Size Distribution Requirements**

Size	Sand and Gravel	Granular Fill:
Percent Finer by Weight		
4 inch	100	100
1/2 inch	50-85	---
No. 4	40-75	---
No. 10	---	30-90
No. 40	10-35	10-70
No. 100	---	---
No. 200	0-8	0-15

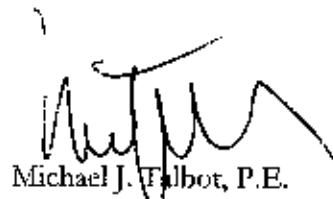
Any asphalt, concrete, debris, existing building materials, topsoil, vegetation and organic soils should be stripped from beneath the proposed structure. It should be noted that concrete was encountered in boring WF-1A, and is reportedly present along the eastern edge of the existing building. In addition, utilities (such as the existing water line located within the footprint of the proposed building) should be removed from beneath the new structure. Asphalt, concrete, debris, topsoil or organic soils stripped from the excavation should not be re-used as fill beneath structures. To avoid point loads, any cobbles or boulders larger than 4 inch diameter, encountered at the subgrade for footings and slabs, should be removed and replaced with compacted Sand and Gravel fill.

Fill placed beneath footings and floorslabs should be densified to at least 95% of the Modified Proctor dry density as defined in ASTM D1557, Method C. Fill should be placed in lifts of no more than 12-inches and compacted with at least four passes with a vibrating drum roller (minimum 3,000 pound weight). To facilitate compaction, the moisture content should be maintained at or near optimum.

We appreciated the opportunity to be of service on this project. If you have any questions, please call the undersigned.

Sincerely yours,  
O'Reilly, Talbot & Okun Associates, Inc.

  
Ashley T. Mickiewicz, P.E.  
Project Engineer

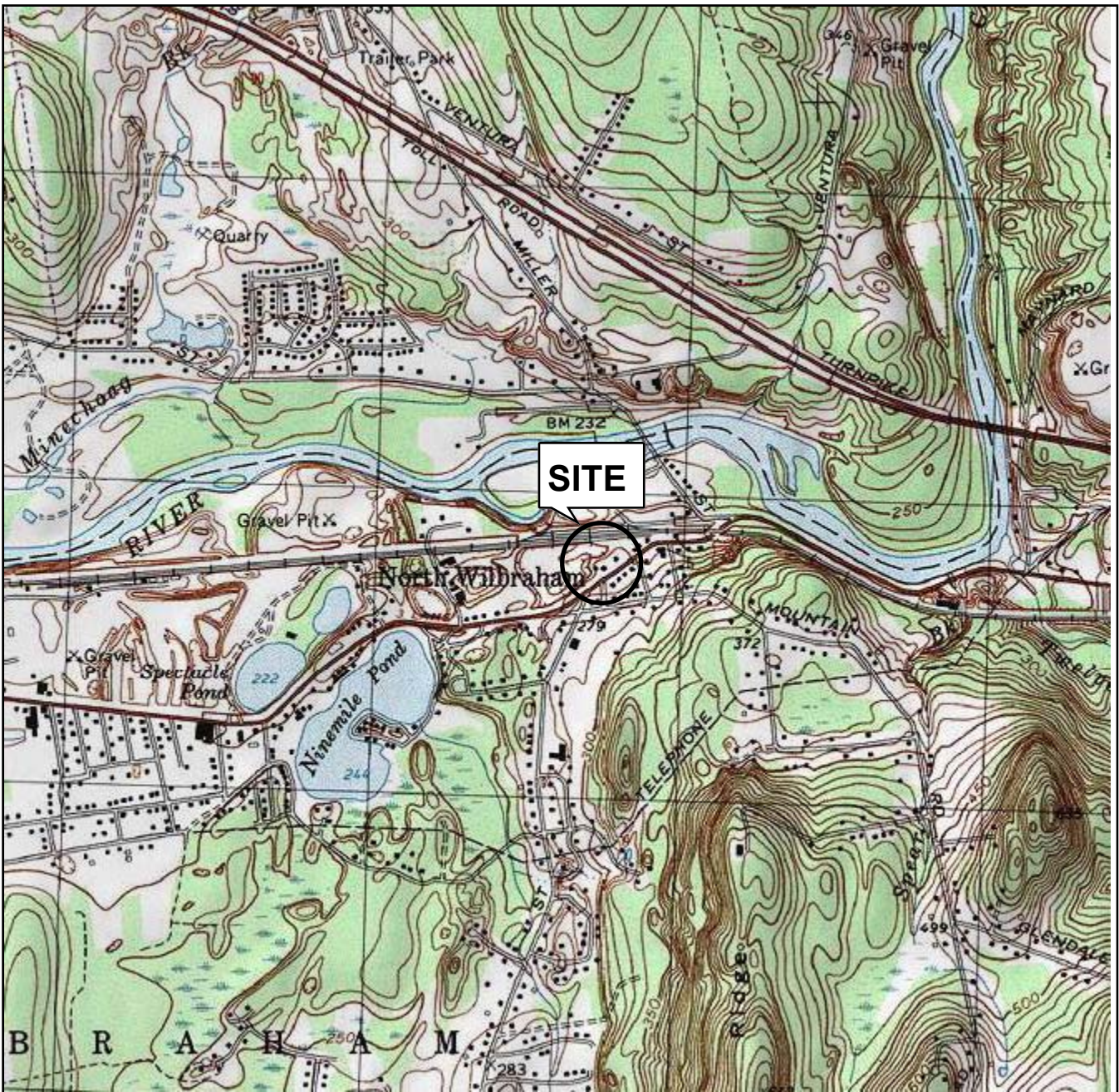
  
Michael J. Talbot, P.E.  
Principal

Attachments: Limitations, Site Locus, Site Plan, Boring Logs

c: Jeff McLiravy (Tecton Architects)  
Rob Johnson (Johnson Structural Engineering, Inc.)

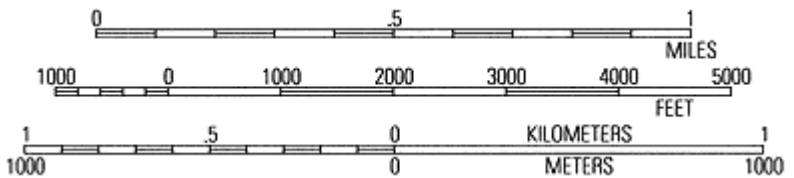
## LIMITATIONS

1. The observations presented in this report were made under the conditions described herein. The conclusions presented in this report were based solely upon the services described in the report and not on scientific tasks or procedures beyond the scope of the project or the time and budgetary constraints imposed by the client. The work described in this report was carried out in accordance with the Statement of Terms and Conditions attached to our proposal.
2. The analysis and recommendations submitted in this report are based in part upon the data obtained from widely spaced subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the recommendations of this report.
3. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.
4. In the event that any changes in the nature, design or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by O'Reilly, Talbot & Okun Associates Inc. It is recommended that we be retained to provide a general review of final plans and specifications.
5. Our report was prepared for the exclusive benefit of our client. Reliance upon the report and its conclusions is not made to third parties or future property owners.

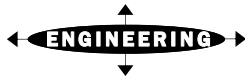


Topographic Map Quadrant: Ludlow, MA  
Map Version: 1969  
Current as of: 1975

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**O'Reilly, Talbot & Okun**  
[ ASSOCIATES ]



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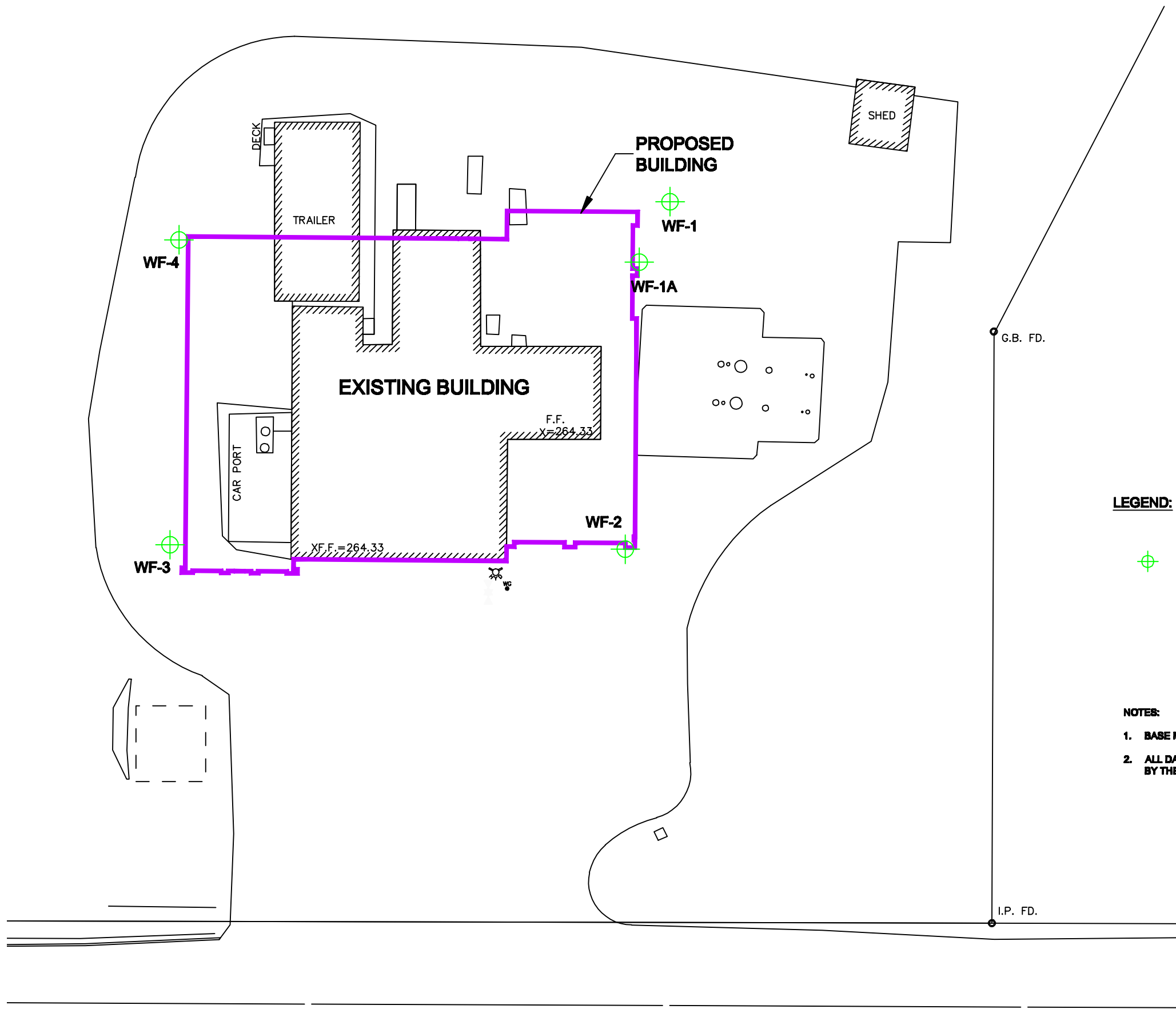
Wilbraham Fire Department  
2770 Boston Road  
Wilbraham, Massachusetts

## SITE LOCUS

September, 2011

Figure 1

01-222010241 Tendon Architecture Inc 01-01 Wilbraham Fire Station Boston Rd Wilbraham MA-Geotechnical/CAD File:J2241-01-01 Wilbraham Fire Dept.dwg



**LEGEND:**

 SOIL BORING PERFORMED BY SEABOARD ENVIRONMENTAL DRILLING ON 09/09/11, OBSERVED BY OTO

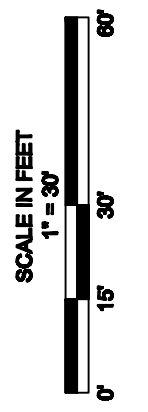
**NOTES:**

1. BASE MAP PROVIDED TO OTO IN ELECTRONIC FORMAT.
2. ALL DATA IS TO BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD(S) USED IN DEVELOPING THIS PLAN.

DESIGNED BY: SMM  
 CHECKED BY: ALM  
 DRAWN BY: CDA  
 DATE: SEPTEMBER 2011

**O'REILLY, TALBOT & OKUN**  
 ASSOCIATES  
 ENGINEERING

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 SUITE 500  
 SPRINGFIELD, MA 01103  
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**WILBRAHAM FIRE DEPARTMENT**  
 270 BOSTON ROAD - WILBRAHAM, MASSACHUSETTS

**SITE PLAN**

PROJECT No.  
**J2241-01-01**

FIGURE No.  
**2**