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SECTION 2
FACILITY ANALYSIS

FACILITY ANALYSIS OVERVIEW

SECTION 2: FACILITY ANALYSIS

The existing facility analysis is a collection of information created through a collaborative effort of numerous individuals. The analysis summarizes data gathered at the sites of Elm Street Middle School, Fairgrounds Middle School, Pennichuck Middles School, and a proposed site off Cherrywood Drive that is owned by the City. The findings assist in facilitating recommendations for the proposed options identified in *Section 4: Concept Design* of this report, future projects outside of the proposed scope identified in *Section 4: Concept Design*, and other building and site conditions or needs. Information was gathered and investigations were completed by the following entities and project team members:

- Harriman
    - Civil Engineer
    - Architects and Designers
    - Structural Engineers and Designers
    - Mechanical and Plumbing Engineers and Designers
    - Electrical Engineer and Designers
- City of Nashua
    - Director of Plant Operations
    - Assistant Director for Maintenance
    - Assistant Director of Safety and Security
    - Maintenance Staff
    - School Administration
- RPF Environmental, Inc.
- Desmarais Environmental, Inc.
- Vanasse & Associates, Inc.
- NDT Corporation
- Hayner/Swanson, Inc.
- Foley & Buhl Engineering, Inc.
- Milone & Macbroom

The existing facility analysis is to be used as a tool for recognizing the conditions of the site and buildings as they were at the time of the investigations. Work identified or recommended in this section of the report is not intended to be representative of the proposed scope of work identified in the options outlined in *Section 4: Concept Design*.

EXISTING CONDITIONS/FINDINGS

SECTION 2: FACILITY ANALYSIS

This section contains the existing conditions and findings in the following areas

ELM STREET MIDDLE SCHOOL

- / Site Analysis
- / Architectural Analysis
- / Structural Analysis
- / Mechanical Analysis
- / Plumbing Analysis
- / Fire Protection Analysis
- / Electrical Analysis

FAIRGROUNDS MIDDLE SCHOOL

- / Site Analysis
- / Architectural Analysis
- / Structural Analysis
- / Mechanical Analysis
- / Plumbing Analysis
- / Fire Protection Analysis
- / Electrical Analysis

PENNICHUCK MIDDLE SCHOOL

- / Site Analysis
- / Architectural Analysis
- / Structural Analysis
- / Mechanical Analysis
- / Plumbing Analysis
- / Fire Protection Analysis
- / Electrical Analysis

SITE ANALYSIS

General

Evaluation of the site at Elm Street Middle School, located in Nashua, NH, involved walking around the school and grounds, making observations of existing site features. Photographs were taken to document these existing conditions. The goal of this study is to look for deficiencies and to gather relevant information on the conditions of the site. Included is an evaluation of the surface drainage and associated infrastructure, evidence of erosion from stormwater runoff, and existing site circulation and parking, including observations associated with Americans with Disabilities Act (ADA) access from the adjacent streets and parking areas to the building.

Google Earth Image dated April 22, 2018

Existing Conditions

The school is located in an urban residential neighborhood, surrounded on all four sides by streets (Elm Street to the east, West Otterson Street to the north, Chestnut Street to the west, and Lake Street to the south). To the east of the site is Main Street, with many commercial businesses. The school building occupies the majority of the site, with various green spaces and parking areas around the building, as well as two courtyards within the building footprint. The green space in the southwest corner of the site is currently occupied by four portable classroom buildings (containing a total of eight classrooms).

Site topography generally slopes gradually from south to north and from west to east. Site circulation patterns are clear, but occur in a number of different locations. There are three separate loop drives, including one to the north off West Otterson Street, one to the west off Chestnut Street, and one to the south off Lake Street. Handicap accessibility is provided at locations within each of these drives.

The pavement throughout the site generally appears to be in good condition. Observations of the pavement did not include many potholes, large cracks, or areas of substantial differential settlement. Instead, the pavement conditions appear to be consistent with expected exposure to the elements, in addition to general wear and tear.

ADA accessibility from southern loop drive

General cracking on existing paved surfaces

View looking south from West Otterson Street

Observed pavement in general good condition

Recent site work (circa 2012) has included expansions of paved on-site parking areas to the north of the building along West Otterson Street, and to the south along Lake Street. These renovations added approximately 10 parking spaces to each on-site lot. On-site parking is insufficient to meet current needs. Most of the parking for the school is located on the street in lined spaces along Elm Street and Lake Street.

Each of the recently paved parking areas have clear paint markings, including directional markings (two-way or one-way traffic). Other on-site paved areas that are not lined for parking are still utilized as such in various locations in the southwestern corner of the site. At the time of the site visit, several vehicles were observed parking on the paved sidewalk area along the existing west-facing facade (see photos). Harriman conducted the visit during school vacation hours, so it is unclear whether this is a regular occurrence.

Parking lot to the north of the school

Vehicles observed on existing paved walk

Parking lot to the south of the school

Vehicles observed on existing paved walk

Observations of the existing vegetative areas located on the outside of the building (on the eastern/southwestern portions of site) were limited due to the snow cover on the grounds. Similarly, the amount of drainage infrastructure observed on the site was minimal due to the site conditions and general snow cover throughout the site. In general, approximately two catch basins or drainage manholes were observed for each of the parking areas and appeared to be in good condition, as no differential settlement was observed surrounding the structures.

Other observations made during the site visit included signage, lighting, and ADA accessibility throughout the site. Signage at the site includes various signs to direct drivers, such as "one way," "no parking," "do not enter," and "permit parking only." Many other signs were observed including signage for pet cleanup, pedestrian traffic, drug-free school zones, handicap parking signage, and general school signage (see photos).

Snow covered green space on eastern side of school

Elm Street Middle School signage in southeast of site

Existing catch basin located south of existing building

"Do Not Enter" signage at southern loop drive

Due to the relatively flat topography throughout the site, ADA accessibility appears to be sufficient throughout the property. Most doorways observed have accessible routes to entrances, and all modular buildings observed have ramps for access. Handicap parking spaces were also observed in the parking areas to the north and south of the school. Some existing walkways, specifically within the eastern portion of the site, may require repairs, as some of the concrete joints have separated, cracked, and settled, causing a noticeable change in elevation over some portions of the walkway (see photo below).

Concrete walkway damage on eastern portion of site

ADA ramps/detectable plates at modulars

ARCHITECTURAL AND CODE ANALYSIS

Original 1936 Building

The original building is a three-story exterior load bearing masonry walls and four stories at center forming a "T" shaped building with a partial basement for mechanical room location. Exterior walls are triple wythe brick. The spaces in this section are primarily classrooms, administration, and educational support.

Edmund Keefe Auditorium is located at the southern end, with a full stage and balcony seating. Main floor seating is accessed from the first floor, and balcony seating is accessed from the front lobby and second floor. The gymnasium is located at the northern end, with balcony seating which is now used for storage. Exterior walls of both the Auditorium and Gymnasium are four wythe brick.

Based on the era of construction and existing drawings, little-to-no insulation was used in the exterior walls. The three- and four-story sections have floors and a roof system that indicate gypsum concrete plank supported by wide flange beams. Further investigation done by NDT Corporation in August of 2019 indicates that a significant portion of the existing floor system is constructed of 2" +/- thick tongue and groove wood decking spanning between steel beam support framing. The auditorium roof framing is constructed of long span trusses. Our obser-

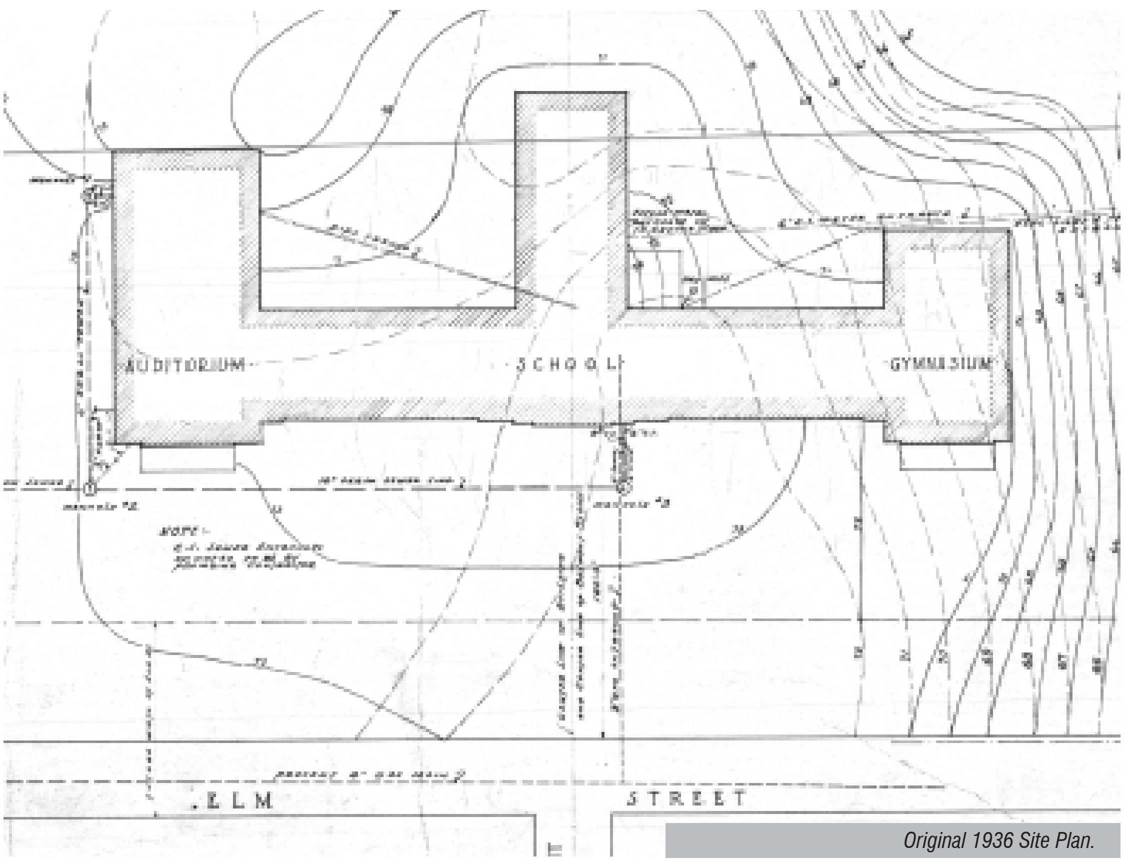
Original 1936 front entrance with four stories


Original 1936 Keefe Auditorium entrance


Original 1936 Gymnasium entrance

vations noted that the original roof sheathing system had been replaced with metal decking. The gymnasium was observed to be very similar to the auditorium; however we could not access the top cord of trusses/roof deck (refer to structural analysis for more details). The interior walls finished at the perimeter appear to be skim coat plaster over masonry exterior wall.

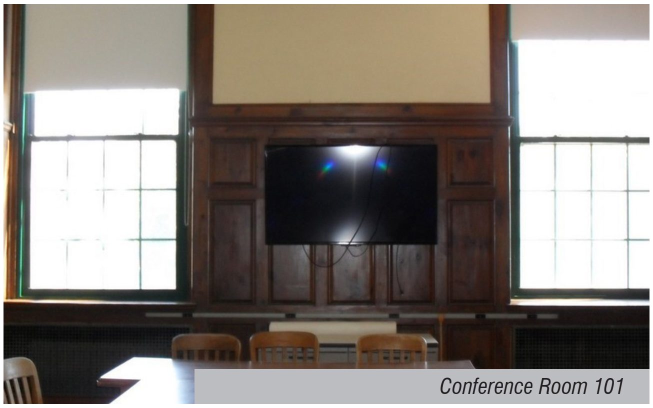
In order to increase the envelope performance, one option would be to apply metal furring to the interior side of the exterior walls with metal studs. Prior to applying metal studs, remove plaster and wood furring (if any exist) down to the existing brick. Apply metal studs and fill the voids with spray foam insulation to seal the perimeter of the envelope, and add a layer of gypsum dry wall. Special care is needed to preserve original millwork in spaces such as Conference 101, with fire place and Auditorium millwork to remain.



Original 1936 Site Plan.

Keefe Auditorium

Original 1936 Keefe Auditorium entrance



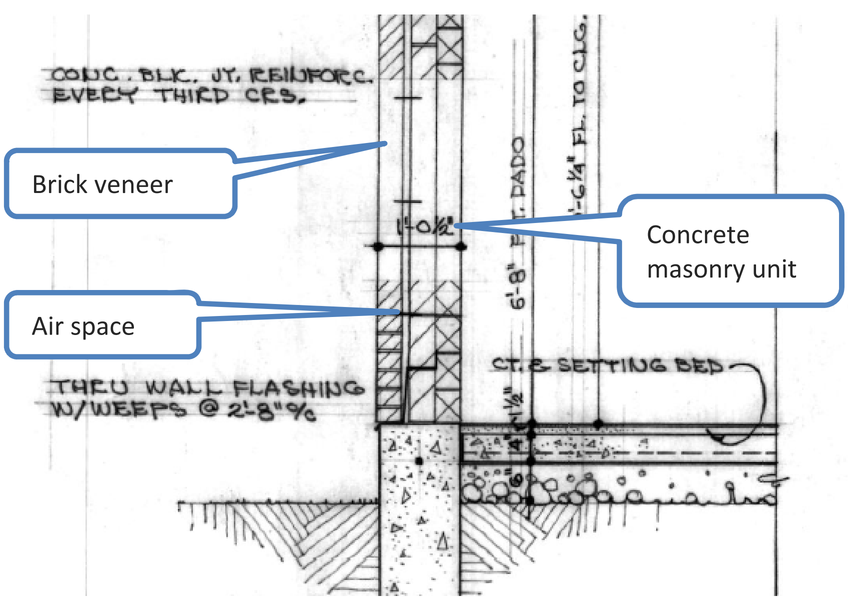
Conference Room 101

Original 1936 northeast corner

1961 Additions and Renovations

A single story was added at the west side, connecting the full-length of the back of the building and creating two large courtyards. Multiple construction systems were utilized.

- The southwest classroom and the northern classroom additions are constructed with masonry bearing walls ranging between 8”-12” thick (exterior and interior). The exterior walls are 4” veneer brick with 8” CMU. These masonry walls support open web metal roof joists with depths from 16”-24”.
- The cafeteria at the west portion is constructed of a precast/pre-stressed reinforced concrete system. This system consists of precast concrete columns supporting precast/pre-stressed concrete girders. The concrete girders support precast concrete “V-shaped” roof panels.
- At the northwest section, the upper locker room floor framing is constructed of a combination of masonry bearing walls and wide flange bearing beams. The low roof in this area is framed similarly to the typical classroom areas.
- The Gymnasium roof is constructed of long span steel trusses. The metal deck is supported by deep steel wide-flange beams that span between the trusses. These wide-flange beams are supported by the steel double angle trusses which span between reinforced concrete columns. Locker rooms are built at half levels from Gymnasium. The exterior walls are 4” veneer brick with 8” CMU,



1961 Addition – Typical wall section from existing drawings including infill between reinforced concrete columns at the West and East sections.

Based on the era of construction and existing drawings, little to no insulation was used in the exterior walls. Walls consist of 4" brick veneer, air cavity (for drainage) and 8" CMU (load bearing) (refer to structural section for more details).

1961 Addition – Gymnasium west elevation

1961 Addition – Classroom northern elevation

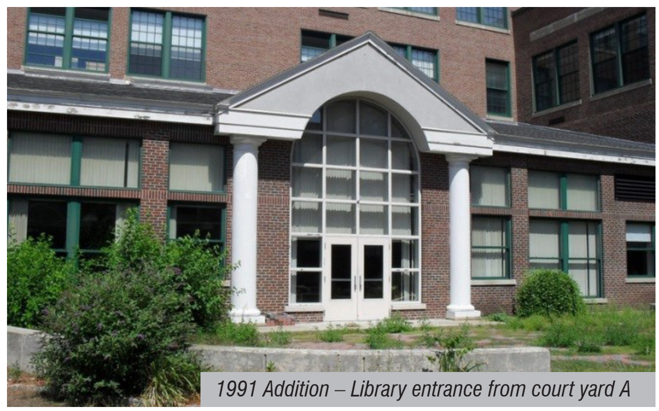
1961 Addition – Gymnasium entrance

1961 Addition – Classroom southwest elevation

1961 Addition – Cafeteria west elevation

1991 Additions and Renovations
This addition consists of one story to relocate the Library, additional corridor width near the Cafeteria, and expanded toilet areas. Based on the existing drawings provided, the exterior walls consist of 4" brick veneer, 2"air cavity (for drainage), and 2" rigid insulation with an R-value of 11 +/- and 8" CMU (load bearing). The Library's roof system is constructed of plywood sheathing attached to wood trusses. These wood trusses are supported by masonry bearing walls and steel beams bearing on tubular steel columns. The corridors, toilet area, and store areas are all framed with plywood sheathing roof system attached to dimensional lumber framing; all of which are bearing on masonry bearing walls. The framing constructed in 1991 was not accessible for the Library and auxiliary spaces.

Exterior Brick Walls and Precast Concrete
The brick face appears to have been fairly well maintained; however, there is some evidence of brick veneer water damage, loose mortar or cracking, rusted brick veneer lintels, and precast sills/ bandings that have separated. It was reported that minor leaks are most likely through the wall and roof intersection; there are over 16 different roof levels. Some ceiling tiles are stained and indicate ongoing leaks. With the upgrade of the heating system, the existing unit ventilators will be removed and the exterior vent grill will also be removed, requiring the exterior openings to be infilled with matching brick veneer. Precast concrete structural framing exposed to the exterior has moderate to major spalling and cracking. Some areas have exposed reinforcing.


1991 Addition – Library entrance from court yard A

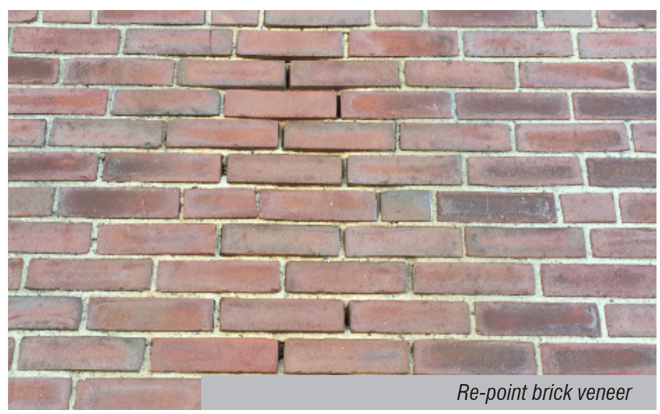

1991 Addition – added corridor width from court yard B


Unit ventilator (UV) grill to be removed and infill with brick

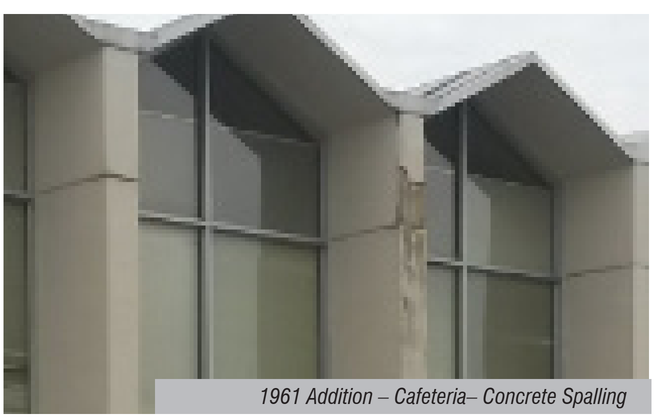
Unit ventilator (UV) grill to be removed and infill with brick

Re-point brick veneer

Re-point brick veneer



Re-point brick veneer



1961 Addition – Cafeteria– Concrete Spalling

1961 Addition – Gymnasium entrance – Concrete Spalling

Windows

The windows were replaced in 1991 with aluminum thermal pane glazing. They vary in function; double hung, awning, and fixed. They appear to be in fair to good condition. It has been reported that many of the double hung windows are difficult to open. Many screens are broken or missing. A commercial window's life expectancy is based on average wear-and-tear of windows. Aluminum windows are expected to last between 15 and 20 years, and can be extended with regular maintenance

Observation of the large double hung windows: the sash is very heavy, and we understand the counterbalancing mechanism is constantly being replaced. The window system should be replaced. The operable sash size should be reduced to lessen weight of lifting sash, or different operation types should be explored.

Roofs

All of the existing roofs have been re-roofed—many of them several times. The only roof that may be original is the 1991 Library addition, which is asphalt shingles. Per District documents, the oldest re-roofing is dated 1988, with over ten separate roof areas over the years. Some roofs have been re-roofed in recent years. A recent report done by the District indicates 16 different areas of roofing needing replacement and/or repairs. Several of the roof areas are indicated in the report to have less than 5 years of life left. The majority of the flat roofs are Firestone or Carlisle EPDM roofing systems with a variety of rigid board insulations and thicknesses. There is minimal information on type or thickness of insulation. Most recent re-roofing documents, i.e. 2004, indicate two layers of 1-1/2" of polyisocyanurate. The 1961 Gymnasium and its entrance were re-roofed in 1997 with a Sarnifil PVC roofing system. The Cafeteria appears to have been re-roofed in 1992 with a Sarnifil PVC roofing system.

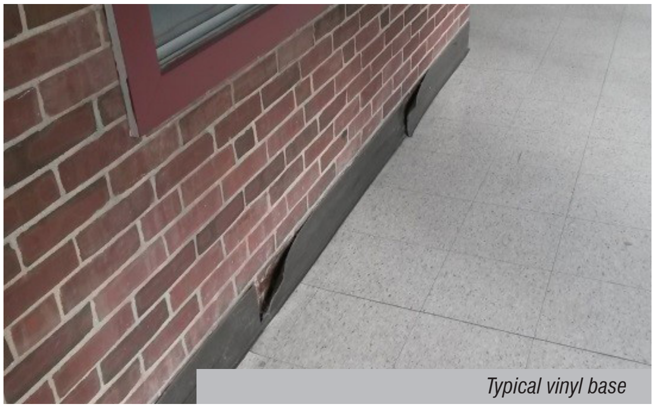
Roofs over 15 years old or showing sign of premature aging should be considered for re-roofing. Conduct roof cuts to verify insulation thickness over existing roof systems. Also, verify if existing built-up tar and gravel is roofed over and test for asbestos before determining roof replacement.

Ceramic Floor and Wall Tile

All of the toilet facilities have ceramic floor and ceramic wall tile or seamless floors, with conditions varying from fair to good. Most of the plumbing fixtures appear to have been replaced in 1991 and vary with manually operated faucets and flushometers. With the extensive renovations, we would consider replacing all toilets with water saving 1.28 gallons per flush and hand free operators.

In our experience with the Broad Street and Sunset Heights renovations, new a toilet base outline will not cover over existing floor finish. We recommend replacing all floors with new ceramic tile, with ceramic tile walls full height on wet walls. This would establish all toilet rooms and fixtures of a consistent fixture types, new partitions, and finishes.

Typical double hung window



Typical vinyl base

Typical double hung window

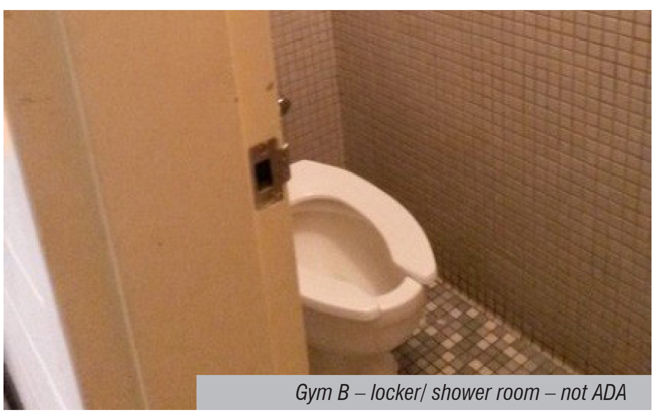
Stair to locker/shower rooms

Example of reducing window sash

Steps at rear entrance to cafeteria lobby

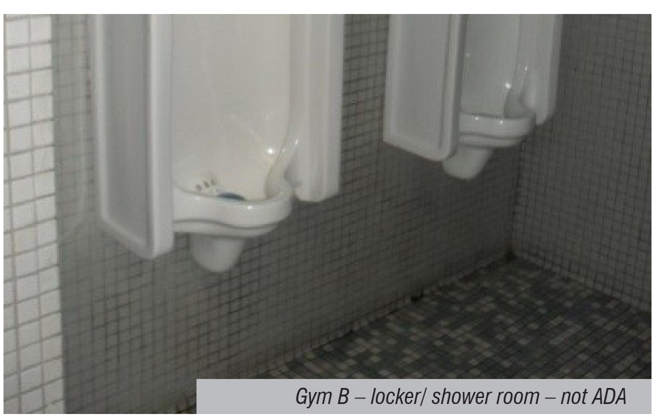
Gym B – locker/ shower room – not ADA

Auditorium toilet room – not ADA

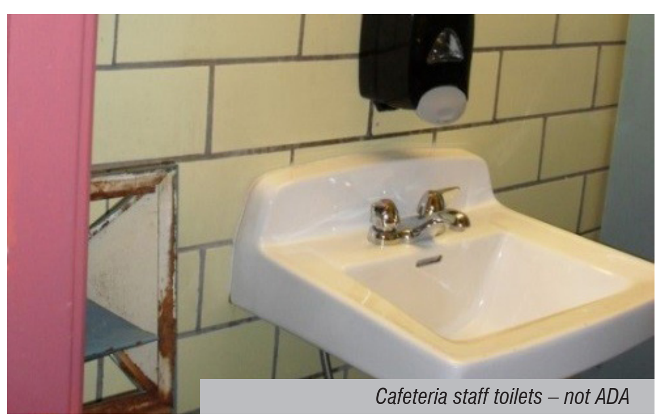


Gym B – locker/ shower room – not ADA

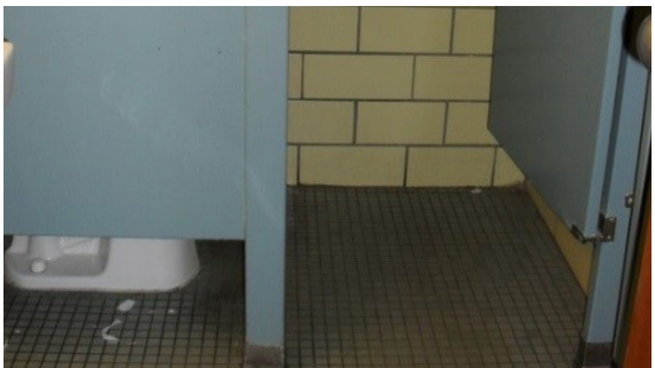
Auditorium toilet room – not ADA



Gym B – locker/ shower room – not ADA



Cafeteria staff toilets – not ADA



Cafeteria staff toilets – not ADA

Special Education Toilet - does not meet ADA dimensional criteria

Toilet room near Music – urinal against partition

Note door swing and changing table

Toilet room near Music – lavatory mirror too high

Acoustical Tile Ceiling (ATC) and Plaster Ceilings

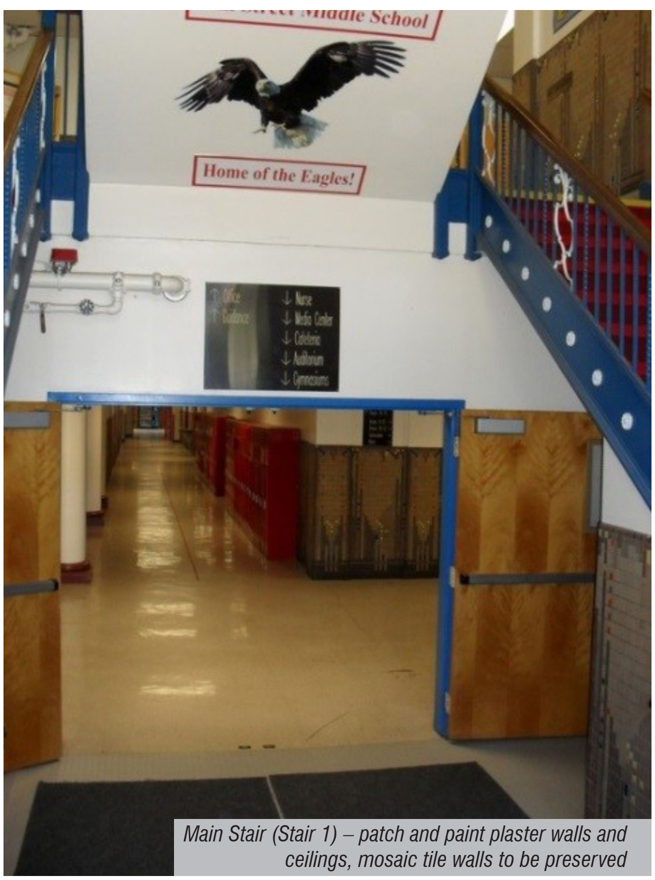
Many of the ceiling tiles are bowed and vary in type and grade. Due to the anticipated installation of a new mechanical system with required duct work, new light fixtures, running IT lines, fire alarm, communication wiring, etc. will require most of the existing ATC to be removed and replaced.

The existing plaster ceilings in classrooms on the perimeter wall and stair wells, with paint peeling off, will remain. Patch plaster ceilings and walls as required before painting.

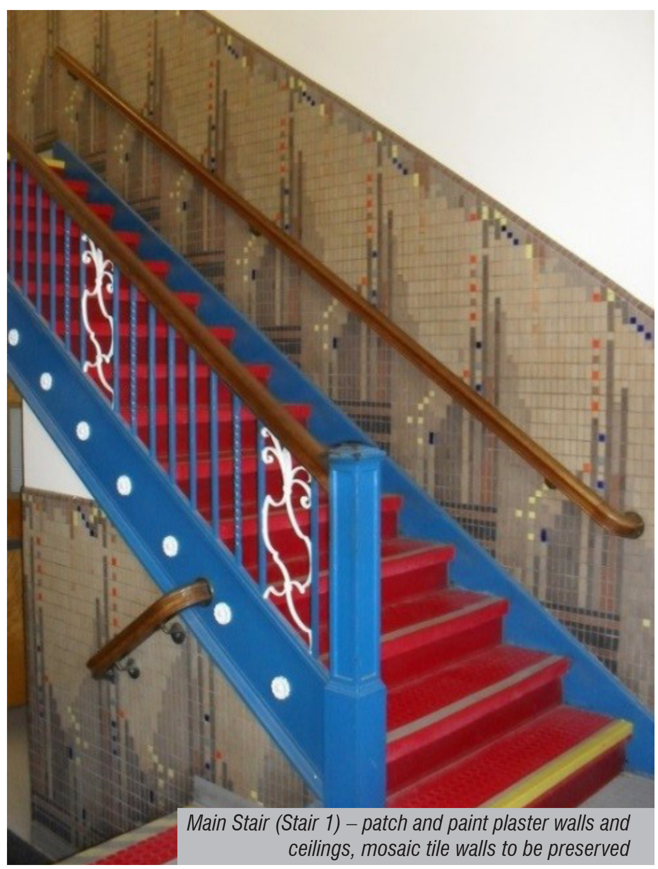
Painting

Per our experience at Broad Street and Sunset Heights, most of the walls will need to be painted, along with exposed plaster that will remain. Paint Gymnasium A and B, including exposed Gymnasium structure. Note: one or both gymnasiums maybe used for temporary classrooms for swing space during construction, similar to Broad Street and Sunset Heights Elementary Schools.

Auditorium is not to be painted at this time.



Main Stair (Stair 1) – patch and paint plaster walls and ceilings, mosaic tile walls to be preserved

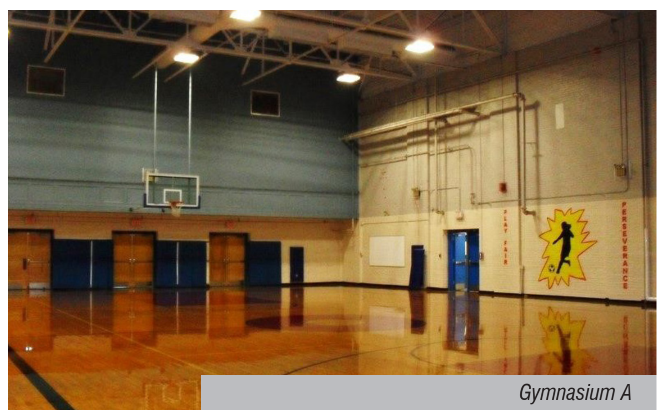


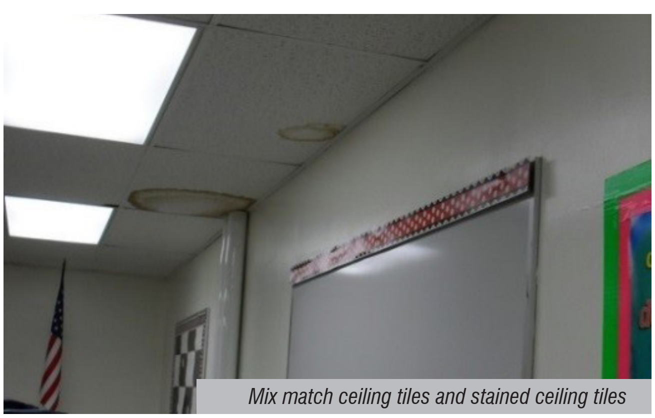
Main Stair (Stair 1) – patch and paint plaster walls and ceilings, mosaic tile walls to be preserved

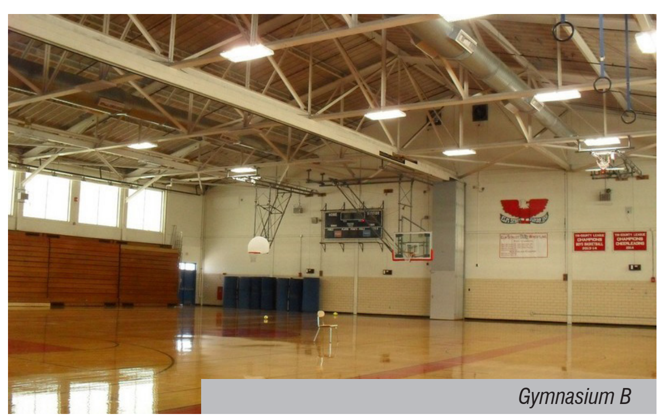

Plaster ceilings to be patched and painted


Stair wells to be patched and painted


Mix match ceiling tiles and stained ceiling tiles


Gymnasium A


Mix match ceiling tiles and stained ceiling tiles


Gymnasium B

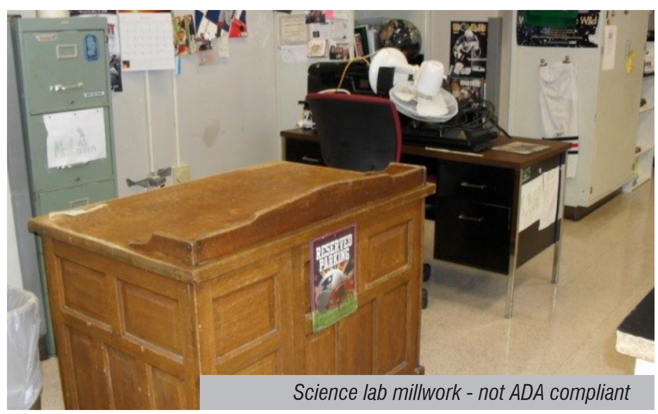
Typical Millwork/Perimeter Walls
Due to the anticipated new mechanical system, it will require new baseboard fin tube radiation on exterior walls at classrooms, art, science, and Administration areas. All new millwork will be required to accommodate fin tube radiation and displacement air grills that will provide storage for students and teachers, similar to Broad Street and Sunset Heights Elementary Schools.

Visual Display Boards/Projectors/Screens
Marker and Tack Boards: Many of the teaching spaces in the 1936 original building have traditional chalk boards, with some marker boards mounted over the chalk boards. Most all other teaching spaces have marker boards. All have a variety of tack boards in a variety of conditions.

Technology Integration: In the digital world of teaching, integration of technology in the school curriculum is forever evolving. Presently, there are a variety of delivery methods in the teaching spaces. The majority are projectors and laptops on carts with a pull-down screen. Some rooms have ceiling mounted projectors with a pull-down screen; some project onto white boards that require a non-glare surface. Other spaces have interactive boards (Projector and Eno Boards). The School District's Technology Department, along with the Technology Committee, is continuously exploring the latest options and cost.

At Sunset Heights Elementary School, during the design process, the Nashua School District's Technology Department, preferred vendor, school administrators (with staff input), architect, and construction manager reviewed the school's specific needs to meet their educational program. At Sunset Heights, each teaching space is typically equipped with a new 7' Eno Board with 4' white boards on each side. Each space required 4 to 5 IT drops, so existing data wiring was upgraded, and wireless access points were also reviewed. Additional electrical outlets were required, etc.


Science lab millwork - not ADA compliant



Science lab millwork - not ADA compliant


Family & Consumer Science – laminate edge peeled off, counter height not ADA compliant

Family & Consumer Science – laminate edge peeled off, counter height not ADA compliant

Projector/pull down screen/white board.

Administration area counter low and sags at sink

Administration area counter low and sags at sink

Wire management exposed.

Doors and Hardware
Exterior doors have a variety of maintenance repairs and finishes. Many doors are aluminum entrance curtain wall system that has failed at the hinges. Typical modifications are to install hinges to surface of frame or door, install metal plate to reinforce hardware mounting, etc.

Interior doors vary from wood doors in wood frames, wood doors in hollow metal frames, and metal doors in hollow metal frames. Hardware varies in age and quality. Some meet ADA accessibility with lever handles and others have knob sets that do not meet code.

Two doors to typical classroom – one lever handle and the other original knob

General Building Codes
Below are the code sections that are most relevant to this analysis:

- / New Hampshire fire code or state fire code means the adoption by reference of the:
  - / Life Safety Code NFPA 101, 2015 edition
  - / Uniform Fire Code NFPA 1, 2015 edition

- / New Hampshire building code or state building code means the adoption by reference of the:
  - / International Building Code 2015
  - / International Energy Conservation Code 2015
  - / International Existing Building Code 2015
  - / International Mechanical Code 2015
  - / International Plumbing Code 2015
  - / International Residential Code 2015
  - / National Electrical Code 2017 (NFPA 70)

As amended by the state building code review board and ratified by the legislature in accordance with RSA 155-A: 10, per 155-A: 2 State Building Code.

I. All buildings, building components, and structures constructed in New Hampshire shall comply with the state building code and state fire code. The construction, design, structure, maintenance, and use of all buildings or structures to be erected and the alteration, renovation, rehabilitation, repair, removal, or demolition of all buildings and structures previously erected shall be governed by the provisions of the state building code.

II. To the extent that there is any conflict between the state building code and the state fire code, the code creating the greater degree of life safety shall take precedence.

Construction Type and Occupancy
NFPA 101 classifies the occupancy of this facility as mixed use of both:

- Existing educational (E): classrooms, art, kitchen, and offices/support spaces.
- Existing assembly (A): gymnasiums, cafeteria, Library and offices/support spaces. Per NFPA under Existing Educational; these spaces can be classified as Accessory Assembly, Offices and Storage.

NFPA 101 classifies the occupancy of this facility as mixed use:

- Existing assembly (A): auditorium separated use. Two hour rated separation. Wall appears to be rated, however door and frames from corridor G39 and G50, and Music area G59 and G 60 to be replaced with 90 minute assembly.

Fire Protection System
Note: The sprinkler system covers the entire building. The classrooms into the corridors that are typically part of the means of egress need not be fire rated. They can be smoke resistant without closures. All other rooms adjoining the corridor are to be fire rated unless meeting other special requirements. Typical adjoining spaces of different uses are required to have fire rated separation and with a future renovation, fire rated separations will depend on the final reconfiguration of the spaces. Refer to Fire Sprinkler Protection section of this report.

International Building Code 2009 (IBC)
Allowable Height and Building Area
The following reflects Chapter 5 of IBC 2015, Table 504.3, 504.4 and Table 506.2: Building with automatic sprinkler system.

NOTE: This allows calculation of area limitations to consider the classroom as a separate building.

Group E – Education Ground Floor existing foot print 121,100 sq. ft without Auditorium. Construction Type II-B.

- Allowable height 3 story with automatic sprinkler system - NOT MET
- Allowable square footage 43,500 sq. ft. - *NOT MET
  - Require two hour fire wall to divide building square footage not to exceed approximately 43,500 square feet. Exact amount will include a small amount frontage increase.

Life Safety Code NFPA 101
Number of Exits
Per Section 13.2.4.3 Number of Exits - Assemble
Assembly occupancies with occupant loads greater than 600 but fewer than 1000 shall have three separate means of egress. Existing occupant loads presently plus 1500 occupancies.

Common Path of Travel - 15.2.5.3.1
Common path of travel shall not exceed 100 feet in a building protected throughout by an approved, supervised automatic sprinkler system. The facility is in compliance.

Dead-Ends – 15.2.5.2
No dead-end corridor shall exceed 20 feet, other than in buildings protected throughout by an approved, supervised automatic sprinkler system, in which case dead-end corridors shall not exceed 50 feet. The facility is in compliance.

Travel Distance – 15.2.6
15.2.6.2 Travel distance to an exit shall not exceed 150 feet from any point in a building, unless otherwise permitted by 15.2.6.3 or 15.2.6.4.

15.2.6.3 Travel distance shall not exceed 200 feet in educational occupancies protected by an automatic sprinkler system.

Stairs
Presently there are three types of stairs. The 1936 stairs are reminiscent of the era, with wood handrails and iron balusters. The handrail terminates at a square iron post at the top and bottom of the stairs and landings. Handrails are not continuous at landings. The 1991 stair in the Library and 1961 renovation that modified Stair #4 are constructed from pipe rails for handrails, balusters and post. At landings the handrails are continuous.

Dimensional Criteria - 7.2.2.2

7.2.2.2.1.1 Stairs shall meet the following criteria (included interior and exterior to a building):

Table 7.2.2.2.1.1(a) New Stairs

Feature	Dimensional Criteria ft/in.	mm
Minimum width	See 7.2.2.2.1.2.	
Maximum height of risers	7 in.	180
Minimum height of risers	4 in.	100
Minimum tread depth	11 in.	280
Minimum headroom	6 ft 8 in.	2030
Maximum height between landings	12 ft	3660
Landing	See 7.2.1.3, 7.2.1.4.3.1, and 7.2.2.3.2.	

Table 7.2.2.2.1.1(b) Existing Stairs

Feature	Dimensional Criteria ft/in.	mm
Minimum width clear of all obstructions, except projections not more than 4½ in. (114 mm) at or below handrail height on each side	36 in.	915
Maximum height of risers	8 in.	205
Minimum tread depth	9 in.	230
Minimum headroom	6 ft 8 in.	2030
Maximum height between landings	12 ft	3660
Landing	See 7.2.1.3 and 7.2.1.4.3.1.	

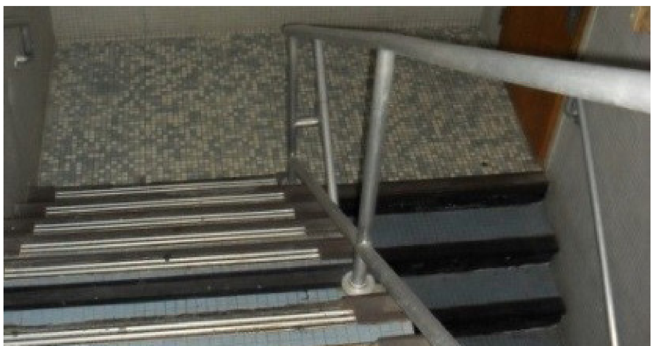
(3) Approved existing stairs shall be permitted to be rebuilt in accordance with the following:

(a) Dimensional criteria of Table 7.2.2.2.1.1(b)

(b) Other stair requirements of 7.2.2

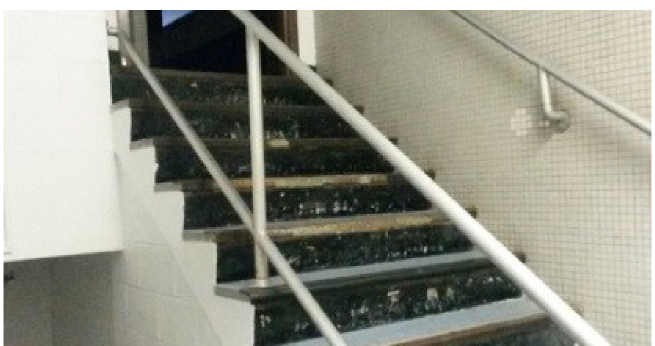
Other stair requirements are dimensions of guardrails, handrails, balusters handrail extensions, etc.

NOTES: All stairs conform to Table 7.2.2.2.1.1 (b) Existing Stairs; however, 1939 stairs do not conform to other dimension requirements such as guardrails, handrails, balusters handrail extensions, etc.



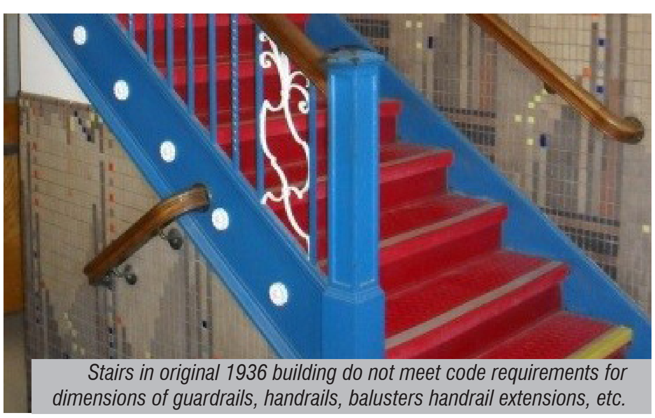
Stairs in boys and girls locker rooms. Does not meet code requirements for guardrails, handrails, balusters handrail extensions, etc.

Stairs in original 1936 building do not meet code requirements for dimensions of guardrails, handrails, balusters handrail extensions, etc.



Stairs in boys and girls locker rooms. Does not meet code requirements for guardrails, handrails, balusters handrail extensions, etc.

Stairs in original 1936 building do not meet code requirements for dimensions of guardrails, handrails, balusters handrail extensions, etc.



Stairs in original 1936 building do not meet code requirements for dimensions of guardrails, handrails, balusters handrail extensions, etc.

Auditorium Stairs: Access to balcony handrails does not meet code.

Windows for Rescue
Per 15.211.1 every room or space greater than 250 ft2 and used for classroom or other educational purposes shall have not less than one outside window for emergency rescue that complies with the following, unless otherwise permitted by 15.2.11.1.2.

15.2.11.1.2 (1) Building protected by approved automatic sprinkler system, not required.

International Energy Conservation Code 2009 – IECC
Section 101 Scope and General Requirements
101.4 Applicability:

101.4.1 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

This code was adopted by New Hampshire State Building Code Review Board and revised effective April 1, 2010. The code is designed to regulate new construction and new work, and is not intended to be applied retroactively to existing buildings except where existing envelope, lighting, mechanical, or service water heating systems are specifically affected by Section 101.4.3. This section addresses that the code does not affect existing buildings.

101.4.3 Additions, alterations, renovations or repairs.

This section simply states that new work must comply with the current requirements for new work. Any alteration or addition to an existing system involving new work is subject to the requirements of the code.

Accessibility Rules And Standards - ADA
General
Note: AB (Architectural Barrier-Free) Committee has amended the rules as they have expired. AB has adopted the 2010 ADA Standards as the AB Code. This coincides with the Department of Justice stating that as of March 15, 2012 the 2010 ADA Standards for Accessibility are to be used.

Below are the Rules and Standards that are applicable:

/ 2010 ADA Standards
/ 2009 International Building Code (IBC). (Accessibility scoping provisions which describe “what, where and how many”. Chapter 11 “control the design and construction of facilities for accessibility to physically disabled persons”.)
/ 2003 ICC/ANSI A117.1-03 standards: Accessible and Usable Buildings and Facilities. (Technical requirements which describe “how”.)

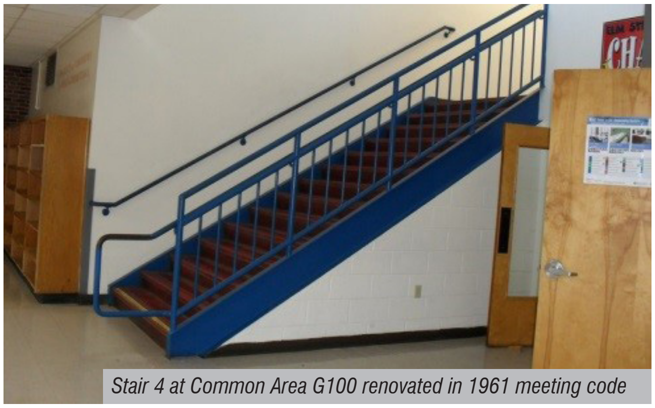
Please note: Due to the construction addition in 1961, most portions of the building do not comply with current requirements for new construction. In many cases alterations to the portions of the building did comply at the time of the alteration. With future additions/renovations, it is required to upgrade the facility depending on the extent of the proposed additions/alterations to the facility. Refer to Percent of Alterations and Cost at the end of this section.

Title II - § 35.150 Existing Facilities

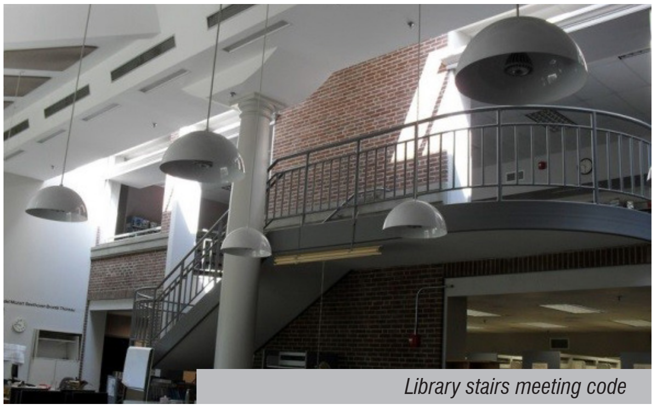
http://www.ada.gov/regs2010/titleII_2010/titleII_2010_regulations.htm#a35150

The requirements of Title II of the ADA allow the public entity to provide “program access” when alterations of the facility would result in an undue burden for the public entity. This means that all services provided on the second floor of the original 1890 building must be provided on the first floor until an accessible route to the second floor is provided. There is no accessible route to the two-story section with the space that contains educational programs, offices, student services, etc. These areas contain “Primary functions.”

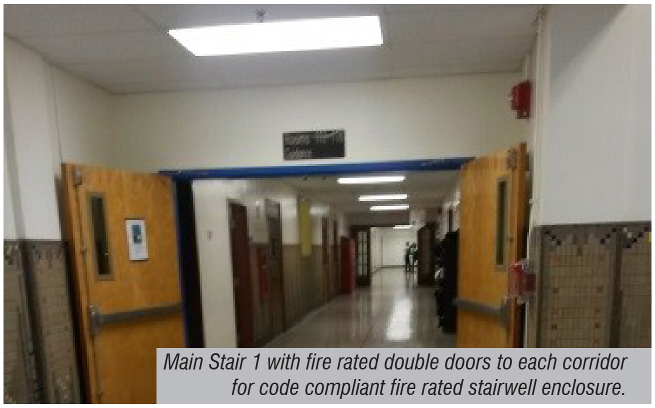
Main Stair 1 with fire rated double doors to each corridor for code compliant fire rated stairwell enclosure.



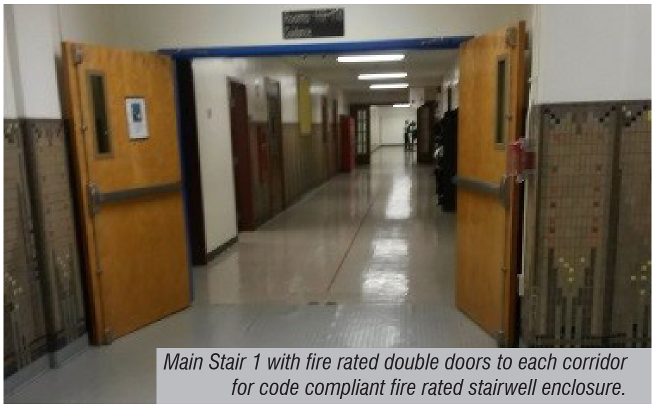
Stair 4 at Common Area G100 renovated in 1961 meeting code



Library stairs meeting code



Main Stair 1 with fire rated double doors to each corridor for code compliant fire rated stairwell enclosure.



Main Stair 1 with fire rated double doors to each corridor for code compliant fire rated stairwell enclosure.

New Construction and Alterations
35.151 New construction and alterations
(b) Alterations, (4) Path of Travel, (i) Primary functions. A "Primary functions" is a major activity for which the facility is intended. Areas that contain a primary function include, but not limited to, the dining area of a cafeteria, the meeting rooms in a conference center, as well as offices and other work areas in which the activities of the public entity using the facility are carried out.

ICC/ANSI A117.1
405 Ramp
Ramp slope not steeper than 1 in 12, rise shall be 30 inches maximum, with dimensional criteria for landings, ramp run, handrails, etc.

Toilet Facilities
(604 Water Closets & Toilet Compartments, 605 Urinals, 606 Lavatories & Sinks, 609 Grab Bars)
Handicap toilet rooms are required to have dimensional floor clearances (5' x 5' toilet stalls). Also fixture clearances, water closets and lavatory height and grab bars. None of the toilet facilities are compliant. Examples of noncompliance include: no grab bars, space not adequately sized, and entrance door opening is too small. Because these are open to the public, it should be made handicap accessible during the next major renovation project.

Protruding Objects
Some objects protrude beyond the dimensional requirements per ADA. Examples include fire extinguishers, drinking fountains, displays, etc.

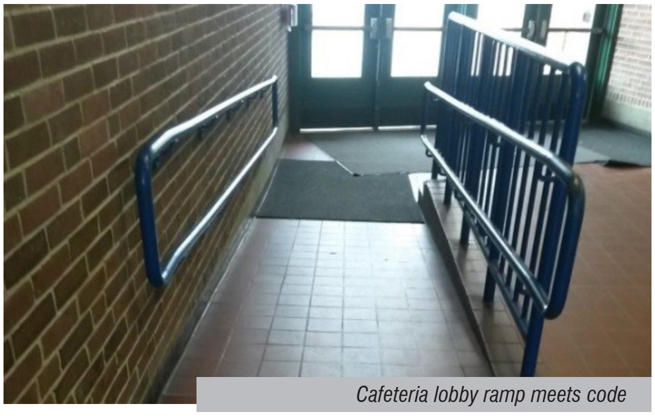
Should alterations to the facility be planned, at least 20% of the alteration budget must be applied to providing an accessible path of travel to the area(s) of primary function, unless the only alterations planned are to provide accessibility, in which case, the entire budget is dedicated to improving accessibility of the facility.

In overall alterations, where the cost to provide accessible facilities exceeds 20% of the alteration budget, Title II, Section 35.151(b)(4)(iv) provides priorities for barrier removal:

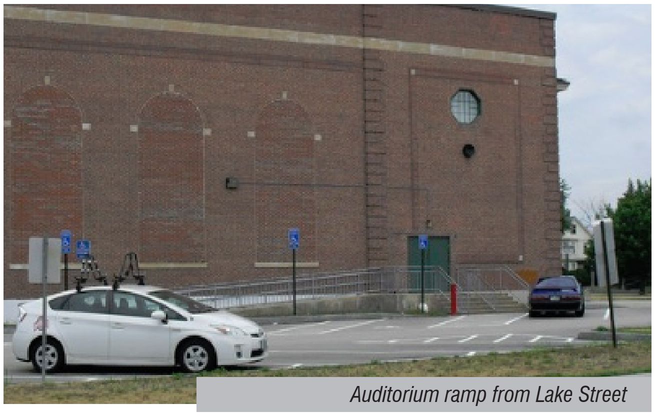
(A) When the cost of alterations necessary to make the path of travel to the altered area fully accessible is disproportionate to the cost of the overall alteration, the path of travel shall be made accessible to the extent that it can be made accessible without incurring disproportionate costs.
(B) In choosing which accessible elements to provide, priority should be given to those elements that will provide the greatest access, in the following order:
(1) An accessible entrance;
(2) An accessible route to the altered area;
(3) At least one accessible restroom for each sex or a single unisex restroom;
(4) Accessible telephones;
(5) Accessible drinking fountains; and
(6) When possible, additional accessible elements such as parking, storage, and alarms.

Alterations must be completed in compliance with the ADA Standards for Accessible Design (ADA Std.) per ADA Title II, § 35.151 New construction and alterations
http://www.ada.gov/regs2010/titleII_2010/titleII_2010_regulations.htm#a35151.

ADA Standards for Existing Buildings and Facilities
http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1010052



Cafeteria lobby ramp meets code

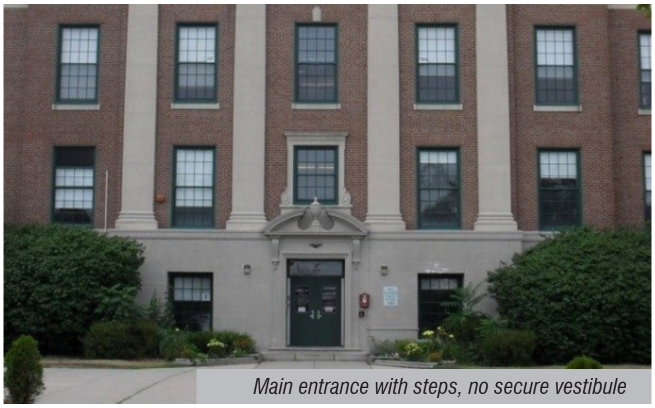


Auditorium ramp from Lake Street

Ground floor ramp at Corridor G107 meets code

Gymnasium A ramp from West Otterson Street

Ground floor ramp at Corridor G107 meets code



Main entrance with steps, no secure vestibule

STRUCTURAL ANALYSIS

General

Accessible structural framing was observed throughout the building to review the existing structure, record the framing arrangement of the structural system, and identify any structural concerns. Gypsum ceilings were located throughout the original school building, which limited observable access to the roof framing, gymnasium roof framing, and the auditorium roof framing. Original structural construction drawings were also reviewed for the 1961 and 1991 additions to the building. The existing structural framing system was reviewed for conformance with the structural provisions of the 2015 International Building Code (IBC) and the 2015 International Existing Building Code (IEBC). The original construction drawings, as well as the site investigation conducted on October 5, 2016 were used to complete this evaluation.

For this structure, the 2015 IBC provisions stipulate a design flat roof snow load magnitude of 47 pounds per square foot (psf). This roof snow load is calculated by multiplying certain adjustment factors to the code-prescribed ground snow load of 60 psf, based on the location and type of structure.

Front view of Elm Street Middle School

Current code also requires that structures be evaluated for possible drift snow loading conditions, in which the snow is anticipated to drift from a higher roof to an adjacent lower roof, resulting in higher snow loads on the lower roof against the wall between the higher and lower roofs. It is important to note that inclusion of snow drifting loads on lower roof areas was not typically considered for structures designed at the time this building was originally constructed, except for the 1991 addition, and reinforcement of lower roof areas is typically necessary to meet current code requirements.

The 2015 IBC identifies minimum live loads to be considered for a variety of building uses. These live loads are provided below:

FLOOR AREA	2015 IBC TABLE 16071.1
Classrooms	40 psf
Offices	50 psf
Fixed Seat Assembly Areas	60 psf
Elevated Corridors	80 psf
Stairs and Lobbies	100 psf
Storage Areas (Light)	125 psf
Gymnasium Floor	100 psf

To meet current code requirements, the structural floor and roof framing must be capable of supporting the code-specified roof snow load, applicable floor live loads, plus the dead weight of the framing system.

The IBC also identifies wind and seismic forces to be resisted by the structural framing system. These forces are determined through consideration of numerous criteria related to soil type, exposure, height, and structural system.

When evaluating an existing structure, the structural system is not required to be capable of supporting current building code requirements unless renovations or alternations are made which impact the existing structure beyond certain thresholds.

Structural Framing System Description

1936 Building

Based on our field observations of the original 1936 building, the roof framing is constructed of a tongue and groove gypsum concrete plank supported by wide flange beams. At the north and south wings of the building, the corridor roof consists of 6" deep wide-flange steel beams spanning approximately 10'-2" between supports and spaced approximately 4'-4" apart. These beams are directly supported on both ends by 12" deep wide flanged steel beams which span approximately 16'-3" between 10" deep steel wide-flange columns. The classroom beams in these wings were found to be 12" deep steel wide-flange beams supported by the 12" deep beams along the corridors and by a masonry bearing wall at the exterior walls.

At the center section of the original 1936 building, the roof framing was observed to be mainly identical to the north and south wings, with the exception of the corridor beams. These beams were identical in size, but span approximately 9'-8"between the support beams along the corridor walls. The floor framing was not accessible for the entire building and could not be reviewed during this visit.

The auditorium roof framing in the 1936 building is constructed of long span trusses. Our observations noted that the original roof sheathing system had been replaced with metal decking. The metal deck is supported by 8" deep steel wide-flange beams that span approximately 14'-4" between the trusses and are located at approximately 6'-1 ½" on center. These wide-flange beams are supported by the steel double angle trusses which span approximately 73'-6" between bearing walls. The trusses are braced at the bottom chord by 5" deep channels at 4' on center.

The 1936 gymnasium roof system was observed to be very similar to the auditorium, except that the steel double angle trusses span 61'-3" between bearing supports, and the bottom chord is not braced. The truss top chord was not accessible with the available equipment on site. For design purposes it was assumed that the top chord is the same size as the bottom chord. The gymnasium floor framing is constructed of 17” x 12” concrete joist beams framing into 21 ½” x 12” concrete girder beams. These girder beams are bearing on 20” x 20” square concrete columns.

1961 Addition
The 1961 addition includes a cafeteria, locker rooms, new gymnasium, and new classroom wings. According to the existing drawings, the southwest classroom additions are constructed with masonry bearing walls ranging between 8” to 12” thick. These masonry walls support open web metal roof joists with depths from 16” to 24”. These joists span between 24’ and 38’ between the bearing supports.

The cafeteria at the west portion of the 1961 addition is constructed of a precast/pre-stressed reinforced concrete system. This system’s precast concrete columns range from 7” to 14” wide by 4’-0” to 5’-0” deep, and support precast/pre-stressed concrete girders that are 14” wide by 3’-6” deep. The concrete girders span between 42’-0” and 63’-6”, and support precast concrete “V-shaped” roof panels. The hallways adjacent to the cafeteria are constructed of masonry bearing walls and 12” to 24” deep joists.

The northern classroom addition is framed similarly to the southwest classrooms. The support walls are masonry bearing walls that support lintels and open-web metal roof joists. These joists range from 8” to 40” deep and span from 23’ to 59’ between the bearing supports.

At the northwest section of the 1961 addition, the upper locker room floor framing is constructed of a combination of masonry bearing walls and wide flange bearing beams. These walls and beams support 14” and 10” deep beams. The low roof in this area is framed similarly to the typical classroom areas of the 1961 addition.

The gymnasium roof is constructed of long span steel trusses. The existing drawings identify that the metal deck is supported by 12” deep steel wide-flange beams that span approximately 22’-0”” between the trusses and are located at approximately 9’-5” on center. These wide-flange beams are supported by the steel double angle trusses which span approximately 113’-6” between columns.

1991 Addition
The additions constructed in 1991 included a library and auxiliary spaces. Using the existing 1991 drawings provided, the library’s roof system is constructed of plywood sheathing attached to wood trusses. These wood trusses are supported by masonry bearing walls and steel wide-flange beams bearing on 4x4 and 5x5 tubular steel columns. The corridors, teachers’ area, and store areas are all framed with a plywood sheathing roof system attached to 2x12 dimensional lumber framing, all of which are bearing on masonry bearing walls. The framing constructed in 1991 was not accessible for the library and auxiliary spaces.

Summary Of Findings
As a result of our limited site observations and field measurements, along with review of the original construction documents from the 1961 and 1991 additions, the major components of the structural framing systems were evaluated. The following summary of findings are provided.

1936 Original Building

Roof Structure

The structural capacities of the roof are as follows:

DESCRIPTION	CURRENT CAPACITY (SNOW LOADS)	CODE REQUIREMENTS (SNOW LOADS)
Central, North, & South Wings	>100 psf	47 psf
Auditorium Roof Trusses	38 psf (limiting members)	47 psf
Gymnasium Roof Trusses	See Below*	47 psf
* Due to inaccessibility to measure the dimensions of the truss top chord, it is not possible to determine a capacity for the overall truss configuration. Disregarding the top chord members, the truss was found to have an approximate capacity greater than the current code design loads. This is similar to what was found for the Auditorium truss constructed during the same time frame.		

The gypsum-concrete roof system in the 1936 building exhibits signs of minor damage and possible small pieces of the gypsum plank were found to be missing at random areas on the planks. This condition was noted at all areas of the building that were visually inspected during the site visit.

Floor Structure

The structural floors throughout the 1936 original building were not accessible during our initial site investigations. In order to gather information regarding the floor structures, NDT Corporation (an independent inspection agency) was contracted directly with the school department to conduct GPR (ground penetrating radar) assessments of the existing floor levels. Through their investigations, it was ultimately concluded that a majority of the floors were constructed of wood planking spanning between steel beams, with the remaining floor areas constructed of the gypsum concrete planking. NDT Corporation's report dated August 23, 2019 provides detailed investigation results.

The cast-in-place reinforced gymnasium floor system was also not evaluated due to the lack of information related to concrete strength, reinforcement size and quantity. In order to complete an evaluation of this floor structure, an x-ray inspection of the columns, girders, and joists would be necessary to obtain accurate rebar mapping within the concrete. This was not completed as part of this scope.

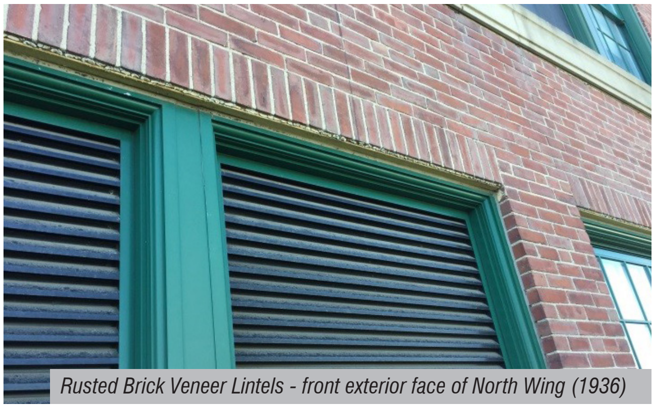
Roof planks at east wing (1936)

Exterior
A visual review of the building's exterior was completed during the site visit. Areas that exhibited damage or deterioration are identified below. (Refer to the 'Key Plan' on page 52 for area designations).

1. 1. Areas were observed where precast sills and bandings have separated and laterally moved from their original location, resulting in open gaps between pieces. Overall, the precast concrete sills and bandings were noted to be in fair to poor condition. The areas of main concern are locations where the precast section has pulled away from the exterior wall.
2. 2. Rusted Lintels were noted in certain locations around the building and are recommended to be repaired or addressed to avoid further deterioration and potential brick cracking above.
3. Minor to moderate cracks were noted in localized random areas, as noted below.
4. 4. Localized areas were noted where the brick veneer had minor water damage. These areas must be repaired to avoid brick and mortar deterioration.


Precast Separation - front face of the North Wing (1936)


Precast Sill Lateral Displacement - back face of South Wing (1936)



Rusted Brick Veneer Lintels - front exterior face of North Wing (1936)

Cracks in Foundation Walls - locations at front face of North Wing (1936)

Water Damage Brick - gymnasium canopy (1936)

Water Damage Brick - East face of Gymnasium (1936)

1961 Addition

Roof Structure

Using the existing construction documents and verifying the strength of the structural elements per Steel Joist Institute (SJI) standards, the structural capacities of the various roof areas are as follows:

DESCRIPTION	CURRENT CAPACITY (SNOW LOADS)	CODE REQUIREMENTS (SNOW LOADS)
Music, Science, & Art Classroom Roof Joists	67 psf	47 psf
Cafeteria Precast Girder Beams	Not Analyzed	47 psf
Kitchen/Storage Area Roof Joists	73 psf	47 psf
Industrial Arts/ Stem. Wing Roof Joists	63 psf	47 psf
Lobby & Locker Room Roof Joists	73 psf	47 psf
Gymnasium Roof Truss	56 psf	47 psf

Floor Structure

Using the existing construction documents and verifying the capacities of the structural systems using SJI standards, the structural capacities of the floors are as follows:

DESCRIPTION	CURRENT CAPACITY (LIVE LOADS)	CODE REQUIREMENTS (LIVE LOADS)
Gymnasium Locker Room Floors	73 psf	60 psf

Exterior

A visual review of the building's exterior was completed during the site visit. Areas that exhibited damage or deterioration are identified below. (Refer to the 'Key Plan' on page 52 for area designations)

1. Rusted Lintels were noted in certain locations around the building and are recommended to be repaired or addressed to avoid further deterioration and potential brick cracking above.

2. The exterior construction joints at the roof level of the cafeteria exhibits significant signs of damage and deterioration. Rebar is exposed at certain joints of the affected area.

1991 Addition

Overall these portions of the building were found to be in good condition, and after reviewing the current construction drawings, it was found that the additions were designed per current code. No concerns were found at this addition.

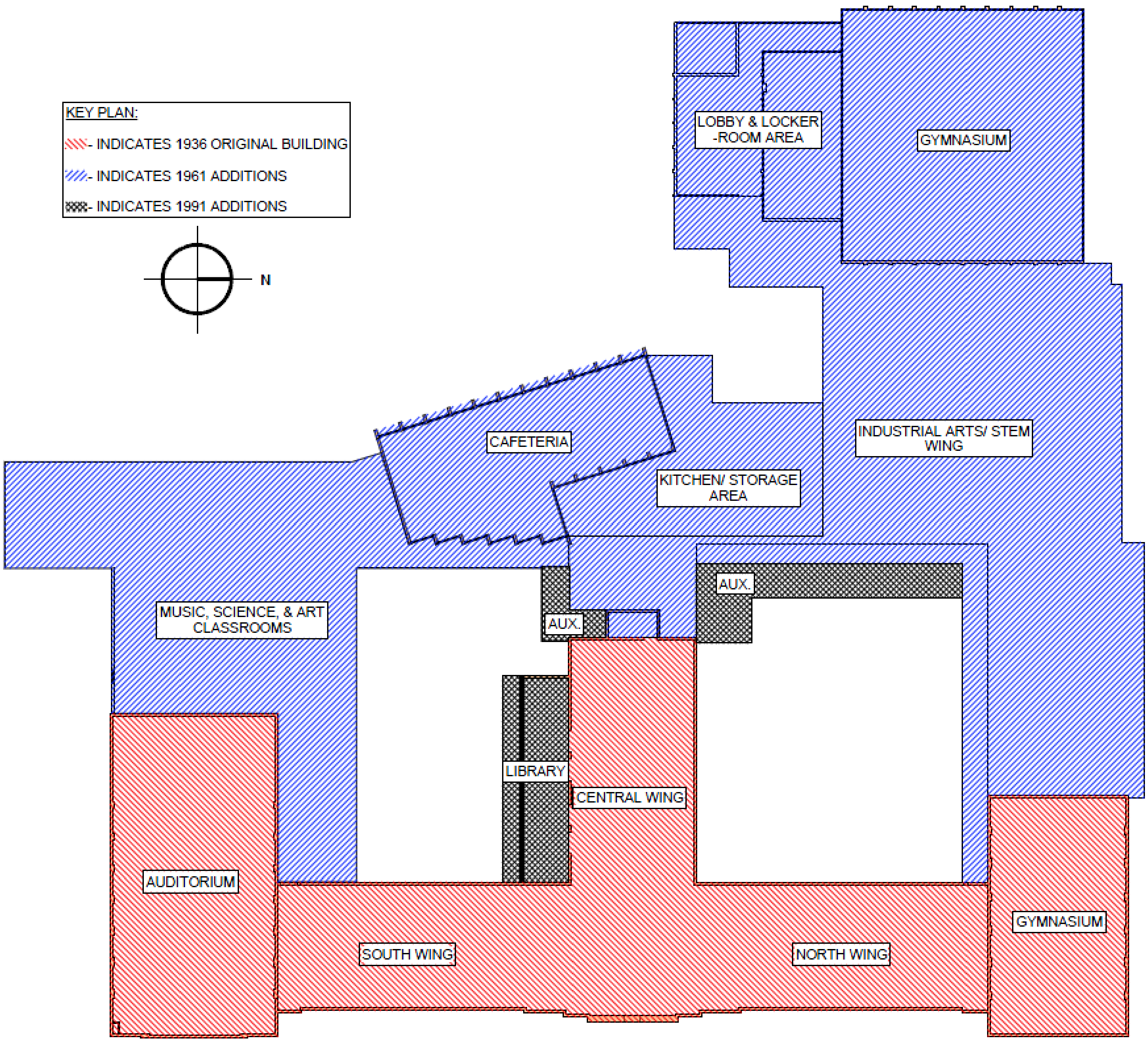
DESCRIPTION	CURRENT CAPACITY (SNOW LOADS)	CODE REQUIREMENTS (SNOW LOADS)
Library Roof Trusses	51 psf	47 psf
Auxiliary Roof Wood Joists	52 psf	47 psf

Rusted Lintel and Mortar Damage - east side of industrial arts/STEM wing (1961)

Pre-Cast Beam Deterioration - rear face of cafeteria at roof (1961)

Pre-Cast Beam Deterioration with Exposed Rebar - rear face of cafeteria at roof (1961)

Pre-cast Concrete Spalling - front face of cafeteria (1961)


KEY PLAN:
- INDICATES 1936 ORIGINAL BUILDING
- INDICATES 1961 ADDITIONS
- INDICATES 1991 ADDITIONS
N
LOBBY & LOCKER -ROOM AREA
GYMNASIUM
CAFETERIA
KITCHEN/ STORAGE AREA
INDUSTRIAL ARTS/ STEM WING
MUSIC, SCIENCE, & ART CLASSROOMS
AUX.
AUX.
LIBRARY
CENTRAL WING
AUDITORIUM
SOUTH WING
NORTH WING
GYMNASIUM

Key Plan

MECHANICAL ANALYSIS

General

The existing Elm Street Middle School in Nashua, NH consists of a building that was constructed in three phases. The original section of the building was constructed in 1937. The projects that followed were a major western addition completed in 1963 and a major renovation and small library addition in 1991.

The basic mechanical systems that were reviewed consisted of:

- boiler plants
- heating distribution
- temperature control
- air moving
- classroom heating and ventilating
- heating terminal units
- local air conditioning units

The ages of the mechanical equipment range from 80 years old in the original building, to a 25-year-old boiler plant and other upgrades in between.

Mechanical System – Boiler Plants

The primary heating system is located in the boiler room in the original 1937 basement. It consists of three natural-gas-fired low-pressure cast iron sectional boilers. The boilers are manufactured by Weil-McLain (Model Number 1794). The gross output rating for each boiler is 4,560 MBH. The net IBR rating for steam is 3,610 MBH. Three base-mounted boiler feed pumps located below the deaerator provide make-up water to each of the boilers. Low pressure steam is piped throughout the majority of the building—except for the 1961 gymnasium—to serve unit ventilators, air handler steam coils, fin tube radiation, unit heaters, and cabinet unit heaters. The steam heating and condensate piping distribution system is all insulated, but may contain some degree of asbestos. Distribution piping located in the hot water areas of the facility have good insulation of a newer age, but it still need to be tested. The pneumatic automatic temperature control system currently installed in the facility should definitely be upgraded to a modern Direct Digital Control (DDC) system.

These boilers were installed since 1991. At 25+/- years of age, they still have serviceable life. ASHRAE estimates the lifespan of a low pressure, cast iron, steam boiler at 35 years. The steam system has a history of modifications and repairs to keep it operating.

The secondary heating system was installed in the basement beneath the foyer of the new gymnasium in the 1961 addition. These two boilers supply hot water to only the gymnasium. This system is hydronic and consists of two Weil-McLain boilers, Model No. 1594. The gross output for each boiler is 4,070 MBH. The net IBR rating for hot water is 3,539 MBH. These boilers are in good condition as they are not the original boilers and have probably been replaced in the past 15-20 years and have 10-15 more years of use.

Mechanical System – Heating Distribution

From what can be gathered from the available drawings, it appears that most of the steam, condensate and hydronic piping were replaced/installed in 1961 during the major renovation/expansion. If that is correct, then the lifespan of those piping systems is very close if not beyond what is expected. Many of the condensate pipes are buried in trenches and the insulation of these systems may contain asbestos. It would be prudent that if the building is to remain in service, the piping systems be removed and replaced. This also applies to the terminal units that are served by these pipes; they are at the end of their serviceable life. Fin tube, cabinet unit heaters, unit ventilators, and air handlers are all of the same age and should be scheduled for removal and replacement.

Mechanical System – HVAC Controls

The existing controls are electro-pneumatic and, though serviceable, they should be replaced with a modern DDC system to control all of the systems including steam, hot water, lighting, domestic hot water, ventilation, and security from one central station. This would not only function better, but be efficient and easier to maintain.

PLUMBING ANALYSIS

Domestic Water Service

The building has two water service entrances. Both entrances are up-to-date with reduced pressure zone backflow preventers and remote reader water meters. The equipment appears to be in good condition and well-supported.

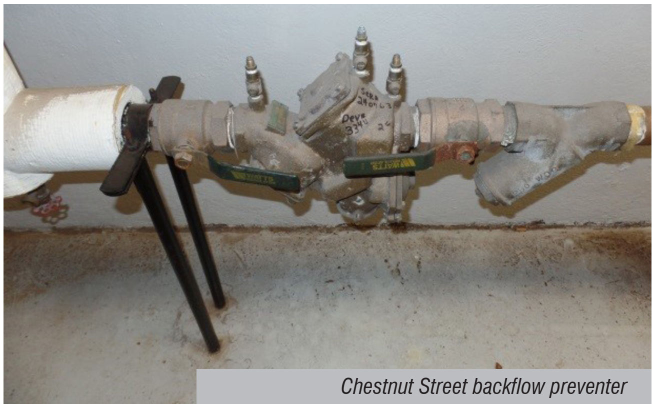
- One entrance is in the basement under the gymnasium facing Chestnut Street with a 3" water feed from Chestnut Street. Some of the piping is uninsulated and condenses during times of elevated humidity. There is an open-ended valve for a bypass. The valve should be connected to the pipe downstream of the water to provide a workable bypass.
- The other water entrance is a 4" ductile iron pipe entrance under the stair below the gymnasium facing Elm Street with a water line from Elm Street. Street pressure is estimated at 59 psi static pressure and 1,750 gpm at 58 psi residual pressure. The Elm Street water entrance has an in-line pressure regulator which is set wide open. Static pressure of 59 psi should not require a pressure-regulating valve. Pressure downstream of the regulator was 55 psi during the survey.

One of three existing low pressure steam boilers

One of two existing hydronic boilers


Chestnut Street water entrance


Transition to site piping with no insulation


Chestnut Street backflow preventer


Elm Street water entrance


Open ended bypass valve


Elm Street water entrance

Domestic Hot Water

There are four domestic hot water sources in the building:

/ One domestic hot water source is in the basement under the gymnasium facing Chestnut Street.

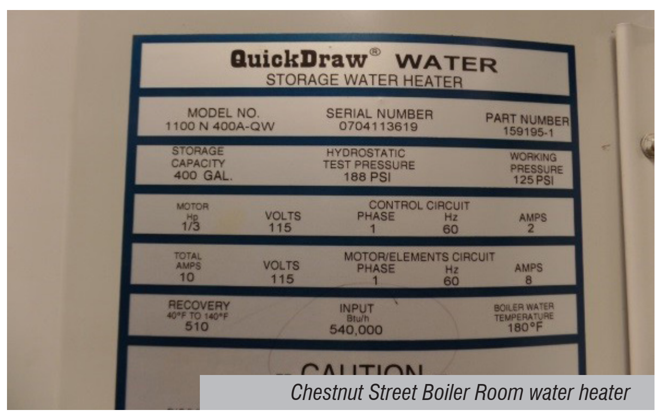
/ A 6 or 10 gallon electric water heater is mounted on a shelf in the room and is independently piped to provide hot water to a custodial sink during summer use.

/ The large PVI water heater is heated by the two boilers and has no summer option for producing hot water for the gymnasium areas of the building. The system does not have hot water available when the boilers are turned off. A PVI water heater stores 400 gallons and can produce 510 gallons per hour at a 100°F temperature rise. The heater was installed in 2004. The first hour rating is 830 gallons. It is estimated that the water is stored at 140°F and a thermostatic mixing valve reduces the water temperature to 120°F. The temperatures were not confirmed since the water heater was not operating during the survey.

/ The third domestic hot water source is located in the main boiler room A9, in the older part of the building. A PVI water heater stores 125 gallons and can produce 250 gallons per hour at an 80°F temperature rise. The heater was installed in 2000. The first hour rating is 830 gallons. It is estimated the water is stored at 140°F and a thermostatic mixing valve reduces the water temperature to 120°F.

/ The fourth domestic hot water source is located near the kitchen in a mechanical room. The heater is gas fired by Vanguard. The heater has a 91 gallon storage capacity and 199,000 BTUH input. The unit has a recovery rate of 181 gallons per hour. The first hour rating is 254 gallons. The unit was installed in 2001. It appears to be in good condition and has been operating normally. The heater supplies 140°F hot water to the dishwasher and kitchen equipment.


Chestnut Street Boiler Room water heater



Chestnut Street Boiler Room water heater

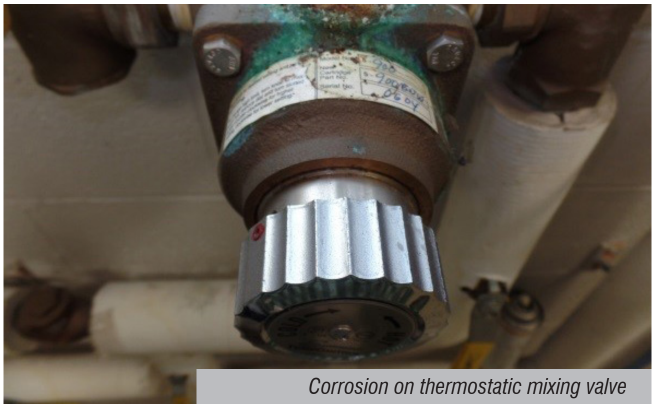
Chestnut Street Boiler Room mixing valve assembly

Chestnut Street Boiler Room mixing valve assembly

Main Boiler Room gas fired water heater

Chestnut Street Boiler Room electric water heater

Gas fired water heater serving Kitchen



Corrosion on thermostatic mixing valve

Gas fired water heater serving Kitchen

Natural Gas

There are two natural gas services to the building. The primary service is on the side of the building facing West Otterson Street. It is unknown whether the gas feed is from Elm Street or West Otterson Street. The gas meter feeds the entire building from this location. A 4” gas main enters the building at the meter assembly to serve the kitchen. The pipe also passes through the building and exits the side wall and drops back into the ground to serve the main boiler room A9 and the sub-gym boiler room.

- West Otterson Gas Meter: Roots model 5M175, 5,000 CFH @ ½” differential. The meter operates at medium pressure from the street. Pressure is reduced downstream of the meter to provide 4 psi into the building. Pressure regulators are located in the building at each appliance to reduce the pressure to comply with the gas fired equipment.
- Main Boiler Room Boiler #1: 5,773 CFH
- Main Boiler Room Boiler #2: 5,773 CFH
- Main Boiler Room Water Heater: 199 CFH
- Kitchen Water Heater: 199 CFH
- Kitchen Equipment (Estimated): 1,500 CFH
- Emergency Generator: 583 CFH
- Total connected gas load: 14,027 CFH or 14.02 Million BTUH

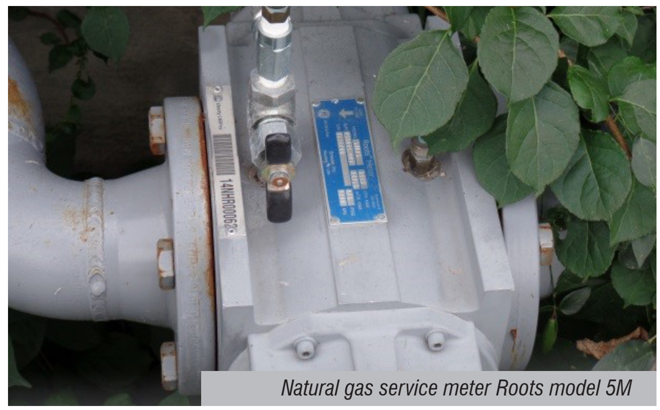
The second gas service entrance is on Chestnut Street serving the Boiler Room.

- Meter model not verified. Estimated model: American Meter AL-1500
- Gym Boiler Room Boiler #3: 4,900 CFH
- Gym Boiler Room Boiler #4: 4,900 CFH
- Total connected gas load: 9,800 CFH or 9.8 Million BTUH


Natural gas service in fenced area


Natural gas service dual pressure regulators


Natural gas service 60 psi to 4 psi label



Natural gas service meter Roots model 5M

Natural gas serving main building

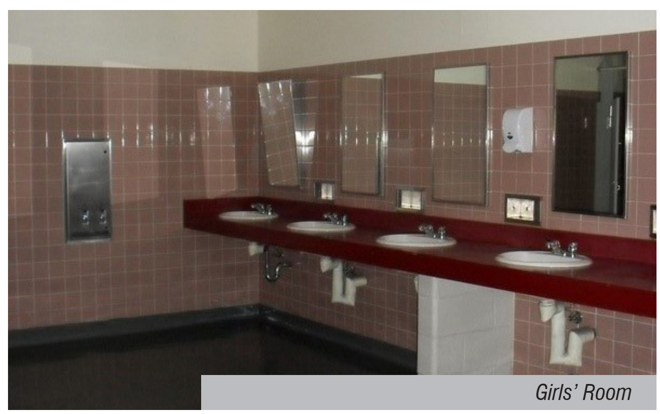
Natural gas serving main building

Chestnut Street natural gas serving Boiler Room A9

Restrooms

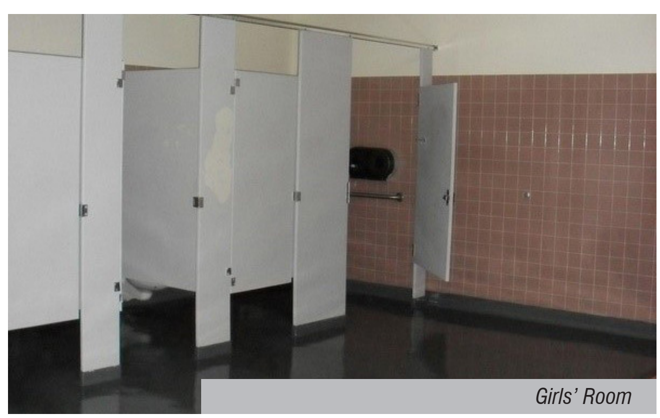
The building has a mix of plumbing fixtures throughout the facility. Most of the utilized fixtures are of modern design with manually operated faucets and flushometers. Water closets are wall-mounted in most cases. It is assumed that the fixtures were installed after 1991. Toilets are assumed to flush with 1.6 gallons per flush. Urinals are assumed to flush with 1 gallon per flush. Lavatories are counter-mounted with manually operated faucets. It is assumed the flow rate of the faucets is 2.2 gallons per minute.

Boys' Room



Girls' Room

Boys' Room



Girls' Room

Gym Boys' Room plumbing fixtures

Gym water closets with modern style flushometers

Gym urinals with modern style flushometers

Gym Girls' Room stalls

Gym typical lavatory with metering faucet

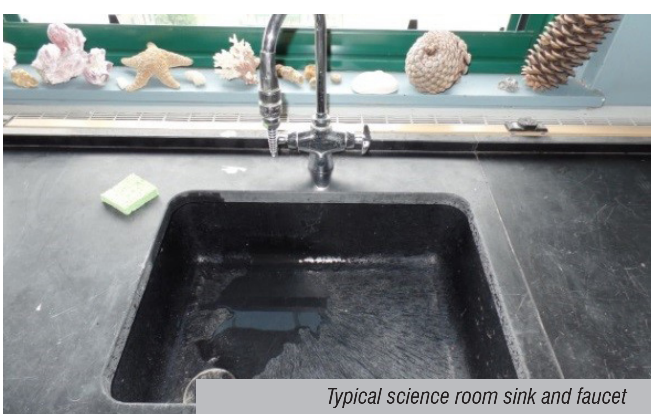
Gym Girls' typical lavatories with original faucets

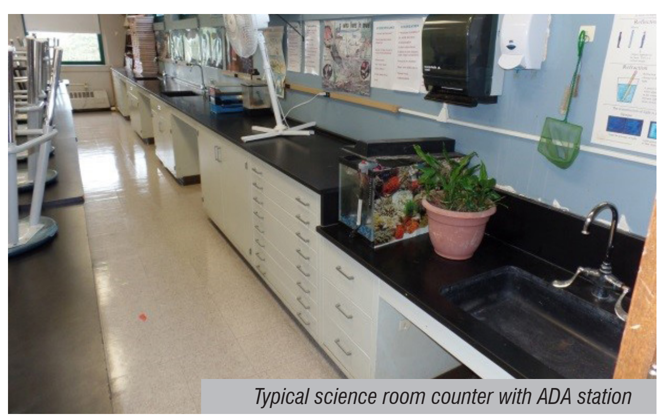
Science Rooms

The science rooms have epoxy sinks integrated to the epoxy counter tops. The drainage is piped with acid-resistant polypropylene piping. The sinks have a swing goose-neck spout faucet. Most faucets have cross handles and a serrated hose tip. An attempt to create an ADA compliant station has a lower counter, wrist blade handle faucet and open knee space. The knee space clearance under the sink does not meet the ADA requirements.


ADA science sink station


Science room eyewash station

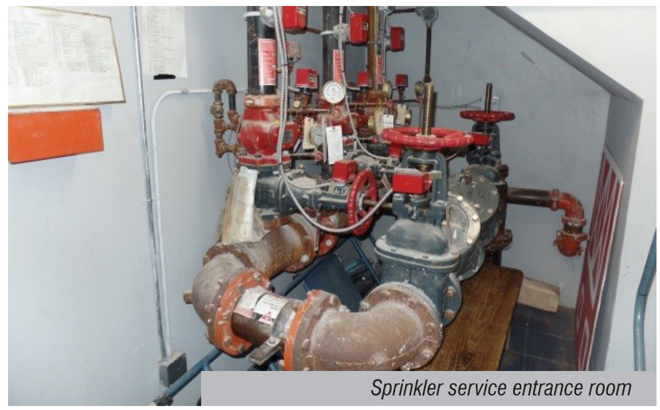

Typical science room sink and faucet


Typical science room counter with ADA station

FIRE PROTECTION ANALYSIS

Fire Sprinkler Service

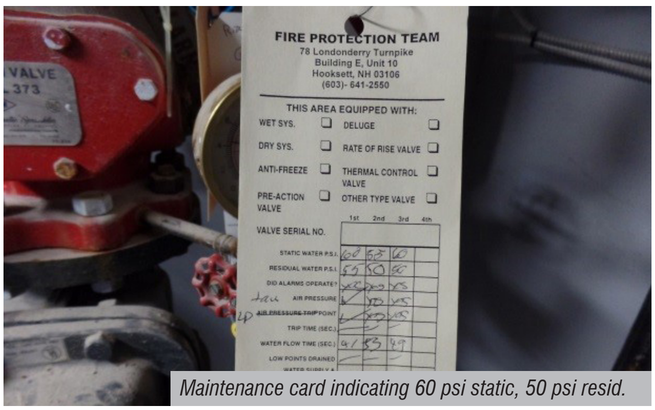
The fire sprinkler system was installed in 1991. All components are 25-years-old. The system consists of an 8” water main stubbed up through the ground floor in the sprinkler room at the front right corner of the building. The fire department connection is mounted on the wall facing West Otterson Street. A 2” water connection on the top of the 8” entrance was capped for a domestic water service, but not connected. The water service is protected by a 6” Febco double check valve backflow preventer. Three 4” wet pipe sprinkler alarm valves are connected to seven sprinkler zones. The maintenance card indicates static pressure of 60 to 65 psi and a residual test pressure of 50 to 55 psi. The riser pressure gauges indicate static pressure of 70 to 75 psi. The greatest demand on the water system is on Zones 2 and 3. Zone 2 demand is 329.0 gpm at 57.92 psi. Zone 3 demand is 369.9 gpm at 56.65 psi. The documented residual pressure on the maintenance card is slightly lower than the pressure demand on the system. It is unknown if the system has a safety factor to account for the 8 psi deficiency of the water supply. Sprinklers are standard response glass bulb type.



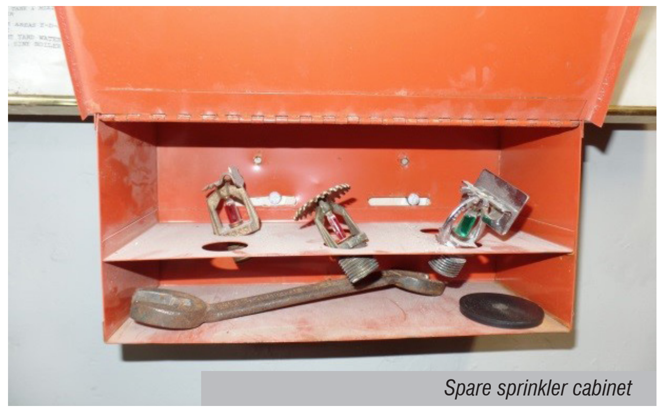
Sprinkler service entrance room

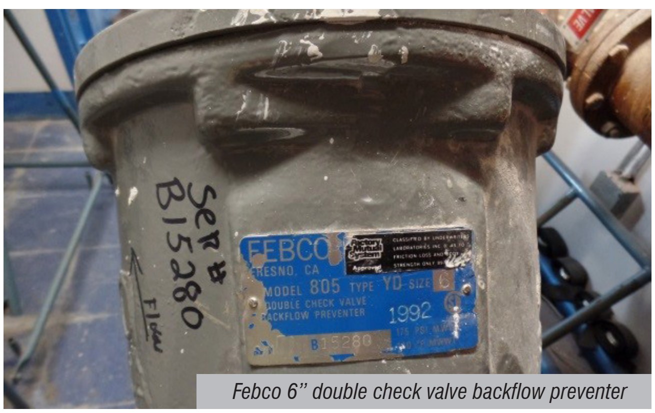
Three sprinkler alarm valves

Three sprinkler alarm valves (seven zones)



Maintenance card indicating 60 psi static, 50 psi resid.


Spare sprinkler cabinet

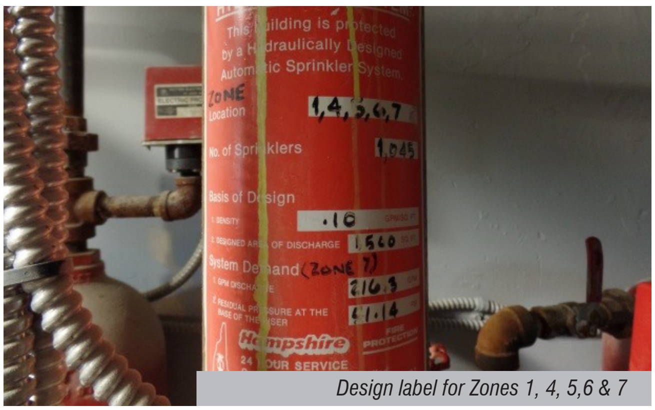


Febco 6” double check valve backflow preventer

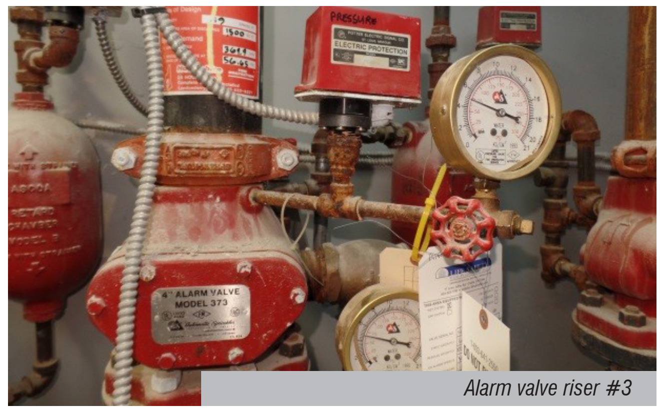

Alarm bell, fire department connection, main drain


8” water pipe stub with 2” cap

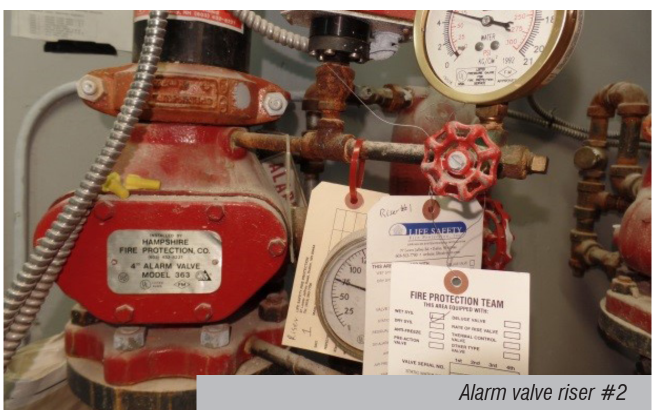
Alarm valve riser #1



Design label for Zones 1, 4, 5,6 & 7



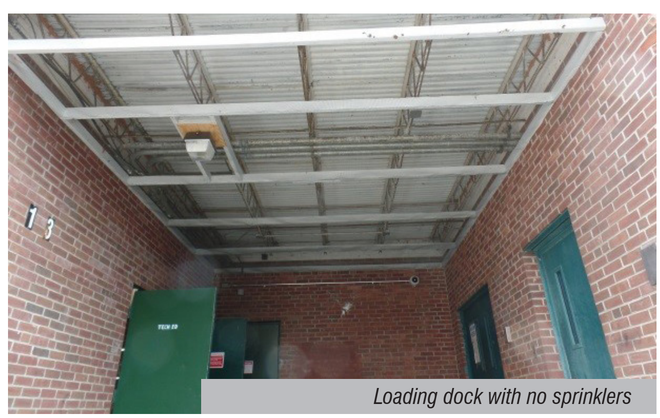
Alarm valve riser #3



Alarm valve riser #2

Design label for Zone 3

Design label for Zone 2


Loading dock with no sprinklers

ELECTRICAL ANALYSIS

General

The existing Elm Street Middle School in Nashua, NH was constructed in three phases. The original section of the building was constructed in 1936. The additions that followed were constructed in 1961, which included renovations and the library addition in 1991.

The basic electrical systems reviewed consisted of:

- Electrical Service Entrance Equipment
- Standby Power System
- Lighting and Power Panelboards
- Interior Lighting
- Exterior Lighting
- Lighting Controls
- Emergency Egress Lighting
- Classroom Power Outlets
- Fire Alarm System
- Security Systems (CCTV, Intrusion Detection, and Access Control)
- Intercom/Public Address System
- Data Infrastructure
- Overall Recommendations for Major Building Renovation

Electrical Service Entrance Equipment

Elm Street Middle School is served by a primary metered radial feed. The primary service enters the property from Chestnut Street to a primary metering pole and then drops at a riser pole to underground, where it runs under the parking area to a pad mount 300kVA transformer near the kitchen. The underground feed then continues under the building to a 500kVA pad mount transformer in Courtyard B (Area B). The meter for the primary metering is on the primary metering pole. Total kVA capacity of transformers is 800kVA and the maximum demand for this service is reported to be 268kVA. The pad mounted transformers are owned by the city of Nashua.

The building is served by two service entrance main distribution switchboards (MDP).

- MDP1 is a Square-D QED2, 120/208V, 3Ø-4W service entrance main distribution switchboard with a 1,600A main breaker and bus rating.
  - This service is fed from the pad-mounted transformer located in Courtyard B.
  - The electrical room is located under Courtyard B.
- MDP2 is a Square-D QEDS, 120/208V, 3Ø-4W service entrance main distribution switchboard with a 1,600A main breaker and bus rating.
  - This service is fed from the pad-mounted transformer located near the kitchen.
  - The electrical room is located under the kitchen.

Records indicate the MDPs were installed in 2013 and they appear to be in good serviceable condition. The main distribution panels contain a variety of breakers which feed downstream panels and mechanical equipment, as well as spares and spaces for future loads.

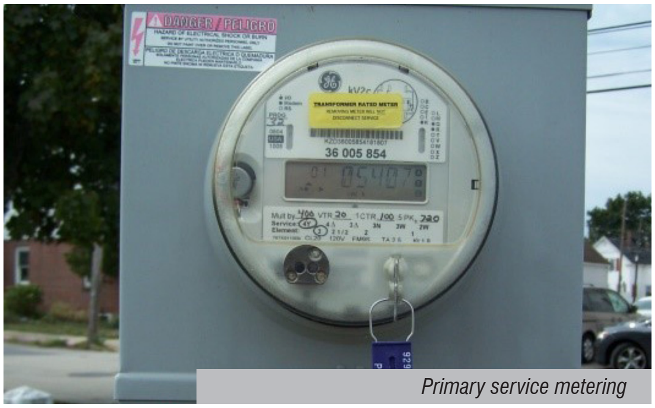
- MDP1 feeds a 200A automatic transfers switch located in the same room as MDP1. Refer to “Standby Power System” section below.
- MDP2 includes provisions for a generator input. The generator input back feeds a 400A breaker that includes a Kirk Key interlocking device. This interlock prevents energizing both from the generator and utility sources.

There is enough capacity between the two services to accommodate considerably more load. However, mechanical loads would be better served by 480V distribution.

If air conditioning any major portion of the building is desired, a new 480V service or services may be required in place of the existing 208V service(s).

Primary riser pole

Pad mount transformer



Primary service metering

Main Distribution Panel - MDP1

Pad mount transformer

Main Distribution Panel - MDP2

Standby Power System

Standby power is supplied by a Kohler Power Systems 45kW 120/208V 3Ø-4W natural gas generator, which is located in Courtyard B. This generator provides power to a 200A Kohler transfer switch in the Main Electrical Room and receives the "normal" feed from MDP1.

As mentioned above, there are provisions for a mobile generator connection to backfeed a breaker in the MDP2. These provisions also include a terminal box for connection of leads from a generator.

- The generator provides emergency egress lighting in most of the building. Areas not covered by the generator, egress lighting is provided with emergency battery units.
- The generator currently monitors "normal" power from MDP1 only (does not monitor "normal" power at MDP2). The generator needs to monitor each service so loss of power from either service will start the generator and provide emergency egress lighting.

Standby generator


Generator Kirk Key Interlock

Generator Kirk Key Interlock

Automatic transfer switch

Lighting and Power Panelboards

Lighting and power panelboards are located throughout the facility. Most panels are not filled to capacity, leaving space for future expansion. Panelboards were observed to be a combination of Square-D NQ and GE A series and, for the most part, in good serviceable condition. Some older model panels exist and are nearing the end of their service life. Several panels are located in the corridors and are accessible to the students.

- / Panelboards should be provided with locks, preventing unauthorized access. Ideally the panelboards would be located in dedicated electrical rooms that would allow access by authorized persons and code-required working clearance.
- / Panelboard feeders require further investigation to determine the condition of each. It is believed that some feeders may be original to the original construction of each phase of construction the building has experienced.

Interior Lighting

In general, lighting is in fair-to-good condition. Some T12 lighting remains in mechanical spaces, but most have been updated to T8, T5, and some LED technologies. Lighting levels throughout the building were adequate, with the areas of most concern being the low levels in the corridors (see space breakdown below).

Most classroom lighting is achieved with two-lamp T8 2x4 troffers with electronic ballasts. There are some classrooms/labs that have parabolic fixtures. Two-level switching arrangements are provided to enable multiple levels of lighting. Lighting levels appear to be adequate.

Gym lights consist of multi-lamp T5 high bay fixtures with occupancy sensors and wire-guards retrofitted with LED replacement lamps. Lighting levels are good. Fixtures appear to be in good condition.

Typical lighting/power panelboards

Panelboard located in wainscot

Typical lighting/power panelboards

Panelboard in janitor closet with no working clearances

Classroom lighting

Gym lighting

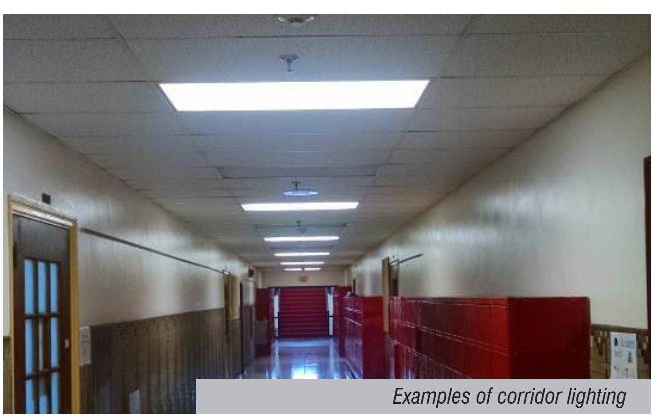
Corridors have many different fixture types, including pendant T8s, surface wraps, downlights and troffers. Spacing varies, but generally lighting levels are low to average. In many cases circuits are switched with key type switches.

Office and support areas have many different fixture types, including surface wraps, downlights, parabolic and troffers. Spacing varies, but generally lighting levels are average. Many areas have multi-level switching arrangements.

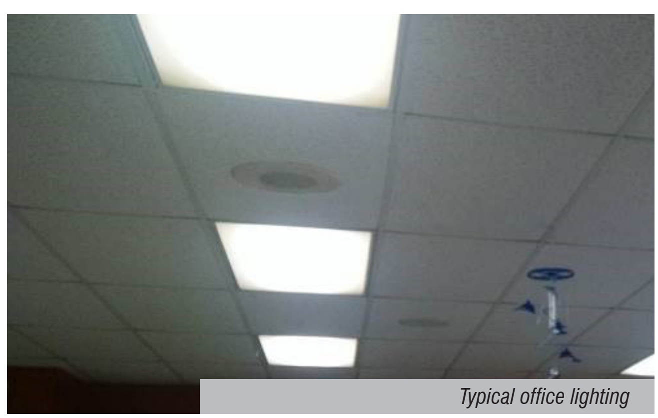
/ Lighting fixtures could be replaced with energy efficient LED fixtures. Lighting fixtures with higher light outputs could be chosen to brighten corridors as needed. There are often energy incentives available through the utility company to assist with the cost of energy efficient upgrades.

Examples of corridor lighting

Typical office lighting



Examples of corridor lighting



Typical office lighting

Exterior Lighting

Exterior lighting is mainly wall-mounted, high pressure, sodium fixtures in the rear, with several street side utility pole-mounted flood lights serving the front of the building. Lighting at the front of the building is minimal, with several walkways that have no lighting at all. Additional lighting is needed in the parking and drive areas.

/ Lighting fixtures could be replaced with energy-efficient LED fixtures. There are often energy incentives available through the utility company to assist with the cost of energy-efficient upgrades.

Lighting Controls

Lighting is currently controlled via wall-mounted switches for most interior spaces, time clock for exterior lighting, and some corridor lighting with little lighting controlled by occupancy sensors.

/ The State of New Hampshire currently enforces IECC 2015 (International Energy Conservation Code).

/ The energy code requires automatic “off” of all lighting not required for safety or security. This can be accomplished with occupancy sensors, centrally-located lighting control relay panels, time clocks, and/or distributed lighting controls.

/ Energy code also requires switching of lighting within “daylight” areas be controlled separately from lighting outside these areas.

Exterior lighting

Exterior lighting

Exterior lighting

Emergency Egress Lighting

Emergency egress lighting is achieved with a combination of self-contained emergency battery units, battery units with remote heads and fluorescent fixtures backed up by the standby generator. Exit signs are of the internally illuminated, remote battery type. In general, there is one remote battery per floor which powers all the emergency lighting on the associated floor. Self-contained units are located to supplement in support and service areas.

Lighting and signage observed appeared to be in good condition and appropriately spaced.

Classroom Power Outlets

There are wall-mounted grounded outlets located throughout the building; however, many classrooms observed had minimal receptacles. In several cases, there were less than four outlets located in a classroom. This raises concerns that as the use of technology proliferates, it will overtax the circuit distribution to those areas.

Fire Alarm System

The fire alarm system is a Notifier NFS-640 with voice evacuation (voice evacuation is not provided throughout the building, only in areas of assembly), installed and maintained by BK Systems. Personnel report that there has been some trouble with the system. There are ongoing repairs and some possible installation flaws with respect to the speaker system. Smoke detectors, notification appliances, and pull stations are located throughout the building. Generally, coverage appeared adequate, though a thorough analysis would be required to verify. In the event of an alarm, the system reports directly to Nashua monitoring/dispatch facility via the city loop system.

- Any work to the fire alarm system will require voice evacuation throughout the building. Recent changes in NFPA requires voice evacuation throughout educational facilities.

Typical life safety lighting and signage

Typical life safety lighting and signage

Fire alarm system

Typical pull station and notification appliance

Typical pull station and notification appliance

Security Systems (CCTV, Intrusion Detection and Access Control)

The school is served by an S2 Security System installed in 2014 by Securadyne Systems. The system encompasses video surveillance, access control, panic alarm and intrusion detection. Surveillance cameras are installed at various locations throughout the building and mounted to the exterior of the building. The motion detector system is IP-based with remote monitoring and control capabilities and an integral Network Video Recorder (NVR). The system has some expansion capabilities should additional devices need to be installed.
Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since their installation on the surveillance system. At minimum, recommend replacing existing and adding new exterior and interior cameras.

- Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since their installation on the surveillance system.
  - CCTV cameras should be upgraded and many should be added to the interior and exterior of the building, covering the entire building perimeter and parking, corridors, lobbies, cafeteria, gymnasiums, and courtyards.
- Access control is limited and the main administration office has no direct contact with the main entrance. An AI Phone allows the administration office to communicate with someone at the main entrance and allows them to enter the building. This person is trusted to proceed to the office.
  - There are four other main entrances (Gymnasium A, Gymnasium B, Cafeteria, and Auditorium) and many other entrances into the building. None of these entrances are controlled by the main administration office.
  - Currently there is no way for anyone to know that the building perimeter doors are closed and/or locked, creating an insecure building.
  - Electronic locks should be provided at all main entrances that are controlled by the main administration office to control access to the building during the school day.
  - Door contacts should be provided at all perimeter doors to ensure visitors are forced to enter the building at the main entrance so the main administration office can control access during school hours.

Intercom/Public Address System

The Intercom/Paging System was fairly recently upgraded to a Bogen Quantum from a Bogen MCP 35A. Only the head end equipment was upgraded, the existing wiring and speaker system was reused. Using the existing wiring requires using the shielding conductor to make the system work, this is believe to be causing some of the issues experienced.

- Wiring should be replaced throughout and speaker placement evaluated to cover any areas lacking coverage.

Data Infrastructure

Data cabling throughout the building does not meet current industry standards. Most current installations are provided with Cat 6A cabling. The most recent renovation Harriman had involvement with was the Sunset Height school in 2015, which used Cat 5E.

The quantity of communications drops throughout the building are low, relative to most middle schools and the quantity of drops requested at the Sunset Height project.

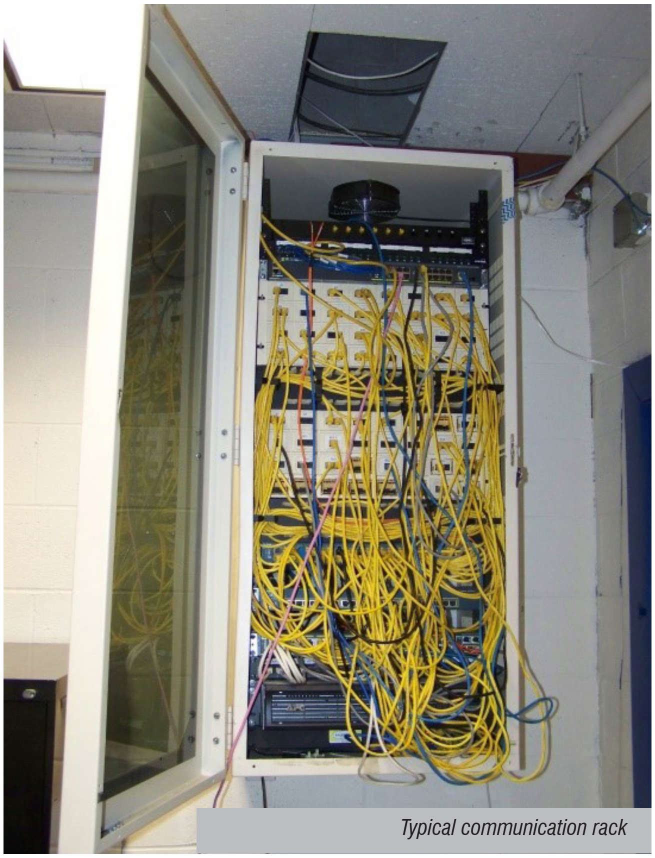
Communications racks observed were wall-mounted, had little to no space to accommodate additional patch panels or switches, and were not in rooms dedicated to IT.

- To accommodate future needs, floor-mounted communications racks should be provided in rooms dedicated to IT.
- Replace and upgrade cabling, jacks, patch panels, and switches to current standards.
- Provide additional drops as required to accommodate the requirements of today and the near future.

Typical exterior cameras

Typical exterior cameras

Security system head end



Typical communication rack

SITE ANALYSIS

General

Evaluation of the site at Fairgrounds Middle School, located in Nashua, NH, involved walking around the school and grounds, and making observations of existing site features. Photographs were taken to document these existing conditions. The goal of the study is to look for deficiencies and to gather relevant information on the conditions of the site. Included is an evaluation of the surface drainage and associated infrastructure, evidence of erosion from stormwater runoff, and existing site circulation and parking, including observations associated with Americans with Disabilities Act (ADA) access from the adjacent streets and the parking areas to the building.

Google Earth image dated April 22, 2018

Existing Conditions
The school is located in an urban residential neighborhood, bordered by Earlview Avenue to the west, Hassel Brook Road to the south, and Cleveland Street to the north (main entrance off of Cleveland Street). There is green space found in small areas throughout the school campus, and a large green space, consisting of athletic fields (baseball field, track, etc.) to the west of the school. During the time of the site visit, most areas were snow-covered.

Site topography generally slopes from east to west and from south to north. The slope from Cleveland Street to the front of the school is fairly steep (approximately 5-8%), which features a bus loop and access to parking lots on both the east and west sides of the loop. The eastern lot is small and has a secondary entrance/exit back onto Cleveland Street. The western lot is larger, and has a drive that connects this lot to another lot behind the school (southern lot). A third entrance off of Cleveland Street, which appears to be a fire lane, leads to a drive around the eastern perimeter of the school and connects to the southern parking lot (see aerial plan).


Snow-covered courtyard south of school building


View of athletic fields looking west from parking


View of bus loop entrance to front of school


Fire lane entrance drive, view looking south

The pavement throughout the site appears to generally be in fair condition, with noted exceptions. Observations of the pavement included some potholes, large cracks, and areas of differential settlement. The pavement bus loop (nearest the main entrance) and fire lane, in particular, appeared to be in poor condition, and included numerous areas where ice had ponded, indicating that the road was not properly draining stormwater, and areas where pavement has eroded (see adjacent photos).

Each of the paved parking areas appeared to have clear paint markings, including handicap markings. Other on-site paved areas that are not lined for parking, are still utilized as such in the front (north-facing) of the building, adjacent to the bus loop. At the time of the site visit, several vehicles were observed to be parking on the paved walk area leading to what appeared to be the main entrance and various gym egress doors (see photos below). Harriman conducted the visit during school vacation hours, so it is unclear whether this is a regular occurrence.

Observations of the existing vegetative areas located on the outside of the building was limited due to the snow cover on the grounds and playgrounds. Similarly, the amount of drainage infrastructure observed on the site was minimal due to the site conditions and overall snow cover throughout the site. Areas

Ice build-up at southern egress door

Potholes and pavement in general disrepair

Pavement damage at top of existing bus loop (west)

Pavement damage at top of existing bus loop (east) of erosion were observed adjacent to the existing fire lane. In general, the observed catch basins and drainage manholes appeared to be in fair condition. Differential settlement, pavement cracking, and some puddling appeared surrounding some of the structures. It should be noted that some of the puddling (ice/snow) may be a result of the cold weather conditions.

Vehicles observed on existing paved walk

Vehicles observed on existing paved walk

Pavement cracking surrounding existing catch basin

Puddling surrounding existing catch basin

Other observations made during the site visit included fencing, signage, lighting, ADA accessibility, and location of items, such as dumpsters and recycling containers. In addition to signs for pet cleanup, pedestrian traffic, drug-free school zones, handicap parking signage, and general school signage, some signage for directing drivers was also observed. For example, there is signage to indicate that vehicles are prohibited from entering into the bus loop during certain times of the day. However, there is no signage at the exit of the bus loop to indicate that drivers should not enter into that lane.

The dumpster and recycling container were located on the backside of the school (southern facing). The dumpster was located on top of a concrete foundation and had a perimeter fence enclosure, including privacy slats. The recycling container also appeared to have a concrete pad foundation, but was not properly situated upon the pad (see photo). Lighting for the school parking areas seemed to be minimal, with some spot lighting observed from the exterior of the school building. The larger site lighting infrastructure that was observed was for the athletic fields. Perimeter fencing that secured the athletic fields appeared to be in good condition.

ADA accessibility appears to be sufficient throughout the property with appropriate ramps onto sidewalks from the ADA parking spaces. Most doorways observed have accessible routes to entrances. Some existing walkways may require repairs, as some of the paved walks have large cracks (see photo).


Handicap and visitor parking signage


Pedestrian crossing signage at bus loop exit


Dumpster and pad location with fence enclosure

Recycling container and pad location


Paved walkway damage


ADA ramp into existing school entrance

ARCHITECTURAL AND CODE ANALYSIS

General Architectural Overview

The original building was built on the site at the corner of Cleveland Street and Fairview Avenue in Nashua, New Hampshire in approximately 1962. The original building is a single-story building with "flat" roofs, with the majority of framing spanning to bearing walls. Around 1996, there was a significant renovation/addition to Fairgrounds Middle School, which appears to have included some significant mechanical upgrades as well as an addition of the library, three classroom wings, and a fitness space near the gymnasium. Some additional mechanical upgrades were performed about three years ago.

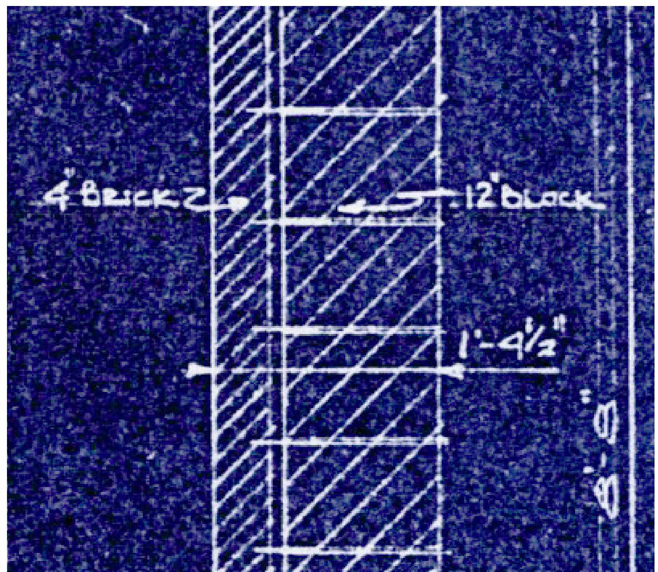
The building is currently configured with classroom wings that branch off from a central hub area. The hub appears to have originally been the library, but in the 1996 renovation/addition a new library was built and this space was converted into art and other supporting spaces. Opposite the classroom wings are supporting program spaces like the kitchen, cafeteria, administration, STEM, industrial arts and the gymnasium. The boiler room and electrical room are located in a basement area under the teacher's room next to the cafeteria. Storage areas are generally spread throughout the building, but are in short order. Review of how to increase storage spaces should be considered.

Generally speaking, the facility appears in architecturally sound condition and has clearly benefited from maintenance. Below is our more in depth assessment of the building.

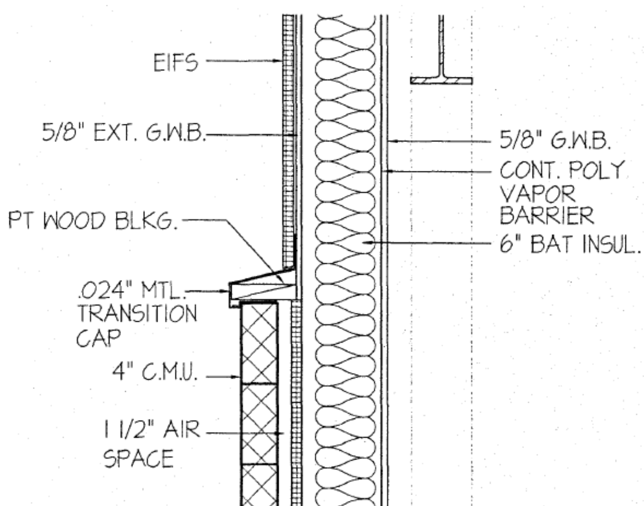
Building Shell

Exterior Walls and Façade

The exterior of the original building consists mostly of a brick veneer and EIFS; while the 1996 addition used split-faced masonry block as the primary façade finish. Other materials present are vinyl and metal soffit panels, metal flashings, and metal roof edges.



Section detail from 1961 Tracy and Hildreth Architects drawings



Section detail from 1995 Turner Group drawings

The wall construction appears to mostly consist of either brick veneer over a CMU back-up at the original building or CMU veneer over an air space, rigid insulation and insulated steel stud (or CMU) or EIFS over plywood sheathing and insulated steel studs at the 1996 additions. No clear evidence of any air vapor barrier was observed in the exterior wall system.

Most brick and mortar joints appear to be in good-to-fair condition overall; however, localized areas of joints in poor shape were noted and should be repaired. Brick weeps were not noted at the base of the brick around the original building, but were found in areas of the new addition CMU veneer. Although not prevalent everywhere around the building, there were some areas of efflorescence noted in a few locations on the masonry veneer. Efflorescence of masonry usually occurs when moisture occurs behind the brick and the moisture pushes the salts that are naturally in the brick and joints to the surface. A proper cleaning of these surfaces can typically alleviate any visual concerns. In instances where the building lacks an air vapor barrier or weather tends to breach the wall system, there is potential for reoccurrence. Regular inspection of sealants should be performed and resealed if the inspections warrant it. Any missing sealant at joints should be filled to prevent infiltration of weather.

Areas where masonry shows efflorescence and growth from moisture

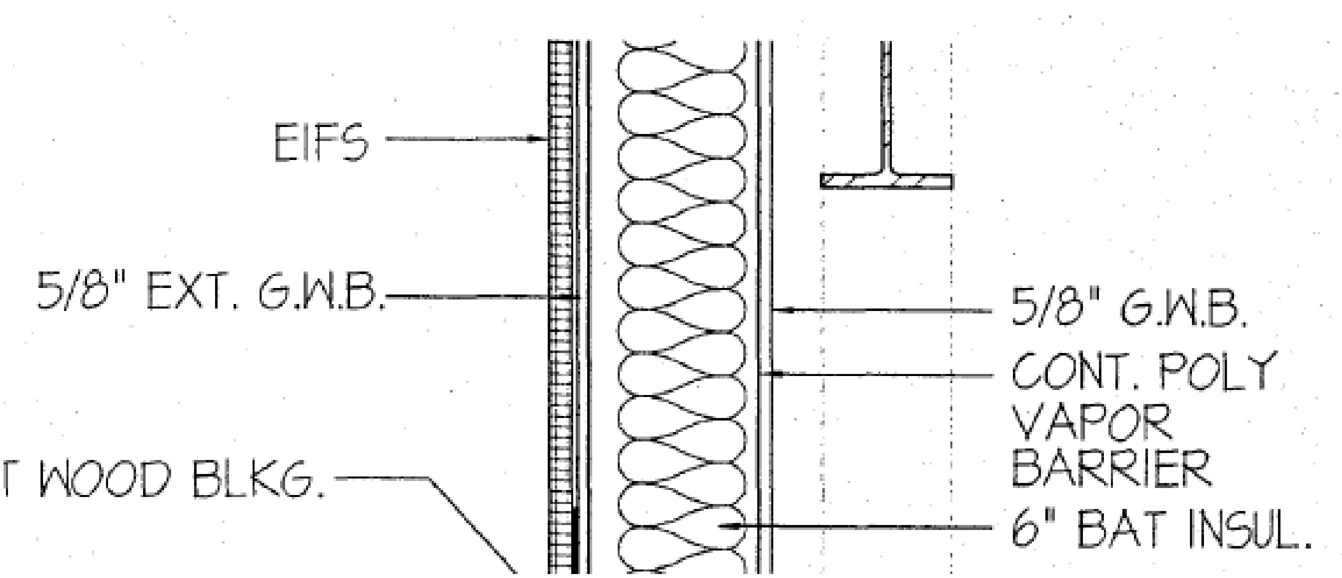

Areas where masonry shows efflorescence and growth from moisture

Areas where masonry shows efflorescence and growth from moisture

Locations with EIFS were generally in good shape. Some areas of damage or possible repairs were noted. At some locations it was noted that the paint did not match other locations. It is recommended to repair any damage and properly repaint EIFS. Continue a maintenance plan with inspections and periodic repainting as required.

The roof fascia and soffits appear to be in good condition. A few locations of minor damage of missing pieces were noted. We recommend those minor items be repaired. Any open soffits should be closed up to prevent pests from entering and creating nests.

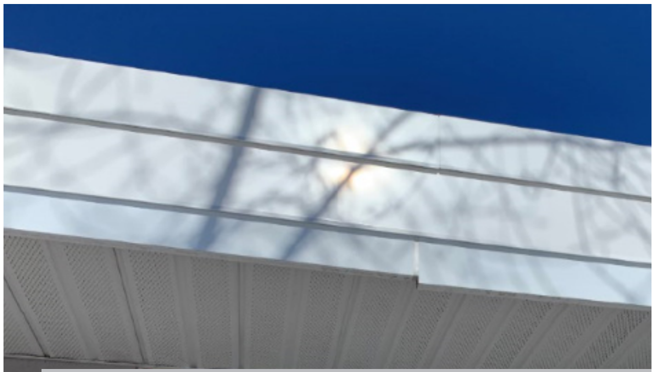
EIFS (exterior insulated finish system) damage/painting



Section detail from 1995 Turner Group drawings

EIFS (exterior insulated finish system) damage/painting

EIFS (exterior insulated finish system) damage/painting



Minor damage or missing pieces of fascia and trim

Minor damage or missing pieces of fascia and trim

Minor damage or missing pieces of fascia and trim

Minor damage or missing pieces of fascia and trim

A ramp located near the library addition was noted as having rails embedded into spalling concrete. These should be repaired to prevent unintentional failure of the rail supporting persons leaning against it.

Windows

The windows appear to have been replaced during the 1996 renovation, with primarily aluminum-clad wood, double hung windows. Some windows were noted to be fixed type windows. They generally appear to be in good condition; however, some windows were found to be damaged. Damaged windows should be replaced. The glass was noted to be insulated panels and none were noted as failing at this time. A commercial window's life expectancy is based on average wear-and-tear of windows. Clad windows are expected to last around 25 years, and but can be extended with regular maintenance. In many cases the screen at the windows were missing. Replacement of any missing or damaged screens should be done to prevent pests from entering the building when windows are open.

The sills of the windows are made of prefinished metal at the 1996 additions. They are made from sloped rowlock brick at the original portions of the building. The locations with prefinished metal were noted as being in good shape. Several locations of brick window sills were noted as being in poor shape and may even allow weather into the wall cavity. At these locations, sealant may have been missing or disturbed, or in some locations the brick joints may have been disintegrating. Review of the locations should be done and repaired where needed. Resealing of windows should be done and continued maintenance should persist to ensure long life of wall components.

Refer to the structural narrative for further information on lintels conditions.

Spalled concrete at railing

Windows and sills

Windows and sills

Windows and sills

Windows and sills

Doors and Frames

The exterior hollow metal doors and frames were noted as being in very poor condition in a majority of locations. They have succumbed to years of moisture and salting and have severe rust damage. It is recommended that the doors and frames be replaced with new galvanized or aluminum doors and frames.

The headers to the doors are steel lintels. Refer to the structural narrative for further information on lintels conditions.

It was noted that some doors had a step as you exited through them. This does not meet code and a walk off pad at the floor level should be created with appropriate grading sloping down to meet ADA standards.

Windows and sills

Windows and sills

Roofs
There are a few different roof types on this building. The majority of the building has EPDM roofing. It was reported that most of the older roofing was replaced in the past year or two. The EPDM areas remaining were reported to be the areas that were installed during the 1996 additions. These areas are now approaching 25 years old and should be considered for replacement. The newer classroom wing additions are under a sloped shingled roof. The existing drawings indicate the shingles are installed over an ice guard (at eaves) and 3/16" OSB, rigid insulations, and a ½" plywood layer. The slope of the roof is noted to be an 8:12 pitch, and venting of the roof space appears to occur at the soffit and at the ridge vent.

Roofs over 15-years-old should be considered for re-roofing. Conduct roof cuts to verify insulation thickness over the existing roof systems. Also, verify if existing built-up tar and gravel is roofed over and test for hazardous materials before determining roof replacement.

Interior Finishes
Asbestos Containing Building Materials (ACBM)
An AHERA report has been provided by the Owner and hazardous-materials-containing materials are identified in the report. The original school was built before the 1973 EPA Clean Air Act which banned most spray-applied asbestos products; however, not all ACBM's are illegal in the U.S. and could still be used today. ACBM's could have been used during the construction of this building and it is recommended that a renovation impact study be performed prior to construction on any building that may contain such hazards. A renovation impact study may not indicate all hazards and proper safety procedures shall be followed by Contractors on site to notify the Owner and Architect of any suspicious materials that may be hazardous-material-containing.

In review of the 1996 construction documents created by H.L. Turner Group, it was noted that areas of V.A.T. was encapsulated by areas of carpet. Any planned flooring changes or work in these areas will need to be noted by Contractors. This does not imply other areas are clear (see above).

Vinyl Composition Tile (VCT)
The VCT in the building was in fair condition and appeared to be maintained regularly. There were some localized areas of tile that showed wear and several locations where tile was beginning to pull up. It is not known if matching tile can be found to replace any damage that does exist. Any renovations will need to address required flooring changes as needed. VCT life span is very much dictated by the amount and type of traffic, and the level of maintenance it receives. Regular cleaning and waxing is important to extend the life of the product. During any major renovations, it would be recommended that flooring of this age be considered for replacement.

Carpet
The carpet around the building was noted to be holding up quite well for its expected age. The carpet would appear to have been installed in the 1996 renovation/addition, and it is not clear if it has been replaced since. Carpet of this age should be considered for replacement, especially in areas of high use.

Acoustical Ceiling Tile (ACT)
The ceiling tiles throughout this building are installed in a peculiar way in a majority of the original building. They have been installed between the bottoms of the structural members. The ceiling appears to be in good condition in these spaces and due to the nature of the smaller tiles, do not show any signs of sagging. This installation does create some difficulties when trying to run wiring and such. Any infrastructure needs to be installed below the ceiling as the structure blocks most pathways. Lowering the ceilings is not a viable option as the ceilings are generally fairly low as they stand. Any damaged or stained tiles should be replaced to match existing tiles.

The ceilings in the newer classroom additions appear to be a drywall board covered in an acoustical spray applied insulation over the scissor truss framing. These are generally in good shape, but we recommend fresh painting during any remodel.

Partitions and Painting
A majority of partitions in the original building are made of concrete masonry units (CMU). Many of the CMU partitions are noted as being structural bearing walls. Some areas of the 1996 addition/renovation were constructed of CMU and others were steel stud and gypsum drywall.

The masonry inside the building is well-kept and, due to the nature of the product, has held up quite well. Renovations can be more costly when dealing with CMU walls, but are usually offset long term by the durability of the product, as suggested above. The addition of outlets and data boxes at CMU usually implies adding surface conduit, raceways, and/or wire mold to get the wire to the boxes. This can often be visually unappealing. One option is to fur out walls where these utilities are being added, but this can add to the cost of a renovation.

During any significant renovation it is recommended that the building or spaces be painted. At other times, it is recommended the building be repainted as part of long-term maintenance or as needed due to damage.

Ceramic tile wainscoting was used in the newer addition corridors and is generally in poor shape in many of the areas, with chipped and broken tiles. Replacement by patching or wholesale is recommended.

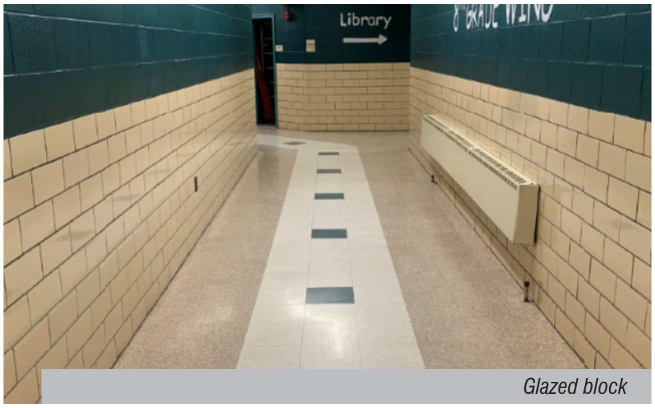
A glazed tile CMU block can be found in many locations of the original building. Overall these blocks appeared to be in fair to good shape. During renovations it can be difficult to patch these particular blocks and often will need to be filled with grout and painted. Painting of these blocks requires additional preparation and special paints to properly adhere.

ACT ceilings

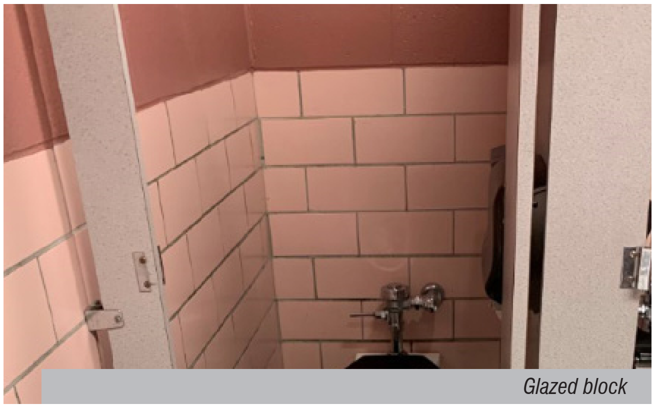
ACT ceilings


Ceramic tile damage


Ceramic tile damage



Glazed block


Glazed block

Additional Building Finish items

Gymnasiums

- The wood gym floor has evident areas of wear. It appears the floor is original to the building and should be considered for replacement.
- The bleachers on the west side of the court are in poor shape and might be original to the building. The bleachers on the east side of the court are newer but have been reported to have continuous operational issues. Consideration for replacement of both sets should be considered to meet ADA requirements, proper operation, and to be able to accommodate a roll-down curtain should one be installed.
- The acoustic properties of the space were poor. The space could benefit from the addition of sound panels around the walls to absorb some of the sounds in the space.
- The existing divider partition is outdated and should be replaced with a roll down curtain which is easier to operate and better equipped to create a more flexible space.
- The windows to the space have shades over them that are chain driven. Long chains hang down the wall and the shades appear to be down most of the time to block out the sun. Natural daylight could help improve the environment of the space. Replacement of the windows with a frosted translucent wall panel system could not only improve the aesthetics and environment of the space, but could also increase energy efficiency of the opening.

Lockers

- The lockers were located in the classroom wing corridors and in the central team area. Overall the lockers were in poor shape, with damaged or missing doors. It is recommended to replace lockers throughout the spaces. Handicap-accessible lockers should be appropriately located throughout the field of lockers to accommodate those with accessibility concerns.

Millwork + Casework

Typical classrooms contain plastic laminate-finished counters and wood or plastic laminate cabinets. The condition is noted to be in fair shape in many locations, but poor in others.

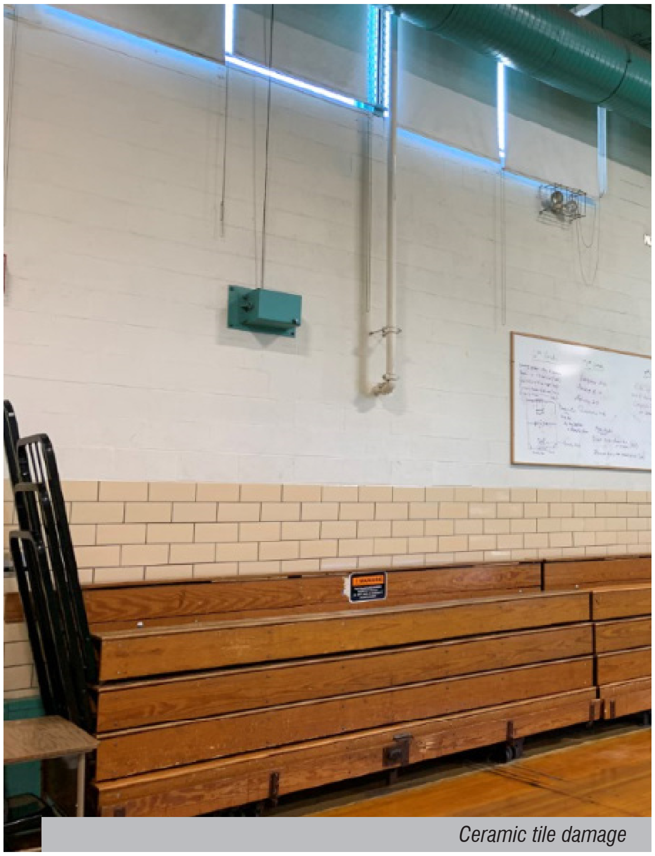
In the original building, science classroom casework was noted to have epoxy tops over wood cabinets. Limited handicapped accessible stations were found and should be considered in future work. Damage to tops was noted in several locations. Cabinets were in fair shape, but could benefit from refinishing or replacement. The newer additions had a few science rooms and these rooms were noted to be in good shape. Epoxy tops sat upon plastic laminate cabinets that were in good shape. Some accountability for accessibility was taken in these newer rooms.

Lockers had plastic laminate tops that students could utilize. Many were noted to be in fair shape. These should be replaced if and when lockers are replaced.

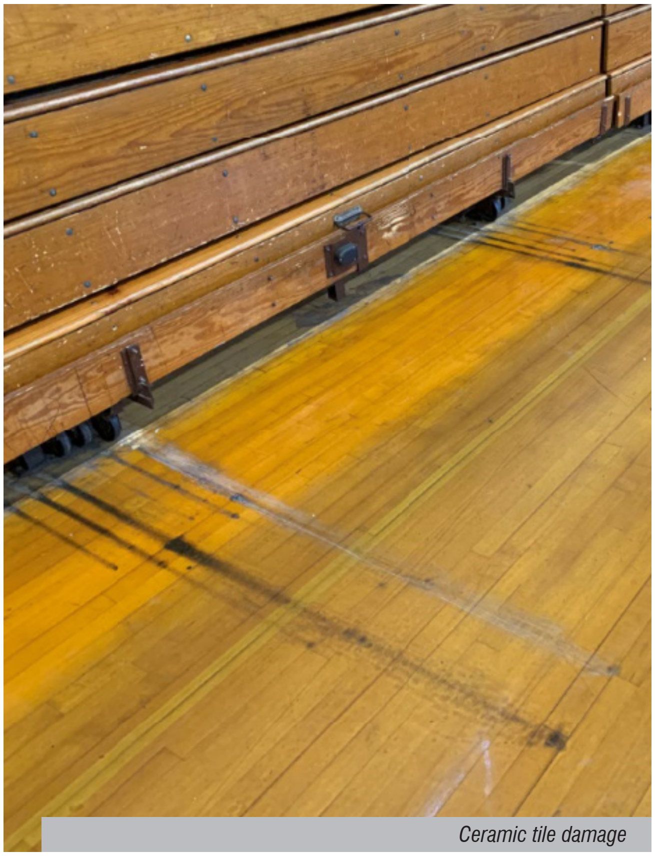
Art spaces had multiple tops in the room with plastic laminate cabinets. The overall condition of this casework could be classified as fair to poor. The art rooms would benefit from updated casework.

The administration reception space utilized a tall built-in plastic laminate and wood trim counter in front of portable desks for the administration staff. The casework appeared to be in fair condition; however, the reception counter was not handicap accessible. Replacement is recommended to accommodate accessibility.

The FACS room's casework is finished in plastic laminate. Overall the casework and counters were in fair shape. One station was found to be adjusted for wheelchair-bound persons. Each room should provide handicap accessibility.

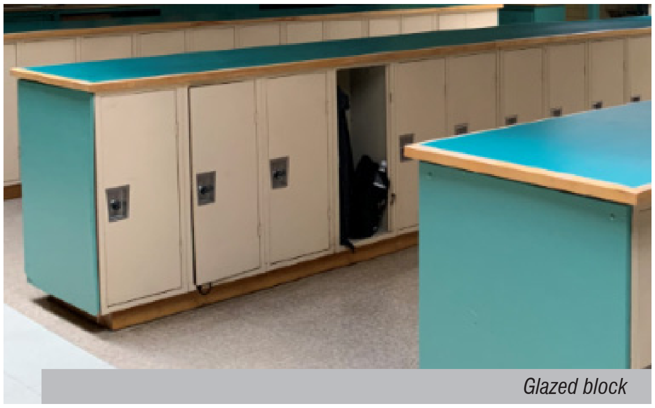


Ceramic tile damage



Ceramic tile damage

Glazed block



Glazed block

Visual Display Boards/Projectors/Screens
In the world of teaching, integration of technology in the school curriculum is continually evolving. Presently, there are a variety of delivery methods in teaching spaces. They range from projectors and laptops on carts with a pull-down screen, to ceiling mounted projectors with a pull-down screen. Some project onto whiteboards that require a non-glare surface. Other spaces have interactive boards (Projector and Eno Boards). The District's Technology Department, along with the Technology Committee, is continuously exploring the latest options and costs.

Consideration should be given to bringing all teaching spaces/walls up to the District's current teaching standards.

Doors and Hardware
Exterior doors are noted above in the Building Shell portion of this report.

Interior doors vary with finishes, vintage, and appearance. There was note of some doors having wired glass in them. Door hardware appears to meet modern day accessibly requirements. The handles to classrooms appear to have been installed in relatively recent years as they have classroom security function. Replacement of door panels should be considered. Standardization of finish appearance and material should be implemented during replacement. Any doors that do not meet ADA size requirements and handling should be updated during the replacement process.

General Code-related Items
Below are the code sections that are most relevant to this analysis:

- New Hampshire fire code or state fire code means the adoption by reference of the:
  - Life Safety Code NFPA 101, 2015 edition
  - Fire Code NFPA 1, 2015 edition
- New Hampshire building code or state building code means the adoption by reference of the:
  - International Building Code 2015
  - International Energy Conservation Code 2015
  - International Existing Building Code 2015
  - International Mechanical Code 2015
  - International Plumbing Code 2015
  - International Residential Code 2015
  - National Electrical Code 2017 (NFPA 70)

As amended by the state building code review board and ratified by the legislature in accordance with RSA 155-A: 10, per 155-A: 2 State Building Code.

I. All buildings, building components, and structures constructed in New Hampshire shall comply with the state building code and state fire code. The construction, design, structure, maintenance, and use of all buildings or structures to be erected and the alteration, renovation, rehabilitation, repair, removal, or demolition of all buildings and structures previously erected shall be governed by the provisions of the state building code.

II. To the extent that there is any conflict between the state building code and the state fire code, the code creating the greater degree of life safety shall take precedence.

Construction Type and Occupancy
NFPA 101 classifies the occupancy of this facility as mixed use of both:

- Existing educational (E): classrooms, art, kitchen, and offices/support spaces.
- Existing assembly (A): gymnasiums, cafeteria, Library and offices/support spaces. Per NFPA under Existing Educational; these spaces can be classified as Accessory Assembly, Offices and Storage.

Fire Protection System
Note: The sprinkler system covers the entire building. The classrooms into the corridors that are typically part of the means of egress need not be fire rated. They can be smoke resistant without closures. All other rooms adjoining the corridor are to be fire rated unless meeting other special requirements.

Typical adjoining spaces of different uses are required to have fire rated separation and with a future renovation, fire rated separations will depend on the final reconfiguration of the spaces. Refer to Fire Sprinkler Protection section of this report.

Life Safety Code NFPA 101

Dead-Ends – 15.2.5.2

No dead-end corridor shall exceed 20 feet, other than in buildings protected throughout by an approved, supervised automatic sprinkler system, in which case dead-end corridors shall not exceed 50 feet. The security gates used to separate public spaces from the classrooms creates a dead end corridor when closed. It is recommended these be replaced with pairs of doors on hold opens egressing towards the public areas. These could still separate the space while eliminating the dead end corridor. These would also be released in an emergency creating a better safety feature than exist now.

Travel Distance – 15.2.6

15.2.6.2 Travel distance to an exit shall not exceed 150 feet from any point in a building, unless otherwise permitted by 15.2.6.3 or 15.2.6.4.

15.2.6.3 Travel distance shall not exceed 200 feet in educational occupancies protected by an automatic sprinkler system.

International Energy Conservation Code 2015 – IECC

Section 101 Scope and General Requirements

101.4 Applicability:

101.4.1 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

This code was adopted by New Hampshire State Building Code Review Board and revised effective April 1, 2010. The code is designed to regulate new construction and new work, and is not intended to be applied retroactively to existing buildings except where existing envelope, lighting, mechanical, or service water heating systems are specifically affected by Section 101.4.3. This section addresses that the code does not affect existing buildings.

101.4.3 Additions, alterations, renovations or repairs.

This section simply states that new work must comply with the current requirements for new work. Any alteration or addition to an existing system involving new work is subject to the requirements of the code.

Accessibility Rules and Standards - ADA

General

Note: AB (Architectural Barrier-Free) Committee has amended the rules as they have expired. AB has adopted the 2010 ADA Standards as the AB Code. This coincides with the Department of Justice stating that as of March 15, 2012 the 2010 ADA Standards for Accessibility are to be used.

Below are the Rules and Standards that are applicable:

- 2010 ADA Standards
- 2015 International Building Code (IBC). (Accessibility scoping provisions which describe “what, where and how many”. Chapter 11 “control the design and construction of facilities for accessibility to physically disabled persons”)
- 2003 ICC/ANSI A117.1-03 standards: Accessible and Usable Buildings and Facilities. (Technical requirements which describe “how”)

New Construction and Alterations

35.151 New construction and alterations

(b) Alterations, (4) Path of Travel, (i) Primary functions. A “Primary functions” is a major activity for which the facility is intended. Areas that contain a primary function include, but not limited to, the dining area of a cafeteria, the meeting rooms in a conference center, as well as offices and other work areas in which the activities of the public entity using the facility are carried out.

STRUCTURAL ANALYSIS

Existing Structural System—General

Accessible structural roof framing was observed within the building to review the existing structure, record the framing arrangement of the structural system, and identify any structural concerns. Original structural construction drawings were also reviewed for the 1961 and 1995 additions to the building. The existing structural framing system was reviewed for conformance with the structural provisions for the 2015 International Building Code (IBC), and the 2015 International Existing Building Code (IEBC) and ASCE 7-10. The original construction drawings, as well as the site investigation conducted on February 27, 2019 was used to complete this evaluation.

For this structure, the 2015 IBC provisions stipulate a design flat roof snow load magnitude of 47 pounds per square foot (psf). This roof snow load is calculated by multiplying certain adjustment factors to the code-prescribed ground snow loads of 60 psf, based on the location, type, and use of the structure.

Current code also requires that structures be evaluated for possible drift snow loading conditions, in which the snow is anticipated to drift from a higher roof to an adjacent lower roof, resulting in higher snow loads on the lower roof against the wall between the higher and lower roofs. It is important to note that inclusion of snow drifting loads on lower roof areas was not typically considered for structures designed at the time this building was originally constructed. Except for the 1995 addition, the reinforcement of low roof areas is typically necessary to meet current code requirements.

To meet current code requirements, the roof framing must be capable of supporting the code specified roof snow load and the dead weight of the framing system.

The 2015 IBC identifies minimum live loads to be considered for a variety of building uses. These live loads are provided below:

FLOOR AREA	2015 IBC TABLE 16071.1
Classrooms	40 psf
Offices	50 psf
Lobbies	100 psf
Storage Areas (Light)	125 psf
Gymnasium Floor	100 psf

The IBC also identifies wind and seismic forces to be resisted by the structural framing system. These forces are determined through consideration of numerous criteria related to soil type, exposure, height, and structural system.

When evaluating an existing structure, it is important to note the structural system is not required to be capable of supporting current building code requirements unless renovations or alternations are made which impact the existing structure beyond specific thresholds.

Front entrance of Fairgrounds Middle School

Structural Framing System Description

The Fairgrounds Middle School was constructed in 1961 and was expanded with a 1995 addition to add classrooms, a media center, and a general fitness area. The school consist of four wings, three being identical and one larger. The identical wings have an open locker space in the middle of the wing and classrooms on either side. The larger wing supports the administration area as well as the gymnasium, cafeteria and kitchen, and technical classrooms. The four wings come together at a central octagonal art space. The 1995 addition added classrooms to the end of the classroom wings and near the cafeteria. The addition also included a media center between two of the classroom wings.

The roof of the classroom wings are constructed with long span metal deck that spans 28 feet between bearing walls and beams. Based on the deck designation on the original construction documents, this metal deck has a capacity of 67 pounds per square foot. The bearing walls are CMU block walls that divide the classrooms. The octagonal art room has a steel beam and column structure that supports a higher roof. The rooms around the art area have a steel deck roof that bear on CMU walls.

The roofs in the gym and cafeteria/band area were constructed of steel double angle trusses spanning 63’-8” and 57’-11” respectively with a 2 1/2” Tectum plank roofing. From field observations the joists have x-bracing that braces the top and bottom chords. The joists do not appear to have uplift bracing. The lateral bracing is not continuous to the bearing walls in the gymnasium and the cafeteria bracing was inaccessible during the visit. This bracing needs to be continuous to distribute lateral loads to the bearing walls. The locker room area adjacent to the gym and the kitchen have long span steel deck and CMU support walls similar to the classroom wings.

1995 Addition

This addition at the end of the classroom wings were gable-style wood framed roof joists bearing on CMU walls. The gable wood framed trusses have tie rods every 10 feet. The original construction documents provided did not include truss bracing details and the truss space was not accessed during the visit. There are mechanical rooms at the center of these additions. The mechanical rooms have steel columns and beams to support the roof and other equipment. These areas were not accessed as part of the visit.

The media center’s roof is supported by steel joists. The joists span between steel beams that are supported by steel tube columns at the exterior walls and the interior walls that divide the computer labs. The joists appear to have appropriate top and bottom chord bracing but appears to be missing uplift bracing. The media center has brace frames between certain columns to transfer lateral forces to the foundation.

A portion of an exterior wall was demoed for the general fitness area. Steel tube columns were added to support an existing lintel. The fitness area has a flat roof supported by steel joists that span between the end walls and a line of steel beams down the center of the area. The new classrooms near the cafeteria also utilize steel joists, but has a CMU bearing wall instead of steel beams dividing the spans.

Summary Of Findings

As a result of our limited site observations and field measurements, the major components of the structural framing systems were evaluated. The following summary of findings are provided:

Roof Structure

The original construction documents require the roof to be designed for 40 psf live load. Although all are that were analyzed as part of this study show capacities that meet current loads, there may be locations in this building that do not.

The flat roof areas supported by long span decking was evaluated using a Robertson Long Span Roof deck design guide circa 1960. The original construction documents call out 7 1/2” LS1-14 to span approximately 28’ over the classroom wings. In this configuration the long span deck will have a capacity of 67 pounds per square foot. A steel beam that spans over the locker section was marked on plan as a 14WF84. This beam span approximately 31’-4” and has a tributary width of 28’-4”. In this configuration this beam would have a capacity of 71 psf. This is sufficient to hold current flat snow loads.

Long span steel deck was used on the flat roof above the lobby. The deck was evaluated and was found to have a capacity of 82 psf. This part of the roof has higher roofs on two sides which result in snow drift to occur. The code prescribed drift load for this roof is 123 psf. It does not appear that this roof was designed for snow drift loads.

All of the sloped roofs were constructed of wood framed trusses were not evaluated as part of this study. From the construction documents provided for the 1995 additions, the roofs were designed using the 1993 BOCA code. The plans specified a ground snow load of 60 psf, top chord live load of 50 psf, bottom chord live load of 10 psf, and top chord dead load of 15 psf. The additions were also designed to have a max deflection of L/360.

The gymnasium roof deck was constructed of out of Tectum panels. These panels have a capacity of 50 pounds per square foot. This is sufficient to carry current snow loads.

All metal roof joists that were reviewed did not have the appropriate uplift bracing at the first panel point of the members.

Exterior

A visual review of the building's exterior was completed during the site visit. Areas that exhibited damage or deterioration are identified here.

1. Areas were observed where there was damage to the mortar around bricks.

2. Rusted Lintels were noted in certain locations around the building and are recommended to be repaired or addressed to avoid further deterioration and potential brick cracking above.

3. Concrete entry slab detail damage and exposed rebar caused by exposure and salt.

4. Cracking in existing mortar both horizontal and vertical

5. Minor to moderate cracks were noted in localized areas at the foundation.

Rusted Brick Veneer Lintels

Entry slab damage–front entrance

Mortar Spalling—Corner of Gymnasium

Entry slab damage–entrance near custodial room

Vertical crack

Horizontal crack

Foundation crack

MECHANICAL ANALYSIS

General

The existing Fairgrounds Middle School in Nashua, NH consist of a building that was originally constructed in the early 1960s (construction documents dates August 1961). A major classroom addition was done around the mid 1990s (construction documents dated October 1995). With the exception of the boilers, most of the HVAC systems were updated as part of the 1995 project.

The basic mechanical systems that were reviewed consisted of:

- boiler plants
- heating distribution
- temperature control
- air moving
- classroom heating and ventilating
- heating terminal units
- air conditioning components

Boiler Plant

The primary heating system is in the boiler room located in the basement. It consists of two, natural gas-fired, cast iron sectional hot water boilers which are Series 3 manufactured by Weil-McLain and are original to the building in 1961. The burners were replaced in 1995. The gross output rating for each boiler is 4,360 MBH. The boilers had their gaskets replaced 3 and 5 years ago. During the 1995 renovation, horizontal expansion tanks were replaced with floor mounted vertical tanks arranges so that 3 tanks serve each boiler. Each boiler is connected to an induced draft, utility set fan. Combustion air is supplied mechanically though a propeller wall fan ducted to a wall louver in an area-way.

It been reported that some spaces located above the boiler room overheat.

Heating Distribution

Two base mounted pumps, sized for 265 GPM and 66 FT-HD, circulate water in a lead/standby arrangement. The pumps are not connected to a VFD. Hot water pipes exit the boiler room through tunnels located under portions of the main building. A good portion of the piping in the trench appears to be uninsulated based on visual observation from the boiler room. It has been reported that certain areas of the building lack sufficient heat due to ample water flow. A small in-line circulator has been installed in the kitchen area to boost water flow to that area.

HVAC Systems

The classroom wings are heated, ventilated, and cooled with custom modular air handlers with hot water heating coils and DX cooling coils. Each air handler is connected to a dedicated outdoor air unit which utilizes a flat plate heat exchanger. The DX coils are served from a roof mounted condensing unit. Air is delivered to the classroom spaces through displacement diffusers. Additional classroom heating is provided by perimeter fin tube.

The core space in the classroom wing is heated and ventilated with a flat plate heat recovery unit with a hot water heating coil. Cooling in the core space consist of ductless split systems with wall mounted units.

The library is heated, ventilated, and cooled with a custom modular air handler with a hot water heating coil and DX cooling coil which is served from a condensing unit mounted at grade. Air is delivered to the library via exposed spiral ducts mounted high in the space. Additional library heating is provided by perimeter fin tube.

The administration area is heated, ventilated, and cooled with custom modular air handlers with a hot water heating coils and DX cooling coils which are served from condensing units mounted at grade. Air is delivered through ductwork to ceiling mounted diffusers. Additional heating is provided by perimeter fin tube.

The gym is heated and ventilated with a custom modular air handler with a hot water heating coil. Air is delivered to the gym via exposed spiral ducts mounted high in the space.

The cafeteria is heated, ventilated, and cooled with custom modular air handlers with a hot water heating coil and DX cooling coil which is served from condensing units mounted on the roof. Air is delivered to the space via exposed spiral ducts mounted in the space.

Other classroom spaces such a cooking lab, industrial arts, and music are heated, ventilated, and cooled with custom modular air handlers with hot water heating coils and DX cooling coils which have condensing units on the roof. Supplemental perimeter fin tube provides additional heat. The cooking lab has residential style range hoods which are ducted directly to the outside.


Base mounted pumps


Uninsulated heating and domestic trench piping

The kitchen contains three exhaust hoods on of which is inactive. The main kitchen hood is an island type hood manufactured by Halton. It's a "Capture Jet" system which injects room air into the hood with an in-line fan to induce capture velocity. The other active hood serves the dishwasher. Make-up air is transferred from the adjacent cafeteria. A hydronic unit heater provides heat for the kitchen with perimeter fin tube for surrounding support spaces.

Mechanical System – HVAC Controls

There is a mixture of pneumatic and DDC control. The compressor is located in the boiler room. Perimeter fin tube radiators are controlled using pneumatic actuators. The air handlers use DDC for VFD, damper, and hot water control.


One of two existing Weil-McLain boilers

PLUMBING ANALYSIS

General

The existing Fairgrounds Middle School in Nashua, NH was constructed in two phases. The original building was constructed in the early 1960's. The building experienced a major renovation with additions that was constructed in the mid-1990's.

Domestic Water Service

The water service enters the boiler room. A 4" ductile iron pipe enters the basement. The 4" pipe splits to two 2" copper lines. One line has two shut-off valves in the closed position as a bypass of the water meter. The other line serves the 2" water meter. The two lines manifold together and connect to two 2" Reduced Pressure Zone backflow preventers in parallel. A boiler feed line with an independent reduced pressure zone backflow preventer is mounted overhead above the water meter. The backflow preventers look to be within two years old and are lead-free models. Water pressure to the building has a static pressure of 45 psi. None of the three BFPS are piped down to a floor drain. In the event of a release of water from a backflow preventer, water will splash a large area and the water will eventually find its way to a floor drain.

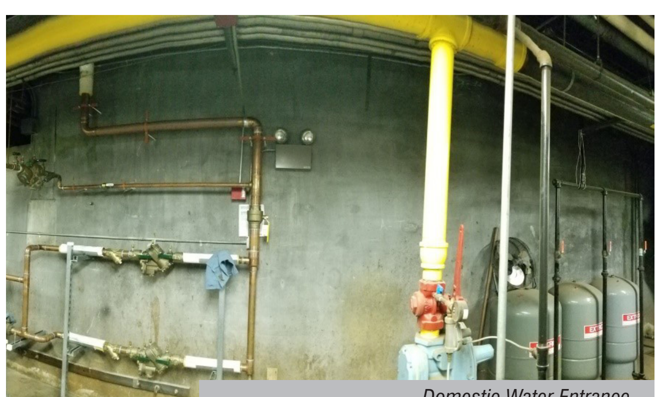
Domestic Hot Water

The domestic water heating consists of a copper finned water heater mated to a vertical storage tank. The water heater is a RAYPAK, with natural gas fired with 728 MBH input. The unit was installed in 2009. The unit can develop 721 gallons per hour at 100°f rise. The unit has an efficiency rating of 82% Hot water from the water heater is stored in a 250 gallon (estimated) vertical storage tank. The tank temperature is maintained at 130°f.

Two circulating pumps recirculate hot water to the kitchen and the remainder of the building to maintain hot water temperature in the piping. The kitchen circulator is an older bronze Taco model. The building circulator is a new stainless-steel Taco model. The water heating system is oversized for the facility, with nearly 1,000 gallons of first-hour demand available. Unused showers greatly reduce the need for hot water from the system. Hot water is delivered to the building at two temperatures. 130°f hot water is delivered to the kitchen directly from the storage tank. Note: Pipe labels on the kitchen piping are marked 140°f. The remainder of the building is served with 120°f hot water through a master thermostatic mixing valve.

The mixing valve is a 1-1/2" Honeywell model MX129C. The unit has some surface corrosion from a past leak at the union, at the top of the valve. The mixing valve is not a lead-free model. The mixing valve should be replaced with a lead-free model of the same size.

There is a large abandoned hot water storage tank (estimated at 1,000 gallons) mounted on a stand along the wall. The piping has been disconnected from the tank. The tank and connected piping should be removed back to the active piping.



Domestic Water Entrance

2" Backflow Preventer

Gas Fired Water Heater

2" Water Meter

1-1/2" Thermostatic Mixing Valve

Gas Fired Water Heater and Vertical Storage Tank

Abandoned Hot Water Storage Tank

Natural Gas

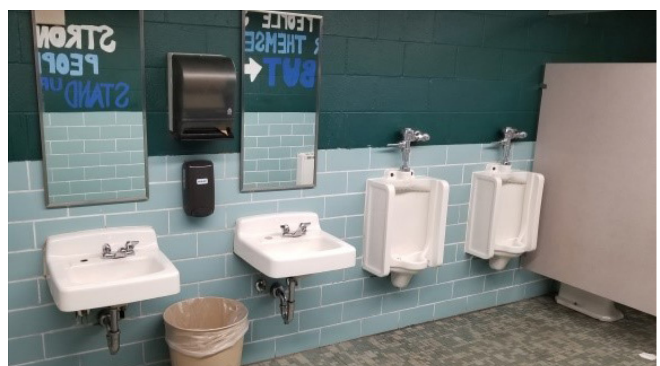
The building is served by Natural Gas supplied by Liberty Natural Gas. The gas service is located outside the boiler room. The gas service enters the building at a 7” water column. The meter has a capacity of 5 Million BTUH. The piping is in very good condition. It is believed that the gas piping was installed in 1995. No issues were found with the piping installation.

- Gas Meter: The meter is a Roots Model 5M175. The meter operates and delivers 2 PSI pressure downstream of the pressure regulator to the building.
- Boiler #1: 4,360 CFH/MBH
- Boiler #2: 4,360 CFH/MBH
- Boiler Room Water Heater: 728 CFH/MBH
- Kitchen Equipment (Estimated): 501 CFH/MBH
- Total Connected Gas Load: 9,949 CFH/MBH or 9.95 Million BTUH

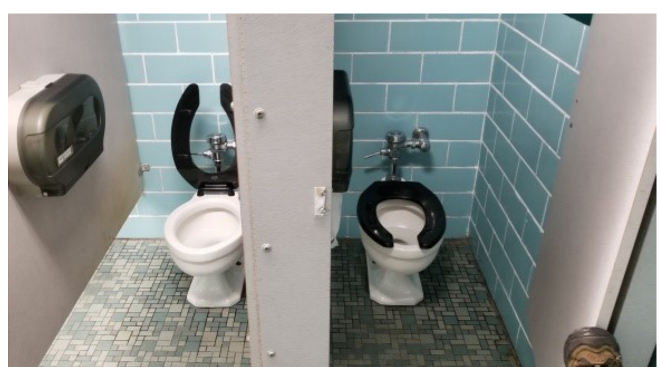
Natural Gas Service Entrance

Restrooms

The restroom fixtures are 1962 vintage, except in a few instances. The toilets are a mix of floor-mounted and wall hung models. The existing fixtures use much more water than the water saving fixtures now required by law. The nurse’s room and retrofitted ADA stalls have new fixtures. Some upgrades to the restrooms were made in 1996 to replace the faucets and flush valves on existing fixtures. In the 23 years following, it is assumed repairs have been made to some fixtures, faucets, and flush valves on an as-necessary basis. Two restrooms (one Girl’s and one Boy’s) have been modified to provide ADA compliant access.



Typical Boy’s Restroom (non ADA Compliant)



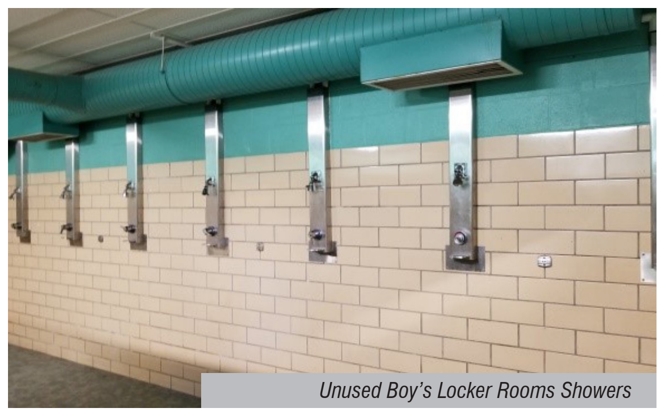
Typical Boy’s Restroom (non ADA Compliant)

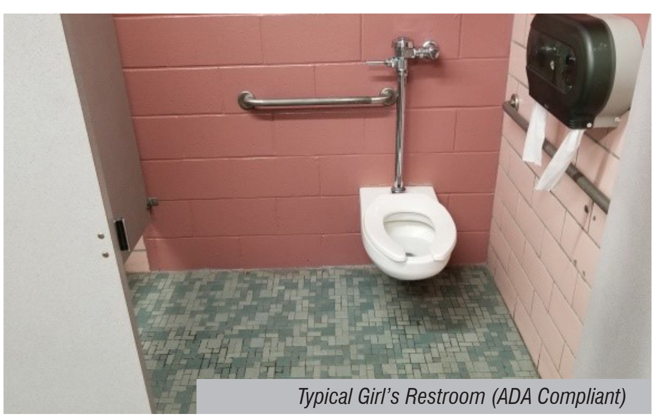
EXISTING CONDITIONS/FINDINGS (CONT.)—FMS
SECTION 2: FACILITY ANALYSIS


Typical Girl's Restroom (non ADA Compliant)


Typical Girl's Restroom (ADA Compliant)


Typical Girl's Restroom (non ADA Compliant)


Unused Boy's Locker Rooms Showers


Typical Girl's Restroom (ADA Compliant)


Boy's Locker Room (No privacy partition)

Custodial Rooms

The cast iron service sinks located in the custodial rooms are 1962 vintage. The rim of the sink is approximately 26" above the finished floor. These sinks were the standard at the time. The new standard is a floor-mounted mop basin which has a low lip of 6" above the finished floor and a rim of 12" above finished floor. The existing service sinks make it difficult for the staff to empty heavy water buckets or to drain the floor washing machines.

Life Skills

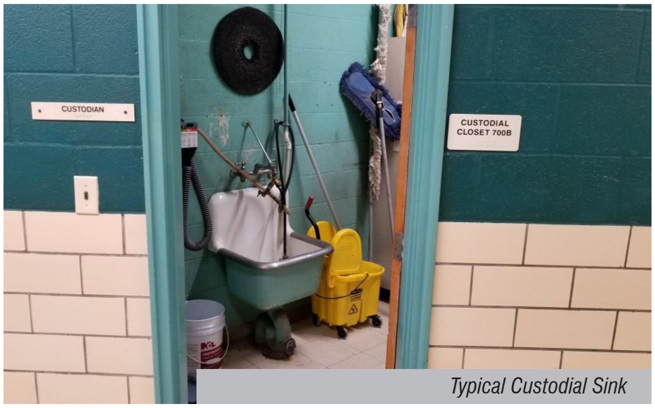
The life skills rooms have six gas ranges. Using open flames in classrooms is of concern for student use. Typically, ranges are electric to eliminate the open flame hazard. If gas is preferred to remain, safety measures should be implemented to automatically turn the gas off in the event of a fire alarm condition. At least one station in the room has been converted for compliance.

Science

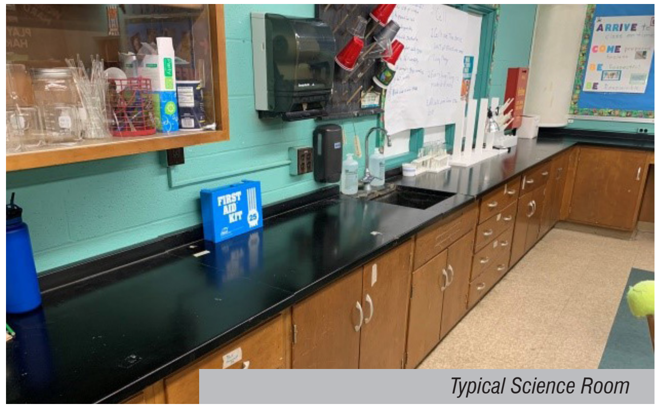
The Science rooms have epoxy resin sinks and counters. The sinks have goose-neck spouts with hot and cold water faucets with lever handles. The sinks are not ADA compliant.

Art

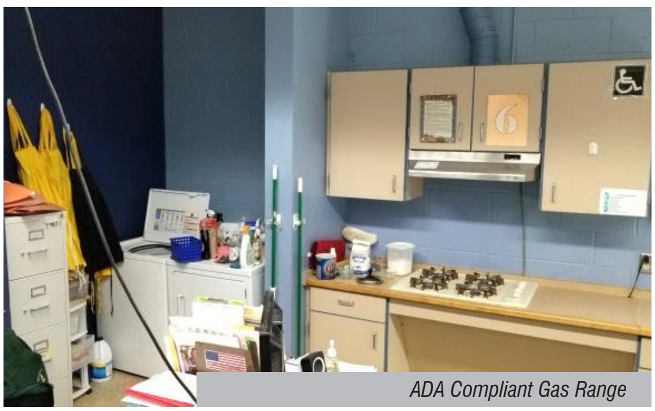
The Art rooms have one large vitreous china wall hung sink. The sinks are in good condition. The sinks are not ADA compliant. Each sink has a solids interceptor trap on the waste piping.



Typical Custodial Sink



Typical Science Room


ADA Compliant Gas Range

Typical Science Sink


ADA Compliant Sink


Typical Art Room Sink with Solids Interceptor

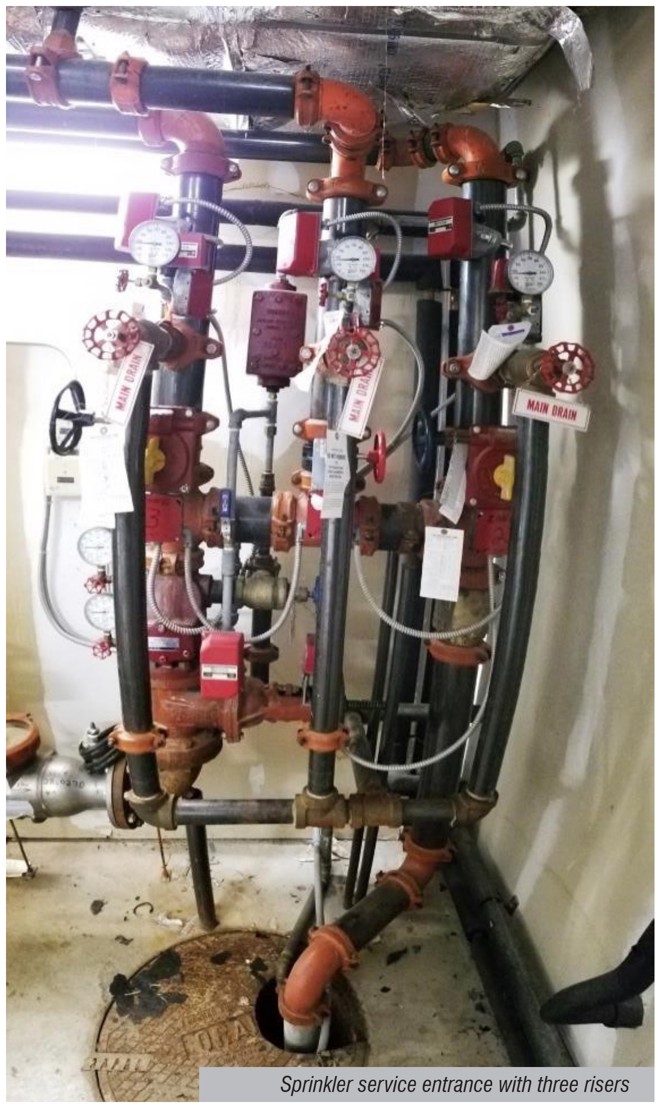
FIRE PROTECTION ANALYSIS

Fire Sprinkler Service

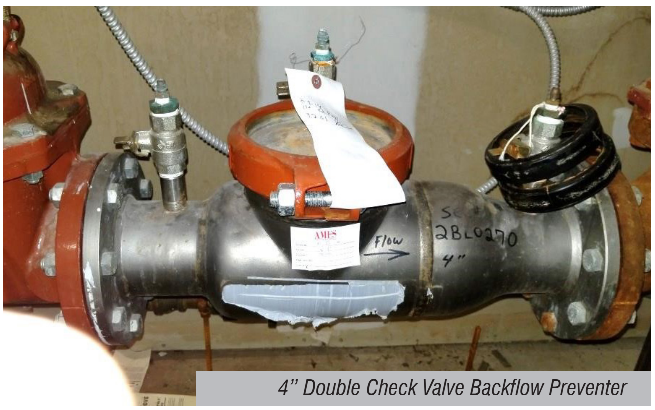
The existing Fairgrounds Middle School in Nashua, NH was constructed in two phases. The original building was constructed in the early 1960s. The building experienced a major renovation with additions that was constructed in the mid-1990s.

The sprinkler system was installed in the mid-1990s. Three wet pipe riser valves serve all areas of the building. The static pressure at the base of the risers on the day of the survey was 50 psi. The test cards indicate a static pressure of 60 psi. It appears the sprinkler piping and calculations were produced with 60 psi incoming static pressure or higher. The design calculation labels on the piping indicate a required pressure for each protected zone between 48 and 53 psi flowing pressure. At a static pressure of 50 psi, the system will not flow water to the design areas at the calculated rate.

A large portion of the building has exposed sprinkler piping and sprinklers. Depending on the piping installation, the sprinklers are both pendant and upright style. The sprinklers in finished spaces are standard response, chrome-plated with metal fusible link operation. The sprinklers are approximately 25 years old. Sprinklers need to be tested when they are 50 years old.



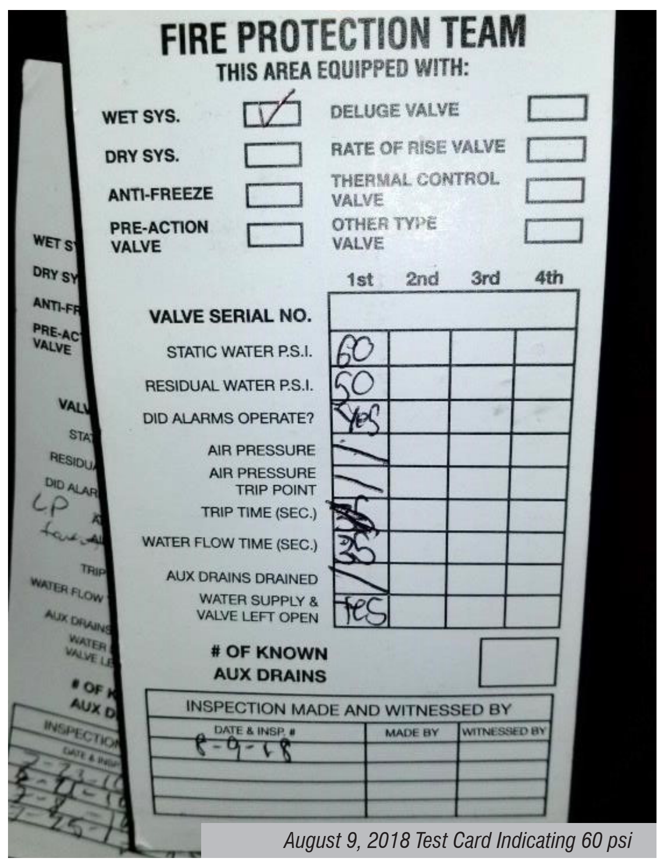
Sprinkler service entrance with three risers


4" Double Check Valve Backflow Preventer


Spare Sprinkler Head Cabinet


Zone 2 & 3 Pressure Gauges at 50 psi


Zone 1 Pressure Gauges at 50 psi



August 9, 2018 Test Card Indicating 60 psi

ELECTRICAL ANALYSIS

General

The existing Fairgrounds Middle School in Nashua, NH was constructed in two phases. The original building was constructed in the early 1960s. The building experienced a major renovation with additions that was constructed in the mid-1990s.

The basic electrical systems that will be reviewed consist of:

- Electrical Service Entrance Equipment
- Portable Emergency Power System
- Lighting and Power Panelboards
- Interior Lighting
- Exterior Lighting
- Lighting Controls
- Emergency Egress Lighting
- Classroom Power Outlets
- Fire Alarm System
- Security Systems (CCTV, Intrusion Detection and Access Control)
- Intercom/Public Address System
- Data Infrastructure
- Overall Recommendations for Proposed Building Additions and Renovations

Electrical Service Entrance Equipment

Fairgrounds Middle School is served by a 300kVA pad mounted transformer located behind the building near the Kitchen and Boiler Room entrances. Primary / Utility Co. overhead lines enter the property overhead from Wilson Street through a patch of woods separating the school from a residential neighborhood to a riser pole located opposite the paved parking / fire road from the pad-mounted transformer and building, then run underground to the pad-mounted transformer. Metering is provided at the transformer pad. Maximum demand for this service in the past twelve months is reported to be 299kW (approximately 330kVA / .90pf)—approximately 2.8VA/ft^2. The pad mounted transformers are owned by the city of Nashua.

The building is served by a single service entrance main distribution switchboard (MDP). The MDP is a Square-D QED2, 120/208V, 3Ø-4W service entrance main distribution switchboard with a 2,000A main breaker. The Main and "Normal" Distribution Sections have a 2,000A bus rating and the "Emergency" Distribution Section has an 800A bus rating. MDP is located in a dedicated sub grade electrical room, located adjacent to the boiler room.

Besides the building, MDP also serves the adjacent illuminated sports field. MDP is made up of three sections:

- Main Section (2,000A)–houses the feeders entering from the pad mounted transformer and main breaker.
- "Normal" Distribution Section (2,000A)–houses distribution breakers feeding panelboards not backed up by the portable generator.
- "Emergency" Distribution Section (800A)–houses distribution breakers feeding panelboards backed up by the portable generator.

In place of a transfer switch, there is an 800A breaker in the "normal" Distribution Section that feeds the "Emergency" distribution Section and an 800A breaker in the "Emergency" Distribution Section that receives power from the portable generator (when connected). These breakers are equipped with Kirk Key Interlock devices that prevent a generator from energizing the Utility Co. lines when connected.

MDP was installed in the mid-1990s and appears to be in good serviceable condition. MDP contains a variety of breakers which feed downstream panels and mechanical and sports fields. There is "SPACE" available for additional breakers.

MDP is capable of providing a maximum of 576kVA (or 4.85VA/ft^2 based on the buildings existing square footage).

The pad mounted transformer, Main Distribution Switchboard (MDP) and associated secondary feeders will require upgrading to accommodate proposed loads.

*Pad Mounted Transformer –
Meter and Portable Generator Connection in Background*

Main Distribution Switchboard - MDP

*Circuit breakers feeding the "emergency" distribution section with
Kirk Key Devices Typical Art Room Sink with Solids Interceptor*

*Circuit breakers feeding the "emergency" distribution section with
Kirk Key Devices Typical Art Room Sink with Solids Interceptor*

Portable Emergency Power System

Provisions to connect a portable generator are located on the building exterior outside the kitchen (see image above). The generator can power the “emergency” distribution section of MDP which feeds twelve of the buildings’ panelboards.

Lighting and Power Panelboards

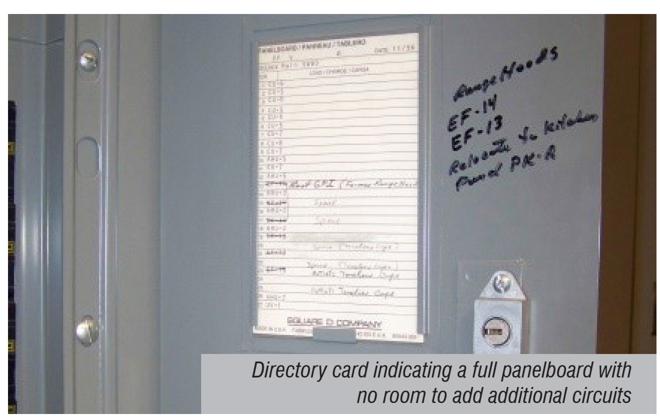
Lighting and power panelboards are located throughout the facility. Panelboards observed were either full or nearly full (no room to feed additional circuits). Load centers have been placed adjacent to existing panelboards in some locations to accommodate additional circuits. Most all panelboards are located outside areas of student access, mostly located in janitor’s closets or mechanical spaces.

Most panelboards observed were either Federal Pacific or Square-D. Federal Pacific panelboards appear to have been in place since the original building was constructed in the early 1960’s, the Square-D panelboards were installed as part of the 1990’s renovation and additions. The original Federal Pacific panelboards have been in service beyond their serviceable life, some have labeling indicating that breakers are failing.

While electrical equipment can continue to serve a facility much longer, general accepted life expectancy of electrical equipment is 30 years.

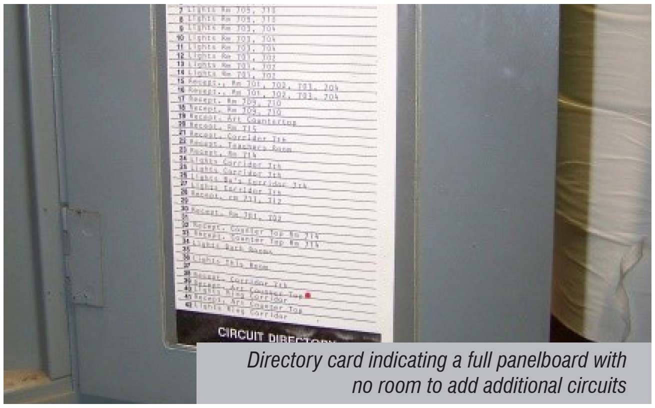
/ Add additional panelboards and/or replace panelboards with tubs containing larger quantities of circuit breakers to allow additional circuits as needed.
/ All Federal Pacific panelboards need to be replaced. Feeders serving each of these panelboards should be considered for replacement as the feeders are almost 60 years old.
/ Any panelboards located in student accessible locations should be relocated to areas of no student access.

Typical Square-D panelboard installed in the 1990’s renovations and additions

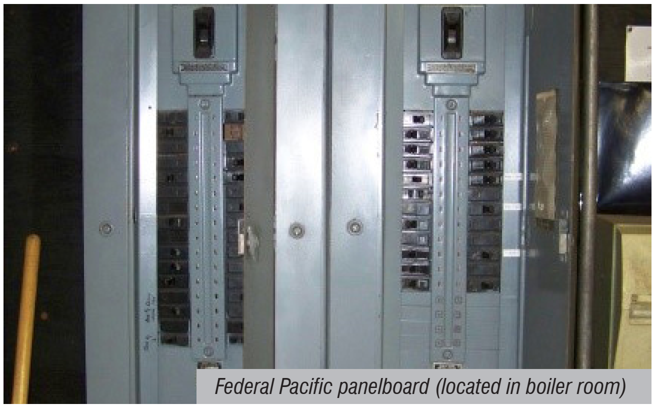


Directory card indicating a full panelboard with no room to add additional circuits

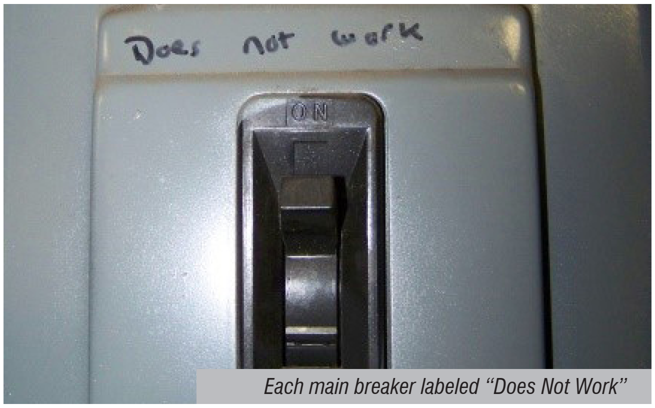
Typical Federal Pacific panelboard installed in the early 1960's



Directory card indicating a full panelboard with no room to add additional circuits



Federal Pacific panelboard (located in boiler room)



Each main breaker labeled "Does Not Work"

One of few panels located in an area with student access.

Load center located adjacent to panelboard LA-R to accommodate additional circuits.

Interior Lighting

In general, lighting is in fair to good condition. Lighting fixtures exist using both fluorescent and LED technologies. Lighting levels throughout the building were adequate. Corridors and Gymnasium lighting have been upgraded to LED, fluorescent remains elsewhere.

- / Lighting fixtures could be replaced with energy efficient LED fixtures. Lighting fixtures with higher light outputs could be chosen to brighten corridors as needed.
- / There are often energy incentives available through the utility company to assist with the cost of energy efficient upgrades.

Exterior Lighting

Exterior lighting is mainly wall-mounted LED fixtures. Under canopy lighting fixtures appears to be HID. Lighting at the front of the building in the drop-off loop is minimal, with the driving area and walkways having no lighting at all.

- / Additional lighting is needed in the parking and drive areas.

Lighting Controls

Lighting is currently controlled via wall mounted switch for most interior spaces with time clocks for exterior lighting.

- / The state of New Hampshire currently enforces IECC 2015 (International Energy Conservation Code).
- / The energy code requires automatic “off” of all lighting not required for safety or security. This can be accomplished with occupancy sensors, centrally located lighting control relay panels, time clocks and/or distributed lighting controls.
- / Energy code also requires switching of lighting within “daylight” areas be controlled separately from lighting outside these areas.
- / Provide occupancy sensor control with local toggle switches to comply with state energy code.

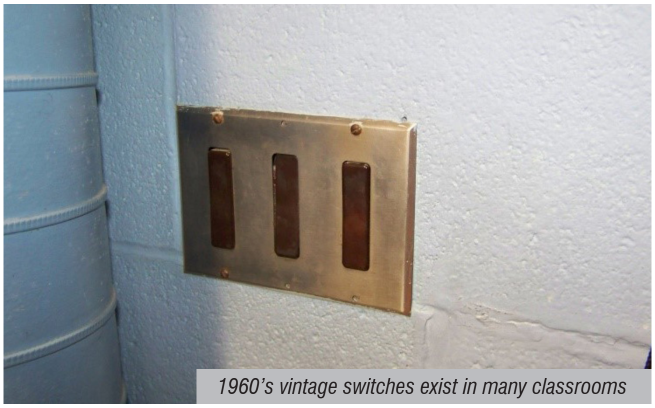
Typical Corridor Lighting in 1960's Building - LED


Typical Classroom in 1990's Addition - Fluorescent


Typical Classroom Lighting in 1960's Building - Fluorescent


Exterior Building Mounted Wall Pack - LED


Typical Corridor in 1990's Addition - Fluorescent


1960's vintage switches exist in many classrooms

Emergency Egress Lighting
Emergency egress lighting is achieved with a self-contained emergency battery units and battery units with remote heads. Exit signs are of the self-powered, internally illuminated. There is no emergency egress lighting outside the building. NFPA requires emergency lighting to a "public way" outside the building.

Emergency Egress lighting did not appear to be spaced to provide the NFPA average foot-candle levels and you could not always view two exit signs.

No egress lighting was observed in the "Shop" classrooms.

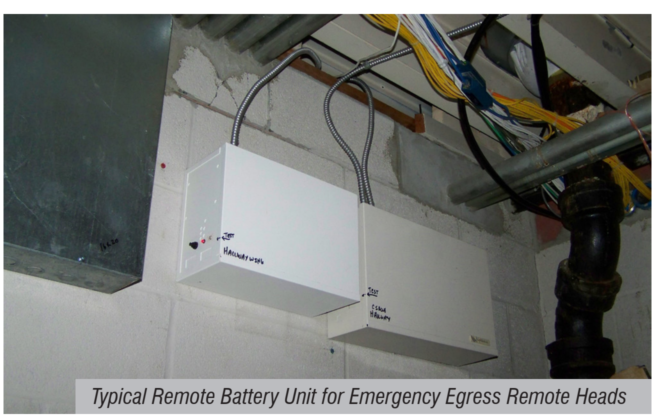
- Provide additional and replace existing emergency battery units to provide the code required egress lighting levels.
- Add exit signs as necessary so there are always two paths to egress.

Classroom Power Outlets
There are wall-mounted grounded outlets located throughout the building; however, many classrooms observed had minimal receptacles. This raises concerns that as the use of technology proliferates, it will overtax the circuit distribution to those areas.

- Add receptacles to facilitate needs.

Typical Exit Sign


Typical Remote Heads – Neither pointing down corridor standing in


Typical Remote Battery Unit for Emergency Egress Remote Heads

Fire Alarm System
The fire alarm system is a Notifier AFP-400. Smoke detectors, notification appliances and pull stations are located throughout the building. Generally, coverage of notification appliances is inadequate. Typical classrooms area missing notification. In the event of an alarm, the system reports directly to Nashua monitoring / dispatch facility via the city loop system.

There is currently no “Ansul” system for each of the ranges for the Fire Alarm System and the Fire Alarm System does not shut off power to the ranges located in the Family and Consumer Science Classroom.

- / Replace the existing Fire Alarm System with new throughout with a full voice evacuation system.
- / Recent changes in NFPA requires voice evacuation throughout educational facilities.

Security Systems (CCTV, Intrusion Detection and Access Control)
The school is served by an S2 Security System installed by Securadyne Systems. The system encompasses video surveillance, access control, panic alarm, and intrusion detection. Surveillance cameras are installed at various locations throughout the building and mounted to the exterior of the building. The motion detector system is IP based with remote monitoring and control capabilities and an integral Network Video Recorder (NVR). The system has some expansion capabilities should additional devices need to be installed.

Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since the installation of the surveillance system. At a minimum, we recommend replacing existing and adding new exterior and interior cameras.

- / Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since the installation on the surveillance system. CCTV cameras should be upgraded and many should be added to the interior and exterior of the building, covering the entire building

Fire Alarm System Control Panel

Typical Interior Camera Above an Exit Sign perimeter and parking, corridors, lobbies, cafeteria, gymnasiums, and courtyard.

- Access control is limited and the main administration office has no direct contact with the main entrance. An AI Phone allows the administration office to communicate with someone at the main entrance and allows them to enter the building. This building has the benefit of having a single main entrance.
- Currently there is no way for anyone to know that the building perimeter doors are closed and/or locked, creating an insecure building. Electronic locks should be provided at all main entrances that are controlled by the main administration office to control access to the building during the school day. Door contacts should be provided at all perimeter doors to ensure visitors are forced to enter the building at the main entrance so the main administration office can control access during school hours.

Intercom/Public Address System

The Intercom/Paging System was upgraded to a Bogen MultiCom-2000. Only the head end equipment was upgraded, the existing wiring and speaker system was reused. Using the existing wiring requires using the shielding conductor to make the system work, this is believed to be causing some of the issues experienced.

- Wiring should be replaced throughout and speaker placement evaluated to cover any areas lacking coverage.

Data Infrastructure

Data cabling throughout the building does not meet current industry standards. Most current installations are provided with Cat 6A cabling. The most recent renovation Harriman had involvement with was the Sunset Heights school in 2015. The Sunset Heights project used Cat 5E. The quantity of communications drops throughout the building are low relative to most middle schools and the quantity of drops requested at the Sunset Heights project. Communications racks observed are

Typical Interior Camera

Security System Head End

wall-mounted, had little to no space to accommodate additional patch panels or switches, and are not in rooms dedicated to IT.

- To accommodate future needs, floor mounted communications racks should be provided in rooms dedicated to IT.
- Replace and upgrade cabling, jacks, patch panels, and switches to current standards.
- Provide additional drops as required to accommodate the requirements of today and the near future.

Typical Exterior Camera

Typical Communications Rack

SITE ANALYSIS

General

Evaluation of the site at Pennichuck Middle School, located in Nashua, NH, involved walking around the school and grounds, and making observations of existing site features. Photographs were taken to document these existing conditions. The goal of the study is to look for deficiencies and to gather relevant information on the conditions of the site. Included is an evaluation of the surface drainage and associated infrastructure, evidence of erosion from stormwater runoff, and existing site circulation and parking, including observations associated with Americans with Disabilities Act (ADA) access from the adjacent streets and the parking areas to the building.

Existing Conditions

The school is located in an urban residential neighborhood, bordered on two sides by Manchester Street to the west and Henri A. Burque Highway to the south. The entrance to the Pennichuck Middle School is located parallel to Ferry Road, where it meets into Manchester Street, creating a four-way intersection with stop signs at Ferry Road and the school exit. There is green space found in small areas, or courtyards, surrounding the school building, along with a large green space, consisting of athletic fields (baseball field, track, tennis courts, etc.) to the northeast of the school. During the time of the site visit, most of these areas were snow-covered.

Google Earth image dated April 22, 2018

Site topography is relatively flat, sloping very gradually and generally in a direction from east to west. The main entrance off of Manchester Street features three lanes, one for incoming traffic, two for outgoing traffic. Internal site circulation continues with a one-way paved drive to the right (southerly direction) which leads to two on-site modulars with ADA ramps, and continues as a one-way drive around three sides of the school (western, southern, and eastern-facing). The majority of the site parking is located to the south of the school, which leads to a main entrance for the school. Additional parking is located north of the school.

View of athletic fields looking east

School entrance/exit onto Manchester Street

Parking located north of the building

Parking located south of the building

Potholes and eroded pavement area

The pavement throughout the site appears to generally be in fair condition, with noted exceptions. Observations of the pavement included numerous potholes, large cracks, and various areas of differential settlement. The pavement surrounding existing manholes and drainage infrastructure in particular appeared to be in poor condition.

Each of the paved parking areas appeared to mostly have clear paint markings, including handicap markings. Other on-site paved areas that are not lined for parking, were still utilized as such at one of the main school entrances (south-facing). At the time of the site visit, a few vehicles were observed to be parking on the concrete walk area leading to what appeared to the entrance (see photos below). Harriman conducted the visit during school vacation hours, so it is unclear whether this is a regular occurrence.

Observations of the existing vegetative areas located within the athletic fields and on the outside of the building was limited due to the snow cover on the grounds. The amount of drainage infrastructure observed on the site was limited to the pavement due to the site conditions and overall snow cover throughout the site. In general, the observed catch basins and drainage manholes appeared to be in fair condition. Differential settlement and pavement cracking appeared surrounding some of the structures. In the southwestern portion of the school site, there appeared to be a stormwater detention pond, as this area was depressed in elevation from the surrounding areas.

Other observations made during the site visit included fencing, signage, lighting, ADA accessibility, and location of items, such as dumpsters and recycling containers. Perimeter security fencing borders the majority of the site and appeared to be in good condition throughout. Signage for the site includes general/informational school signage, one-way, no parking, “do not enter,” no loitering, and handicap and visitor parking signage. The two ADA handicap parking spaces in the southern parking area do not have signs, but are instead painted to signify their purpose.

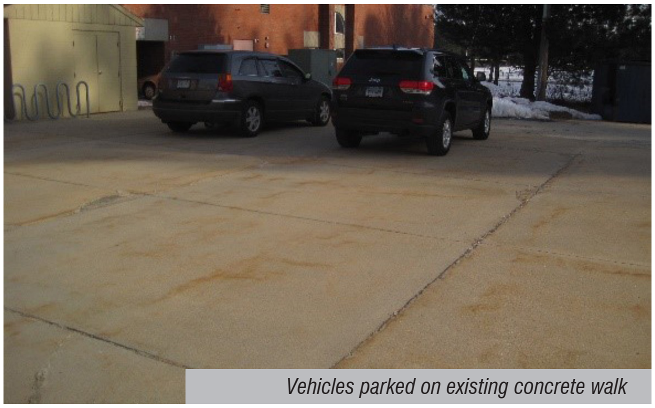
Differential settlement and cracking around manhole

Pavement damage/cracking observed

Large pothole within roundabout/loop area

Painted crosswalk leading to athletic fields

Catch basin settled and surrounding pavement cracking



Vehicles parked on existing concrete walk

Site lighting in northern parking lot area

Catch basin settled, pavement cracking, and puddling

Perimeter security fencing along northern lot

The dumpster and recycling container were located near the southern entrance of the school. The dumpster was located on top of a concrete pad foundation, alongside a recycling container. However, the recycling container was not properly situated upon the pad (see photo).

The school also has access for entering the property via a pedestrian bridge over Henri A. Burque Highway. The bridge spans over the highway and then connects to a paved walkway that appears to meet ADA accessibility standards (unconfirmed). The paved walk is constructed in a cross slope path before connecting to the existing southern parking lot, where its termination meets with a crosswalk to connect to the school's southern entrance. In the middle of the path's cross-slope path, there is a trench drain that should collect stormwater from the paved path, but appears in disrepair and full of soil sediment. Other areas surrounding this walk appear to have some erosion, but remains in fair condition.

ADA accessibility appears to be sufficient throughout the property with appropriate ramps onto sidewalks from the ADA parking spaces. Most doorways observed have accessible routes to entrances.

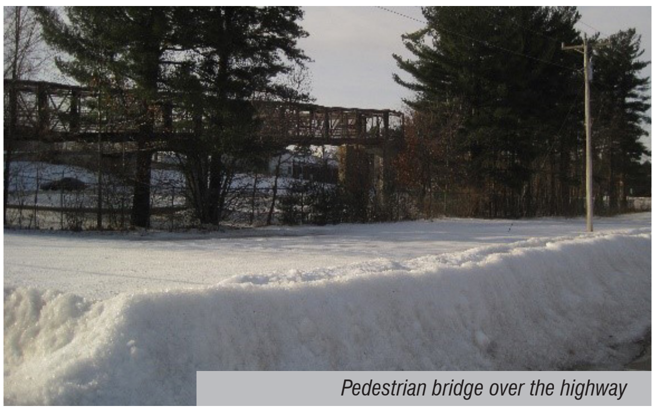
"No Parking" sign at access drive near athletic fields

Dumpster and recycling container near entrance


"Do Not Enter" signage and site lighting


Recycling container located partially on concrete pad

EXISTING CONDITIONS/FINDINGS (CONT.)—PMS
SECTION 2: FACILITY ANALYSIS


Pedestrian bridge over the highway


Trench drain in paved walk filled with sediments


Paved walk cross-slope construction to pedestrian bridge


Paved ADA ramp into existing school entrance


Minimal erosion noted and connection to entrance


ADA ramp into existing modular building

ARCHITECTURAL AND CODE ANALYSIS

General Architectural Overview

The original building was built on the site at the corner of Manchester Street and Henri A Burque Highway (Route 3) in Nashua, New Hampshire in approximately 1988. The single-story building consists of sloped roofs with trusses supported by bearing walls, as well as areas with "flat" roofs with framing spanning to bearing walls.

The building is currently configured with classroom wings that branch out from a central corridor area. Inside the central corridor space are supporting teaching spaces such as the library and resource rooms. Opposite the classroom wings are supporting programs and spaces like the kitchen, cafeteria, administration, STEM, industrial arts, and the gymnasium. The boiler room and electric room are between the kitchen and the industrial arts area of the building, opposite the classrooms wings. Storage areas are generally spread throughout the building, but the bulk of them reside near the cafeteria and on a mezzanine above the locker rooms that support the gymnasium.

Referencing the original construction documents and walking through the existing facility, it does not appear that many major architectural renovations or additions have been made to the building since the original construction in or around 1988. Minimal adjustments to spaces have been noted, like creating additional work spaces and offices in larger designed spaces, the removal of a ramp in the original general vocal music room, and the ELL room. The biggest modification noted was the removal of the stage and General Instrumental Music Room components to create a larger cafeteria space.

Two modular buildings were leased and placed on site in 1999 and later purchased. Each modular consists of two classroom spaces, for a total of four classroom spaces in the modular. The modular buildings do not share any physical connectivity to the main building, so students must exit the building in order to enter the modular.

Generally speaking, the facility appears in architecturally sound condition and has clearly benefited from maintenance. Below is our more in depth assessment of the building.

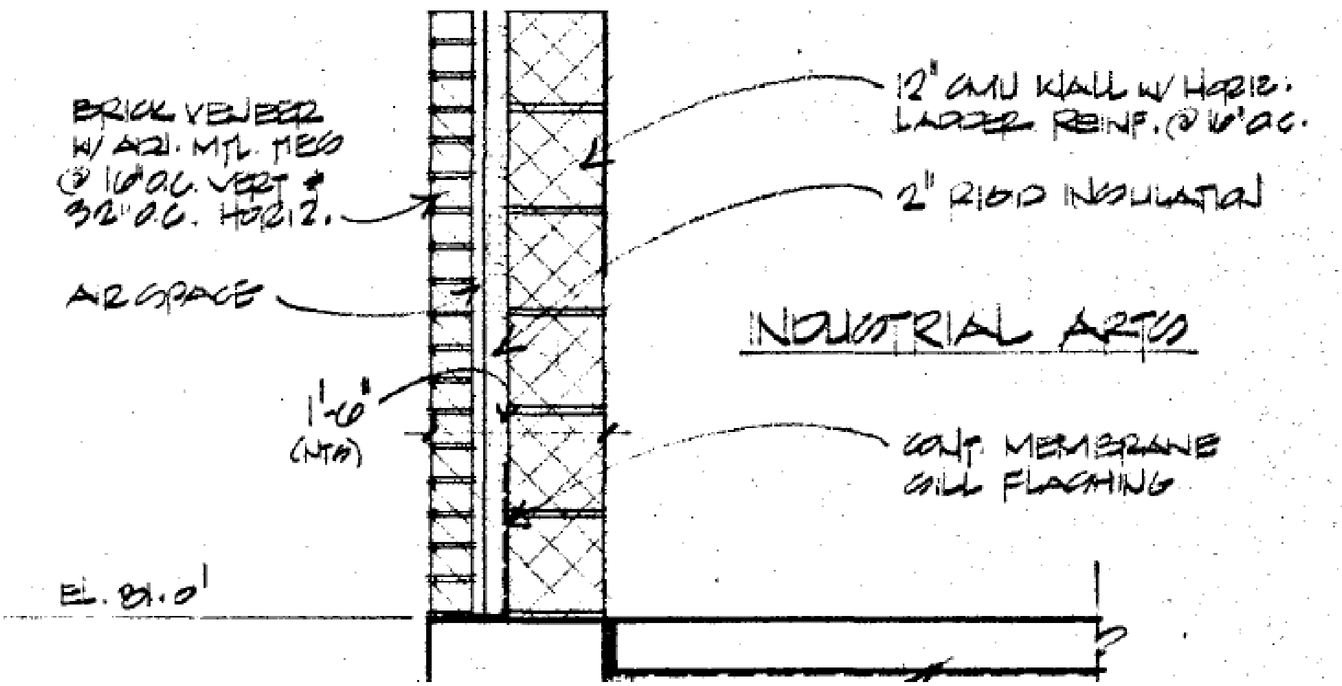
Building Shell

Exterior Walls and Façade

The exterior of the building consist mostly of a brick and split-faced block veneer. Other materials present are precast concrete sills, banding, and lintels; metal wall panels; metal flashings and roof edges; and plywood fascia at pitched roof areas.

The wall construction generally appears to consist of brick veneer, an air space, and 2" rigid insulation over a CMU bearing wall. No evidence of any air vapor barrier was observed in the exterior wall system. Walls were noted to be 1'-6" at 12" CMU locations and 1'-2" at 8" CMU locations.

Most brick and mortar joints appear to be in good condition overall. Brick weeps were noted at the base of the brick and above windows around the building. The majority of brick and CMU veneer located at ground level under pitched roofs were noted as heavily soiled. A proper thorough cleaning could alleviate any visual impurities and aesthetics. Although not prevalent everywhere around the building, some efflorescence was noted in a few areas of the building on the brick. It was most notably seen on the northeast side of the building. Efflorescence of brick usually occurs when moisture exists behind the brick and the moisture pushes the salts that are naturally in the brick and joints to the surface. A proper cleaning of these surfaces can typically alleviate any current visual concerns. In instances where the building lacks an air vapor barrier or weather tends to breach the wall system, reoccurrence can potentially happen. There was some evidence of missing sealant at brick expansion joints. Regular inspections of sealants should be done and upkept, should the inspections warrant it. Any missing sealant at joints should be filled to prevent infiltration of weather.

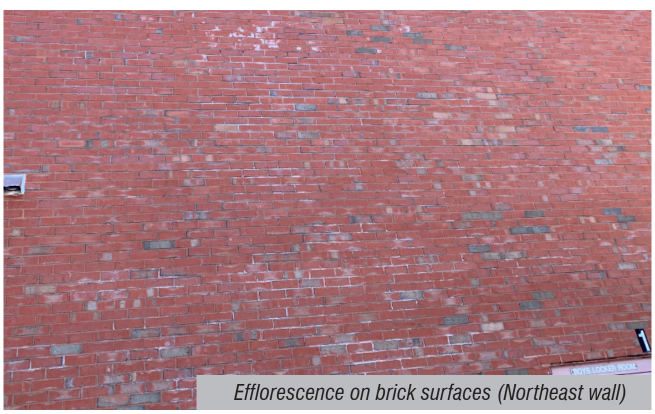


Section detail from 1986 CMK Architects drawings

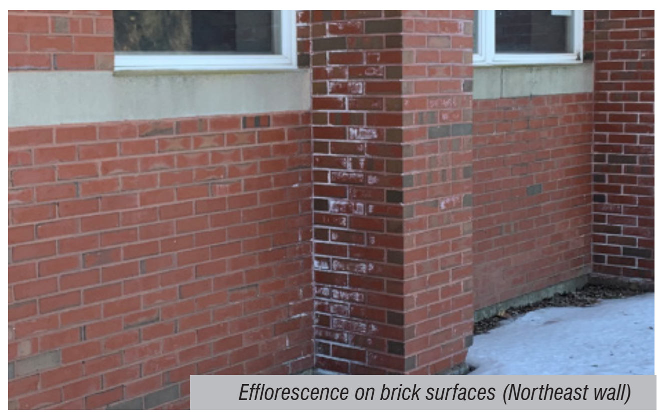
Area where brick needs cleaning

Area where brick needs cleaning

Areas where brick needs cleaning due to roof run-off



Efflorescence on brick surfaces (Northeast wall)



Efflorescence on brick surfaces (Northeast wall)

Proper sealant at brick expansion joints

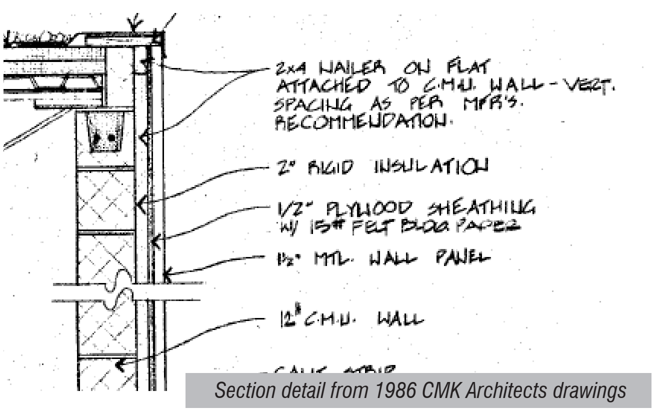
Missing sealant at brick expansion joints

EXISTING CONDITIONS/FINDINGS (CONT.)—PMS

SECTION 2: FACILITY ANALYSIS

At the locations utilizing the metal wall panel façade, the wall system consists of metal wall panel over building paper attached to plywood sheathing. The sheathing appears to be attached through 2” of rigid insulation into the CMU bearing wall. Aside from the building paper, no evidence of an air vapor barrier was found.

The fascia boards and soffits located at the pitched roofs are constructed of painted plywood and painted wood trim. The condition of the fascia and soffits are mostly in fair condition, with localized areas of damage that should be repaired. A new coat of paint should be applied to preserve the integrity of the wood. Multiple areas of flaking paint were observed. One method often utilized to reduce maintenance of the fascia and soffits is to warp them in prefinished metal. This eliminates the necessity for regular painting and preserves the wood for a longer life span.



Section detail from 1986 CMK Architects drawings

Metal wall panel above roof

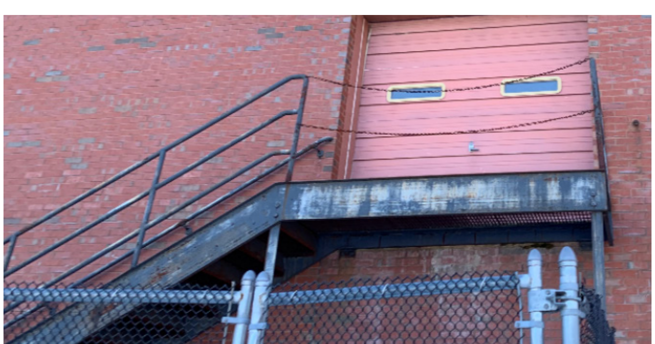
Fascia and soffits with paint flaking

Damage to fascia and trim

The undersides of the main and rear, secondary main entry were painted drywall. According to the original drawings, there were two layers of fire-rated drywall. The majority of the ceilings were in fair shape. Some damage was noted at the rear entry soffit. Repair utilizing the appropriate drywall should be made. Occasional painting of the soffit should be done to prevent peeling of the surface long term.

There was a metal stair located near the Gym that provides access to the storage space above the locker rooms. The stairs' steel shows obvious signs of aging. Flaking and peeling paint was observed as well as some rusting at the stringers for the steps. The stairs were inaccessible at the time of our visit, and it is recommended that further investigation of the rust be done to see if structural integrity is still in place. If no structural repairs are needed, the stairs, stringers and railings should be cleaned, prepped, and painted to preserve the metal.

Noted damage at rear entry soffit



Stair at storage above locker rooms. Signs of rust and need for paint evident.

Windows

The windows appear to be original to the building, built in the late 1980s. The windows are a clad wood window in several configurations of functions. The majority of them are crank out clad, with several awning and fixed windows throughout the building. They appear to be in good condition. The glass was noted to be insulated panels and none were noted as failing at this time. A commercial window's life expectancy is based on average wear-and-tear of windows. Clad windows are expected to last around 25 years, and can be extended with regular maintenance.

The sills of the windows are made of precast. Generally the precast is in good condition. Resealing the joints is an important part of maintaining walls at windows and should be part of a regular maintenance program. It is recommended that any joints missing sealant be resealed.

The headers at the window brick were either precast or steel angles. The precast sills were in good shape, with only a few instances of damage. The damage appeared cosmetic, not structural, in nature. The steel lintels were galvanized and the ones inspected appeared to be in good shape. It was noted that the tops of the angles were grouted where the brick begins. This generally is not desired to allow any water in the brick to weep out below the brick, above the angle. It is recommended that the mortar between the top of the angle and the brick be cleaned out to support this. Refer to the Structural narrative for further information on lintels condition.

Doors and Frames

The exterior hollow metal doors and frames were noted as being in very poor condition in a majority of locations. They have succumbed to years of moisture and salting and have severe

Exterior windows

Exterior doors

Exterior windows

Exterior doors


Exterior doors

rust damage. It is recommended that the doors and frames be replaced with new galvanized doors and frames.

The headers to the doors are a mix of precast and steel lintels. The majority of steel lintels appeared to be galvanized and in fair shape. Refer to the Structural narrative for further information on lintels condition.

It was noted that some doors had a step as you exited through them. This does not meet code and a walk off pad at the floor level should be created, with appropriate grading sloping down to meet ADA.

Roofs

There are a few different roof types on this building. The majority of the classroom wings are under a sloped singled roof. The existing drawings indicate the fiberglass shingles are installed over a 15# felt and ¾" plywood. The slope of the roof is noted to be a 4:12 pitch and venting of the roof space was observed at the soffit and at the overhang at the top of the roof or by a ridge vent, depending on the roof area. They also indicate that there is 6" of blown in cellulose insulation over 6" of fiberglass batt insulation at the ceiling line below. This would give you an approximate R-value of 38-40. The roof was last replaced 2001.

The membrane roof over the center corridor space between the classroom wings is a membrane roof that was installed 1987. There is clear evidence of the age and the roof in this area should be considered for replacement. It is unclear how much insulation exists at this time. A core could be performed to confirm. Originally, the building was designed with two layers of 2" rigid insulation.

The roof over the technical education area is a membrane roof that was replaced in 2001. Originally, the building was designed with two layers of 2" rigid insulation; it is unclear if additional insulation was added. Some areas of this roof may be leaking as evidenced by staining on ceiling tiles.

The roof over the gymnasium is a ballasted membrane roof that was installed in 2001. The original construction documents indicate there are two layers of 2" rigid insulation. This is equal to approximately an R20. It is unclear whether more insulation was added during the reroof in 2001.

Roofs over 15 years old should be considered for re-roofing. Conduct roof cuts to verify insulation thickness over existing roof systems. Also, verify if existing built-up tar and gravel is roofed over and test for hazardous materials before determining roof replacement.

Modular Buildings

The two modulars on site are traditionally built modular buildings. They were placed on site with the intent of using them as temporary classrooms. Each modular contains two classrooms. Access to the modular is gained through the egress doors at the ends of the main corridors in the school. Once outside, students and staff walk down a paved path to a wooden ramp that climbs to the floor level of the modular and into a vestibule with doors to each of the classrooms.

The modular buildings appear to be placed on pads with skirting around the underside. They have vinyl siding and shingled roofs.

The use of modular buildings for education is generally intended to be temporary. If continued use is required, the age of the roofing should be assessed and replaced if there is evidence of damage, aging, or if it is more than 15 years old. Any vinyl siding, trim, and skirting should be checked for damage and replaced if found. A full cleaning of the vinyl should also be done. Regular inspections should be performed on any ramps or stairs to the buildings and confirmation of code requirements will need to be done.

Additionally, if the structures remain for the long term, a covered and secure vestibule may be desired to keep students and staff safe. The recommendation for long term capacity needs would be to remove the modular buildings and build proper additions to the existing school to accommodate additional classrooms/students.

Modular building

Modular building

Interior Finishes

Asbestos Containing Building Materials (ACBM)

We are not aware of any AHERA report for this building. The school was built after the 1973 EPA Clean Air Act, which banned most spray-applied asbestos products, however not all ACBMs are illegal in the US and could still be used today. ACBMs could have been used during the construction of this building and it is recommended that a renovation impact study be done prior to construction on any building that may contain such hazards. A renovation impact study may not indicate all hazards, and proper safety procedures shall be followed by Contractors on site to notify the Owner and Architect of any suspicious materials that may be hazardous-material-containing.

Vinyl Composition Tile (VCT)

The VCT in the building was in fair condition and appeared to be maintained regularly. There were some localized areas of tile that appeared to be patched in and some chipping of other tiles. It is not known if matching tile can be found to replace any damage that does exist. The VCT is original to the building, installed in 1987. Any renovations will need to address required flooring changes as needed. VCT's life span is very much dictated by the amount and type of traffic, and the level of maintenance it receives. Regular cleaning and waxing is important to extend the life of this product. During any major renovations, it would be recommended that flooring of this vintage be considered for replacement.

Acoustical Ceiling Tile (ACT)

Many of the ceiling tiles are bowed and vary in type and grade. There were multiple locations of staining from leaks above. Replacement of ceiling tiles should be considered.

The suspended ceiling grid was noted to be off-color or aged throughout the facility where it exists. Correction can include replacement of grid and tiles or in some cases it may be appropriate to clean and paint the grid when new ceiling tiles are installed. Should painting be the preferred method, proper technique and paints should be used to reduce the chance of paints peeling prematurely.

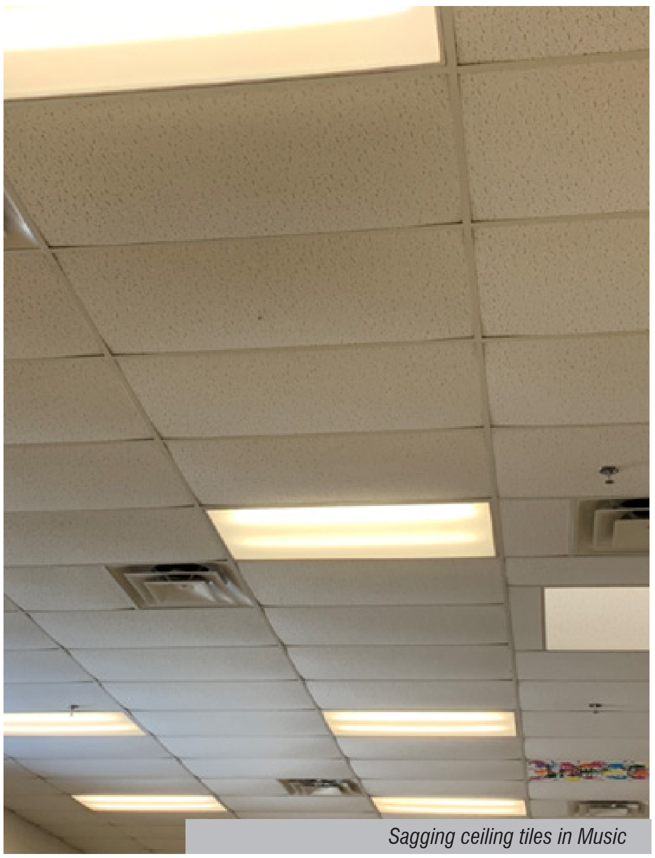
Partitions and Painting

Almost all partitions in the building are made of concrete masonry units (CMU). Many of the CMU partitions are noted as being structural bearing walls. It appears that any partitions that are not masonry were added after the original construction to divide spaces into smaller segments.

The masonry inside the building is well-kept and, due to the nature of the product, has held up quite well. Renovations can be more costly when dealing with CMU walls, but are usually offset long term by the durability of the product, as suggested above. The addition of outlets and data boxes at CMU usually implies adding surface conduit, raceways, and/or wire mold to get the wire to the boxes. This can often be visually unappealing. One option is to fur out walls where these utilities are being added, but this can add to the cost of a renovation.

During any significant renovation it is recommended that the building or spaces be painted. At other times, it is recommended that the building be repainted as part of long term maintenance, or as needed due to damage.

Multiple classrooms were noted to have fabric folding partitions. The folding partitions are in poor condition and should either be replaced or removed and filled in if they are not utilized. These folding partitions generally do not do a good job of separating sound from one classroom to the next, however, the flexibility of the space is often more important and should be reviewed as needed.


Sagging ceiling tiles in Music


Folding partition

Additional Building Finish items

Gymnasiums

- The wood gym floor has areas that have been patched and do not match. At the location of the volleyball net, the floor has a slight distortion. Replacement should be considered.
- The bleachers not only need refinishing, but are not accessible to meet today's codes. Replacement should be considered.
- The acoustic properties of the space were poor. It was very loud with students present. The space could benefit from the addition of sound panels around the walls to absorb some of the noise in the space.

Toilet Rooms

- The lavatories were installed in plastic laminate counters. At this time, the condition of the laminate that was reviewed appeared in good shape. At the time of replacement, alternate products should be considered for the counter surface where sinks are present, as laminate can be subject to moisture issues. Moisture getting under the laminate can lead to lifting of the finish. Other products like solid surfacing can have a higher initial cost, but tend to have less maintenance costs long term.
- The toilet partitions inspected were painted steel. It is clear that they have been maintained and painted in the past. Signs of painted-over chipped paint were observed. There were some signs of rust in areas of the partitions and doors. It is recommended that the partitions be replaced. Additional consideration should be given to review the lack of handicap-compliant stalls in the gang toilets if renovations take place. Note: There are single-user handicap toilet rooms in an adjacent area. There appears to be a lack of teacher handicap stalls.
- The flooring in the gang toilets is noted to be epoxy flooring. These floors are showing signs of age and wear and should refinishing or replacement should be considered.

Gym

Gym

Toilet room lavatories

Entrances

- Doors used as entrances to the building ideally would have built-in entrance mats to capture moisture, sand, and salt from entering the building. This increases the lifespan of the flooring and reduces maintenance time and costs. Multiple doors around the building did not have built-in entrance mats and, if desired, further identification of which doors are used as entrances versus exit-only is needed.

Library

- The skylight in the library is showing significant signs of age. The panels have yellowed from sun exposure and it gives off a less-than-desirable feel to the space. It was also reported that the sound from rain on the skylight can make it nearly impossible to teach in the space. Replacement or removal of the skylight should be considered. Note: Removal of the skylight will eliminate any natural light from the space.
- Light switches for the Library were in a location above bookshelves that were difficult to find and reach. It is likely that a wheelchair-bound individual would not be able to reach the switches.

Lockers

- The lockers were located in the classroom wing corridors. Overall the lockers were in fair shape. It was noted that the lockers are single-stacked and narrow. The width is about 6” wide, making it a tight fit for backpacks or coats. Modern locker widths are usually 12” wide for acceptable use. Handicap-accessible lockers should be appropriately located throughout the field of lockers to accommodate those with accessibility concerns. Numerous padlocks were installed on the lockers, which may indicate that the lockers are used by the students.

Skylight in library

Lockers

Millwork + Casework
Typical classrooms contained plastic laminate finished casework. There tended to be a length of counter with shelving below, flanked by tall storage units with doors. This casework was noted to be in fair to good condition in most locations.

Science casework was also noted to be plastic laminate finished casework. It was noted that several locations of laminate counter work surfaces were delaminating or damaged. Best practice is to keep laminate surfaces away from sinks, when fiscally feasible, to avoid the delamination caused by moisture getting under the laminate. Science counters are also best suited for an epoxy top material as they resist not only moisture, but chemical and physical damage. Several fume hoods were identified and reported to be abandoned for several years. It was unclear if this was a programmatic or functionality issue. Limited handicap-accessible stations were found and should be considered in future work.

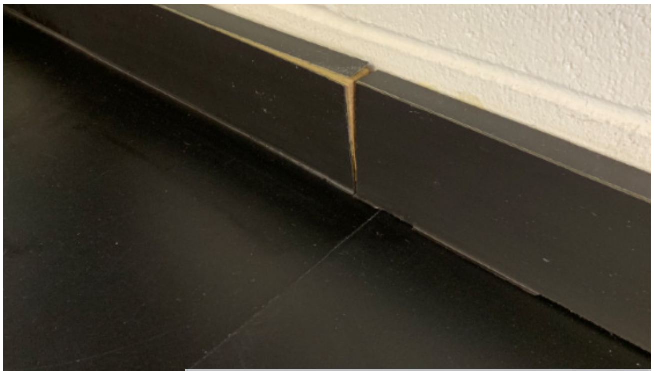
The library casework was also plastic laminate finished. The space contained several surrounding built-in shelf units, a reception desk, computer room counter, tables, chairs, and adjustable wall shelving. The computer counter was supported with nominal wood lumber angled back to the wall, and the counters—in combination with the chairs present—gave limited adjustability for students using the stations.

Music had built-in laminate storage cabinets that appeared to be in fair shape.

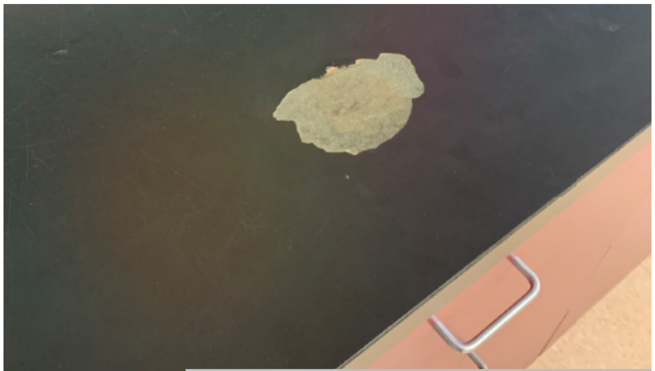
The administration/reception space utilized a tall built-in plastic laminate and wood trim counter in front of portable desks for the administration staff. The casework appeared to be in fair condition, however, the space with the desks did appear to be slightly confined if numerous individuals needed to access the area behind the counter. There was no area at the front reception counter that addressed handicap accessibility.

The FACS rooms were again finished in plastic laminate. Overall the casework and counters were in fair to poor shape. It was noted that some of the backsplash had separated from the counter. Some of the doors on the cabinets were misaligned and may not close properly. Laminate counters at sinks locations were found to be delaminating in areas. One station was found to be adjusted for wheelchair bound persons. Each room should provide handicapped accessibility.

FACS casework



Science casework/counters



Science casework/counters

Fume hood

Visual Display Boards/Projectors/Screens
Technology Integration: In the digital world of teaching, integration of technology in the school curriculum is continually evolving. Presently, there are a variety of delivery methods in the teaching spaces. They range from projectors and laptops on carts with a pull-down screen, to ceiling mounted projectors with a pull-down screen. Some project onto white boards that require a non-glare surface. Other spaces have interactive boards (Projector and Eno Boards). The school District's Technology Department, along with the Technology Committee, is continuously exploring the latest options and evaluating their costs.

Consideration should be given to bring all teaching spaces/walls up to the District's current teaching standards.

Doors and Hardware
Exterior doors are noted above in the Building Shell portion of this report.

Interior doors are generally painted hollow metal doors with painted hollow metal frames. According to the existing drawings, any glass in the doors is a tempered glass. Door hardware appears to meet modern day accessibly requirements. The handles to classrooms appear to have been installed in relatively recent years as they have a classroom security function. One area of concern that was brought up by staff was that classrooms often have tall glass sidelights adjacent to the door that was of concern for safety and security. Most teachers cover the glass with paper or by some other method. Replacement of these frames should be considered.

Sidelight at classroom door

Code-related Items

General

Below are the code sections that are most relevant to this analysis:

- New Hampshire fire code or state fire code means the adoption by reference of the:
  - Life Safety Code NFPA 101, 2015 edition
  - Fire Code NFPA 1, 2015 edition

- New Hampshire building code or state building code means the adoption by reference of the:
  - International Building Code 2015
  - International Energy Conservation Code 2015
  - International Existing Building Code 2015
  - International Mechanical Code 2015
  - International Plumbing Code 2015
  - International Residential Code 2015
  - National Electrical Code 2017 (NFPA 70)

As amended by the state building code review board and ratified by the legislature in accordance with RSA 155-A: 10, per 155-A: 2 State Building Code.

I. All buildings, building components, and structures constructed in New Hampshire shall comply with the state building code and state fire code. The construction, design, structure, maintenance, and use of all buildings or structures to be erected and the alteration, renovation, rehabilitation, repair, removal, or demolition of all buildings and structures previously erected shall be governed by the provisions of the state building code.

II. To the extent that there is any conflict between the state building code and the state fire code, the code creating the greater degree of life safety shall take precedence.

Construction Type and Occupancy

NFPA 101 classifies the occupancy of this facility as mixed use of both:

- Existing educational (E): classrooms, art, kitchen, and offices/support spaces.
- Existing assembly (A): gymnasiums, cafeteria, Library and offices/support spaces. Per NFPA under Existing Educational; these spaces can be classified as Accessory Assembly, Offices and Storage.

Fire Protection System

Note: The sprinkler system covers the entire building. The classrooms into the corridors that are typically part of the means of egress need not be fire rated. They can be smoke resistant without closures. All other rooms adjoining the corridor are to be fire rated unless meeting other special requirements. Typical adjoining spaces of different uses are required to have fire rated separation and with a future renovation, fire rated separations will depend on the final reconfiguration of the spaces. Refer to Fire Sprinkler Protection section of this report.

LIFE SAFETY CODE NFPA 101

Dead-Ends – 15.2.5.2

No dead-end corridor shall exceed 20 feet, other than in buildings protected throughout by an approved, supervised automatic sprinkler system, in which case dead-end corridors shall not exceed 50 feet. The security gates used to separate public spaces from the classrooms creates a dead end corridor when closed. It is recommended these be replaced with pairs of doors on hold opens egressing towards the public areas. These could still separate the space while eliminating the dead end corridor. These would also be released in an emergency creating a better safety feature than exist now.

Travel Distance – 15.2.6

15.2.6.2 Travel distance to an exit shall not exceed 150 feet from any point in a building, unless otherwise permitted by 15.2.6.3 or 15.2.6.4.

15.2.6.3 Travel distance shall not exceed 200 feet in educational occupancies protected by an automatic sprinkler system.

INTERNATIONAL ENERGY CONSERVATION CODE 2015 – IECC

Section 101 Scope and General Requirements
101.4 Applicability:

101.4.1 Existing buildings. Except as specified in this chapter, this code shall not be used to require the removal, alteration or abandonment of, nor prevent the continued use and maintenance of, an existing building or building system lawfully in existence at the time of adoption of this code.

This code was adopted by New Hampshire State Building Code Review Board and revised effective April 1, 2010. The code is designed to regulate new construction and new work, and is not intended to be applied retroactively to existing buildings except where existing envelope, lighting, mechanical, or service water heating systems are specifically affected by Section 101.4.3. This section addresses that the code does not affect existing buildings.

101.4.3 Additions, alterations, renovations or repairs.

This section simply states that new work must comply with the current requirements for new work. Any alteration or addition to an existing system involving new work is subject to the requirements of the code.

ACCESSIBILITY RULES AND STANDARDS - ADA

General
Note: AB (Architectural Barrier-Free) Committee has amended the rules as they have expired. AB has adopted the 2010 ADA Standards as the AB Code. This coincides with the Department of Justice stating that as of March 15, 2012 the 2010 ADA Standards for Accessibility are to be used.

Below are the Rules and Standards that are applicable:

- 2010 ADA Standards
- 2015 International Building Code (IBC). (Accessibility scoping provisions which describe "what, where and how many". Chapter 11 "control the design and construction of facilities for accessibility to physically disabled persons".)
- 2003 ICC/ANSI A117.1-03 standards: Accessible and Usable Buildings and Facilities. (Technical requirements which describe "how".)

New Construction and Alterations
35.151 New construction and alterations
(b) Alterations, (4) Path of Travel, (i) Primary functions. A "Primary functions" is a major activity for which the facility is intended. Areas that contain a primary function include, but not limited to, the dining area of a cafeteria, the meeting rooms in a conference center, as well as offices and other work areas in which the activities of the public entity using the facility are carried out.

STRUCTURAL ANALYSIS

General

Accessible structural roof framing was observed within the building to review the existing structure, record the framing arrangement of the structural system, and identify any structural concerns. The documented existing structural framing system was reviewed for conformance with the structural provisions for the 2015 International Building Code (IBC), the 2015 International Existing Building Code (IEBC) and ASCE 7-10. The site investigation conducted on February 27, 2019 was used to complete this evaluation.

Front entrance of Pennichuck Middle School

For this structure, the 2015 IBC provisions stipulate a design flat roof snow load magnitude of 47 pounds per square foot (psf). This roof snow load is calculated by multiplying certain adjustment factors to the code-prescribed ground snow load of 60 psf, based on the location, type, and use of the structure.

Current code also requires that roof structures be evaluated for possible drift snow loading conditions, in which the snow is anticipated to drift from a higher roof to an adjacent lower roof, resulting in higher snow loads on the lower roof against the wall between the higher and lower roofs.

To meet current code requirements, the roof framing must be capable of supporting the code specified roof snow loads and the dead weight of the framing system.

The 2015 IBC identifies minimum live loads to be considered for a variety of building uses. These live loads are provided below:

FLOOR AREA	2015 IBC TABLE 16071.1
Classrooms	40 psf
Offices	50 psf
Lobbies	100 psf
Storage Areas (Light)	125 psf
Gymnasium Floor	100 psf

The IBC also identifies wind and seismic forces to be resisted by the structural framing system. These forces are determined through consideration of numerous criteria related to soil type, exposure, height, and structural system.

When evaluating an existing structure, it is important to note that the structural system is not required to be capable of supporting current building code requirements unless renovations or alternations are made which impact the existing structure beyond specific thresholds.

Structural Framing System Description

The Pennichuck school is a single story building that was constructed in 1988 and has not had any major additions since then. The school's general layout consists of four classroom wings that are connected to a center core. The classroom wings have a wood framed gable roof structure that bears directly on concrete masonry (CMU) walls at the exterior of the building and at the center corridors. The corridors have concrete headers over the openings at the classroom doors. The corridors are also noted to have steel plate reinforcement spanning from floor to ceiling.

The center core of the building has a flat roof that appears to be supported by CMU walls that divide the rooms. The flat roof framing in this area was not accessible for observation during the site visit. On either side of the center core, a corridor connects to the classroom wings. These corridors have a monoslope wood truss system that ties into the classroom roofs. The wood framed trusses are braced to transfer lateral loads.

The gymnasium roof system was observed to be steel double angle open web roof trusses spanning approximately 73'-0" between bearing supports. The truss is 3'-6"+/- deep and has braced top and bottom chords. The bracing was not continuous for the entire system. At the wall that divides the gym from the locker rooms, the x-bracing was terminated. This will be further discussed in the recommendations section. This bracing needs to be continuous between bearing walls to distribute lateral loads. The bracing and joists above the locker rooms were not observed during the visit.

The roof framing supporting the high roof above the cafeteria was inaccessible during the visit. This roof is flat and bears on CMU walls similar to the gymnasium.

Summary Of Findings
As a result of our limited site observations and field measurements, localized components of the structural framing systems were documented and evaluated. The following summary of findings are provided:

Roof Structure
All of the sloped roofs were constructed of pre-engineered wood-framed trusses. Due to the nature of wood framed truss design, where the wood truss manufacturer utilizes stress-grade lumber and proprietary connections, the capacity of these trusses cannot be evaluated with typical processes. As such the trusses were not evaluated as part of this study. From our observations, the wood framed trusses appear to be in overall good condition, and lateral bracing was present.

Roof Framing and Bracing Above Classroom Wing

The lobby's roof was constructed of metal decking supported by steel joists spaced at 3'-6" +/-. The joists were supported on one end by a steel beam that spanned from the corner of the women's bathroom to the office, a distance of 21'-9" +/-. This steel beam was evaluated and found to have a capacity of approximately 235 psf. This section of the roof has higher roofs on three sides, which results in significant snow drifts onto the low roof. The code prescribed drift load on this area of roof would be approximately 123 psf.

The gymnasium roof members could not be analyzed during the visit. The trusses appear to have the appropriate bracing, but the bracing does not run continuously between both end bearing walls.

Interior

1. The floor of the building is a concrete slab on grade. There is an elevated floor above the locker rooms that was not observed during the site visit. There are cracks in the cafeteria that appear to be the result of opened construction joints in the slab.

2. Expansion joints are filled with an elastomeric product. The product has aged and should be replaced.

Exterior

A visual review of the building's exterior was completed during the site visit. Areas that exhibited damage or deterioration are identified as follows.

1. Areas were observed where there was damage and spalling to the mortar between the bricks and precast concrete sills.

2. Rusted Lintels were noted in certain locations around the building and are recommended to be repaired or addressed to avoid further deterioration and potential brick cracking above.

Roof Framing and Bracing Above Classroom Wing

Construction Joint Crack – Cafeteria

Grout Failure – gym expansion joint


Mortar Spalling- Corner of Gymnasium


Precast Sill Mortar Failure

Rusted Brick Veneer Lintels – Boy's locker room exit

MECHANICAL ANALYSIS

General

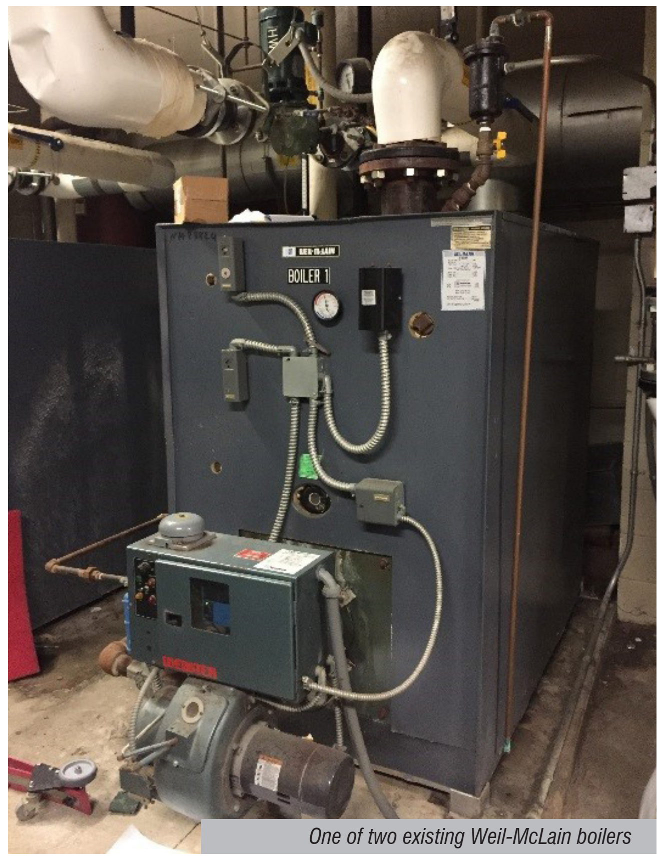
The existing Pennichuck Middle School in Nashua, NH consist of a building that was originally constructed in the mid 1980s (construction documents dates October 1986) with some HVAC upgrades in 2004 which consisted of adding cooling to some spaces.

The basic mechanical systems that were reviewed consisted of:

- boiler plants
- heating distribution
- temperature control
- air moving
- classroom heating and ventilating
- heating terminal units
- air conditioning components

Boiler Plant

The primary heating system consists of two, natural gas-fired, cast iron sectional hot water boilers manufactured by Weil-Mc-Lain 888 and are not original to the building. The burners are Cyclonetic series by Webster with a maximum gas input of 2,396 MBTU. The gross output rating for each boiler is 1,904 MBH. Combustion air is supplied mechanically though an inline ducted to a wall louver in an areaway. The boilers have enough combined capacity to heat the entire building, but not enough to provide redundancy.



One of two existing Weil-McLain boilers

Heating Distribution

Two base mounted pumps (HWP-3 & 4) circulate water in a lead/standby arrangement throughout the building. The pumps are stacked vertically on a custom made rack. Each boiler is served with a separate inline pump (HWP-1 & 2) which are decoupled from the base mounted pumps with closed spaced tees. The exact selection requirements for any of the pumps are unknown as nameplate data was illegible or did not provide ample information. The pumps are not original so information from existing construction documents could not be used. What nameplate data that could be used indicate that the base mounted pumps were installed in 2000 and have an 8.4" impeller with a 7.5 HP motor. The design flow and pressure drop are unknown. None of the pumps are connected to a VFD.

Base mounted pumps

Boiler inline pump

HVAC Systems
The classroom wings are ventilated with rooftop air handlers. Heat is provided by a combination of duct mounted heating coils installed inside and perimeter fin tube. None of the classrooms are cooled with the exception of 3 science rooms which were upgraded in 2004 with dedicated heating, DX cooling, and ventilation air handlers. These units are located in mechanical spaces that are located in the attic area. DX cooling coils are connected to remote roof mounted condensing units. A computer classroom is served by a dedicated air handler similar to the science rooms with heating and DX cooling that was replaced in 2004. The units with cooling located inside are in good condition while the outdoor units are at the end of their useful life.

Other areas that include the library, band, expanded café, office, guidance, and special education are ventilated and cooled with packaged rooftop units. Duct mounted heating coils provide heat. All packaged rooftop units with the exception of the York unit are at the end of their useful life.

The gym is heated and ventilated with a custom modular air handler located inside and is relatively new. The kitchen and cafeteria area is served from one of the original heating and ventilation units. Similarly, the tech ed area is served from an indoor heating and ventilation unit. Additionally, the wood working area has a sawdust collection system as well as recirculating air filtration units. Both heating and ventilation units are at the end of their useful life. The chorus room is served with a floor mounted unit ventilator mounted on an outside wall.

Mechanical System – HVAC Controls
There is a mixture of pneumatic and limited DDC control for the air handlers installed in 2004, the gym, air handler, and the makeup air unit. The pneumatic controls are problematic since it consists of many plastic components which leaks frequently. The compressor is located in the boiler room.

Typical classroom rooftop ventilation unit

York packaged RTU in good condition


Packaged RTU in poor condition

PLUMBING ANALYSIS

General

The existing Pennichuck Middle School in Nashua, NH was originally constructed in 1987. Almost all of the equipment and fixtures are original to the building.

Domestic Water Service

The water service entrance has three water meters and water supplies. A 3” water meter with two 1-1/2” Reduced Pressure Zone backflow preventers serves the building. The two backflow preventers are original to the building and are not lead-free models. The second meter is a 1-1/2” meter with 2” Reduced Pressure Zone backflow preventer which serves irrigation. Gary indicated the irrigation system is not currently utilized. The third meter serves the boiler water make-up. The meter is located on the wall at the back of the boilers. The meter is 1” with a Double Check valve backflow preventer and pressure reducing valve on the supply to the boilers. The two backflow preventers are original to the building and are not lead-free models. The water service equipment appears to be in good condition and well-supported.

Domestic Hot Water

There is a gas fired domestic water heater and storage tank which are original to the building and over 30 years old. The heater is a Rheem model RC627 copper fin water heater. The water heater has an input capacity of 627 MBH and a capacity to generate 602 gallons per hour with a 100 degree temperature rise. The heater is mated to a 750 gallon horizontal storage tank. The tank is stored at 130°f based on thermometers on the piping above the tank. An aquastat in the tank, set at 125°f, operates the water heater to maintain temperature in the tank. An aquastat set to maximum controls the domestic hot water return to run 24-7. The domestic hot water supply from the storage tank is mixed through a Honeywell MX130C. The mixing valve looks new (within two years). Hot water is delivered through the mixing valve to the building at 120°f. A separate hot water line to the kitchen is supplied directly from the storage tank at 130°f. The water heating system is larger than required for the facility.

Natural Gas

The building is served by Natural Gas supplied by Liberty Natural Gas. The gas service is located outside the boiler room. The gas service enters the building at 7” water column. The meter has a capacity of 5 Million BTUH. The pressure regulator and meter are located directly in front of the building’s Fire Department Connection. It is surprising that the fire department accepted this location for the Fire Department Connection.

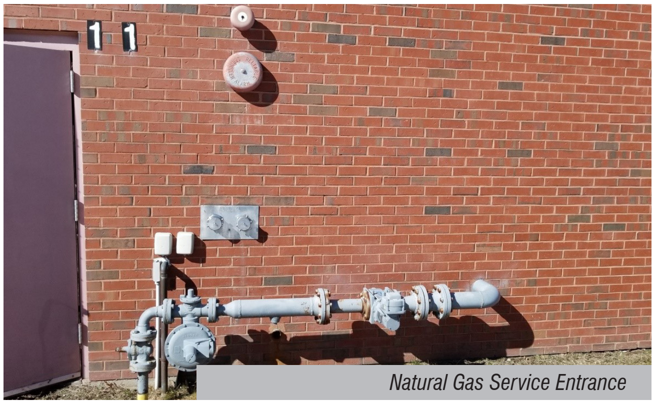
- Gas Meter: Roots model 5M175, 5,000 CFH @ ½” differential. The meter operates at low pressure downstream of the pressure regulator.
- Boiler #1: 2,396 CFH
- Boiler #2: 2,396 CFH
- Main Boiler Room Water Heater: 627 CFH
- Kitchen Equipment (Estimated): 364 CFH
- Total connected gas load: 5,783 CFH or 5.78 Million BTUH

Domestic Water Service Meters (Building and Irrigation)

Building Backflow Preventers

Honeywell Thermostatic Mixing Valve

Gas Water Heater and Storage Tank



Natural Gas Service Entrance

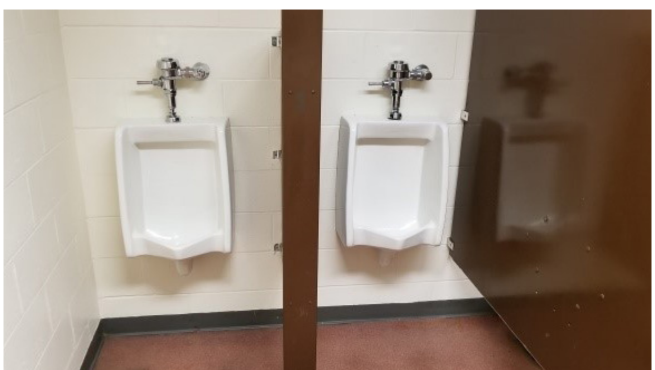
Restrooms

The main restrooms have floor-mounted toilets with manual flush valves. The girl's restroom has an ADA compliant toilet stall and ADA compliant wall-hung lavatory. The women's restroom has an ADA compliant lavatory with a goose-neck spout with wristblade lever handles. The boy's restroom has floor-mounted toilets, wall-hung urinals with manual flush and counter-mounted lavatories. Lavatories are vitreous china oval drop-in sinks with manual two-handle faucets. Lavatory faucets have a flow rate of 2.2 gpm. All lavatory faucets look new within two years except the ADA compliant lavatory and kitchen restroom lavatory. Floor drains are located within the restrooms.

The toilets and urinals are not low flow to meet current water saving standards. Toilets flush with 3.5 gallons per flush. Urinals flush at 1.0 gallons per flush.

ADA Compliant Toilet Stall in Girl's Restroom

Lavatories in Girl's Restroom

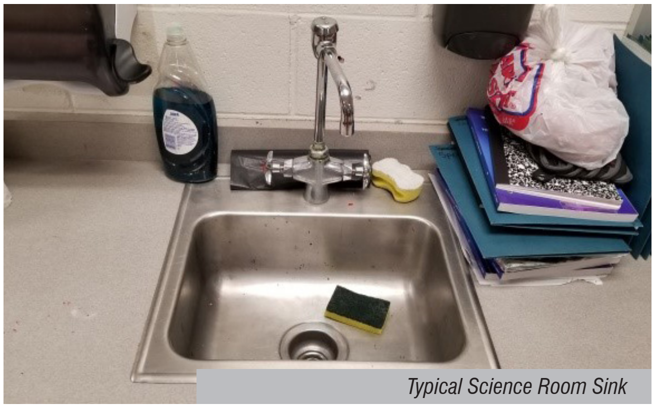


Urinals

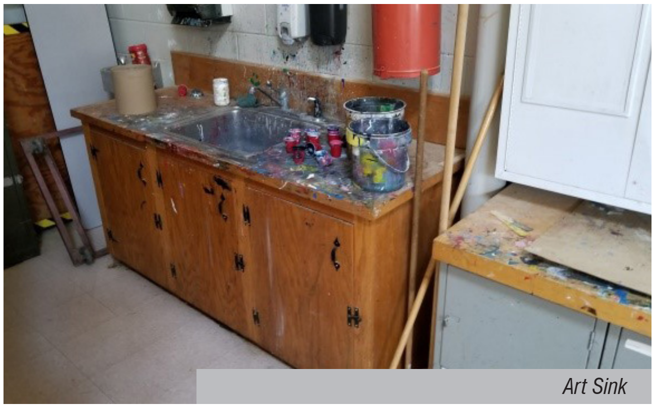
Lavatories and Boy's Restroom

Science and Art Rooms

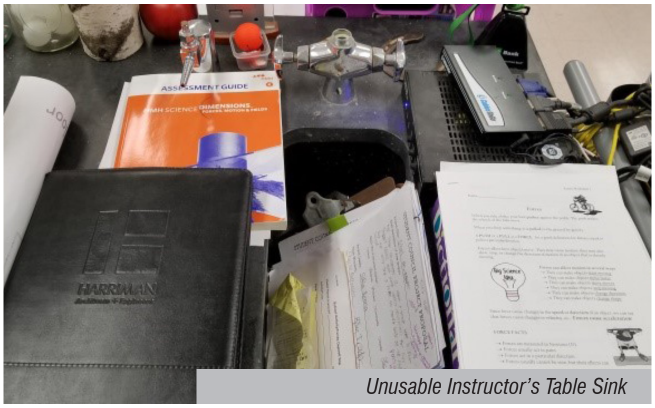
The science rooms have stainless steel sinks with goose-neck faucets. The faucets are supplied with hot and cold water. None of the sinks in are ADA compliant. Emergency eyewash stations are not installed in either Art or Science rooms.



Typical Science Room Sink



Art Sink



Unusable Instructor's Table Sink

Art Sink

Compressed Air
There is a compressed air system located above the paint spray booth. The air compressor serves the Art room and Tech Ed spaces. The compressor was not evaluated in this study. We were not alerted of any concerns with the compressor.

Life Skills Room
The Life Skills room has stainless steel drop-in sinks with swing spout faucets. The fixtures are in good condition. There are no ADA compliant stations in the room.

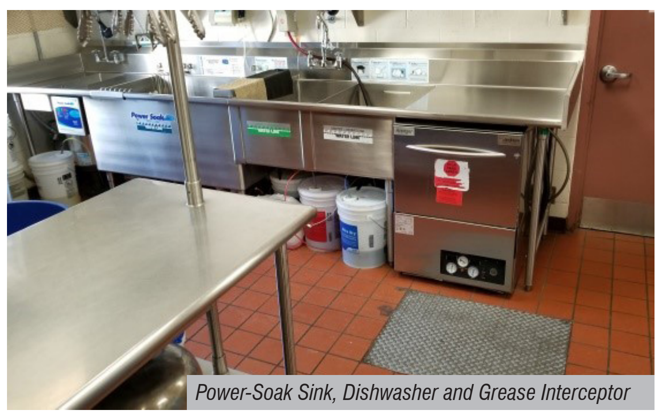

Compressor above Paint Booth


Typical Life Skills Station


Life Skills Instructor Station

Kitchen

The kitchen has a staff restroom and custodial closet. A grease interceptor is recessed in the floor in front of the dishwasher. The grease interceptor serves the three bay Power-Soak Sink and the dishwasher. The food disposal pre-rinse sink bypasses the grease interceptor which is in compliance with code. All kitchen fixtures appear to be in good working order.



Power-Soak Sink, Dishwasher and Grease Interceptor

Natural Gas Fired Appliances

FIRE PROTECTION ANALYSIS

General

The existing Pennichuck Middle School in Nashua, NH was originally constructed in 1987. Almost all of the equipment and fixtures are original to the building.

Fire Protection Water Service

There are two sprinkler services into the building. One service is located in the boiler room. Both locations have a 4" wet and dry pipe riser valve. The dry pipe riser serves all of the cold attic spaces.

The wet pipe riser serves the remainder of the building. A floor-mounted air compressor maintains air pressure in the dry system. The compressor appears to be original to the building. There are no signs of leaking or failure of the air compressor.

A 4" double check backflow preventer is installed below the sprinkler risers. Static pressure is 60 psi at the base of the riser valves. Air pressure in the boiler room is maintained at 30 psi above the dry valve. The dry valve requires a 4 to 1 ratio of water to air pressure. It appears the air pressure is being maintained above the recommended air pressure for the valve, which would be 20 psi.

Standard response sprinklers are installed throughout the building and combustible attic spaces. The sprinklers are original to the 1987 construction, making the heads 32 years old. Testing of sprinklers is required when sprinklers are 50 years old according to NFPA 25.

Sprinklers mounted in the ceilings are chrome pendant style with metal fusible links.


Sprinkler Service Entrance in Boiler Room with Wet and Dry Valve


Sprinkler Service Entrance in Boiler Room with 4" Backflow Preventer in Center


Spare Sprinkler Head Cabinet

ELECTRICAL ANALYSIS

General

The existing Pennichuck Middle School in Nashua, NH was constructed in the mid 1980's. The building does not appear to have experienced any major renovation work since it was constructed.

The basic electrical systems that will be reviewed consist of:

- Electrical Service Entrance Equipment
- Portable Emergency Power System
- Lighting and Power Panelboards
- Interior Lighting
- Exterior Lighting
- Lighting Controls
- Emergency Egress Lighting
- Classroom Power Outlets
- Fire Alarm System
- Security Systems (CCTV, Intrusion Detection and Access Control)
- Intercom/Public Address System
- Data Infrastructure
- Overall Recommendations for Proposed Building Additions and Renovations

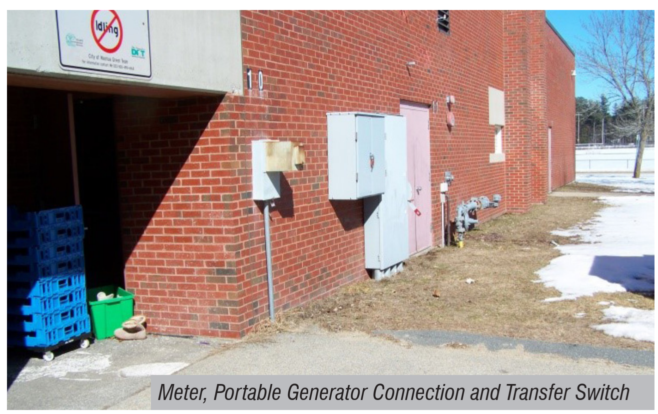
Electrical Service Entrance Equipment

Pennichuck Middle School is served by a 500kVA pad mounted transformer located on the back side of the building near the Kitchen and Boiler Room entrances. Primary / Utility Co. overhead lines pass along the school property (following route 3), the buildings riser pole is fed from these lines. Primary / Utility Co. lines then run underground to the pad mounted transformer. Metering is provided at the transformer pad.

Maximum demand for this service in the past twelve months is reported to be 173kW (approximately 192kVA / .90pf). Approximately 2.02VA/ft².

The pad mounted transformer is owned by the city of Nashua.

Pad Mounted Transformer – Meter, Portable Generator Connection and Transfer Switch Located on the Building



Meter, Portable Generator Connection and Transfer Switch

Overhead Primary Power Lines to Riser Pole

The building is served by a single service entrance main distribution switchboard (MDP).

The MDP is a I-T-E FCI series 6, 277/480V, 3Ø-4W service entrance main distribution switchboard with a 1,200A main switch. Main and distribution section bus ratings are 1,200A. MDP is located in a dedicated electrical room, located between the boiler room and kitchen.

There is a transfer switch and generator connection box located on the exterior of the building. The transfer switch is located ahead of MDP allowing the portable generator to power the entire building.

MDP was manufactured in June of 1987 and appears to be is good condition. However, it may be difficult to obtain circuit breakers and the main circuit breaker should not be relied upon for de-energizing / energizing the building. MDP contains a variety of breaker which feed downstream panelboards. There is “SPACE” available for additional breakers (if available) and a number of “SPARE” circuit breakers.

MDP is capable of providing a maximum of 797kVA (or 8.38VA/ft^2 based on the buildings existing square footage).

/ Any work to the distribution system will require upgrading / replacement of the MDP. While electrical equipment can continue to serve a facility much longer, general accepted life expectancy of electrical equipment is 30 years.

Portable Emergency Power System

Provisions to connect a portable generator are located on the building exterior outside the kitchen (see image above). The generator can power the entire distribution system.

Lighting and Power Panelboards

Lighting and power panelboards are located throughout the facility. 120/208V panelboards observed where either full or nearly full (no room to feed additional circuits), 277/480V panelboards observed has space to accommodate additional circuits.

A majority of the electrical equipment is located in dedicated electrical rooms. In areas where a panelboard serving a classroom, the panelboard is located in an adjacent office that serves as an office to that classroom.

Nearly all electrical equipment was manufactured by I-T-E and was built in July of 1987.

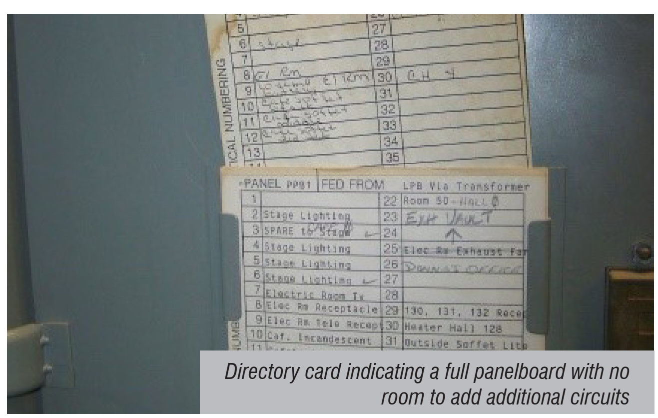
All of the electrical equipment has been in service since the 1980’s putting the equipment just beyond the 30 year life expectancy. Some of the panelboards look dirty but all appears to be in good condition.

While electrical equipment can continue to serve a facility much longer, general accepted life expectancy of electrical equipment is 30 years.

/ Add additional panelboards and / or replace panelboards with tubs containing larger quantities of circuit breakers to allow additional circuits as needed.
/ Open and clean all panelboards. Visually check condition panelboard interiors.
/ Open, clean and test all dry-type transformers.

Main Distribution Switchboard - MDP

Typical 120/208V I-T-E panelboard manufactured and installed in the 1980's



Directory card indicating a full panelboard with no room to add additional circuits

Interior Lighting
In general, lighting is in fair to good condition. Lighting fixtures exist using both fluorescent and LED technologies. Lighting levels throughout the building are adequate.

Gymnasium lighting has been upgraded to LED, fluorescent remains elsewhere.

- Lighting fixtures could be replaced with energy efficient LED fixtures.
- There are often energy incentives available through the utility company to assist with the cost of energy efficient upgrades.

Exterior Lighting
Exterior lighting is mainly wall mounted LED fixtures. Lighting in the parking areas around the building is minimal.

- Additional lighting is needed in the parking and drive areas.

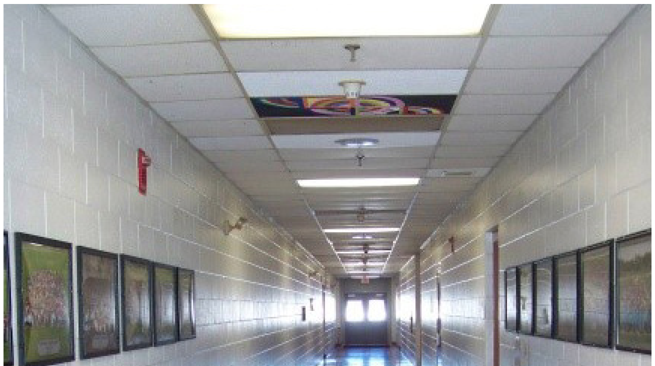
Lighting Controls
Lighting is currently controlled via wall mounted switch for most interior spaces with time clocks for exterior lighting.

- The state of New Hampshire currently enforces IECC 2015 (International Energy Conservation Code).
- The energy code requires automatic “off” of all lighting not required for safety or security. This can be accomplished with occupancy sensors, centrally located lighting control relay panels, time clocks and / or distributed lighting controls.
- Energy code also requires switching of lighting within “daylight” areas be controlled separately from lighting outside these areas.
- Provide occupancy sensor control with local toggle switches to comply with state energy code.

Emergency Egress Lighting
Emergency Egress lighting is achieved with a self-contained emergency battery units and battery units with remote heads. Exit signs are of the self-powered, internally illuminated. There is no emergency egress lighting outside the building. NFPA requires emergency lighting to a “public way” outside the building.

- Emergency Egress lighting appears to provide proper lighting levels.
- Emergency Egress lighting in shop classrooms should be reviewed further.
- Provide additional emergency battery units to provide the code required egress from exterior egress doors.

Classroom Power Outlets
There are wall mounted grounded outlets located throughout the building; classrooms appear to have an adequate number to serve each space.

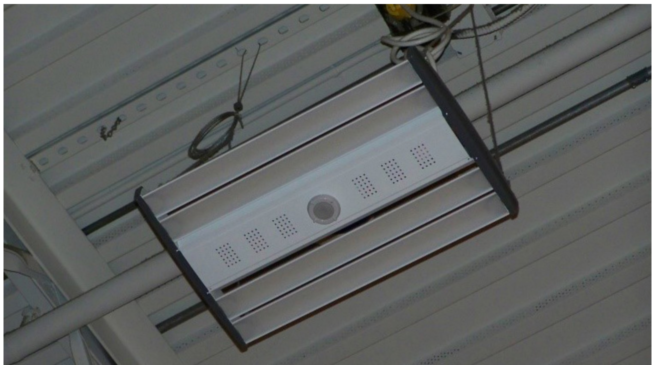


Typical Corridor Lighting

Exterior Building Mounted Wall Pack - LED

Typical Classroom Lighting

Typical Remote Battery Unit for Emergency Egress Remote Heads



Gymnasium Lighting Fixture - LED

Typical Exit Sign

Fire Alarm System

The fire alarm system is a zoned (non-addressable) Simplex system. Smoke detectors, notification appliances and pull stations are located throughout the building. Generally, coverage of notification appliances is adequate. In the event of an alarm, the system reports directly to Nashua monitoring / dispatch facility via the city loop system.

There is currently no "Ansul" system for each of the ranges for the Fire Alarm System and the Fire Alarm System does not shut off power to the ranges located in the Family and Consumer Science Classroom.

- Replace the existing Fire Alarm System with new throughout with a full voice evacuation system.
- Recent changes in NFPA requires voice evacuation throughout educational facilities.

Security Systems (CCTV, Intrusion Detection and Access Control)

The school is served by a S2 Security System installed by Securadyne Systems. The system encompasses video surveillance, access control, panic alarm and intrusion detection. Surveillance cameras are installed at various locations throughout the building and mounted to the exterior of the building. The motion detectors system is IP based with remote monitoring and control capabilities and an integral Network Video Recorder (NVR). The system has some expansion capabilities should additional devices need to be installed.

Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since their installation on the surveillance system. At minimum, recommend replacing existing and adding new exterior and interior cameras.

- Based on a recent Physical Security Enhancement Master Plan report, technology has far advanced since their installation on the surveillance system.
- CCTV cameras should be upgraded and many should be added to the interior and exterior of the building covering the entire building perimeter and parking, corridors, lobbies, cafeteria and gymnasium.
- Access control is limited and the main administration office has no direct contact with the main entrance. An AI Phone allows the administration office to communicate with someone at the main entrance and allow them to enter the building.
- The building has two main entrances:
  - One at administration office.
  - One at the gymnasium.
- Currently there is no way for anyone to know that the building perimeter doors are closed and / or locked creating an insecure building.

Electronic locks should be provided at all main entrances that are controlled by the main administration office to control access to the building during the school day.

Door contacts should be provided at all perimeter doors to ensure visitors are forced to enter the building at the main entrance so the main administration office can control access during school hours.

Non-ADA Compliant Notification Appliance

Fire Alarm System Control Panel

Typical Exterior Camera at Main Entrance

Intercom/Public Address System
The Intercom/Paging System is an old system that appears to be original to the building.

/ Consideration should be given to upgrade and completely replace the existing Public Address System with new.

Data Infrastructure
Data cabling throughout the building does not meet current industry standards. Most current installations are provided with Cat 6A cabling, most recent renovation Harriman had involvement with was the Sunset Height school in 2015, Sunset Heights project used Cat 5E.

The quantity of communications drops throughout the building are low relative to most Middle schools and quantity of drops requested at the Sunset Height project.

Communications racks observed are wall mounted, had little to no space to accommodate additional patch panels or switches and are not in rooms dedicated to IT.

/ To accommodate future needs floor mounted communications racks should be provided in rooms dedicated to IT.
/ Replace and upgrade cabling, jacks, patch panels and switches to current standards.
/ Provide additional drops as required to accommodate the requirements of today and the near future.


Public Address System Head End


Typical Communications Rack

SURVEYS, STUDIES, AND REPORTS
SECTION 2: FACILITY ANALYSIS

ELM STREET MIDDLE SCHOOL

This section contains the following items.

- / AHERA
- / Hazardous Material Report
- / Site Survey
- / Traffic Study
- / Roof Trac Report
- / Floor Cores and Ceiling Panel Evaluation
- / Snow Load Report

RPF Environmental
TESTING & CONSULTING SERVICES

Hazardous Materials Inspection & Assessment
Asbestos, Mold, Lead Paint, Radon, PCBs
Air Quality Testing and Investigations
Industrial Hygiene, Safety & Training

August 31, 2017

Christopher Lessard
SAU 42, Nashua School District
Assistant Director for Safety & Security
38 Riverside Drive
Nashua, NH 03062

Re: 3-Year AHERA Reinspection
RPF File No.: 178129

Dear Mr. Lessard,

RPF Environmental, Inc. (RPF) conducted an asbestos reinspection for the Nashua School District on July 31 and August 1, 2017 with EPA Asbestos Hazard Emergency Response Act (AHERA) requirement. The reinspection included a visual inspection of the areas known to contain asbestos-containing building materials (ACBM) and assumed ACBM, as stated in the AHERA inspection records provided to RPF for review.

In general, the ACBM inspected by RPF during this reinspection was observed to be in good to fair condition and the school should continue to manage the materials in accordance with the AHERA Management Plan and updated recommendations enclosed. However, it is important to note that RPF observed damaged friable ACBM pipe and pipe fitting insulation at the El Street Jr. High School. The areas with damaged ACBM should be addressed as soon as feasible, and care must be used to prevent further disturbance and to avoid the creation of dust.

Buildings included in this reinspection included Amherst Street, Dr. Crisp, Bicentennial, Birch Hill, Broad Street, Charlotte Avenue, Fairgrounds Elementary School, Fairgrounds Middle School, Ledge Street, Main Dunstable, Mt. Pleasant, New Searles, Sunset Heights and Elm Street Jr. High.

Records used to conduct the reinspection included the initial AHERA survey listings provided in the 1988 initial inspection report prepared by Air Quality Consultants, and the 2014 reinspection report prepared by EndPoint Associates. In addition, several bulk sampling and removal reports prepared by Desmaris Environmental and RPF since the 2014 report were reviewed.

This reinspection report should be filed with the AHERA plans for each school building, as well as the central facilities office. Appendix A contains a listing of the ACBM reinspected during this project and the AHERA assessment and minimum recommended actions for each area of ACBM in the school. Appendix B includes management plan recommendations and updates to be used in conjunction with your original management plan for each building.

The Asbestos Program Manager (AHERA-designated person) for the school is required, pursuant to the AHERA Rule, to review this report and the appendices and to then develop a written plan to implement recommendations for management, abatement or additional testing work, as applicable.

If you have any questions or comments, or if you would like assistance with the recommendations provided herein, please do not hesitate to call me.

Sincerely,
RPF ENVIRONMENTAL, INC.

Kara Forsythe
EH&S Consultant, Inspector

Enclosures:

Appendix A: ACBM Inventory
Appendix B: Management Plan Updates
Appendix C: Example Pictures
Appendix D: Reinspection Accreditation
Appendix E: Methodology and Limitations

178129 3 Year AHERA 080117 Rpt

APPENDIX A

CODE DESCRIPTIONS

(Index sheet for use with room by room listings in this appendix)

EPA Assessment Codes:

1. Damaged or significantly damaged thermal systems insulation asbestos containing material (ACM)
2. Damaged friable surfacing ACM
3. Significantly damaged friable surfacing ACM
4. Damaged or significantly damaged friable miscellaneous ACM
5. ACBM with the potential for damage
6. ACBM with the potential for significant damage
7. Any remaining ACBM or friable suspected ACBM

NF. Material is nonfriable and assessments are not required by AHERA.

Response Summary Codes: (Summary of minimum recommendations only, please reference text of report and Appendix for additional recommendations.)

Code Description

1. **Continue to manage this ACBM under the buildings Management Plan, Operations and Maintenance (O&M) Program** and AHERA. Conduct spot maintenance repairs of any minor damage present (nonfriable ACBM) or that occurs in accordance with AHERA and the School O&M Program. Complete periodic cleaning with HEPA vacuums and wet wiping in all areas with friable ACBM on a 6 month basis, at a minimum.

2. **Conduct repair, surface cleaning, encapsulation or enclosure response actions** for this ACBM in accordance with AHERA. Use care to not create dust in the area and to prevent further disturbance. Continue to manage this ACBM under the building Management Plan, O&M Program and AHERA (See Summary Code 1). A licensed consultant design firm must prepare repair specifications (design) prior to obtaining pricing or bids for response actions by licensed asbestos contractors. Some small-scale maintenance work (<3 linear/square feet) can be completed by the school's maintenance staff if they qualify for the licensing exemption and they possess adequate training, current refresher training, and the necessary personal protective equipment and safety programs in place. It recommended that pricing for removal also be obtained as an option for consideration. Complete periodic cleaning with HEPA vacuums and wet wiping in all areas with friable ACBM on a 6 month basis at a minimum.

3. **Remove the ACBM and conduct surface decontamination** as recommended by accredited/licensed project designer in accordance with AHERA. Use care to not create dust in the area and to prevent further disturbance. Continue to manage any remaining ACBM under the building Management Plan, O&M Program and AHERA (See Summary Code 1). All assumed ACBM should be properly tested by a licensed inspection prior to abatement work or as soon as feasible, and the AHERA records updated accordingly. A licensed consultant design firm must prepare repair specifications (design) prior to obtaining pricing or bids for response actions by licensed asbestos contractors. All abatement activities must be conducted by properly accredited and licensed personnel/companies.

4. **Complete verification of AHERA Inspection documentation**. A Licensed inspector must assume materials are ACBM or properly test additional suspect ACBM. Exterior materials, except under certain circumstances, are not covered under AHERA but still must be inspected and handled as ACBM in accordance with other State, local, and federal regulations. Licensed inspector and management planner must update ACBM listings and Management Plans as needed. Obtain architectural statements for new construction/renovation areas in accordance with AHERA. Confirm that proper numbers of samples have been collected.

5. **Accessible ACBM Removed**. Removed material may be deleted from the ACBM listings. Abatement records should be reviewed to verify that all required records are on file at the school. RPF did not audit records for completeness or accuracy.

6. **Material could not be located** and may have been removed or enclosed, or it was not possible to confirm if the materials observed were in fact newer replacement materials. Verify abatement records and, if all records are obtained and complete, update the ACBM listings to reflect the abatement work. If an MNO listing is due to an inaccessible area or locked room, such areas should be inspected when feasible.

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Amherst Street Elementary School								
1892 Building 1st floor	Floor tiles and associated mastics (approx 3 types)	-----	Misc.	No	Good	NF	1,4	Historical documentation state renovations occurred and the floor tile and mastic was removed. It is recommended that the floor tile and mastic be assumed to be ACBM unless documentation stating new floor coverings are non-ACBM.
Threshold by sprinkler room, stairwell, stiarwell by cafeteria entrance	Floor tiles and associated mastic	75 SF	Misc.	No	Fair	NF	2	Materials observed to be cracking. Replace damaged floor tiles, apply wax.
Original Building (Basement areas, Boiler Room walls/ceilings)	Plaster	>5,000 SF	Surf.	Yes	Good	5	1	Accessible materials were observed to be in good conditon, however the majority of the material is covered over with a tin ceiling. Conduct O&M cleaning within 15' of all surfaces with ACBM surfacing
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference the report, code description sheet, and the school management plan for discussion on assessment codes

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See code description sheet, further discussion, and requirements in report

RPF Environmental, Inc.; 320 First NH Turnpike, Northwood, NH 03261 *(603) 942-5432

Amherst Street Elementary School Page 1 of 2

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Amherst Street Elementary School								

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Broad Street School: 390 Broad Street, Nashua, NH								
A Wing, B Wing, D Wing, E Wing, G Wing, J Wing, I Wing	Flooring mastic	40,000 sq. ft.	Misc.	MNO	MNO	MNO	1	Materials are under newer floor coverings. During the renvoations, small areas of removal were conducted to access floor trenches.
Tunnel	Fitting insulation (hard) on fiberglass wrapped pipe	-----	TSI	MNO	MNO	MNO	5	Materials were removed by ABS during the 2014 renovations. Please reference the abatement reports.
Boiler room	Boiler materials-#1 boilers (internal)	-----	MNO	MNO	MNO	MNO	5	
Classrooms and Main Entrance	Transite window panels	1150 SF	MNO	MNO	MNO	MNO	5	
Storage Rm. Next to Stage	HVAC flex connectors	20 LF	MNO	MNO	MNO	MNO	5	Materials were tested during the renovations and found to be non-ACBM and can be removed from the list.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation and/or demolition a full NESHAP survey must be conducted in accordance with various state and federal regulations.						4	Possible inaccessible ACBM also.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

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Broad Street School: Page 1 of 1

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Elm Street Junior High School								
Stage	Pipe insulation	50 LF	TSI	Yes	Damaged	1	2	Materials were observed to have knicks, gouges and exposed edges present. Some materials have been enclosed within a plastic wrap. Conduct surface cleaning and repairs by qualified and licensed personnel. Conduct O&M cleaning within 15' of all surfaces with ACBM insulation.
Stage	Stage Curtain	1 Stage Curtain	Misc.	Yes	Damaged	4	2, 4	Materials were not previously listed on the report and are assumed to be ACBM. RPF observed fraying of the stage curtain along the edges, repair. Conduct O&M cleaning within 15' of all surfaces with ACBM insulation.
Room 30, 31, 32, 33	Pipe fitting insulation	20 observed	TSI	Yes	Damaged	1	2	RPF observed the materials in areas where 1x1 ceiling tiles were loose or had been removed. Materials were observed to be water damaged. Repair. Additional materials are assumed to be present above the 1x1 ceilings in areas that RPF could no gain access to. Conduct O&M cleaning within 15' of all surfaces with ACBM insulation.
Hall outside Room 30	Pipe fitting insulation	30 lf.	TSI	Yes	Damaged	1	2	
Throughout (above ceilings)	Pipe and pipe fitting insulation	unknown	TSI	MNO	MNO	MNO	1,6	Materials are assumed to be present. RPF conducted various spot checks throughout the school and accessible insulation was not observed only fiberglass insulation. However, it is likely that inaccessible materials is present in concealed spaces.

See notes on last page

RFP Environmental, Inc.; 320 First NH Turnpike, Northwood, NH 03261 *(603) 942-5432

Elm Street Junior High: Page 1 of 2

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Elm Street Junior High School								
Boiler Room B	Boiler materials, 2 boilers (internal)	20 CF	unknown	unknwon	MNO	MNO	1,4	Materials are assumed to be ACBM, however RPF could not gain access inside the boilers to reinspect the materials.
Hallway and common areas	Floor tiles beneath new floor on ground floor	-----	Misc.	No	MNO	MNO	1	Materials have been ocvered over with newer flooring.
Throughout	Floor tile mastic	-----	Misc.	No	MNO	MNO	1	
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column. O&M cleaning of surfaces in locations with friable ACBM or damaged ACBM, and Code 2 repairs and cleaning be completed by December 31, 2017.

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Elm Street Junior High: Page 2 of 2

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Bicentennial Elementary School								
Boiler room	Boiler materials (internal) Boiler 2	10 SF	unknown	MNO	MNO	MNO	1,4	Materials are assumed to be ACBM, however RPF could not gain access inside the boilers to reinspect the materials.
Entrances	Transite overhang	75 SF	Misc.	No	Good	NF	1	Includes kitchen side entrance, side entrance by cafeteria, door #35 and door #37.
Throughout	Floor tile mastic	unknown	Misc.	MNO	MNO	MNO	1,6	Materials were not observed and may have been removed. The 6 month report performed by ATC indicates that the floor tiles and mastic were removed in January 1996; however, RPF could not locate removal/testing records indicating that.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

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Bicentenial Elementary School: Page 1 of 1

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Charlotte: 48 Charlotte Avenue								
Throughout	Floor tile mastic	60,000 SF	Misc.	No	Good	NF	4	Materials are assumed to be present underneath newer flooring. Prior to renovation or demolition RPF recommends confirmation testing be performed.
Rooms 2, 4, 6, 11, 12, 13, 15	Floor tile mastic	6,200 SF	Misc.	MNO	MNO	MNO	5	Materials were removed in 2012. Please reference the Desmaris August 2012 report for further details.
Hall by Room 14, 28 A, Hall by AHU7	Non-ACBM Floor tile with PACM mastic	10 SF	Misc.	No	Fair	NF	1	Materials were observed to be cracking along the threshold. 28 A has one chipped floor tile present with PACM exposed.
Boiler room	Boiler materials (internal) Large boiler	10 CF	unknown	MNO	MNO	MNO	5	Materials were removed in 2012. Please reference the Desmaris August 2012 report for further details.
Boiler room ceiling	Glue daubs on boiler room ceiling	300 sq. ft	Misc.	MNO	MNO	MNO	5	Materials were removed in 2012. Please reference the Desmaris August 2012 report for further details.
Exterior Roof	Transite roof panels	unknown	Misc.	MNO	MNO	MNO	5	Materials were removed in 2012. Please reference the Desmaris August 2012 report for further details.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Charlotte: 48 Charlotte Avenue								

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

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Charlotte Avenue Page 2 of 2

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Fairgrounds Elementary School: 37 Blanchard								
Throughout Hallways (tiles abated in 1989)	Floor tile mastic (3 types)	unknown	Misc.	No	MNO	MNO	1	The majority of the material is covered over with newer flooring; however, in various locations throughout the school, floor tiles were chipped and mastic was exposed. Various locations of floor tile and linoleum were removed during the summer of 2011. Please reference the Desmaris report dated August 2011 for further details.
Outside Room 18, Water Bubbler in Hall	Non-ACBM floor tile with ACBM floor tile	3 SF	Misc.	No	Fair	NF	1	Floor tiles are starting to bubble and lift and crack along the expansion joint. Repair and wax.
Exterior Roof	Transite roof panels	unknown	Misc.	No	MNO	MNO	5	Materials were removed in 2012. Please refernce the Desmaris August 2012 report.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua School District: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Birch Hill Elementary School: 17 Birch Hill								
Closet 116A	Floor tile and mastic	200 sq. ft.	Misc.	No	Good	NF	1	These areas were no previously listed on your report, however materials appear to be homogenous.
First and second floor common areas	Floor tile and mastic	1,200 sq. ft.	Misc.	No	Fair	NF	1	Two areas of patched floor tiles.
Paper storage room	Floor tile and mastic	300 sq. ft.	Misc.	No	Good	NF	1	
Boiler room	Boiler materials, Internal	20 CF	MNO	MNO	MNO	MNO	1,4	Materials are assumed to be ACBM; however, RPF could not gain access inside the boilers to reinspect the materials.
Elevator	Floor tile and mastic	20 sq. ft.	Misc.	No	Good	NF	1	
Library: Room 208A and 208B	Floor tile and mastic	400 sq. ft.	Misc.	No	Good	NF	1, 4	These areas were no previously listed on your report, however materials appear to be homogenous.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua Elementary School: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Dr. Crisp Elementary School: 50 Arlington Street								
Boiler room	Boiler materials (internal)	10 CF	unknown	unknown	MNO	MNO	1,4	Materials are assumed to be ACBM; however, RPF could not gain access inside the boilers to reinspect the materials.
Throughout	Floor tile mastic	-----	Misc.	MNO	MNO	MNO	1,4	Material is assumed to be present; however, the material is covered over.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

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Dr. Crisp Elementary School: Page 1 of 1

Nashua Elementary School: 3-Year AHERA Reinspection 2011

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Fairgrounds Middle School: 27 Cleaveland St.								
Under stage far end / inside walls	Pipe fitting insulation	-----	TSI	MNO	MNO	MNO	1,4	Materials are assumed to be enclosed in walls and in service tunnel.
Stage area	Floor tile mastic	unknown	Misc.	MNO	MNO	MNO	1,4	Materials are assumed to be present underneath newer floor coverings.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua Elementary School: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Ledge Street Elementary School: 139 Ledge Street								
Throughout	Floor tile mastic	unknown	Misc.	MNO	MNO	MNO	1, 4	Materials are assumed to be present in various locations of the school. Prior to renovation or demolition confirmation testing should be performed.
Doors 7,8,9 10 and entrances	Floor tile mastic	30 square feet	Misc.	No	Fair	NF	1	Materials are starting to crack along the doors.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua Elementary School: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Main Dunstable Elementary School: 20 Whitford Road								
Above gym entrance	Steel beam with spray-on	6 linear feet	Surf.	MNO	MNO	MNO	----	Material is not observed. During the 2011 RPF observed suspect materials along the center beam above the plaster ceiling. However, RPF reviewed the material further and observed it was concrete overspray on the beam.
Gym teachers office	9" floor tile and mastic	250 sq. ft	Misc.	No	Good	NF	1	
Gym	Roof Drain Insulation	6 linear feet	TSI	Yes	Fair	1	1, 4	Materials are assumed to be ACBM, observed to have water damage. Test/Repair. Conduct O&M Cleaning within 15' of all surfaces with ACBM insulation.
Cafeteria, Room 217A Storage	12” x 12” gray floor tile & mastic	2000 sq. ft	Misc.	No	Good	NF	1	Approximatley 30 sq. ft of replacement floor tiles were observed along the expansion joint. Approxiatley 700 square feet of replacement floor tiles present in patches in the Café.
Wet Areas	Boiler materials	20 CF	TSI	Yes	Good	5	1	Two boilers
Elevator	Floor Tile	40 square feet	Misc.	No	Good	NF	1	
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

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Main Dunstable Elementary School: Page 1 of 1

Nashua Elementary School: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Mt. Pleasant								
Hallways/ gym / cafeteria	Floor Tile Mastic	-----	Misc.	MNO	MNO	MNO	1	Materials have been covered over with newer flooring.
Café, storage by gym	Floor Tile Mastic	12 square feet	Misc.	No	Fair	NF	1	Along heater in café replacement floor tiles present and a few chipped floor tiles by entrance.
Boiler Room	Boiler exhaust insulation	-----	TSI	Yes	Good	5	1, 4	Assumed
Boiler Room	Boiler materials (internal)	-----	unknown	MNO	MNO	MNO	1, 4	Materials are assumed to be ACBM, however RPF could not gain access inside the boilers to reinspect the materials. In addition, there is a statement in the file, however it is not an A/E statement. In addition, EndPoint also conducted additional testing in 2014 for the boiler room. Please reference their 2014 report.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua Elementary School: 3-Year AHERA Reinspection 2014

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
New Searles Elementary School: 39 Shady Lane								
Throughout	Floor Tile Mastic	unknown	Misc.	MNO	MNO	MNO	1	Materials have been covered over with newer flooring.
Art	Kiln	1 Kiln	Misc.	No	Good	NF	1, 4	Assumed
Gym office, Speech 141, Boiler Room entrance, hall outside 237	Non-ACBM floor tile with ACBM flooring mastic	15 sq. ft.	Misc.	No	Fair	NF	1	Rooms were observed to have one-two chipped floor tiles present and should be repaired and waxed.
Front wing and middle wing in back	Transite window panels	2,000 sq. ft	Misc.	No	Good	NF	1	
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

Nashua Elementary School: 3-Year AHERA Reinspection 2017

Location	ACBM	Approximate Quantity	Category	Friable	Condition	Assessment	Response	Notes
Sunset Heights School								
Classrooms Wing B Wing, C Wing, D Wing, F Wing, G Wing and H Wing	Flooring mastic	30,000	Misc	MNO	MNO	MNO	1	Materials under underneath floor coverings.
Front lobby around ceiling beam ends	Tan caulking	2 beam ends @ 3 lf each	Misc	No	Good	NF	1	
Front lobby, around door and window frames to Room A9	Tan Caulking	34 lf	Misc	No	Good	NF	1	
Interior, around door frames at D wing entrance, I-1, H wing entrance, and bathrooms in front of I-1	Grey Caulking	6 doors @ 17-21 lf each		No	Good	NF	1	
On underside of sink basins in countertop in Rooms B2, B3, B4, C1, C2, D1-D4, H1, H2, G1-G4, and F1	Sink Basin Undercoat	2 sq. ft/sink	Misc	No	Good	NF	1	
Front lobby, window wall, along brick, top sill, and center columns	Brown Caulking	65 lf	Misc	No	Good	NF	1	
Hallways	Floor tiles and associated mastics (approx. 5 types)	unknown	Misc.	MNO	MNO	MNO	5	Materials were removed in during the renovations.
Cafeteria	Pipe fittings on fiberglass pipe insulation	9	TSI	MNO	MNO	MNO	5	Materials were removed in during the renovations.
Stage area	Transite window panels	1,500 SF	Misc.	MNO	MNO	MNO	5	Materials were removed in during the renovations.
Throughout	Other suspect materials are present and further review is required. Prior to any renovation or demolition a full survey must be conducted. Several areas are assumed to be ACBM in the existing AHERA reports and confirmation testing is recommended as soon as feasible.						4	Concealed, inaccessible ACBM may also be present.

Category: MISC is miscellaneous material; TSI is thermal system insulation; SURF is surfacing material. Categorized in accordance with 40 CFR Part 763.

Assessment Codes based on 40 CFR Part 763: 1. Damaged or significantly damaged thermal system insulation ACM; 2. Damaged friable surfacing ACM; 3. Significantly damaged friable surfacing ACM; 4. Damaged or significantly damaged friable miscellaneous ACM; 5. ACBM with potential for damage; 6. ACBM with potential for significant damage; 7. Any remaining ACM. "NF" means nonfriable, and assessments are not required. MNO means material not observed. Please reference AHERA and the school management plan for discussion on assessment codes.

Response Codes: 1. Manage ACBM in accordance with Management Plan; 2. Conduct repairs and cleaning; 3. Conduct removal and cleaning; 4. Material suspect and requires further testing; 5. ACBM has been removed and may be removed from listings; 6. ACBM was not observed and further review is required. See further discussion and requirements in report.

Scheduling: For general O&M management of ACBM recommendations, the beginning start date was the inception of the management plan and the completion shall be until removal of all materials or sampling and analysis proved material is non-ACBM unless otherwise specified in the notes/scheduling column.

RPF Environmental, Inc.; 320 First NH Turnpike, Northwood, NH 03261 * (603) 942-5432

Sunset Heights School: Page 1 of 1

APPENDIX B

AHERA Management Plan – 2017 Update Recommendations

The following comments and recommendations should be reviewed in conjunction with the findings and discussions contained in the text of the report, attachments, the school's 1989 initial AHERA Report and Management Plan, and the federal standard 40 CFR Part 763. In particular, the existing Operations and Maintenance program should be referenced for additional work methods, minimum requirements and procedures, and safety and health.

Documentation review during the reinspection consisted of only those specific documents which list ACBM and were provided by the school for RPF to review. A full review or audit of the AHERA Plans for each building (including abatement records), other record-keeping requirements, or AHERA implementation records was not completed as part of this service. Except as otherwise noted, the reinspection work only included ACBM's identified in the inspection report provided to RPF by the school. During the reinspection and initial inspections, abatement documentation and other record-keeping items were not completely reviewed or audited for accuracy and completeness. This type of review was beyond the scope of services for the project.

A full inspection (for confirmation of previous inspection results) was also not completed during this project. In the event that other readily accessible suspect materials were observed by the inspector during the course of the reinspection (materials that may have been missed during the initial inspection or may require confirmation testing), the inspector provided preliminary notation on the reinspection reports to make the school aware that additional inspection or review may be required. Based on the RPF preliminary review of the records provided to RPF, it is RPF's opinion that the AHERA Plans may not address all of the possible ACBM present. However, in accordance with AHERA reinspection requirements, the inspector did not conduct full initial inspection during the course of the reinspection work.

Asbestos Program Manager

The school must maintain a current true and correct statement, signed by the individual designated by the school (the Asbestos Program Manager) that certifies that the general, local education agency responsibilities, as stipulated by the AHERA regulation, have been met or will be met. It is important to update this as personnel changes occur and that a copy is maintained with the current Management Plan documentation. The Asbestos Program Manager must be sure to receive and maintain adequate training and to obtain and file all necessary recordkeeping requirements pursuant to AHERA and the Management Plan, including but not limited to: training, reinspections, surveillance, O&M activity, abatement design and final reports, annual notifications, and other related asbestos management information and documentation.

Resources

Below is an estimated cost for various training and requirements of the AHERA management plan with reasonable cost assumptions over the next three years:

AHERA Management Plan – 2017 Update Recommendations

Task/Description	Estimated Costs
Annual 2-hour Awareness Training	$700
O&M Initial Training - up to 5	$1,600
O&M Refresher Training	$750
6-month Periodic Surveillance (if outsourced and not performed by the trained in-house staff)	$1,500
3-year AHERA Reinspection 2020	$3,500
Additional Inspection, Lab Work, Updates	$1,200

In addition, it is anticipated that some of the repair and cleaning work (small-scale and of short duration) that is recommended will be completed by in-house O&M level trained facilities staff, in accordance with the school's existing O&M Program and AHERA requirements. As such, the incremental increase in cost will likely be approximately $1,500 for various materials and disposal.

3-Year Reinspection

The school must continue to have a reinspection completed by a licensed inspector and management planner at least once during every three-year period from the inception of the Management Plan.

6-Month Surveillance

The school must continue to have periodic surveillance of all ACBM at least every 6-months, by either an adequately trained O&M level staff member or an outside licensed inspector.

Maintenance and Custodial Staff Training

The school shall ensure that all custodial and maintenance employees are properly trained in accordance with AHERA and other applicable rules and regulations

2 Hour Awareness: All janitorial, custodial and maintenance staff shall have a minimum of 2-hour asbestos awareness training upon hiring and each year

O&M Level Training: Maintenance staff who may come in contact or who may disturb asbestos shall have a minimum of 16-hours of training upon hire and annual refresher training per State and EPA/OSHA requirements.

O&M Level Activity

The school must continue to ensure that all appropriate procedures are taken to protect building occupants for any O&M activity undertaken, including but not limited to:

- Restrict entry into the area by persons other than those necessary to perform the maintenance project, either by physically isolating the area or by scheduling.

AHERA Management Plan – 2017 Update Recommendations

- Post signs to prevent entry by unauthorized persons.
- Shut off or temporarily modify the air-handling system and restrict other sources of air movement.
- Use work practices or other controls, such as wet methods, protective clothing, HEPA-vacuums, mini-enclosures, and glove bags, as necessary to inhibit the spread of any released fibers.
- Clean all fixtures or other components in the immediate work area.
- Place the asbestos debris and other cleaning materials in a sealed, leak-tight container for proper disposal at a permitted site.

O&M activity is typically limited to small-scale, short duration work where the primary intent is building maintenance, repair, or renovation where the removal of ACBM is not the primary goal of the job; and, the amount of ACBM to be disturbed or repaired is less than 3 linear or 3 square feet. Larger projects or activity cannot be broken up or scheduled in groups to minimize the quantity of ACBM for the purposes of classifying work as small-scale, short duration O&M activity.

Worker Protection

The school must comply with either the OSHA Asbestos Construction Standard at 29 CFR 1926.1101 (or for public employees the Asbestos Worker Protection Rule at 40 CFR 763.120) including proper training, personal protective equipment, respiratory protection programs, medical surveillance, proper equipment and engineering controls, and other relevant work and safety requirements.

General O&M Cleaning

Cleaning should be completed through each entire room marked (or as otherwise indicated on the attached room-by-room inventory) as having damaged ACBM or friable ACBM present, as stated in AHERA, on a semi-annual basis.

(i) HEPA-vacuum or steam-clean all carpets.

(ii) HEPA-vacuum or wet-clean all other floors and all other horizontal surfaces.

(iii) Dispose of all debris, filters, mop heads, and cloths in sealed, leak-tight containers

Fiber Release Episodes

In the event of the falling or dislodging of small amounts, less than 3 square or 3 linear feet of ACBM, ensure the following is completed by O&M level trained, qualified staff:

RPF Environmental • www.airpf.com

AHERA Management Plan – 2017 Update Recommendations

- Immediately restrict access and thoroughly saturate the debris using wet methods.
- Clean the area using appropriate O&M level methods.
- Place the asbestos debris in a sealed, leak-tight container for proper disposal
- Repair the area of damaged ACBM as applicable according to the AHERA rule.

In the event of the falling or dislodging of more than 3 square or 3 linear feet of ACBM:

- Immediately restrict entry to the area and post signs to prevent entry into the area by persons other than those necessary to perform the response action.
- Shut off or temporarily modify the air-handling system to prevent the distribution of fibers to other areas in the building.
- Contact the school's outside consultant for assistance with testing and design of the appropriate response action. Use the design plan to obtain pricing from qualified abatement contractors to complete the response action.

Other Specific ACBM Updates

Flooring

The floor tile/flooring mastic is present at most of the school and is nonfriable ACBM with the potential for damage. No immediate response action is required, as these materials can safely be managed in place. The materials were in good condition with some minor wear and tear observed. Care should be used not to disturb the underlying flooring (i.e. drilling or cutting holes for electrical/plumbing work). Regarding the flooring that is not covered with carpeting and/or newer 12" floor tile, care should be taken to avoid activities which will abrade the surface of the floor tile. Buffing, stripping, and other flooring maintenance activity should be completed in accordance with the most current guidelines for ACBM flooring. High speed buffing or use of abrasive pads must not be conducted on the ACBM floors. (References the Draft EPA Region I Guidance Document enclosed herein.)

The flooring ACBM must be managed properly in accordance with AHERA and this management plan until they are completely removed.

It should be noted that a recent EPA advisory statement recommends that flooring which was previously tested as asbestos-free be confirmed using electron microscopy prior to any removal or other activities that may results in the disturbance of the flooring.

Pipe and Pipe Fitting Insulation

The insulation was observed the Elm St Jr. High School. Remaining School's materials may be concealed within the wall and ceiling spaces; however, it was not accessible. Much of the materials in the Elm St. Jr. High was observed to be damaged without protective wrap present, and is classified as damaged or significantly damaged ACBM. Repairs/removal is required by licensed and trained personnel. Special care should be used when accessing areas to avoid accidental disturbance to the ACBM insulation or any possible debris and contaminated dust. It is also likely that additional material is present in locations not accessed for the reinspection work or in concealed locations. Initial and periodic cleaning of the adjacent surfaces should be performed on an annual basis at a minimum, using wet-wiping and HEPA vacuuming.

Transite Window Panels

No immediate response action is required. The ACBM is nonfriable with the potential for damage. The ACBM must be managed properly in accordance with AHERA and this management plan until they are completely removed. In the event that any renovation work or other construction, repairs or maintenance is to be completed, then the APM must review the work to determine that the ACBM will not be impacted either directly or indirectly by the work. If there exists a potential that the ACBM may be disturbed, then an accredited project designer/management planner should review the project and prepare abatement specification as required.

Assumed ACBM

Assumed ACBM that does not require any immediate response actions includes the following materials:

- Sink basin undercoat
- Building seam caulk throughout the buildings
- Ceramic tile mastic and grout (2 types) in bathrooms and kitchens
- Gypsum Board with Joint Compound various locations
- Glue Daubs
- Interior Door Caulk
- Covebase, stair treads and adhesive throughout the building
- Various exterior materials.

The gypsum board with joint compound throughout the buildings also requires initial testing and is assumed ACBM. Care should be used not to disturb the materials during the interim including notification and facilities staff, faculty and others that may disturb the gypsum or joint compound materials.

The non-friable assumed ACBM listed above are classified under AHERA as ACBM with the potential for damage. However, it should be noted that nonfriable ACBM and nonfriable assumed ACBM can be rendered friable when, for example, they are subjected to certain forces such as cutting, grinding, sawing, sanding, drilling, high-speed buffing, and other abrasive forces. This is particularly true during demolition or removal of nonfriable ACBM.

AHERA Management Plan – 2017 Update Recommendations

Under normal building conditions, the assumed nonfriable ACBM does not pose an immediate hazard. The materials are in good to fair condition in general, with some minor wear and tear. Care should be taken to ensure that the chalkboards are not broken or chipped. The exterior roofing, caulking, and glazing materials should not be subjected to grinding, cutting, abrasion, or other forces which would result in the production of dust.

The assumed nonfriable ACBM must be managed properly in accordance with AHERA and this management plan until they are completely removed. In the event that any renovation work or other construction, repairs or maintenance is to be completed, then the APM must review the work to determine that the ACBM will not be impacted, either directly or indirectly. If there exists a possibility that the ACBM may be disturbed, then an accredited project designer/management planner should review the project and prepare abatement specification as required.

Testing of the interior, accessible assumed ACBM should be completed as soon as feasible by a licensed inspector and the management plan be updated accordingly by a licensed management planner.

Exterior Suspected ACBM

Exterior ACBM (in many cases) is not directly regulated by AHERA but are regulated by other state and federal regulations. Prior to any disturbance, renovation, or demolition, a licensed inspector must inspect for and sample any suspect exterior ACBM to be impacted or disturbed. If ACBM is found, a licensed project designer should prepare abatement plans as needed to facilitate work.

Warning Labels

The schools must ensure warning labels are and continue to be immediately adjacent to any friable and nonfriable ACBM, suspected ACBM, and assumed to be ACM located in routine maintenance areas (such as boiler rooms, mechanical space and maintenance areas) at each school building. The warning label must read (in print which is readily visible because of large size or bright color) as follows: CAUTION: ASBESTOS. HAZARDOUS. DO NOT DISTURB WITHOUT PROPER TRAINING AND EQUIPMENT.

Asbestos Abatement Activity

Asbestos response actions, as defined by AHERA, must be detailed in a specification (project design) prepared by a licensed asbestos abatement project designer in accordance with AHERA and State regulations. Licensed personnel/contractors must carry out the response actions. Abatement activity itself is beyond the scope of the management plan/O&M program.

AHERA Management Plan – 2017 Update Recommendations

New Construction, Additions and Renovated Space

For any new buildings or renovated space, obtain architectural/engineering (A/E) statements for new construction/renovation areas in accordance with AHERA, certifying that no asbestos was specified or used. In lieu of A/E statements, all newly installed buildings materials must be tested pursuant to the AHERA inspection requirements.

Prior to any renovation or demolition activity, additional inspection and testing by a licensed inspector is required to satisfy current state, EPA and OSHA requirements that may exceed the inspection requirements under AHERA and the existing inspection documentation for the school buildings.

In the event that any renovation work or other construction, repairs or maintenance is to be completed, then the APM must review the work to determine that the ACBM will not be impacted, either directly or indirectly. If there exists a potential that the ACBM may be disturbed, then an accredited project designer/management planner should review the project and prepare abatement specification as required. Only properly accredited and licensed personnel should complete the work.

Conflict of Interest

Pursuant to the EPA AHERA requirements and industry standards, abatement contractors should be engaged for inspection, testing, lab work, design or oversight, and clearance testing services. These services must be performed by qualified, certified firms completely independent of any abatement contractors used to complete work for the school.

**Note: Also reference the 2017 Reinspection Report for additional comments and recommendations.*

OSHA Asbestos Flooring Maintenance Information

RPF Associates, Inc.
1-888-SAFE AIR

OSHA ASBESTOS FLOORING MAINTENANCE SECTION

1926.1101(l)(3) Care of asbestos-containing flooring material.

1926.1101(l)(3)(i)

All vinyl and asphalt flooring material shall be maintained in accordance with this paragraph unless the building/facility owner demonstrates, pursuant to paragraph (g)(8)(i)(I) of this section that the flooring does not contain asbestos.

1926.1101(l)(3)(ii)

Sanding of flooring material is prohibited.

1926.1101(l)(3)(iii)

Stripping of finishes shall be conducted using low abrasion pads at speeds lower than 300 rpm and wet methods.

1926.1101(l)(3)(iv)

Burnishing or dry buffing may be performed only on flooring which has sufficient finish so that the pad cannot contact the flooring material.

..1926.1101(l)(4)

1926.1101(l)(4)

Waste and debris and accompanying dust in an area containing accessible thermal system insulation or surfacing ACM/PACM or visibly deteriorated ACM:

1926.1101(l)(4)(i)

shall not be dusted or swept dry, or vacuumed without using a HEPA filter;

1926.1101(l)(4)(ii)

shall be promptly cleaned up and disposed of in leak tight containers.

OSHA Occupational Safety & Health Administration U.S. Department of Labor Home Index Search

OSHA Standards Interpretation and Compliance Letters

11/05/1999 - Questions regarding the cleaning of asbestos-containing floor tile.

OSHA Standard Interpretation and Compliance Letters - Table of Contents

- **Record Type:** Interpretation
- **Standard Number:** (l)(3)1926.1101;(k)(7)1910.1001
- **Subject:** Questions regarding the cleaning of asbestos-containing floor tile.
- **Information Date:** 11/05/1999

November 5, 1999

William A. Onderick, President
RFM Inc.
1008 Dogwood Lane
West Chester, Pennsylvania 19382

Dear Mr. Onderick:

Thank you for your July 27 letter regarding the cleaning of asbestos-containing floor tile. You wish clarification of the provisions in the Occupational Safety and Health Administration (OSHA) asbestos standards which regulate this activity. Your questions and our answers are provided below.

Question 1:

Are we correct that asbestos floor tile **cleaning** activities (normal maintenance such as stripping and buffing operations) are covered under both the Asbestos General Industry Standard (§1910.1001) and the Asbestos Construction Standard (§1926.1101)?

Answer:

control methods for only Class I or II asbestos work. The fact that the asbestos PELs are not exceeded when the floor stripping uses low abrasion pads at speeds greater than 300 revolutions per minute (rpm) is not a sufficient condition to warrant the receipt of a variance permitting such use. In order to receive a variance, the employer must have implemented some means of maintaining asbestos aerosol levels in the employees' breathing zones at levels equal to or less than the levels occurring at speeds lower than 300 rpm.

:Question 4

While the Construction Standard discusses submitting alternative work procedures, the General Industry Standard does not. How does one handle an alternative work procedure regarding the General Industry Standard?

:Answer

As we noted in our reply to your third question, the Construction Asbestos Standard makes allowances for alternative control methods for only Class I or II asbestos work. Therefore, whether the stripping or buffing of asbestos-containing flooring material is covered by the Construction Asbestos Standard or the General Industry Asbestos Standard, the employer who wishes to use alternative stripping or buffing procedures must seek a permanent variance.

Thank you for your interest in occupational safety and health. We hope you find this information helpful. Please be aware that OSHA's enforcement guidance is subject to periodic review and clarification, amplification, or correction. Such guidance could also be affected by subsequent rulemaking. In the future, should you wish to verify that the guidance provided herein remains current, you may consult OSHA's website at http://www.osha.gov. If you have any further questions, please feel free to contact OSHA's Office of Health Compliance Assistance at (202) 693-2190.

Sincerely,

Richard E. Fairfax, Director
Directorate of Compliance Programs

OSHA Standard Interpretation and Compliance Letters - Table of Contents

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Occupational Safety and Health Administration
Protecting the Safety and Health of America's Workers

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Standard Interpretations
02/09/2000 - Use of electric floor buffer with rotating blade attachment to remove asbestos-containing mastic.

Standard Interpretations - Table of Contents

• **Standard Number:** 1926.1101(g)(8); 1926.1101(b)

OSHA requirements are set by statute, standards and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov.

February 9, 2000

Ms. Paula K. Smith
Attorney for Utah OSHA
State of Utah
Labor Commission
Office of General Counsel
160 East 300 South, 3rd Floor
P.O. Box 146600
Salt Lake City, Utah 84114-6600

Dear Ms. Smith:

Thank you for your December 14, 1999 letter to the Occupational Safety and Health Administration's (OSHA's) Directorate of Compliance Programs (DCP). We are providing you with interpretations of the Construction Asbestos Standard, 29 CFR 1926.1101, based on the specific situation you describe pertaining to floor tile and associated mastic removal.

Scenario: You describe an employer in Utah who was using an electric floor buffer with a rotating blade attachment to remove asbestos-containing mastic without first erecting a negative pressure enclosure (NPE) in which to perform the work. The employer in this scenario had wetted the floor. Utah OSHA (UOSH) believes the floor buffer was a

United States Environmental Protection Agency
Research and Development

National Risk Management Research Laboratory
Cincinnati, OH 45268

EPA/600/SR-95/121 August 1995

EPA

Project Summary

Airborne Asbestos Concentrations During Buffing, Burnishing, and Stripping of Resilient Floor Tile

John R. Kominsky, Ronald W. Freyberg, and James M. Boiano

This study was conducted to evaluate airborne asbestos concentrations during low-speed spray-buffing, ultra high-speed burnishing, and wet-stripping of asbestos-containing resilient floor tile under pre-existing and prepared levels of floor care maintenance. Airborne asbestos concentrations were measured before and during each floor-care procedure to determine the magnitude of the increase in airborne asbestos levels during each procedure. Airborne total fiber concentrations were also measured for comparison with the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) of 0.1 f/cm^3, 8-hr. time-weighted average (TWA). Low-speed spray-buffing and wet-stripping were evaluated on pre-existing floor conditions and three levels of prepared floor-care conditions (poor, medium, and good). Ultra high-speed burnishing and wet-stripping were evaluated on two levels of prepared floor-care conditions (poor and good). All of the computed 8-hr. TWA personal sample results were below the OSHA PEL. It is noted that the floor tile in this study was of low asbestos content and in good condition, hence it is conceivable that floor tile with higher percentages of asbestos could result in higher levels of airborne asbestos during routine floor care maintenance activities. TEM analysis showed higher exposures to fibers predominantly less than 5 µm in length, whereas these shorter fibers were not counted by PCM.

This study shows that low-speed spray-buffing, ultra high-speed burnishing, and wet-stripping of asbestos-containing resilient floor tile can be sources of airborne asbestos in building air. The results suggest that multiple layers of sealant applied to the floor prior to the application of the floor finish can reduce the release of asbestos fibers during polish removal. The results of this study further support the U.S. EPA Recommended Interim Guidance for Maintenance of Asbestos-Containing Floor Coverings.

This Project Summary was developed by EPA's National Risk Management Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Three principal types of preventive maintenance are routinely performed on resilient floor tile: spray-buffing, ultra high-speed burnishing, and wet-stripping followed by refinishing. Spray-buffing is the restorative maintenance of a previously polished floor by use of a floor-polishing machine (operating at 175 to 1000 rpm) immediately after the surface has been mist-sprayed with a restorative product whereby the floor is buffed to dryness. Ultra high-speed burnishing is the buffing of a previously polished floor by using a floor polishing machine (operating at greater than 1500 rpm) without using a restorative spray product. Wet-stripping is the removal of the finish from the floor using a chemical floor-polish stripper and a 175 rpm floor machine equipped with an appropriate strip pad. This current study was conducted to evaluate airborne asbestos concentrations during low-speed spray-buffing, ultra high-speed burnishing, and wet-stripping of asbestos-containing resilient floor tile under pre-existing and prepared levels of floor care maintenance.

Objectives

The objectives of the study were as follows:

- To determine the airborne asbestos concentrations during low-speed spray-buffing of asbestos-containing resilient floor tile in pre-existing floor condition.
- To determine airborne asbestos concentrations during polish removal from asbestos-containing resilient floor tile in pre-existing floor condition.
- To determine and compare the airborne asbestos concentrations during low-speed spray-buffing of asbestos-containing resilient floor tile in poor, medium, and good floor conditions.
- To determine and compare airborne asbestos concentrations during polish removal after low-speed spray-buffing of asbestos-containing resilient floor tile in medium and good conditions using a manual floor machine.
- To determine and compare the airborne asbestos concentrations during ultra high-speed burnishing of asbestos-containing resilient floor tile in poor and good floor conditions.
- To determine and compare the airborne asbestos concentrations during polish removal after ultra high-speed burnishing of asbestos-containing resilient floor tile in poor and good floor conditions using an automated floor machine.
- To determine whether personal breathing zone concentrations during low-speed spray-buffing of floors in pre-existing, poor, medium, and good conditions exceed the OSHA Permissible Exposure Limit (PEL) of 0.1 f/cm³, 8-hr. Time-Weighted Average (TWA).
- To determine whether personal breathing zone concentrations during ultra high-speed burnishing of floors in poor and good conditions exceed the OSHA PEL of 0.1 f/cm³, 8-hr. TWA.
- To determine whether personal breathing zone concentrations during polish removal after low-speed spray-buffing of floors in pre-existing, poor, medium, and good condition exceed the OSHA PEL of 0.1 f/cm³, 8-hr. TWA.
- To determine whether personal breathing zone concentrations during polish removal after ultra high-speed burnishing of floors in poor and good conditions exceed the OSHA PEL of 0.1 f/cm³, 8-hr. TWA.

Site Description

This study was conducted in an unoccupied building located at the decommissioned Chanute Air Force Base (AFB) in Rantoul, IL. The study was conducted in a room which contained approximately 8600 ft² of open floor space tiled with 9-inch by 9-in. resilient floor tile containing approximately 5% chrysotile asbestos. Representatives of the Chemical Specialties Manufacturers Association (CSMA) and a floor products manufacturer visually inspected the physical condition of the floor. Their inspection focused on the evenness of the floor plane and the physical condition of the tile. They concluded that the floor was acceptable for the proposed study.

Configuration for Low-speed Spray-buffing and Wet-stripping Experiments

Approximately 6500 ft² of floor space was isolated as the experimental test area. A containment shell was constructed from 2-in. by 4-in. and 2-in. by 6-in. lumber to provide five equally-dimensioned test rooms, each with approximately 1300 ft² of floor space and 7-ft ceiling height. The containment shell was then surfaced with 6-mil polyethylene sheeting to provide airtight walls and ceilings for the five test rooms. The ceiling for each test room consisted of a single layer of polyethylene sheeting. The walls of each test room were surfaced with seven layers of polyethylene sheeting. Four high-efficiency particulate air (HEPA) filtration units were placed in the hallway outside of the five test rooms to ventilate the test rooms and reduce the airborne asbestos concentrations to background levels after each experiment.

Configuration for Ultra High-Speed Burnishing and Wet-Stripping Experiments

Upon completion of the low-speed spray-buffing and wet-stripping experiments, the test area was reconfigured to accommodate the ultra high-speed burnishing and wet-stripping experiments. The test area was reconfigured to provide a single test room of approximately 6500 ft² of floor space and 7-ft. ceiling height. The ceiling for the test room consisted of a single layer of polyethylene sheeting. The walls were surfaced with eight layers of polyethylene sheeting. Three HEPA filtration units were placed in the hallway outside of the test room to ventilate the test room and reduce the airborne asbestos concentrations to background levels after each experiment. The units were operated during the preparation phase of each experiment but not during the actual burnishing or wet-stripping experiments. All three HEPA units discharged the air outdoors via 12-in. diameter flexible ducting. Fresh air into the test room was obtained directly from outdoors through windows.

Experimental Design

Low-Speed Spray-Buffing and Wet-Stripping

Pre-existing Conditions

Low-speed spray-buffing was first evaluated on the pre-existing floor-care condition. Pre-existing condition was the condition of the floor as it existed in the room prior to evaluating the prepared floor-care conditions. Pre-existing floor conditions consisted of an undetermined number of coats of a Carnauba-type, buffable polish on the floor tile. Low-speed spray-buffing of the pre-existing floor-care condition was evaluated five times, once in each of the five test rooms. Wet-stripping (including polish and sealant removal) was also evaluated on the pre-existing floor-care condition. Wet-stripping of the pre-existing floor-care condition was evaluated five times, once in each of the five test rooms.

Prepared Floor Care Conditions

Low-speed spray-buffing was evaluated on three levels of prepared floor-care conditions: 1) poor floor-care condition, 2) medium floor-care condition, and 3) good floor-care condition. Poor floor-care condition was defined as a floor with one coat of sealant and one coat of polish. Medium floor-care condition was defined as a floor with one coat of sealant and two coats of polish. Good floor-care condition was defined as a floor with two coats of sealant and three coats of polish. Floor-care conditions were defined in consultation with the CSMA and other representatives of floor-care products manufacturers. Each floor-care condition was evaluated five times, once in each of the five test rooms, to yield a total of 15 experiments.

Wet-stripping after low-speed spray-buffing was evaluated on two levels of floor-

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dure had a statistically significant effect on airborne asbestos concentrations measured during the procedure (p=0.0128). Specifically, larger increases in airborne asbestos concentrations were observed during wet-stripping than during spray-buffing. The estimated airborne asbestos concentrations during spray-buffing and wet-stripping as a proportion of the respective baseline concentrations were calculated along with the corresponding 95% confidence interval. The average airborne asbestos concentration measured during low-speed spray-buffing was approximately 11 times greater than the average baseline concentration. The 95% confidence interval for this proportion is (2.6, 47). The lower 95% confidence limit is greater than 1, which indicates this is a statistically significant increase. The average airborne asbestos concentration measured during wet-stripping was approximately 186 times greater than baseline concentrations. The 95% confidence interval for this proportion is (44, 788). The lower 95% confidence limit is greater than 1, which indicates this is a statistically significant increase.

PCM Concentrations

Two personal breathing zone samples were collected during each experiment and analyzed by PCM. None of the individual PCM concentrations exceeded the OSHA PEL of 0.1 f/cm³. The highest individual PCM concentration (0.023 f/cm³) was measured during wet-stripping. The 8-hr TWA concentrations associated with the measured levels were calculated by assuming zero exposure beyond that which was measured during the experiment. The 8-hr TWA concentrations ranged from 0.001 to 0.003 f/cm³ during low-speed spray-buffing and from 0.0003 to 0.003 f/cm³ during wet-stripping of floors in pre-existing condition. None of the 8-hr TWA concentrations exceeded the OSHA PEL of 0.1 f/cm³.

Although the results of the personal breathing zone samples analyzed by PCM were all below the OSHA PEL, considerably higher exposures were shown by the personal breathing zone samples analyzed by TEM. Two primary reasons explain why the TEM concentrations were considerably higher than the PCM concentrations. First, PCM cannot detect fibers thinner than 0.25 μm in width. Second, the PCM method used in this study (i.e., NIOSH 7400) does not count fibers shorter than 5 μm in length. Over 99% of the asbestos structures measured during low-speed spray-buffing and wet-stripping of floors in pre-existing condition were shorter than 5 μm in length and would therefore not be counted by the PCM method.

Caution should be exercised in extrapolating the PCM measurements collected during this study to conditions at other sites. These tile were of low asbestos content and in good condition, and no other asbestos exposure activity was assumed.

Prepared Floor Conditions

TEM Concentrations

Figure 1 illustrates the overall average (geometric mean) concentrations measured before and during low-speed spray-buffing and wet-stripping on floors in prepared floor conditions. Although the mean relative increase in airborne asbestos concentrations during low-speed spray-buffing tended to decrease as the floor care condition improved (i.e., poor condition resulted in a larger relative increase than medium, and medium condition showed a larger relative increase than good), the differences between the three levels of floor care were not statistically significant (p=0.1149). Overall, the average airborne asbestos concentration during low-speed spray-buffing was approximately 2.6 times higher than the average baseline concentration. This increase was statistically significant (p=0.0017). A 95% confidence interval for the mean airborne asbestos concentration during spray-buffing as a proportion of the baseline concentration showed that the overall mean airborne asbestos con-

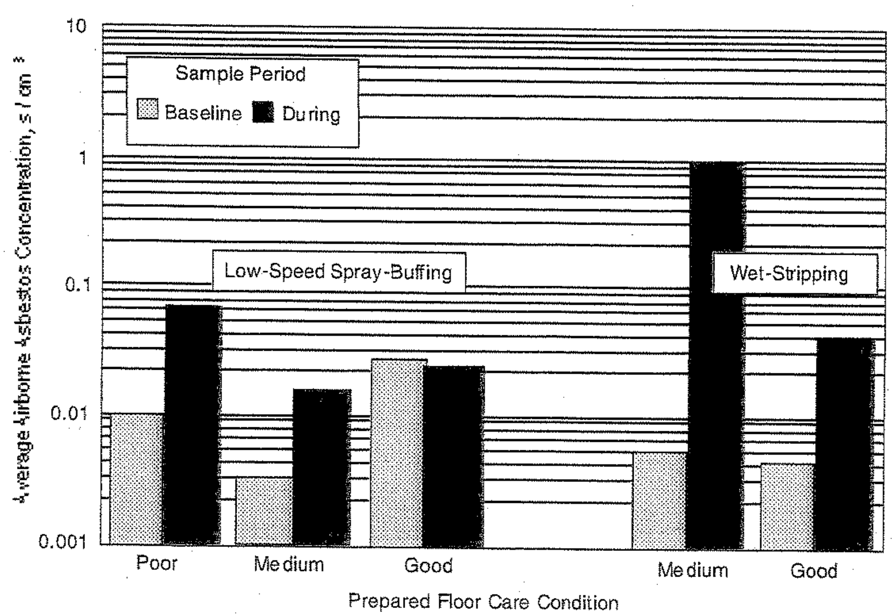

Figure 1. Average airborne asbestos concentrations during low-speed spraying of floors in prepared conditions.

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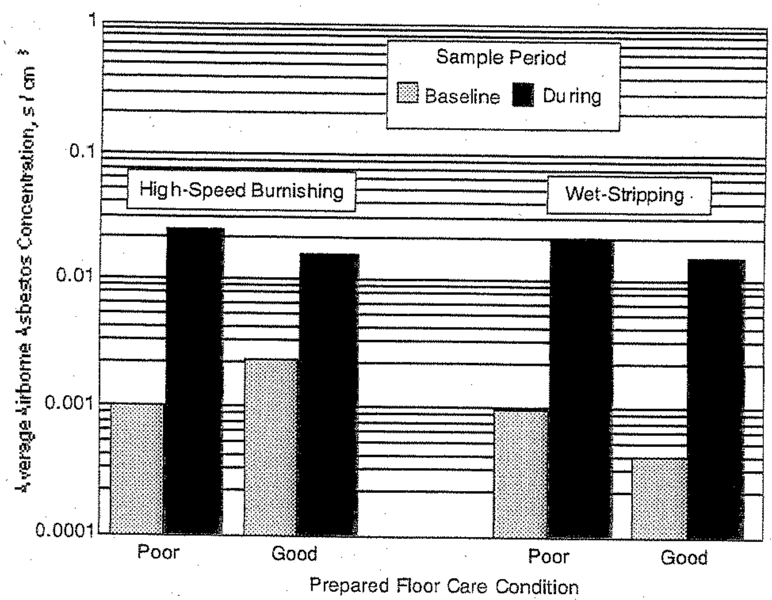

Figure 2. *Average airborne asbestos concentrations measured before and during ultra high-speed burnishing and wet-stripping of floors in prepared conditions.*

TWA concentrations measured during wet-stripping (after ultra high-speed burnishing) exceeded the OSHA PEL of 0.1 f/cm³ for total fibers, all of the 8-hr TWA concentrations measured during ultra high-speed burnishing exceeded the OSHA PEL. These exceedances, however, were due to the excess nonasbestos-containing particulate generated during the burnishing process and not to elevated airborne asbestos particles.

Conclusions

The following are the principal conclusions reached during this study:

1) Larger increases in airborne asbestos concentrations were observed during wet-stripping than during low-speed spray-buffing of floors in pre-existing condition. The average airborne asbestos concentration measured during low-speed spray-buffing was approximately 11 times greater than the average baseline concentration. The average airborne asbestos concentration measured during wet-stripping was approximately 186 times greater than the respective average baseline concentration. In both cases, the increases in airborne asbestos concentrations were statistically significant.

2) The average airborne asbestos concentration measured during low-speed spray-buffing of floors in the three levels of prepared floor-care conditions (poor, medium, and good) was approximately 2.6 times higher than the average baseline concentration. This increase was statistically significant.

3) The level of prepared floor care did not significantly affect the airborne asbestos concentrations measured during low-speed spray-buffing. Although the average increase in airborne asbestos concentrations tended to decrease as the level of floor care improved, the differences due to the three levels of floor care were not statistically significant.

4) Wet-stripping of floors in medium and good condition (after low-speed spray-buffing) resulted in statistically significant increases in airborne asbestos concentrations. The average airborne asbestos concentration measured during wet-stripping of floors in medium condition was approximately 108 times higher than the average baseline concentration, whereas the average airborne asbestos concentration measured during wet-stripping of floors in good condition was approximately 8.0 times higher than the average baseline concentration. The increase was statistically significant for both floor-care conditions.

5) A second layer of sealant appears to significantly decrease airborne asbestos levels during wet-stripping (after low-speed spray buffing). Larger increases in airborne asbestos concentrations were observed during wet-stripping of floors in medium condition than on floors in good condition. The average increase (relative to baseline measurements) in airborne asbestos concentration during wet-stripping of floors in medium condi-

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John R. Kominsky, Ronald W. Freyberg, and James M. Boiano are with Environmental Quality Management, Inc., Cincinnati, OH 45240
***Alva Edwards** is the Technical Project Officer (see below) and*
***Thomas Sharp** is the EPA Project Officer*
The complete report, entitled "Airborne Asbestos Concentrations During Buffing, Burnishing, and Stripping of Resilient Floor Tile," (Order No. PB95-260212; Cost: $27.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Technical Project Officer can be contacted at:
National Risk Management Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

United States
Environmental Protection Agency
Technology Transfer and Support Division (CERI)
Cincinnati, OH 45268

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machine speeds and the release of asbestos particles from asbestos containin floor coverings. The higher the machine speed the greater the probability o asbestos fiber release.

5. When stripping floors becomes necessary, the machine used for stripping th finish should be equipped with the least abrasive pad as possible, a black pa being the most abrasive and the white pad the least abrasive. Consult with you floor tile and floor finish product manufacturer for recommendations on whic pad to use on a particular floor covering. Incorporate the manufacturer recommendations into your floor maintenance work procedures.

6. Do not operate a floor machine with an abrasive pad on unwaxed or unfinishe floor containing-asbestos materials.

<u>Finishing of Vinyl Asbestos Floor Coverings</u>

1. Prior to applying a finish coat to a vinyl asbestos floor covering, appl 2 to 3 coats of sealer. Continue to finish the floor with a high percent soli finish.

It is an industry recommendation to apply several thin coats of a high percen solid finish to obtain a good sealing of the floor's surface, thereby minimizin the release of asbestos particles from the floor's surface.

2. If spray-buffing of floors is used, always operate the floor machine at th lowest rates of speed possible and equip the floor machine with the leas abrasive pad as possible. A recent USEPA study indicated that spray-buffing wit high-speed floor machines resulted in significantly higher airborne asbesto concentrations than spray-buffing with low speed machines.

3. When dry-burnishing of floors is used, always operate the floor machine a the lowest rate of speed possible to accomplish the task (i.e., 1200-1750 rpms) and equip the floor machine with the least abrasive pad as possible.

4. After stripping a floor and applying a new coat of sealer and finish, us a wet mop for routine cleaning whenever possible. When dry mopping, a petroleum-based mop treatment is not recommended for use.

5. During the winter months where sanding and/or salting of icy parking lot becomes necessary, it is an industry recommendation that a 16-24 ft. matting b used at the entrance way to the school building and where feasible inside th doorway. This would significantly eliminate the scuffing of floors by abrasiv sanding materials brought into the building on the shoes of students. Also mor frequent wet mopping and dry mopping of floors should be performed during th winter months to minimize damage to the floors.

6. Custodial and maintenance personnel responsible for daily VAT maintenanc should be limited to maintaining VAT floors totaling no more than 15,000-25,00 square feet per person/8-hour day, depending on conditions and othe responsibilities of the custodial and maintenance personnel.

DEFINITIONS

1. VAT: Vinyl Asbestos Tile.

2. Non-Friable: Any Asbestos Containing Material that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

3. Spray Buffing or Burnishing: The act of buffing or burnishing a floor finish while using a polishing or rejuvenating liquid. This liquid is sprayed on the floor in front of the buffer or burnisher a small area at a time. The floor machine is then used to polish the floor with this liquid. As a rule, polishes only polish while rejuvenaters help fill in minute scratches while polishing. Some of these products contain cleaners to help remove soiling on lightly soiled floors. How often these procedures are performed depends on many factors, such as, floor finish, traffic, machinery used, etc.

4. Dry Burnishing: The act of burnishing (high speed polishing) without any polishers, rejuvenaters or cleaners. Just the burnishing machine and the proper pad. This procedure hardens the finish and brings out the shine. Burnishing is performed using what is called a high speed burnisher or buffer. Simply put, this machine is a standard floor machine with an additional set of wheels for stability. These machines operate between 1,000 and 3,000 rpm. The faster the rpm, the faster and better the job can be performed.

5. Wet Scrubbing: A lightly abrasive (scrub) pad or brush is used on a 175-300 rpm floor machine to remove surface wear and dirt from the floor without removing all the floor finish. The floor is scrubbed with a neutral floor cleaner and water. This liquid is then removed with a mop or preferably with a wet vacuum. After rinsing, the floor is then re-coated with a compatible floor finish. The number of coats depends on the given situation and materials used.

6. Floor Stripping: When the floor finish has become heavily imbedded with soiling or discolored, it becomes necessary to totally remove (strip) the existing finish. This is accomplished by first applying a compatible floor finish remover or stripper. After the appropriate dwell time, the finish is liquified. The floor is then scrubbed using an abrasive pad or brush on a 175-300 rpm floor machine. The resulting liquid is then removed using a wet vacuum. These steps, in some cases, have to be repeated two or more times to assure the removal of all the existing finish. The floor is now rinsed as is appropriate with the products being used. The floor is now ready for finishing.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 25 1990

OFFICE OF
PESTICIDES AND TOXIC SUBSTANC

MEMORANDUM

SUBJECT: Recommended Interim Guidance for Maintenance of Asbestos-Containing Floor Coverings

FROM: Robert C. McNally, Chief
Assistance Programs Development Branch
Environmental Assistance Division (TS-799)

TO: Interested Parties

Attached are recommended interim guidelines for stripping wax or finish coat from asbestos-containing floors in your buildings. They were developed by the U.S. Environmental Protection Agency (EPA) in consultation with asbestos control professionals and several flooring material and floor care product manufacturers to reduce any possible exposure to asbestos fibers.

In November 1989, the local NBC affiliate in Washington, D.C. produced and aired a 3-part series on the potential danger of stripping asbestos-containing floor tiles. The NBC network news carried a brief portion of the series on November 29. The series concluded that stripping excess wax or finish coat from asbestos-containing floor tiles in schools may increase the asbestos exposure of school maintenance personnel and school children.

The series has precipitated numerous telephone calls to EPA Headquarters and to the ten EPA Regional offices. Perhaps many of you have also received calls from parents, staff, custodial workers, and others.

Since its airing, EPA's Environmental Assistance Division has tried to explain more clearly what the series did and did not demonstrate. First, there is no clear evidence that the "routine" stripping activities described in the series produced significantly elevated levels of asbestos fibers. In fact, the air levels generated during routine stripping were below those which require special procedures under federal regulation. Thus,

(continued on back)

APPENDIX C

1. Ledge Street School, example of cracked floor tile along the entrance.

2. Ledge Street School, example of cracked floor tile along the entrance.

3. Charlotte Avenue, example floor tile damage.

4. Charlotte Avenue, example of flooring damaged.

5. Mt. Pleasant, damaged flooring with ACBM mastic exposed in chair room.

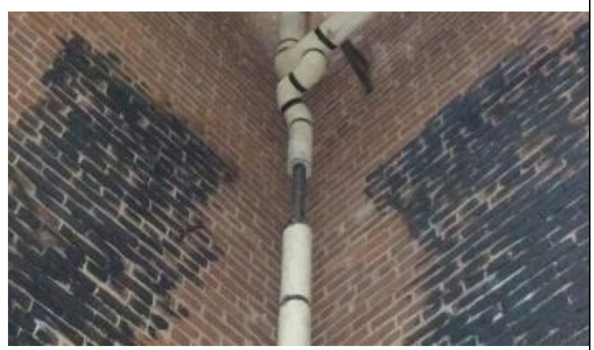
6. Mt. Pleasant, damaged and chipped flooring with mastic exposed.

EXAMPLE PICTURES		RPF Environmental TESTING & CONSULTING SERVICES
Site Address: SAU 42; Nashua School District		www.airpf.com **888-SAFE AIR** **File No. 178129**

7. Broad Street School, example chipped flooring along a floor hatch with ACBM mastic.

8. Elm Street, damaged pipe fitting outside Room 30 above ceiling.

9. Elm Street School, damaged ACBM pipe fitting insulation above ceiling.



10. Elm Street School, damaged pipe insulation in stage area.

11. PACM Stage Curtain at Elm Street School.

12. Assumed Kiln at New Searles School.

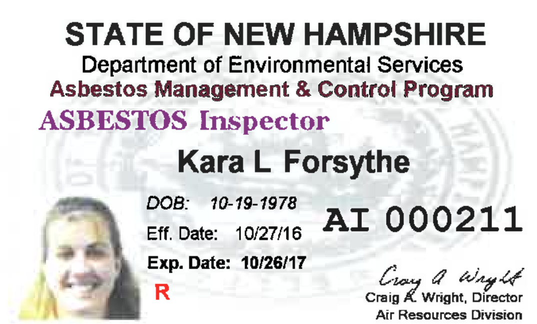
EXAMPLE PICTURES		RPF Environmental TESTING & CONSULTING SERVICES
Site Address: SAU 42; Nashua School District		www.airpf.com **888-SAFE AIR** **File No. 178129**

13. Flooring chipped with ACBM Mastic at Main Dunstable.

14. Assumed ACB roof drain at Main Dunstable.

EXAMPLE PICTURES		RPF Environmental TESTING & CONSULTING SERVICES
Site Address: SAU 42; Nashua School District		www.airpf.com **888-SAFE AIR** **File No. 178129**

APPENDIX D


STATE OF NEW HAMPSHIRE
Department of Environmental Services
Asbestos Management & Control Program
ASBESTOS Inspector
Kara L Forsythe
DOB: 10-19-1978
Eff. Date: 10/27/16
Exp. Date: 10/26/17
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AI 000211
Craig A. Wright, Director
Air Resources Division

RPF ENVIRONMENTAL, INC.

320 First NH Turnpike, Northwood, NH 03261 (603) 942-5432
Class Location: Northwood, NH

This is to certify that

Kara Forsythe

has completed the requisite training and
has passed an examination for accreditation as:

Asbestos Inspector - Annual Refresher
Pursuant to Title II of the Toxic Substance Control Act, 15 U.S.C. 2646

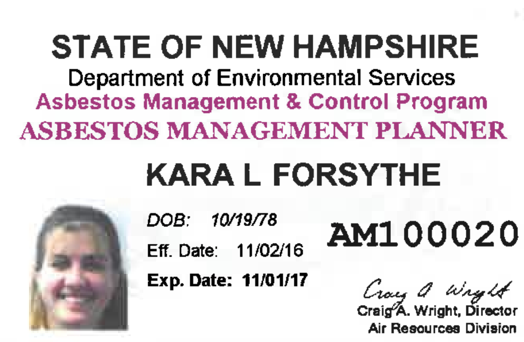
January 5. 2017
Course Date

January 5. 2017
Examination Date

January 5, 2018
Expiration Date

177649- 01- 101778
Certificate Number/DOB

Dennis N. Francoeur Jr., Instructor



STATE OF NEW HAMPSHIRE
Department of Environmental Services
Asbestos Management & Control Program
ASBESTOS MANAGEMENT PLANNER

KARA L FORSYTHE

DOB: 10/19/78
Eff. Date: 11/02/16
Exp. Date: 11/01/17

AM100020

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Kara Forsythe

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has passed an examination for accreditation as:

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January 27, 2017
Course Date

January 27, 2017
Examination Date

January 27, 2018
Expiration Date

177773-01 / 10-19-1978
Certificate Number/DOB

Dennis N. Francoeur Jr., Instructor

APPENDIX E

AHERA REINSPECTION METHODS & LIMITATIONS
(Page 1 of 2)

Reinspection Methods

The reinspection was completed in accordance with Part 763.85 (b) of 40 CFR Part 763, Subpart E - Asbestos Hazard Emergency Response Act (AHERA). Accessible ACBM's which were identified in the existing AHERA reports were visually reinspected in accordance with AHERA, to (a) observe whether the materials are friable, (b) observe the conditions of the ACBM and potential for disturbance, and (c) to assess the hazard potential of the ACBM. Documentation review consisted of only those specific documents which list ACBM which were provided by the school to RPF for review. A full review or audit of the AHERA Plans for the building (including abatement records), other record keeping requirements, and AHERA implementation records were not completed as part of this service. Please note that this reinspection report is intended to comply with the federal regulation and the report should not be considered or referenced as a detailed, full initial AHERA room-by-room inspection. Please also reference the initial AHERA Inspection Report prepared for the building by RPF and subsequent update records. This reinspection does not meet the requirements for full inspections prior to renovation or demolition activity.

A full inspection (for confirmation of previous inspection results) was also not completed during this project. In the event that other readily accessible suspect materials were observed by the inspector during the course of the reinspections (materials that may have been missed during the initial inspection or may require confirmation testing), the inspector provided preliminary notation on the reinspection reports to make the school aware that additional inspection or review may be required. However, in accordance with the AHERA reinspection requirements, the inspector did not conduct full initial inspection during the course of the reinspection work.

Limitations

- This reinspection only included the school buildings designated in the RPF listing. If other buildings are used as school buildings in accordance with 40 CFR Part 763 and need to be reinspected, please notify our office to make necessary arrangements. This reinspection and report does not meet the requirements set forth by US EPA, OSHA, and State agencies for conducting full asbestos inspections prior to renovation or demolition.

- The observations and conclusions presented in the report were based solely upon the services described herein, and not on scientific tasks or procedures beyond the Scope of Services as discussed in the proposal and text of the report. The conclusions and recommendations are based on visual observations and testing (which was limited as indicated in the report), and were arrived at in accordance with generally accepted standards of industrial hygiene practice and asbestos professionals. In addition and as applicable, where sample analyses were conducted by an outside laboratory, RPF has relied upon the data provided and has not conducted an independent evaluation of the reliability of this data.

- Observations were made of the designated accessible areas of the site as indicated in the report. While it was the intent of RPF to conduct a survey to the degree indicated, it is important to note that not all suspect ACBM material at the site(s) were specifically assessed. Visibility was limited, as indicated, due to the presence of furnishings, equipment, solid walls, and solid or suspended ceilings throughout the facility. Suspect material may have been used and may be present in areas where detection and assessment is difficult until renovation and/or demolition proceeds.

- Although some assumptions may have been stated regarding the potential presence of inaccessible or hidden ACBM, a full inspection for all ACBM or a destructive inspection for possible inaccessible suspect ACBM was not conducted. This inspection did not include a hazard assessment survey or testing to determine current dust concentrations of asbestos in and around the building. The survey was limited to ACBM as indicated herein and a site assessment for other possible environmental health and safety hazards or subsurface pollution was not performed as part of the scope of this initial site inspection.

- Where access to portions of the surveyed area was unavailable or limited, RPF renders no opinion of the condition and assessment of these areas. The survey results only apply to areas specifically accessed by RPF during the site inspection.

- Interiors of mechanical equipment and other building or process equipment may also have ACBM gaskets or insulation present and were not included in this inspection. Further inspections would likely be required prior to renovation or demolition activity.

- Existing reports, drawings and analytical results provided by the Client to RPF (as applicable), were not verified and, as such, RPF has relied upon the data provided as indicated and has not conducted an independent evaluation of the reliability of this data.

- All hazard communication and notification requirements, as required by 40 CFR Part 763, U.S. OSHA regulation 29 CFR Part 1926, 29 CFR Part 1910, and other applicable rules and regulations, by and between the Client, general contractors, subcontractors, building occupants, employees, and other affected persons were the responsibility of the Client and Client's abatement contractor and are not part of the Scope of Services to be provided by RPF.

- Results presented in the report are limited to the materials and conditions present at the time that the site inspection was actually performed by RPF. The applicability of the observations and recommendations presented in this report to other portions of the site were not determined as part of this scope of work. Many accidents, injuries and exposures, and environmental conditions are a result of individual employee/employer actions and behaviors, which vary from day to day and with operations being conducted. Changes to the site that occur subsequent to the RPF inspection may result in conditions which differ from those present during the survey and presented in the findings of the report. For example, during construction changes it is possible that previously inaccessible suspect material may be encountered. As such, the contractors, employer's OSHA-competent persons, and other affected staff should be advised of the possible presence of inaccessible ACBM and suspect ACBM. In the event that newly identified suspect material is encountered, please contact RPF to arrange for proper inspection, assessment and testing as applicable.

- Typically, hazardous building materials such as asbestos, lead paint, PCB's, mercury, refrigerants, hydraulic fluids and other materials may be present in buildings. The survey performed by RPF only addresses the specific items as indicated in the report. In general, it is recommended that surveys for all accessible hazardous building material be performed. Notify RPF to arrange for additional survey work as needed.

desmarais environmental

HAZARDOUS MATERIAL REPORT

ELM STREET SCHOOL
NASHUA, NEW HAMPSHIRE

2019

320 Hemlock Lane, Barrington, NH 03825 ph 603-664-5500 fax 603-664-5600 www.denvironmental.com

August 4, 2019

Re: Asbestos Survey Elm Street School – Nashua, NH

Desmarais Environmental, Inc. conducted a non-destructive asbestos and PCB survey of the Elm Street School in Nashua, New Hampshire.

The purpose of this survey was to determine the presence of asbestos and PCB -containing materials in order to ensure compliance with the regulatory requirements to renovate the building.

Reasonable efforts have been made by Desmarais Environmental, Inc personnel to locate and sample suspect asbestos-containing materials (ACM). However, for any facility, the existence of unique or concealed ACMs and debris is a possibility. In addition, sampling and laboratory analysis constraints typically hinder the investigation. Desmarais Environmental, Inc. does not warrant, guarantee or profess to have the ability to located or identify all asbestos containing materials within the area surveyed.

BACKGROUND INFORMATION

Asbestos is a term to describe six naturally occurring mineral fibers that are commonly found in a wide array of building construction materials due to the fiber strength and heat resistant properties. When asbestos containing materials become damaged or are disturbed during repair, remodeling or demolition activities; microscopic fibers become airborne. Asbestos fibers are so tiny and light that they can remain airborne for many hours. When inhaled, they can cause health problems. The three (3) most common types of asbestos are chrysotile, amosite and crocidolite. The lesser common types are tremolite, anthophyllite, and actinolite. Nearly 95% of all asbestos in the United States is chrysotile.

The Environmental Protection Agency classifies asbestos-containing building materials (ACBM) into three (3) general categories.

1. Surfacing Materials
    a. Any material that has been sprayed-on or troweled-on, or otherwise applied to surfaces. Textured ceilings, joint compound, and fireproofing are some examples of surfacing materials.
2. Thermal System Insulation (TSI)
    a. Any material applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior mechanical components designed to prevent heat loss or water condensation.
3. Miscellaneous Materials
    a. Any material that is not surfacing or thermal system insulation. Floor tiles, ceiling tiles, and transite board are some examples of miscellaneous materials.

The condition of asbestos containing materials is classified according to its friability, the current state of condition and its potential for disturbance. Friability is determined by the ability, when dry, to be crumbled, pulverized, or reduced to powder by hand pressure. The current state of condition is broken up into three categories

1. Significantly Damaged
    a. Over 10% evenly distributed damage or over 25% of the localized damage.
2. Damaged
    a. Less than 10% evenly distributed damage or less than 25% of the localized damage.
3. Good
    a. No visible damage or very little damage.

The potential for disturbance is categorized by answering three (3) questions with high, moderate or low. The three questions are as follows,

1. The potential for contact with the material?
2. The influence of vibration on the material?
3. The potential for air erosion on the material?

Any question with a high answer shows potential for significant damage, any question answered with moderate shows potential for damage and all questions answered with low shows low potential.

The Environmental Protection Agency established the National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, regulation to require the owner of a demolition or renovation activity and prior to commencement of the demolition or renovation, to thoroughly inspect the affected facility or part of the facility where the demolition or renovation operation will occur for the presence of asbestos. EPA defines a facility as any institutional, commercial, public, industrial, or residential structure, installation or building. It includes any structure, installation, or building containing condominiums or individual dwelling units operated as a residential cooperative, but excludes residential buildings having four or fewer dwelling units.

The State of New Hampshire established Env-A 1800 (Asbestos Management and Control) to better deal with asbestos within residential buildings. Under Env-A 1804.01, the State of New Hampshire requires that the owner/operator of a facility has an asbestos survey completed on the affected portion(s) prior to undertaking any demolition or renovation activity. According to Env-A 1802.31, the State of New Hampshire defines a facility as any institutional, commercial, public, or private building or structure, work place, ship, installation, active waste disposal site, inactive waste disposal site operated after July 9, 1981, or rental dwelling.

Asbestos samples of suspect materials were collected as described below according to type and quantity of material per homogeneous area. A homogeneous area is defined as a suspect material of similar age, appearance, function and texture.

Material	Samples
Miscellaneous materials	One sample per homogeneous area
Surfacing materials	Three samples per homogeneous area
Thermal system insulation	Three samples per homogeneous area

LABORATORY ANALYTICAL METHOD

All bulk samples collected were forwarded to Optimum Analytical, Inc. located in Salem, NH. Optimum is a NIST/NVLAP and AIHA-accredited laboratory.

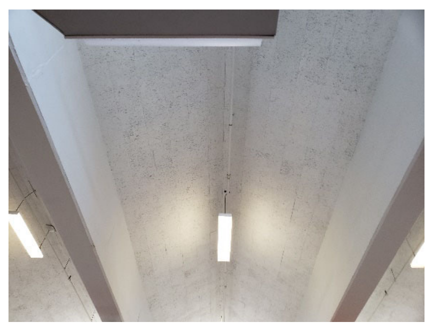
Analyses were performed using standard optical microscopy and petrographic techniques. A representative portion of the bulk sample was placed on a glass slide, immersed and macerated in the appropriate index oils. This was then examined under plane and fully polarized light on the petrographic microscope. The following features were used to identify unknown particles and fibers: Morphology, index of refraction, birefringence, size, color, etc.

Analytical results (compositions and percentages) are listed on the bulk report form attached. For the purpose of these analyses, asbestos determination and identification is based on definitions as set forth in the US. EPA Environmental Monitoring Systems Laboratory TEST METHOD "Interim Method for the Determination of Asbestos in Bulk Insulation Samples," EPA-600/M4-82-020.

Polarized-light microscopy is not consistently reliable in detecting asbestos in floor tiles. Confirmation by Transmission Electron Microscopy is recommended for negative floor tile samples.

RESULTS

Asbestos Ceiling Plaster



Asbestos Ceiling Tile

Floor Core non-Asbestos

Non-Asbestos Glue Dots

Assumed Asbestos Blackboard

Asbestos Floor Tile & Mastic
Asbestos Mastic on 12X12

Asbestos Pipe Fittings

TABLE OF ASBESTOS BULK SAMPLING RESULTS

Sample #		Description	Location	Results
	Unit			
1		12X12 Tan Mosaic Floor Tile	Room 7	None
2		Adhesive	Room 7	None
3		Leveler	Hall Ground	None
4		Black Tile under leveler	Hall Ground	**5% Chrysotile Asbestos**
5		No sample		None
6		No Sample		None
7		Tan Cove Base	Room #6	None
8		Adhesive	Room #6	None
9		Brown Cove Base	SE Entry	None
10		Adhesive	SE Entry	None
11		12X12 Light Blue Floor Tile	Art	None
12		Adhesive	Art	None
13		Short Brown Cove Base	Art	None
14		Adhesive	Art	None
15		Tall Brown Cove Base	Hall Outside Room #20	None
16		Adhesive	Hall Outside Room #20	None
17		Aqua Tile under #11&12	Art	**5% Chrysotile Asbestos**
18		Nastic	Art	**2% Chrysotile Asbestos**
19		Glue Dot	First Hall above drop Ceiling	None
20		Plaster	First Hall above drop Ceiling	None
21		Plaster	First Hall above drop Ceiling	**2% Chrysotile Asbestos**
22		Plaster	First Hall above drop Ceiling	None
23		12X12 Tan Mosaic	Room #101	None
24		Adhesive	Room #101	None
25		Lightweight Concrete	Room #101	None
26		12X12 Wal Tile	First Hall	None
27		Rubber Flooring	SE Entry	None
28		Adhesive	SE Entry	None
29		Wall Plaster	202	None
30		Wall Plaster	Hall First	None
31		Wall Plaster	101	None
32		12X12 Tan Mosaic	Hall outside 32	None

33		Adhesive	Hall outside 32	**2% Chrysotile Asbestos**
34		9X9 Green Floor Tile	Custodian Outside #32	**5% Chrysotile Asbestos**
35		Mastic	Custodian Outside #32	**2% Chrysotile Asbestos**
36		Glue Dot Caf Ceiling Tile	Caf	None
37		Ceiling Tile	Caf	**2% Amosite Asbestos**
38		Ceiling Tile	Hall near Gym B	None
39		Glue Dot	Hall near Gym B	None
40		Window Caulk	Room 33	None
41		Uninvent Caul	Room 33	None
42		Window Caulk	Room 1	None
43		Window Caulk	Room 43	None
44		Window Caulk	Room 46	None
45		Window Caulk	Gym B	None

None = No Asbestos Structures Detected or material not present

DISCUSSION

Asbestos (Known)

Floors
Asbestos flooring is present on the ground floor of the original building. The asbestos flooring and mastic are under a layer of non-asbestos floor tile and the hallways include a layer of floor leveler between the non-asbestos tile and asbestos tile and mastic below.

The upper floors of the original building have a non-asbestos tile with a thick layer of gypsum. Coring tools were not able to penetrate the depth of the gypsum. There is a possibility of an asbestos tile beneath the gypsum or an asbestos vapor barrier or paper. A larger destructive hole would need to be made to access below the gypsum when building is taken out of service.

The cafeteria and 30's rooms are either asbestos floor tile and mastic or non-asbestos floor tile and asbestos mastic.

Ceilings
Ceilings in the original building are a drop ceiling with a plaster ceiling on metal lathe above. The plaster above the drop ceiling appears to have had the topcoat partially removed but still contains asbestos. Plaster ceilings throughout the original building are asbestos containing.

12X12 ceilings in the café area and 30's wing is asbestos. Similar ceiling in the Gym B hall are non-asbestos.

Pipe Insulation
Pipe fittings are present above spline ceilings and likely present above plaster and other hard ceilings. Roof drains are also likely asbestos where they attach to roof deck and any horizontal runs.

Previous inspections identified the following asbestos-containing materials
Stage curtain
2'X4" Ceiling Tile Stage
Transite in the Penthouse Projector Room
Textured wall Auditorium
Transite Panels in window walls
Transite Panels in roof system

Asbestos (Assumed)

Blackboards and glue dots should be considered asbestos. Most blackboards are covered with other boards or white boards.

Waterproofing may be present behind any masonry exterior wall, frost and basement walls.

Vermiculite may be in some CMU block walls or attic spaces and should be assumed asbestos-containing.

Majority of roofs are membrane but could have an asbestos-roof that was covered.

POLYCHLORINATED BIPHENYLS (PCBs

Polychlorinated Biphenyls (PCBs) were used in the construction, renovation and repair of many buildings, including schools, from the 1950's through the late 1970's. PCBs may be present in products and materials produced before the 1979 PCB ban. PCB's were used in industrial and commercial applications including electrical, heat transfer, and hydraulic equipment. They were also used as plasticizers in paints, plastics and rubber compounds; and in pigments in dyes and some papers. PCBs commonly found in building construction include exterior window and door caulking and expansion joints. Most commercial PCB mixtures are known in the United States by their industrial trade names; the most common name is Aroclor. The primary focus in identifying polychlorinated biphenyls (PCBs) for this survey was in caulk within the buildings in preparation for its renovation or demolition.

All bulk samples collected were forwarded Phoenix Environmental Laboratories located in Manchester, Connecticut.

Analyses were performed using EPA Method 8082 PCBs by gas chromatography. This method is used to determine the concentrations of PCBs as Aroclors or as individual PCB congeners in extracts from solids. A measured weight of the sample is extracted and analyzed using electron capture detectors (ECD) or electrolytic conductivity detectors (ELCD).

Photographs

POLYCHLORINATED BIPHENYLS (PCBs) RESULTS

Sample #	Description	Location	Results PPM
PCB 1	Window Caulk	Room 33	53
PCB 2	Univent Caulk	Room 33	980
PCB 3	Window Caulk	Room 1	ND
PCB 4	Window Caulk	Room 43	32
PCB 5	Window Caulk	Room 46	260
PCB 6	Window Caulk	Gym B	25

ND = None Detected
1,000 µg/Kg = 1 PPM

Three of the six caulks exceeded regulatory limits and will require some action depending if the building is renovated or demolished. All six caulks tested appear similar.

PCB materials above 50 PPM fall under EPA regulations requiring removal or encapsulation.

PCB removal could require masonry removal as the clean-up requires achieving less than 1 PPM in all substrates. PCB's migrate into surrounding masonry require its removal to below 1 PPM.

Encapsulation is possible typically requiring significant testing and an application to the EPA as a temporary landfill. Factor six months to a year for the approval process to EPA.

A contingent of $500 will be used as a median figure.

PCB remediation can vary greatly depending on approach.

Remediation Estimate

Note: If quantities could be estimated a remediation price was included. If a material is assumed or could not be quantified a contingency figure was provided.

Material	Asbestos Confirmed or Assumed	Contingent	Estimate
Floor Tile and Mastic (2 layers)	Confirmed		$210,000.00
Floor Tile and mastic (1 layer)	Confirmed		$225,000.00
Ceiling Plaster	Confirmed		$644,000.00
Ceiling Tile	Confirmed		$150,000.00
Pipe Insulation/Fittings	Confirmed	$50,000.00	
Blackboards & Glue dots	Assumed	$25,000.00	
Roof Drains	Assumed	$10,000.00	
Waterproofing	Assumed	$100,000.00	
Roofing	Assumed	$50,000.00	
Vermiculite	Assumed	$100,000	
2’X4’ Ceiling Tile	Confirmed		
Transite	Confirmed	$30,000.00	
Textured Wall	Confirmed		$10,000.00
Transite Window Wall	Confirmed		$100,000.00
Radiator Shield	Confirmed	$10,000.00	
Vermiculite	Assumed	$25,000.00	
PCB Window Caulking	Confirmed	$500,000.00	
Subtotal Remediation		$800,000.00	$1,339,000.00
IH/Consulting		$160,000.00	$267,800.00
Total			$2,566,800.00

The laboratory reports are presented in Appendix 1 and marked-up floor plans in Appendix 2.

If you have any questions regarding this report or require additional services, please do not hesitate to contact our office at (603) 664-5500.

Respectively submitted,
Desmarais Environmental, Inc.

Raymond G. Desmarais, CIH, CSP
New Hampshire Licensed Inspector, Management Planner & Designer
New Hampshire License #024-IMD

Appendix 1
Laboratory Reports

OPTIMUM
Analytical and Consulting, LLC

85 Stiles Road, Suite 201
Salem, NH 03079
603-458-5247

Ray Desmarais
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington NH 03825

Project Reference:	
Laboratory Batch #:	1930420
Date Samples Received:	07/16/2019
Date Samples Analyzed:	07/23/2019
Date of Final Report:	07/24/2019

SAMPLE IDENTIFICATION:

Forty Five (45) samples from Elm St. School; Nashua, NH project were submitted by Ray Desmarais on 07/16/2019

This bulk sample(s) was delivered to Optimum Analytical Consulting, LLC (Optimum) located in Salem, New Hampshire for asbestos content determination.

ANALYTICAL METHOD:

Analytical procedures were performed in accordance with the U.S. Environmental Protection Agency (EPA) Recommended Method for the Determination of Asbestos in Bulk Samples by Polarized Light Microscopy and Dispersion Staining (PLM/DS)(EPA-600/M4-82-020, EPA-600/ R-93-116). This report relates only to those samples analyzed, and may not be indicative of other similar appearing materials existing at this, or other sites. Quantification of asbestos content was determined by Calibrated Visual Estimation. Optimum is not responsible for sample collection activities or analytical method limitations. The laboratory is not responsible for the accuracy of results when requested to physically separate and analyze layered samples.

In any given material, fibers with a small diameter (<0.25µm) may not be detected by the PLM method. Floor tile and other resinously bound material may yield a false negative if the asbestos fibers are too small to be resolved using PLM. Additional analytical methods may be required. Optimum recommends using Transmission Electron Microscopy (TEM) for a more definitive analysis.

Optimum will retain all samples for a minimum of three months. Further analysis or return of samples must be requested within this three month period to guarantee their availability. This report may not be reproduced except in full, without the written approval of Optimum Analytical and Consulting, LLC.

Use of the NVLAP and AIHA Logo in no way constitutes or implies product certification, approval, or endorsement by the National Institute of Standards and Technology or the American Industrial Hygiene Association.

Detection Limit <1%, Reporting Limits: CVES = 1%, 400 Point Count = .25%, 1000 Point Count = 0.1%; Present or Absent are observations made during a qualitative analysis.

This report is considered preliminary until signed by both the Laboratory Analyst and Laboratory Director or Supervisor. If you have any questions regarding this report, please do not hesitate to contact us.

Jamie L. Noel
Laboratory Director

Kristina Scaviola
Laboratory Supervisor

NVLAP Lab ID#: 101433-0

PAGE: 1 of 8

OPTIMUM
Analytical and Consulting, LLC
85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

CLIENT:	Desmarais Environmental, Inc.
ADDRESS:	320 Hemlock Lane
CITY / STATE / ZIP:	Barrington NH 03825
CONTACT:	Ray Desmarais
DESCRIPTION:	PLM Analysis
LOCATION:	Elm St. School; Nashua, NH

ORDER #:	1930420
PROJECT #:	
DATE COLLECTED:	07/16/2019
COLLECTED BY:	Ray Desmarais
DATE RECEIVED:	07/16/2019
ANALYSIS DATE:	07/23/2019
REPORT DATE:	07/24/2019
ANALYST:	Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-001 1	Room 7 12x12 Floor Tile, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-002 2	Room 7 Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-003 3	Hall Ground Leveler, White	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-004 4	Hall Ground Black Tile Under Leveler, Black	LAYER 1 100%	Chrysotile	5%	Cellulose Fiber Non-Fibrous Material	1% 94%
		Total % Asbestos:		5.0%	**Total % Non-Asbestos:**	95.0%
1930420-005 5	No Sample	LAYER 1 100%				
1930420-006 6	No Sample	LAYER 1 100%				
1930420-007 7	Room 6 Cove Base, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-008 8	Room 6 Cove Base Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

PAGE: 2 of 8

OPTIMUM
Analytical and Consulting, LLC

85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

CLIENT: Desmarais Environmental, Inc.
ADDRESS: 320 Hemlock Lane
CITY / STATE / ZIP: Barrington NH 03825
CONTACT: Ray Desmarais
DESCRIPTION: PLM Analysis
LOCATION: Elm St. School; Nashua, NH

ORDER #: 1930420
PROJECT #:
DATE COLLECTED: 07/16/2019
COLLECTED BY: Ray Desmarais
DATE RECEIVED: 07/16/2019
ANALYSIS DATE: 07/23/2019
REPORT DATE: 07/24/2019
ANALYST: Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-009 9	SE Entry Cove Base, Brown	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-010 10	SE Entry Cove Base Mastic, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-011 11	Art 12x12 Floor Tile, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-012 12	Art Mastic, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-013 13	Art Cove Base, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-014 14	Art Cove Base Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-015 15	Hall Outside Room #20 Cove Base, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-016 16	Hall Outside Room #20 Cove Base Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

PAGE: 3 of 8

OPTIMUM
Analytical and Consulting, LLC

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

CLIENT:	Desmarais Environmental, Inc.	**ORDER #:**	1930420
ADDRESS:	320 Hemlock Lane	**PROJECT #:**	
CITY / STATE / ZIP:	Barrington NH 03825	**DATE COLLECTED:**	07/16/2019
CONTACT:	Ray Desmarais	**COLLECTED BY:**	Ray Desmarais
DESCRIPTION:	PLM Analysis	**DATE RECEIVED:**	07/16/2019
LOCATION:	Elm St. School; Nashua, NH	**ANALYSIS DATE:**	07/23/2019
		REPORT DATE:	07/24/2019
		ANALYST:	Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-017 17	Art Aqua Tile Under #11 and #12, Green	LAYER 1 100%	Chrysotile	5%	Cellulose Fiber Non-Fibrous Material	2% 93%
		Total % Asbestos:		5.0%	**Total % Non-Asbestos:**	95.0%
1930420-018 18	Art Mastic, Black	LAYER 1 100%	Chrysotile	2%	Cellulose Fiber Non-Fibrous Material	2% 96%
		Total % Asbestos:		2.0%	**Total % Non-Asbestos:**	98.0%
1930420-019 19	First Hall Above Drop Ceiling Glue Dot, Brown	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-020 20	First Hall Above Drop Ceiling Plaster, White	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	5% 95%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-021 21	First Hall Above Drop Ceiling Plaster, White	LAYER 1 100%	Chrysotile	2%	Cellulose Fiber Non-Fibrous Material	5% 93%
		Total % Asbestos:		2.0%	**Total % Non-Asbestos:**	98.0%
1930420-022 22	First Hall Above Drop Ceiling Plaster, White Note: Very Small Amount of Plaster	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	5% 95%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-023 23	Room #101 12x12 Mosaic, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-024 24	Room #101 Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

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OPTIMUM
Analytical and Consulting, LLC

85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

CLIENT: Desmarais Environmental, Inc.
ADDRESS: 320 Hemlock Lane
CITY / STATE / ZIP: Barrington NH 03825
CONTACT: Ray Desmarais
DESCRIPTION: PLM Analysis
LOCATION: Elm St. School; Nashua, NH

ORDER #: 1930420
PROJECT #:
DATE COLLECTED: 07/16/2019
COLLECTED BY: Ray Desmarais
DATE RECEIVED: 07/16/2019
ANALYSIS DATE: 07/23/2019
REPORT DATE: 07/24/2019
ANALYST: Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-025 / 25	Room #101					
	LAYER 1 Lightweight Concrete, Gray	LAYER 1 100%	None Detected		Cellulose Fiber	15%
					Non-Fibrous Material	85%
	LAYER 2 Adhesive, Black	LAYER 2 100%	None Detected		Cellulose Fiber	2%
					Non-Fibrous Material	98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-026 / 26	First Hall 12x12 Wall Tile, White	LAYER 1 100%	None Detected		Cellulose Fiber	5%
					Mineral Wool	65%
					Fibrous Glass	15%
					Non-Fibrous Material	15%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-027 / 27	SE Entry Rubber Flooring, Gray	LAYER 1 100%	None Detected		Cellulose Fiber	1%
					Non-Fibrous Material	99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-028 / 28	SE Entry Adhesive, Tan	LAYER 1 100%	None Detected		Cellulose Fiber	1%
					Non-Fibrous Material	99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-029 / 29	202 Wall Plaster, White	LAYER 1 100%	None Detected		Cellulose Fiber	1%
					Non-Fibrous Material	99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-030 / 30	Hall First Wall Plaster, White	LAYER 1 100%	None Detected		Cellulose Fiber	1%
					Non-Fibrous Material	99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-031 / 31	101 Wall Plaster, White	LAYER 1 100%	None Detected		Cellulose Fiber	1%
					Non-Fibrous Material	99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

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OPTIMUM
Analytical and Consulting, LLC

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

CLIENT:	Desmarais Environmental, Inc.	**ORDER #:**	1930420
ADDRESS:	320 Hemlock Lane	**PROJECT #:**	
CITY / STATE / ZIP:	Barrington NH 03825	**DATE COLLECTED:**	07/16/2019
CONTACT:	Ray Desmarais	**COLLECTED BY:**	Ray Desmarais
DESCRIPTION:	PLM Analysis	**DATE RECEIVED:**	07/16/2019
LOCATION:	Elm St. School; Nashua, NH	**ANALYSIS DATE:**	07/23/2019
		REPORT DATE:	07/24/2019
		ANALYST:	Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-032 32	Hall Outside 32 12x12 Floor Tile, Beige	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	1% 99%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-033 33	Hall Outside 32 Mastic, Black	LAYER 1 100%	Chrysotile	2%	Cellulose Fiber Non-Fibrous Material	2% 96%
		Total % Asbestos:		2.0%	**Total % Non-Asbestos:**	98.0%
1930420-034 34	Custodian Outside #32 9x9 Floor Tile, Green	LAYER 1 100%	Chrysotile	5%	Cellulose Fiber Non-Fibrous Material	1% 94%
		Total % Asbestos:		5.0%	**Total % Non-Asbestos:**	95.0%
1930420-035 35	Custodian Outside #32 Mastic, Black Note: Very small amount of mastic	LAYER 1 100%	Chrysotile	2%	Cellulose Fiber Non-Fibrous Material	2% 96%
		Total % Asbestos:		2.0%	**Total % Non-Asbestos:**	98.0%
1930420-036 36	Caf Glue Dot, Brown	LAYER 1 100%	None Detected		Cellulose Fiber Non-Fibrous Material	3% 97%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-037 37	Caf Ceiling Tile, Gray	LAYER 1 100%	Amosite	2%	Cellulose Fiber Fibrous Glass Non-Fibrous Material	65% 15% 18%
		Total % Asbestos:		2.0%	**Total % Non-Asbestos:**	98.0%
1930420-038 38	Hall Near Gym B Ceiling Tile, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	65% 15% 20%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

PAGE: 6 of 8

OPTIMUM
Analytical and Consulting, LLC

85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY

PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

CLIENT: Desmarais Environmental, Inc.
ADDRESS: 320 Hemlock Lane
CITY / STATE / ZIP: Barrington NH 03825
CONTACT: Ray Desmarais
DESCRIPTION: PLM Analysis
LOCATION: Elm St. School; Nashua, NH

ORDER #: 1930420
PROJECT #:
DATE COLLECTED: 07/16/2019
COLLECTED BY: Ray Desmarais
DATE RECEIVED: 07/16/2019
ANALYSIS DATE: 07/23/2019
REPORT DATE: 07/24/2019
ANALYST: Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)
1930420-039 39	Hall Near Gym B Glue Dot, Brown	LAYER 1 100%	None Detected		Wollastonite Cellulose Fiber Non-Fibrous Material	5% 1% 94%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-040 40	Room 33 Window Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-041 41	Room 33 Univent Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-042 42	Room 1 Window Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-043 43	Room 43 Window Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-044 44	Room 46 Window Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%
1930420-045 45	Gym B Window Caulk, Gray	LAYER 1 100%	None Detected		Cellulose Fiber Fibrous Glass Non-Fibrous Material	1% 1% 98%
		Total % Asbestos:	No Asbestos Detected		**Total % Non-Asbestos:**	100.0%

PAGE: 7 of 8

OPTIMUM
Analytical and Consulting, LLC
85 Stiles Road, Suite 201, Salem, NH 03079 Phone: (603)-458-5247

BULK SAMPLE ANALYSIS REPORT
POLARIZED LIGHT MICROSCOPY
PLM (EPA-600/M4-82-020, EPA-600/ R-93-116) NVLAP Lab Code: 101433-0

CLIENT:	Desmarais Environmental, Inc.	**ORDER #:**	1930420
ADDRESS:	320 Hemlock Lane	**PROJECT #:**	
CITY / STATE / ZIP:	Barrington NH 03825	**DATE COLLECTED:**	07/16/2019
CONTACT:	Ray Desmarais	**COLLECTED BY:**	Ray Desmarais
DESCRIPTION:	PLM Analysis	**DATE RECEIVED:**	07/16/2019
LOCATION:	Elm St. School; Nashua, NH	**ANALYSIS DATE:**	07/23/2019
		REPORT DATE:	07/24/2019
		ANALYST:	Kristina Scaviola

REPORT OF ANALYSIS

Laboratory ID Sample No.	Sample Location Description	Layer No. Layer %	Asbestos Type	(%)	Non-Asbestos Components	(%)

Analyst Signatory:
Kristina Scaviola

NVLAP Lab Code: 101433-0

PAGE: 8 of 8

PHOENIX Environmental Laboratories, Inc.

Thursday, July 25, 2019

Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Project ID: ELM STREET SCHOOL
SDG ID: GCD59737
Sample ID#s: CD59737 - CD59742

This laboratory is in compliance with the NELAC requirements of procedures used except where indicated.

This report contains results for the parameters tested, under the sampling conditions described on the Chain Of Custody, as received by the laboratory. This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included.

All soils, solids and sludges are reported on a dry weight basis unless otherwise noted in the sample comments.

A scanned version of the COC form accompanies the analytical report and is an exact duplicate of the original.

If you are the client above and have any questions concerning this testing, please do not hesitate to contact Phoenix Client Services at ext.200. The contents of this report cannot be discussed with anyone other than the client listed above without their written consent.

Sincerely yours,

Phyllis Shiller

Phyllis Shiller
Laboratory Director

NELAC - #NY11301
CT Lab Registration #PH-0618
MA Lab Registration #M-CT007
ME Lab Registration #CT-007
NH Lab Registration #213693-A,B
NJ Lab Registration #CT-003
NY Lab Registration #11301
PA Lab Registration #68-03530
RI Lab Registration #63
UT Lab Registration #CT00007
VT Lab Registration #VT11301

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Telephone (860) 645-1102 Fax (860) 645-0823

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Sample Id Cross Reference

July 25, 2019

SDG I.D.: GCD59737

Project ID: ELM STREET SCHOOL

Client Id	Lab Id	Matrix
PCB1	CD59737	CAULK
PCB2	CD59738	CAULK
PCB3	CD59739	CAULK
PCB4	CD59740	CAULK
PCB5	CD59741	CAULK
PCB6	CD59742	CAULK

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ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59737

Project ID: ELM STREET SCHOOL
Client ID: PCB1

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1221	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1232	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1242	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1248	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1254	53000	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1260	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1262	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1268	ND	7100	ug/Kg	10	07/23/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	96		%	10	07/23/19	SC	30 - 150 %
% DCBP (Confirmation)	103		%	10	07/23/19	SC	30 - 150 %
% TCMX	107		%	10	07/23/19	SC	30 - 150 %
% TCMX (Confirmation)	111		%	10	07/23/19	SC	30 - 150 %

Ver 1

Project ID: ELM STREET SCHOOL
Client ID: PCB1

Phoenix I.D.: CD59737

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
BRL=Below Reporting Level L=Biased Low
QA/QC Surrogates: Surrogates are compounds (preceeded with a %) added by the lab to determine analysis efficiency. Surrogate results(%) listed in the report are not "detected" compounds.

Comments:

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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59738

Project ID: ELM STREET SCHOOL
Client ID: PCB2

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1221	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1232	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1242	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1248	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1254	980000	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1260	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1262	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
PCB-1268	ND	110000	ug/Kg	100	07/22/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	Diluted Out		%	100	07/22/19	SC	30 - 150 %
% DCBP (Confirmation)	Diluted Out		%	100	07/22/19	SC	30 - 150 %
% TCMX	Diluted Out		%	100	07/22/19	SC	30 - 150 %
% TCMX (Confirmation)	Diluted Out		%	100	07/22/19	SC	30 - 150 %

Ver 1

Project ID: ELM STREET SCHOOL
Client ID: PCB2

Phoenix I.D.: CD59738

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
BRL=Below Reporting Level L=Biased Low
QA/QC Surrogates: Surrogates are compounds (preceeded with a %) added by the lab to determine analysis efficiency. Surrogate results(%) listed in the report are not "detected" compounds.

Comments:

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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59739

Project ID: ELM STREET SCHOOL
Client ID: PCB3

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1221	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1232	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1242	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1248	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1254	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1260	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1262	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
PCB-1268	ND	710	ug/Kg	1	07/25/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	69		%	1	07/25/19	SC	30 - 150 %
% DCBP (Confirmation)	52		%	1	07/25/19	SC	30 - 150 %
% TCMX	55		%	1	07/25/19	SC	30 - 150 %
% TCMX (Confirmation)	46		%	1	07/25/19	SC	30 - 150 %

Ver 1

Project ID: ELM STREET SCHOOL
Client ID: PCB3

Phoenix I.D.: CD59739

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

Ver 1

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59740

Project ID: ELM STREET SCHOOL
Client ID: PCB4

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1221	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1232	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1242	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1248	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1254	32000	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1260	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1262	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
PCB-1268	ND	8900	ug/Kg	10	07/23/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	92		%	10	07/23/19	SC	30 - 150 %
% DCBP (Confirmation)	99		%	10	07/23/19	SC	30 - 150 %
% TCMX	102		%	10	07/23/19	SC	30 - 150 %
% TCMX (Confirmation)	108		%	10	07/23/19	SC	30 - 150 %

Ver 1

Project ID: ELM STREET SCHOOL
Client ID: PCB4

Phoenix I.D.: CD59740

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
BRL=Below Reporting Level L=Biased Low
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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

Ver 1

PHOENIX

Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59741

Project ID: ELM STREET SCHOOL
Client ID: PCB5

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1221	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1232	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1242	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1248	260000	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1254	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1260	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1262	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
PCB-1268	ND	79000	ug/Kg	100	07/24/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	Diluted Out		%	100	07/24/19	SC	30 - 150 %
% DCBP (Confirmation)	Diluted Out		%	100	07/24/19	SC	30 - 150 %
% TCMX	Diluted Out		%	100	07/24/19	SC	30 - 150 %
% TCMX (Confirmation)	Diluted Out		%	100	07/24/19	SC	30 - 150 %

Ver 1

Project ID: ELM STREET SCHOOL
Client ID: PCB5

Phoenix I.D.: CD59741

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
BRL=Below Reporting Level L=Biased Low
QA/QC Surrogates: Surrogates are compounds (preceeded with a %) added by the lab to determine analysis efficiency. Surrogate results(%) listed in the report are not "detected" compounds.

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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

Ver 1

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Report

July 25, 2019

FOR: Attn: Mr.Ray Desmarais, CIH, CSP
Desmarais Environmental, Inc.
320 Hemlock Lane
Barrington, NH 03825

Sample Information		Custody Information		Date	Time
Matrix:	CAULK	Collected by:		07/16/19	11:00
Location Code:	DESMAR	Received by:	CP	07/18/19	10:37
Rush Request:	Standard	Analyzed by:	see "By" below		
P.O.#:					

Laboratory Data

SDG ID: GCD59737
Phoenix ID: CD59742

Project ID: ELM STREET SCHOOL
Client ID: PCB6

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference
Caulk Extraction for PCB	Completed				07/21/19	BX/KL/SB	SW3540C
PCB (Soxhlet SW3540C)							
PCB-1016	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1221	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1232	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1242	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1248	25000	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1254	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1260	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1262	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
PCB-1268	ND	7100	ug/Kg	10	07/24/19	SC	SW8082A
QA/QC Surrogates							
% DCBP	99		%	10	07/24/19	SC	30 - 150 %
% DCBP (Confirmation)	90		%	10	07/24/19	SC	30 - 150 %
% TCMX	109		%	10	07/24/19	SC	30 - 150 %
% TCMX (Confirmation)	95		%	10	07/24/19	SC	30 - 150 %

Ver 1

Page 13 of 19

Project ID: ELM STREET SCHOOL
Client ID: PCB6

Phoenix I.D.: CD59742

Parameter	Result	RL/ PQL	Units	Dilution	Date/Time	By	Reference

RL/PQL=Reporting/Practical Quantitation Level (Equivalent to NELAC LOQ, Limit of Quantitation) ND=Not Detected at RL/PQL
BRL=Below Reporting Level L=Biased Low
QA/QC Surrogates: Surrogates are compounds (preceeded with a %) added by the lab to determine analysis efficiency. Surrogate results(%) listed in the report are not "detected" compounds.

Comments:

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Phyllis Shiller, Laboratory Director
July 25, 2019
Reviewed and Released by: Greg Lawrence, Assistant Lab Director

Ver 1

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587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

QA/QC Report

July 25, 2019

QA/QC Data

SDG I.D.: GCD59737

Parameter	Blank	Blk RL	LCS %	LCSD %	LCS RPD	MS %	MSD %	MS RPD	% Rec Limits	% RPD Limits
QA/QC Batch 488714 (ug/Kg), QC Sample No: CD59738 10X (CD59737, CD59738, CD59739, CD59740, CD59741, CD59742)										
Polychlorinated Biphenyls										
PCB-1016	ND	170	87	80	8.4				40 - 140	30
PCB-1221	ND	170							40 - 140	30
PCB-1232	ND	170							40 - 140	30
PCB-1242	ND	170							40 - 140	30
PCB-1248	ND	170							40 - 140	30
PCB-1254	ND	170							40 - 140	30
PCB-1260	ND	170	83	82	1.2				40 - 140	30
PCB-1262	ND	170							40 - 140	30
PCB-1268	ND	170							40 - 140	30
% DCBP (Surrogate Rec)	91	%	80	81	1.2				30 - 150	30
% DCBP (Surrogate Rec) (Confirm	91	%	81	82	1.2				30 - 150	30
% TCMX (Surrogate Rec)	87	%	92	77	17.8				30 - 150	30
% TCMX (Surrogate Rec) (Confirm	82	%	88	73	18.6				30 - 150	30

Comment:

A LCS and LCS Duplicate were performed instead of a matrix spike and matrix spike duplicate.

If there are any questions regarding this data, please call Phoenix Client Services at extension 200.

RPD - Relative Percent Difference
LCS - Laboratory Control Sample
LCSD - Laboratory Control Sample Duplicate
MS - Matrix Spike
MS Dup - Matrix Spike Duplicate
NC - No Criteria
Intf - Interference

Phyllis Shiller, Laboratory Director
July 25, 2019

Page 15 of 19

Thursday, July 25, 2019
Criteria: None
State: NH

Sample Criteria Exceedances Report
GCD59737 - DESMAR

SampNo	Acode	Phoenix Analyte	Criteria	Result	RL	Criteria	RL Criteria	Analysis Units
CD59737	$PCB_SOXR	PCB-1221	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1232	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1242	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1248	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1254	NH / Requested PCB RL /	53000	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1260	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1262	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1268	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59737	$PCB_SOXR	PCB-1016	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1221	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1268	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1262	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1260	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1254	NH / Requested PCB RL /	980000	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1248	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1232	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1016	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59738	$PCB_SOXR	PCB-1242	NH / Requested PCB RL /	ND	110000	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1254	NH / Requested PCB RL /	32000	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1016	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1221	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1232	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1260	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1262	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1268	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1242	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59740	$PCB_SOXR	PCB-1248	NH / Requested PCB RL /	ND	8900	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1254	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1268	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1260	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1248	NH / Requested PCB RL /	260000	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1242	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1232	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1221	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1016	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59741	$PCB_SOXR	PCB-1262	NH / Requested PCB RL /	ND	79000	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1268	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1016	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1221	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg

Thursday, July 25, 2019

Criteria: None

State: NH

Sample Criteria Exceedances Report

GCD59737 - DESMAR

SampNo	Acode	Phoenix Analyte	Criteria	Result	RL	Criteria	RL Criteria	Analysis Units
CD59742	$PCB_SOXR	PCB-1232	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1242	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1248	NH / Requested PCB RL /	25000	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1254	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1260	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg
CD59742	$PCB_SOXR	PCB-1262	NH / Requested PCB RL /	ND	7100	1000	1000	ug/Kg

Phoenix Laboratories does not assume responsibility for the data contained in this exceedance report. It is provided as an additional tool to identify requested criteria exceedences. All efforts are made to ensure the accuracy of the data (obtained from appropriate agencies). A lack of exceedence information does not necessarily suggest conformance to the criteria. It is ultimately the site professional's responsibility to determine appropriate compliance.

PHOENIX
Environmental Laboratories, Inc.
587 East Middle Turnpike, P.O.Box 370, Manchester, CT 06045
Tel. (860) 645-1102 Fax (860) 645-0823

ACCREDITED IN ACCORDANCE WITH nelac NY # 11301

Analysis Comments

July 25, 2019 SDG I.D.: GCD59737

The following analysis comments are made regarding exceptions to criteria not already noted in the Analysis Report or QA/QC Report: None.

NO cooler NO coolant

PHOENIX *Environmental Laboratories, Inc.*

CHAIN OF CUSTODY RECORD

587 East Middle Turnpike, P.O. Box 370, Manchester, CT 06040
Email: info@phoenixlabs.com Fax (860) 645-0823
Client Services (860) 645-8726

Temp 23.0 Pg of

Data Delivery:
☐ Fax #:
☒ Email Ray@denvironmental.com

Customer: Desmarais Environmental, Inc.
Address: 320 Hemlock Lane
Barrington, NH 03825

Project: Elm Street School
Report to:
Invoice to:

Project P.O:
Phone #: (603) 664-5500
Fax #: (603) 664-5600

Client Sample - Information - Identification

Sampler's Signature ____________ Date: ______

Matrix Code:
DW=drinking water WW=wastewater S=soil/solid O=oil
GW=groundwater SL=sludge A=air X=other

Analysis Request: PCB Soxhalet; Soil VOA Vials [ ] methanol [ ] Sod Bisulfate; GL Soil container ( )oz; GL Soil container ( )oz; 40 ml VOA Vial [ ] As is [ ] HCl; GL Amber 1000ml [ ] As is [ ] H2SO4; PL As is [ ] 250ml [ ] 500ml [ ] 1000ml; PL H2SO4 [ ] 250ml [ ] 500ml; PL HNO3 250ml; PL NaOH 250ml; Bacteria Bottle

Phoenix Sample #	Customer Sample Identification	Sample Matrix	Date Sampled	Time Sampled	PCB Soxhalet
59737	★ PCB1	S	7/16/2019	11am	x
59738	★ PCB2	S	7/16/2019	11am	x
59739	★ PCB3	S	7/16/2019	11am	x
59740	★ PCB4	S	7/16/2019	11am	x
59741	★ PCB5	S	7/16/2019	11am	x
59742	★ PCB6	S	7/16/2019	11am	x
					x
					x
					x
					x
					x
					x

Relinquished by:	Accepted by:	Date:	Time:
Ray Desmarais	Fed Ex		
Fed Ex	Krystal Hall	7/18/19	10:37

Turnaround: ☐ 1 Day* ☐ 2 Days* ☐ 3 Days* ■ Standard ☐ Other
* SURCHARGE APPLIES

CT/RI ☐ RCP Cert ☐ GW Protect ☐ GA Mobility ☐ GB Mobility ☐ SW Protection ☐ Res. Vol. ☐ Ind. Vol. ☐ Res. Criteria ☐ Other

MA ☐ MCP Certification ☐ GW-1 ☐ GW-2 ☐ GW-3 ☐ S-1 ☐ S-2 ☐ S-3 ☐ MWRA eSMART ☐ Other

Data Format ☐ Excel ☐ PDF ☐ GIS/Key ☐ EQuIS ☐ Other ______

Data Package ☐ ASP-A ☐ NJ Reduced Deliv. * ☐ NJ Hazsite EDD ☐ Phoenix Std Report ☐ Other

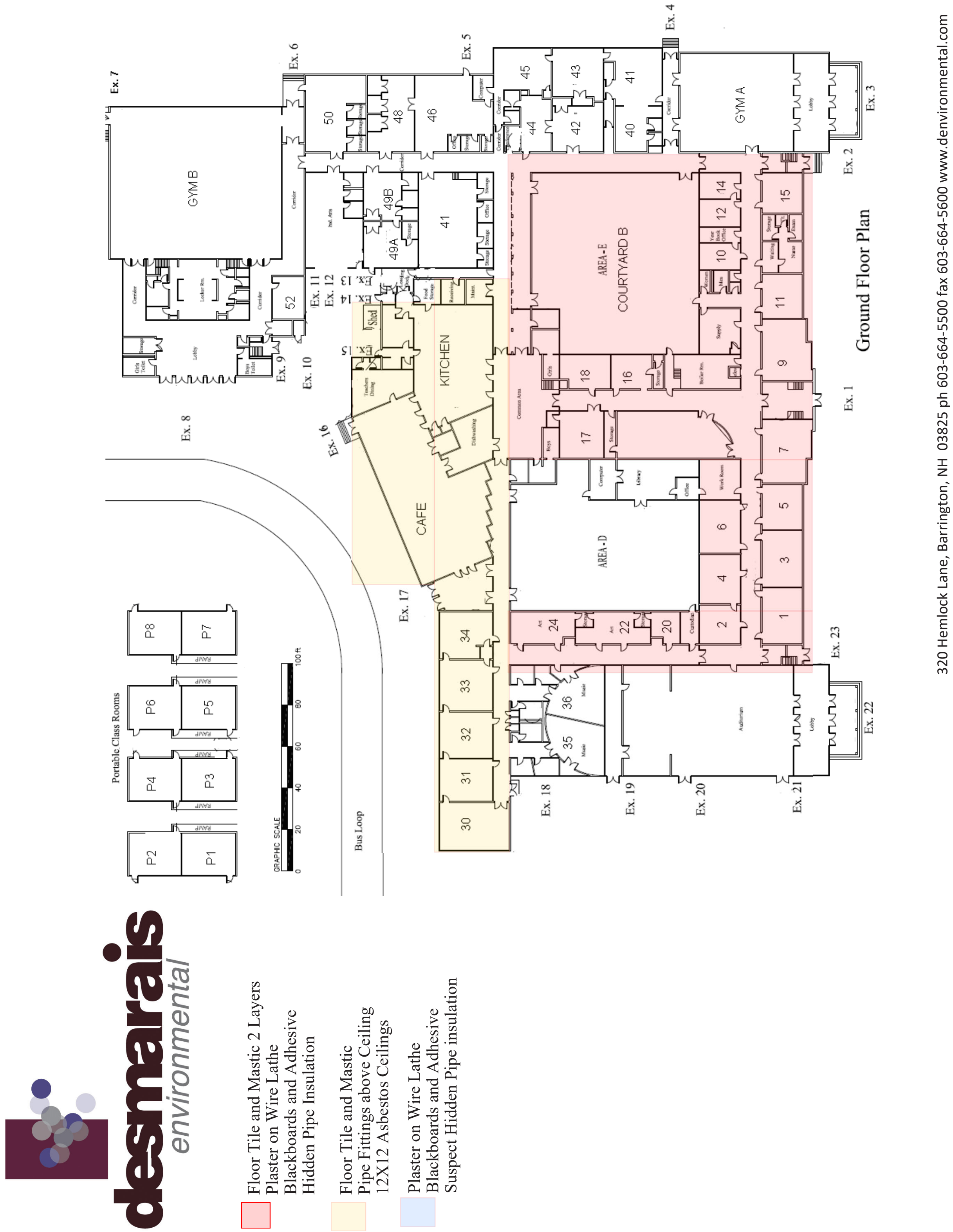
Comments, Special Requirements or Regulations:
★ RCVD in bags

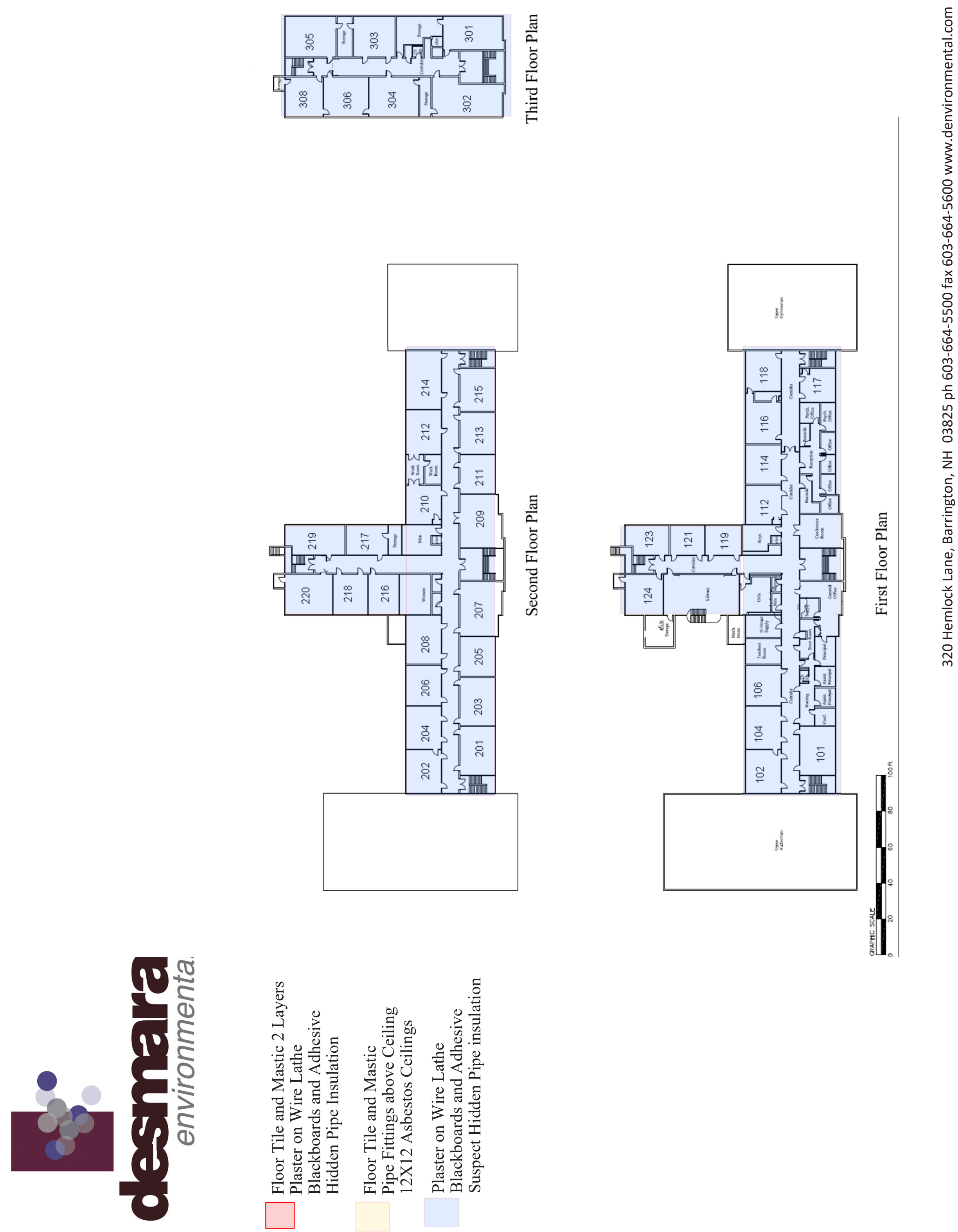
State where samples were collected: ______

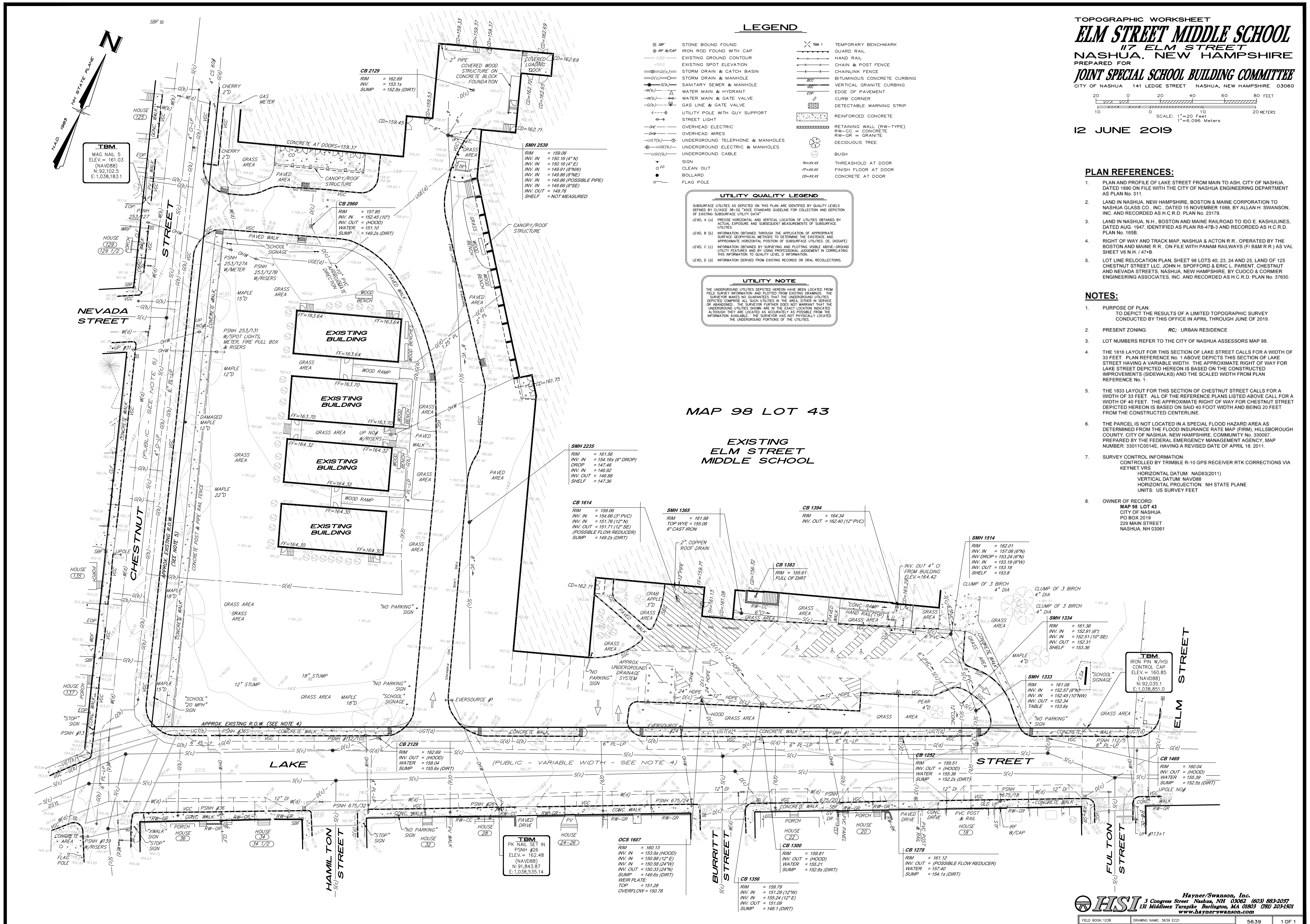
Page 19 of 19

Appendix 2
Diagrams

320 Hemlock Lane, Barrington, NH 03825 ph 603-664-5500 fax 603-664-5600 www.denvironmental.com


Ground Floor Plan
320 Hemlock Lane, Barrington, NH 03825 ph 603-664-5500 fax 603-664-5600 www.denvironmental.com
GYM A
GYM B
COURTYARD B
AREA - E
AREA - D
KITCHEN
CAFE
Bus Loop
Portable Class Rooms
GRAPHIC SCALE
desmarais environmental
Floor Tile and Mastic 2 Layers
Plaster on Wire Lathe
Blackboards and Adhesive
Hidden Pipe Insulation
Floor Tile and Mastic
Pipe Fittings above Ceiling
12X12 Asbestos Ceilings
Plaster on Wire Lathe
Blackboards and Adhesive
Suspect Hidden Pipe insulation


desmara environmental
Floor Tile and Mastic 2 Layers
Plaster on Wire Lathe
Blackboards and Adhesive
Hidden Pipe Insulation
Floor Tile and Mastic
Pipe Fittings above Ceiling
12X12 Asbestos Ceilings
Plaster on Wire Lathe
Blackboards and Adhesive
Suspect Hidden Pipe insulation
Third Floor Plan
Second Floor Plan
First Floor Plan
GRAPHIC SCALE
320 Hemlock Lane, Barrington, NH 03825 ph 603-664-5500 fax 603-664-5600 www.denvironmental.com


TOPOGRAPHIC WORKSHEET
ELM STREET MIDDLE SCHOOL
117 ELM STREET
NASHUA, NEW HAMPSHIRE
PREPARED FOR
JOINT SPECIAL SCHOOL BUILDING COMMITTEE
12 JUNE 2019
LEGEND
UTILITY QUALITY LEGEND
UTILITY NOTE
PLAN REFERENCES:
NOTES:
MAP 98 LOT 43
EXISTING ELM STREET MIDDLE SCHOOL
EXISTING BUILDING
NEVADA STREET
CHESTNUT STREET
LAKE STREET
ELM STREET
HAMILTON STREET
BURRITT STREET
FULTON STREET
Hayner/Swanson, Inc.

MEMORANDUM

TO:	Mr. Shawn Smith Joint Special School Building Committee 38 Riverside Street Nashua, MA 03062	**FROM:**	F. Giles Ham, P.E. Derek Roach, E.I.T Vanasse & Associates, Inc. 35 New England Business Center Drive Suite 140 Andover, MA 01810 (978) 474-8800
DATE:	September 20, 2019	**RE:**	8286
SUBJECT:	Middle School Construction and/or Renovations Nashua, New Hampshire		

As requested, Vanasse & Associates, Inc. (VAI) has evaluated the potential middle school projects at three existing middle schools in Nashua, New Hampshire as well as at the proposed site for a potential middle school to be located off Buckmeadow Road. This report identifies existing vehicle, pedestrian, and bicycle volumes within the study area for each location, identifies the parking demand at the existing middle schools, provides queue observations, evaluates safety, and provides recommendations. The following provides a brief summary of the study findings.

PROJECT DESCRIPTION

The City of Nashua has determined the need to either build a new middle school or renovate existing schools in the city. Currently, Nashua has 3 middle schools in operation: Elm Street Middle School, Fairgrounds Middle School, and Pennichuck Middle School. If the Elm Street Middle School is to remain open then the three existing middle school would be renovated and the students would be dispersed among the schools such that each school has approximately 800 students. If the Elm Street Middle School is closed then the other two existing middle schools would be renovated and a new middle school would be built off of Buckmeadow Road. In this scenario the students would also be dispersed such that each school has approximately 800 students.

ELM STREET MIDDLE SCHOOL

The Elm Street Middle School is located at 117 Elm Street and is bounded by Lake Street to the south, West Otterson Street to the north, Chestnut Street to the west, and Elm Street to the east. The school has approximately 166 staff employees and approximately 1,039 enrolled students. The school uses 26 buses to transport approximately 660 students to and from school while another 489 students walk to and from school. The study area is listed below and graphically depicted in Figure 1.

- West Otterson Street at Chestnut Street
- West Otterson Street at East School Driveway
- West Otterson Street at West School Driveway
- West Otterson Street at Elm Street
- Elm Street at Belmont Street

Figure 1
Elm Street Middle School
Traffic Count Program
6:30 - 8:30AM and
1:00 - 3:00PM

VAI Vanasse & Associates, Inc.
Transportation Engineers & Planners

R:\8286\8286SLM.dwg, 8/27/2019 10:23:55 AM

- Lake Street at Elm Street
- Lake Street at East School Driveway
- Lake Street at Middle School Driveway
- Lake Street at West School Driveway
- Lake Street at Chestnut Street
- Chestnut Street at School Driveway

Existing Traffic Volumes

In order to establish baseline traffic-volume conditions within the study area, manual turning movement counts (TMCs) were completed in June 2019. Counts included vehicles, pedestrians, and bicyclists. The TMCs were conducted during the weekday morning (6:30 to 8:30 AM) and weekday afternoon (1:00 to 3:00 PM) peak periods, which represent the peak periods for school traffic. The existing weekday morning and weekday afternoon vehicular volumes for all the study area intersections are graphically depicted in Figure 2 and Figure 3, respectively. The existing weekday morning and weekday afternoon pedestrian and bicycle volumes for all the study area intersections are graphically depicted in Figure 4 and Figure 5, respectively.

Parking Demand

Parking observations were conducted on-site and on the adjacent streets to the school property to determine the parking demand for the school. The number of parked vehicles was recoded at 8:10 AM and 2:10 PM. At 8:10 AM, 74 vehicles were parked on-site (2 lots) and 33 were parked on Elm Street adjacent to the school. At 2:10 PM, 65 vehicles were parked on-site and 29 were parked on Elm Street adjacent to the school. The West Otterson Street lot is at capacity and additional teacher parking appears to be needed.

Queue Observations

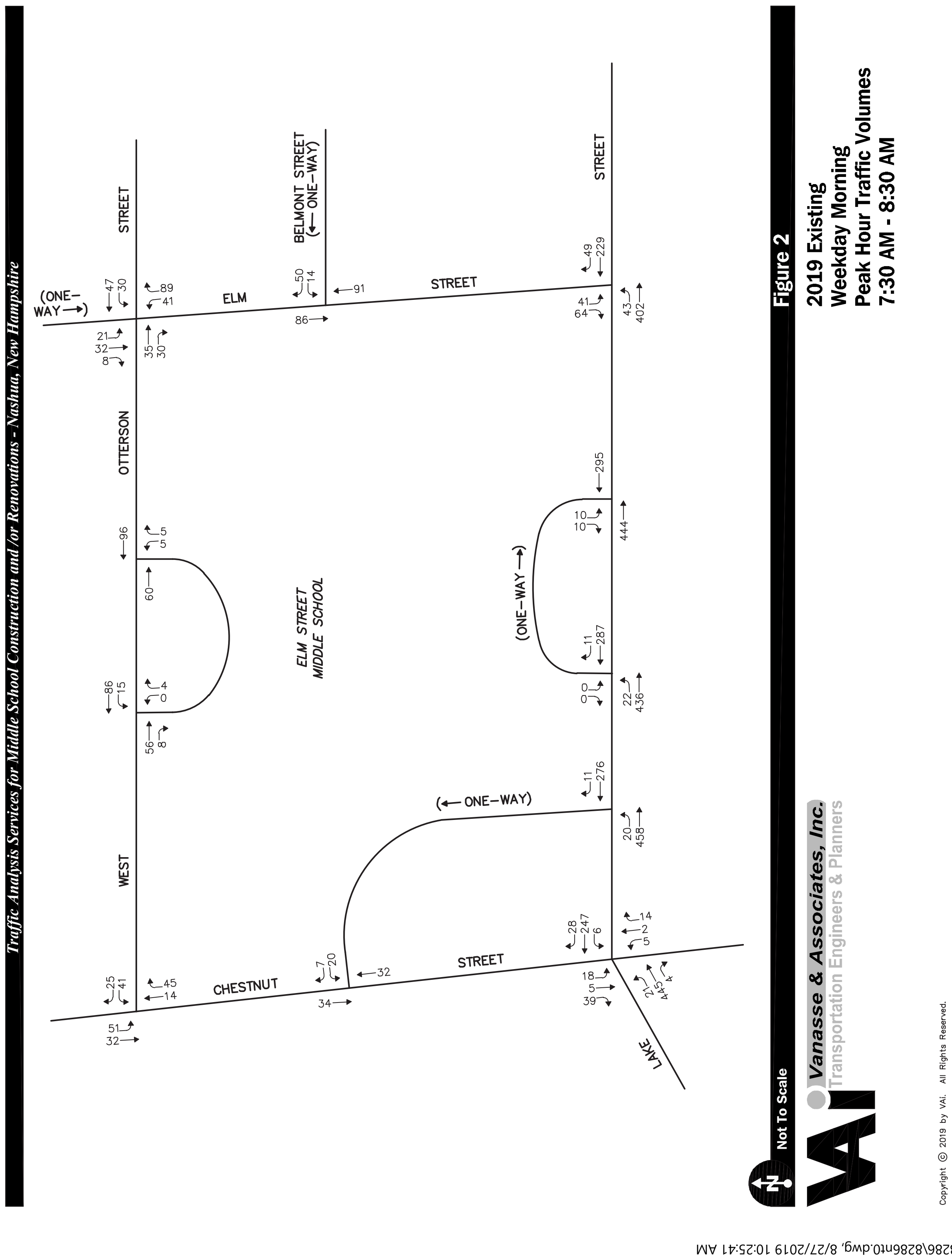
Vehicle queue observations were conducted during the weekday morning drop-off and weekday afternoon pick-up periods on Elm Street where drop-offs and pick-ups are designated. Based on these observation, vehicle queue ranged from 5 to 10 vehicles.

Overall, traffic operations are as expected during drop-off and pick-up times. Additional off-street parking appears to be needed and all school zone signage needs to be upgraded.

Proposed Modifications

Redistributing the students such that each school has approximately 800 students will decrease the existing number of enrolled students at this school and would correspond to a decrease in traffic in the area. The proposed renovations will include changing the drop-off and pick-up operations on-site and upgrading the school zone signage. Based on good engineering principles the buses will have a separate drop-off and pick-up area from the parents drop-off and pick-up area. The new circulation will have buses enter and exit from Chestnut Street and parent traffic enter from Lake Street and exit out Chestnut Street. Based on the review of the exiting middle school signage, it was determined that the signage does not meet the Manual on Uniform Traffic Devices (MUTCD)[1] standards for school signage. The signage at the school will be upgraded to meet MUTCD standards. Figure 6 lists the MUTCD standard signage for schools.

[1] *Manual on Uniform Traffic Control Devices,* 2009 Edition; Federal Highway Administration; 2009


Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
WEST OTTERSON STREET
ELM STREET
BELMONT STREET (← ONE-WAY)
(ONE-WAY →)
ELM STREET MIDDLE SCHOOL
(ONE-WAY →)
(← ONE-WAY)
CHESTNUT STREET
LAKE STREET
Figure 2
2019 Existing
Weekday Morning
Peak Hour Traffic Volumes
7:30 AM - 8:30 AM
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
Copyright © 2019 by VAI. All Rights Reserved.
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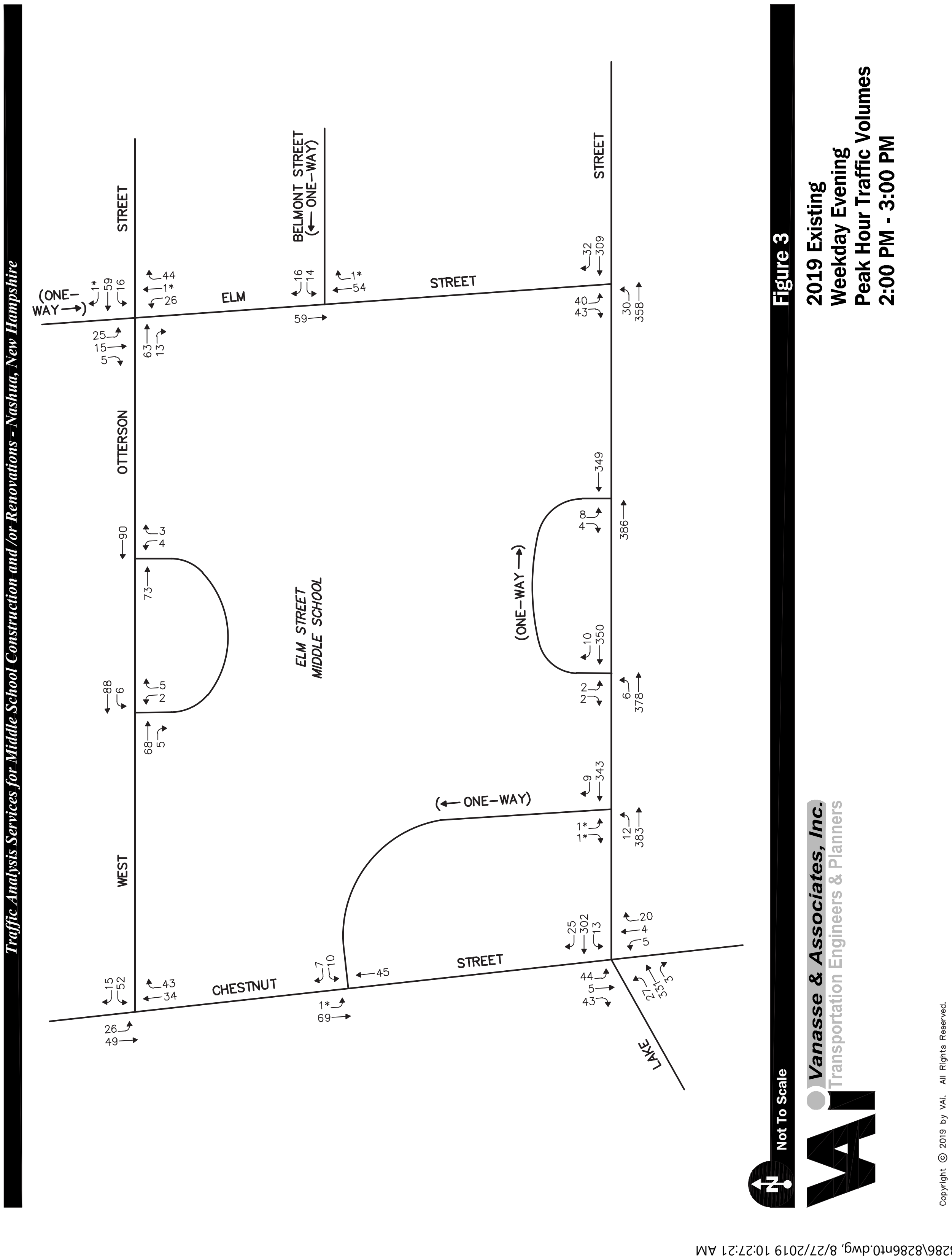
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
Figure 3
2019 Existing
Weekday Evening
Peak Hour Traffic Volumes
2:00 PM - 3:00 PM
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
Copyright © 2019 by VAI. All Rights Reserved.
WEST OTTERSON STREET
ELM STREET
CHESTNUT STREET
BELMONT STREET (← ONE-WAY)
LAKE
ELM STREET MIDDLE SCHOOL
(ONE-WAY →)
(← ONE-WAY)
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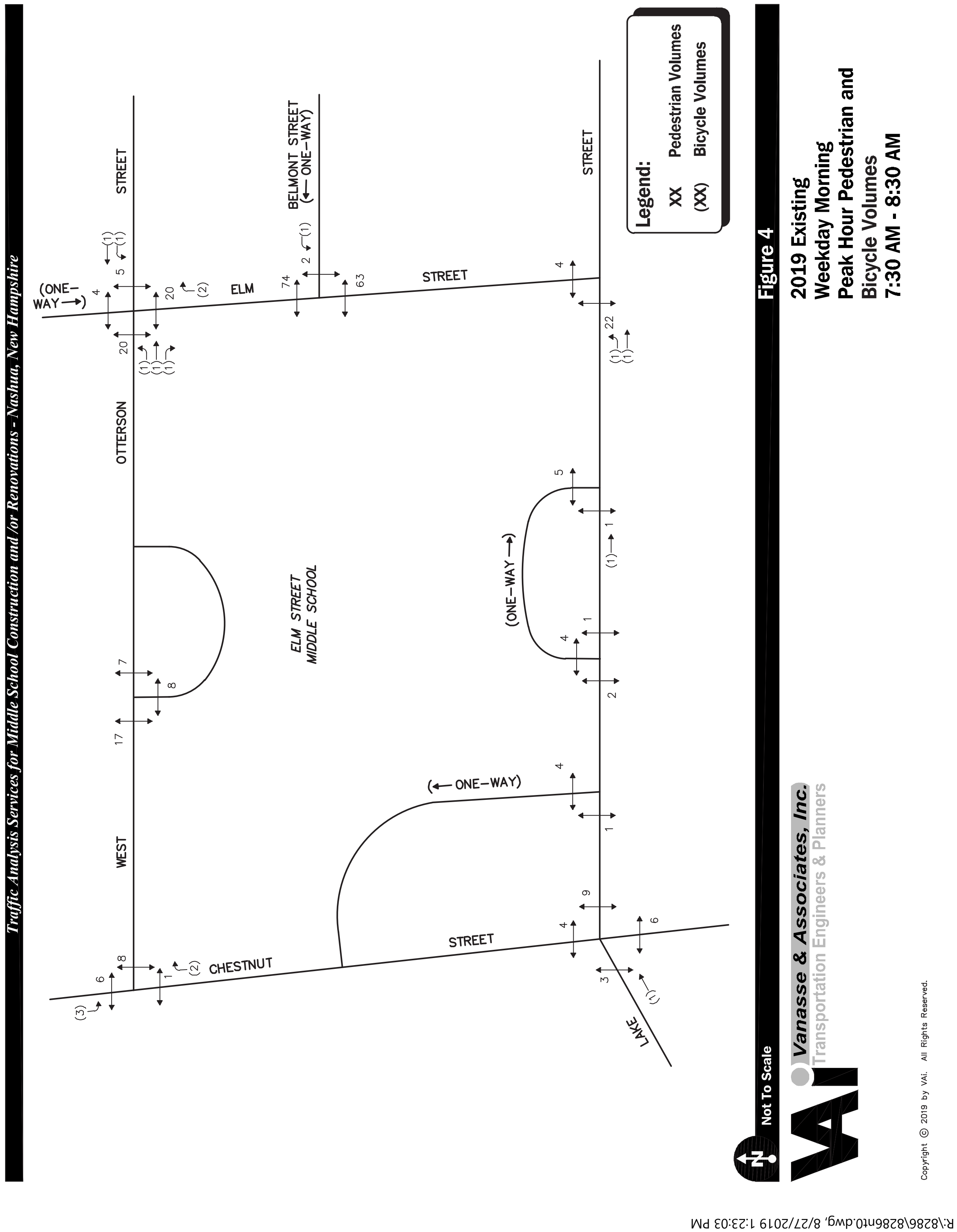
Traffic Analysis Services for Middle School Construction and /or Renovations - Nashua, New Hampshire
WEST OTTERSON STREET
ELM STREET
CHESTNUT STREET
LAKE STREET
BELMONT STREET (← ONE-WAY)
(ONE-WAY →)
(← ONE-WAY)
(ONE-WAY →)
ELM STREET MIDDLE SCHOOL
Legend:
XX Pedestrian Volumes
(XX) Bicycle Volumes
Figure 4
2019 Existing Weekday Morning Peak Hour Pedestrian and Bicycle Volumes
7:30 AM - 8:30 AM
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
Copyright © 2019 by VAI. All Rights Reserved.
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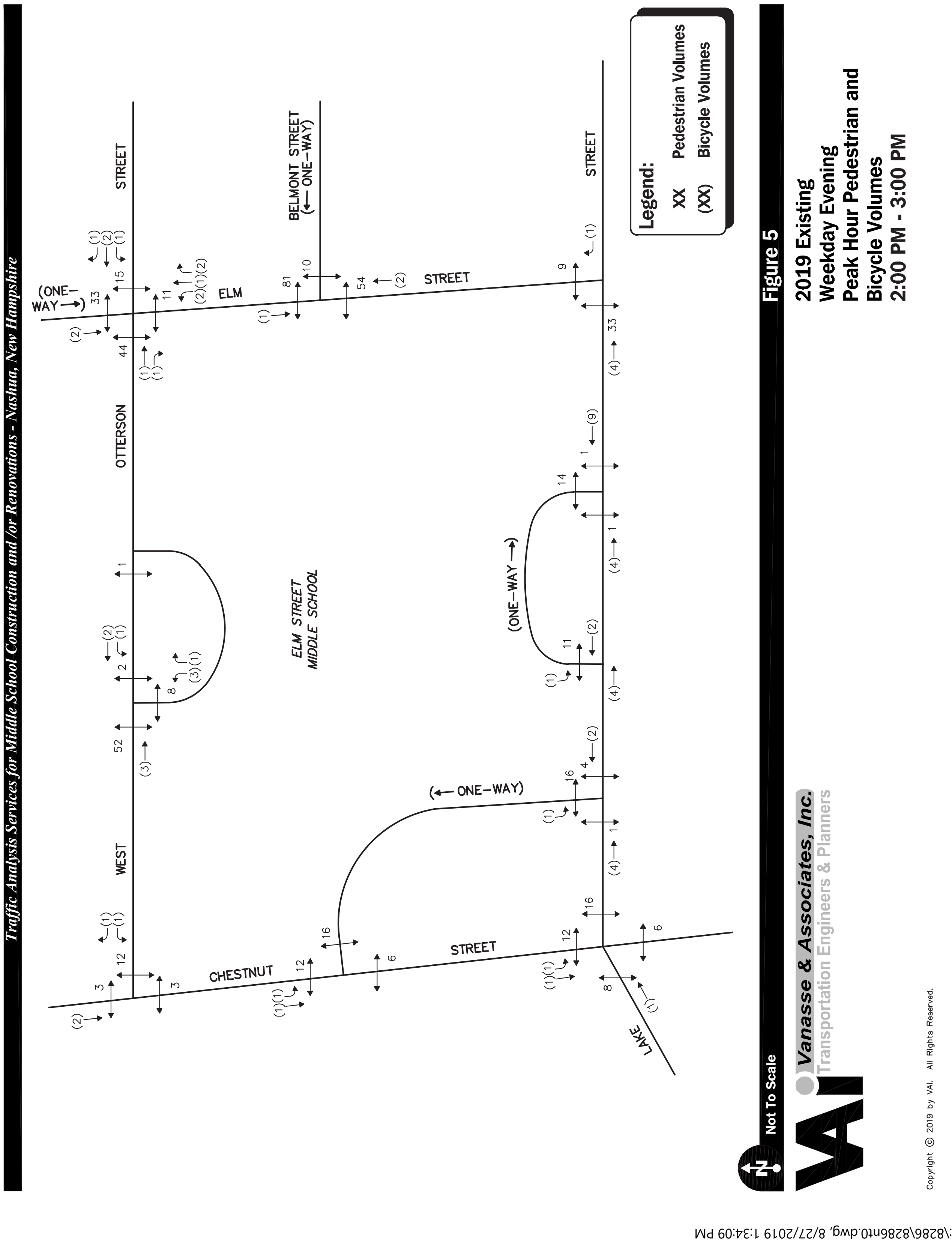
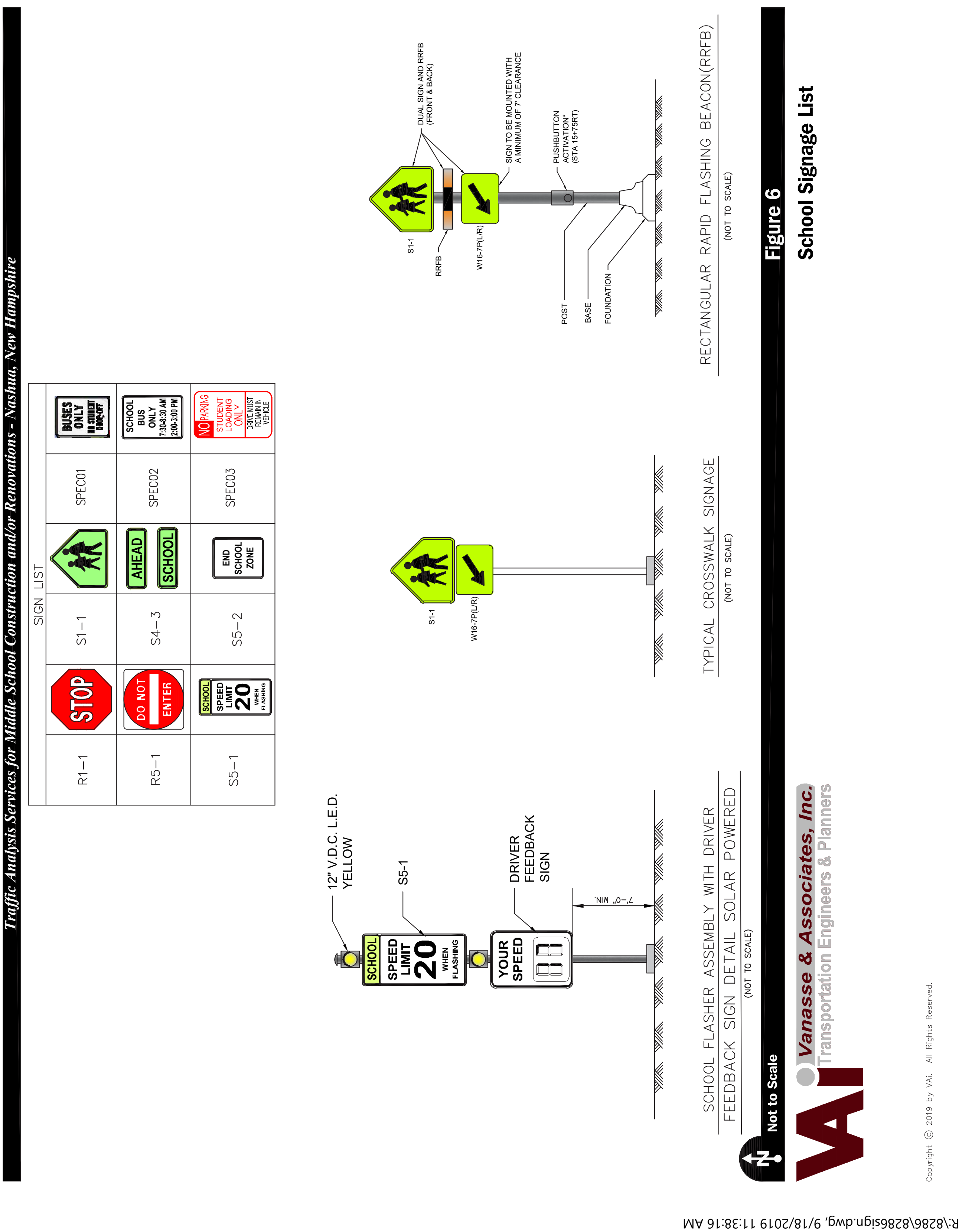

Traffic Analysis Services for Middle School Construction and /or Renovations - Nashua, New Hampshire
WEST
OTTERSON
STREET
CHESTNUT
STREET
ELM
STREET
BELMONT STREET
(← ONE-WAY)
(ONE-WAY →)
(← ONE-WAY)
(ONE-WAY →)
LAKE
STREET
ELM STREET
MIDDLE SCHOOL
Legend:
XX Pedestrian Volumes
(XX) Bicycle Volumes
Figure 5
2019 Existing
Weekday Evening
Peak Hour Pedestrian and
Bicycle Volumes
2:00 PM - 3:00 PM
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
Copyright © 2019 by VAI. All Rights Reserved.
R:\8286\8286nt0.dwg, 8/27/2019 1:34:09 PM


Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
SIGN LIST
R1–1
STOP
S1–1
SPEC01
BUSES ONLY NO STUDENT DROP-OFF
R5–1
DO NOT ENTER
S4–3
AHEAD
SCHOOL
SPEC02
SCHOOL BUS ONLY 7:30-8:30 AM 2:00-3:00 PM
S5–1
SCHOOL SPEED LIMIT 20 WHEN FLASHING
S5–2
END SCHOOL ZONE
SPEC03
NO PARKING STUDENT LOADING ONLY DRIVE MUST REMAIN IN VEHICLE
12" V.D.C. L.E.D. YELLOW
S5-1
DRIVER FEEDBACK SIGN
YOUR SPEED
7'–0" MIN.
SCHOOL FLASHER ASSEMBLY WITH DRIVER FEEDBACK SIGN DETAIL SOLAR POWERED
(NOT TO SCALE)
S1-1
W16-7P(L/R)
TYPICAL CROSSWALK SIGNAGE
(NOT TO SCALE)
S1-1
RRFB
W16-7P(L/R)
DUAL SIGN AND RRFB (FRONT & BACK)
SIGN TO BE MOUNTED WITH A MINIMUM OF 7' CLEARANCE
PUSHBUTTON ACTIVATION* (STA 15+75RT)
POST
BASE
FOUNDATION
RECTANGULAR RAPID FLASHING BEACON(RRFB)
(NOT TO SCALE)
Not to Scale
Figure 6
School Signage List
VAI Vanasse & Associates, Inc.
Transportation Engineers & Planners
Copyright © 2019 by VAi. All Rights Reserved.
R:\8286\8286sign.dwg, 9/18/2019 11:38:16 AM

FAIRGROUND MIDDLE SCHOOL

The Fairgrounds Middle School is located at 27 Cleveland Street and is bounded by Cleveland Street to the north and Fairview Avenue to the west. The school has approximately 130 staff employees and approximately 703 students enrolled. The school uses 10 buses to transport approximately 343 students to and from school while another 383 students walk to and from school. The study area is listed below and graphically depicted in Figure 7.

- Fairview Avenue at Cleveland Street
- Cleveland Street at School Main Entrance
- Cleveland Street at East School Driveway
- Almont Street at Cleveland Street

Existing Traffic Volumes

In order to establish base traffic-volume conditions within the study area, manual turning movement counts (TMCs) were completed in June 2019. Counts included vehicles, pedestrians, and bicyclists. The TMCs were conducted during the weekday morning (6:30 to 8:30 AM) and weekday afternoon (1:00 to 3:00 PM) peak periods, which represent the peak periods for school traffic. The existing weekday morning and weekday afternoon vehicular volumes for all the study area intersections are graphically depicted in Figure 8. The existing weekday morning and weekday afternoon pedestrian and bicycle volumes for all the study area intersections are graphically depicted in Figure 9.

Parking Demand

Parking observations were conducted on-site to determine the parking demand for the school. The number of parked vehicles was recoded at 8:15 AM and 1:45 PM. At 8:15 AM, 97 vehicles were parked on-site and at 1:45 PM 101 vehicles were parked on-site.

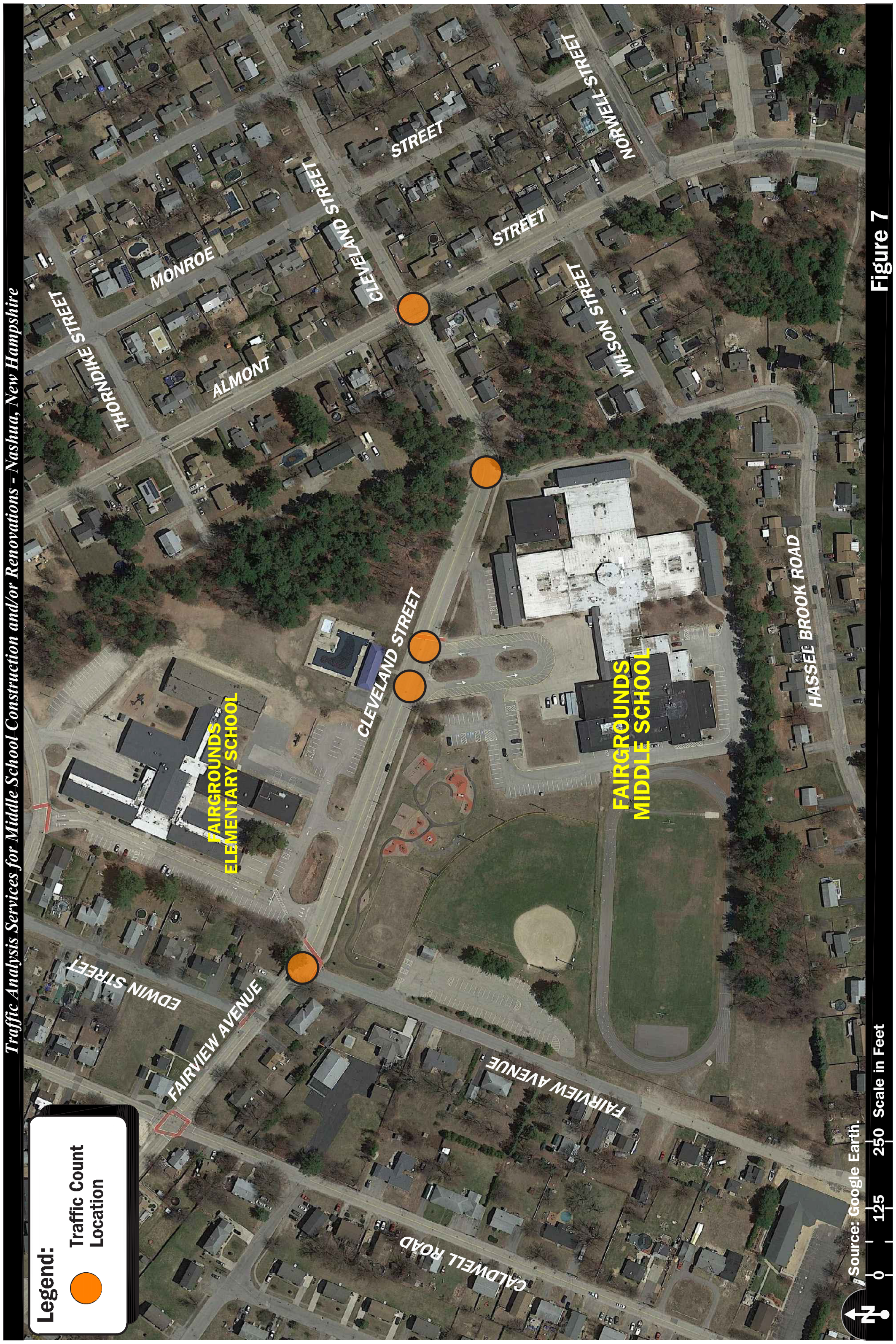
Queue Observations

Vehicle queue observations were conducted during the weekday morning drop-off and weekday afternoon pick-up periods on Cleveland Street where drop-offs and pick-ups are designated. Based on these observation, the maximum vehicle queue on Cleveland Street was 14 vehicles in the westbound direction. Additional drop-off and pick-ups occur along both sides of Cleveland Street

Overall, traffic conditions are quite busy and are complicated by the simultaneous school hours of the Fairgrounds Elementary School. Most drop-off and pick-up activity occurs on-street and could be aided by a striped shoulder. All school zone signage in the area needs to be upgraded.

Trip Generation

Whether the new middle school is built or not, the Fairgrounds Middle School will have its student population increase from 703 students to approximately 800 students. To estimate the traffic increase due to the increase in enrolment, trip generation rates published by the Institute of Transportation Engineers (ITE) Trip Generation manual for Land Use Codes (LUC) 522 – Middle School/Junior High School were used. A summary of the expected vehicle trip generation is summarized in Table 1.



Fairgrounds Middle School
Traffic Count Program
6:30 - 8:30AM and
1:00 - 3:00PM

VAI Vanasse & Associates, Inc.
Transportation Engineers & Planners

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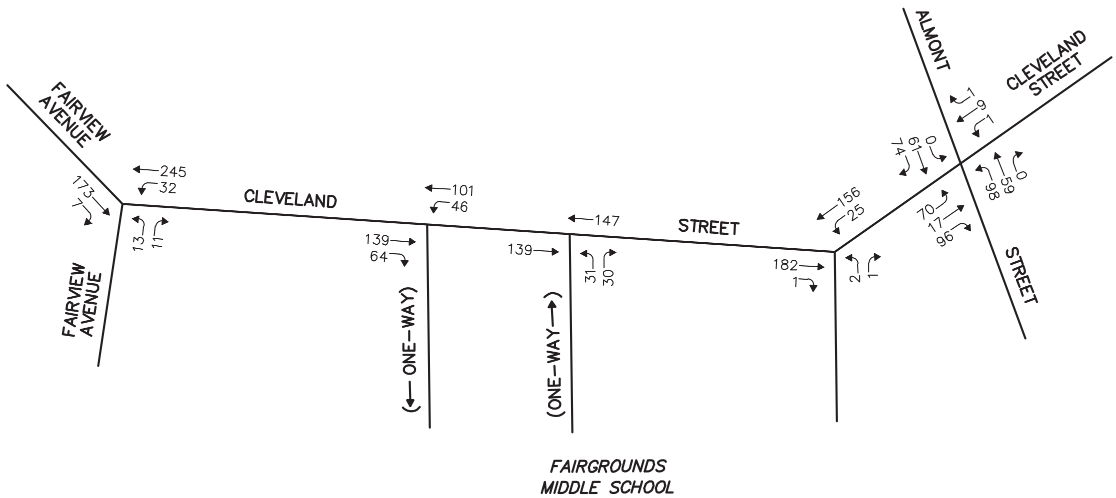
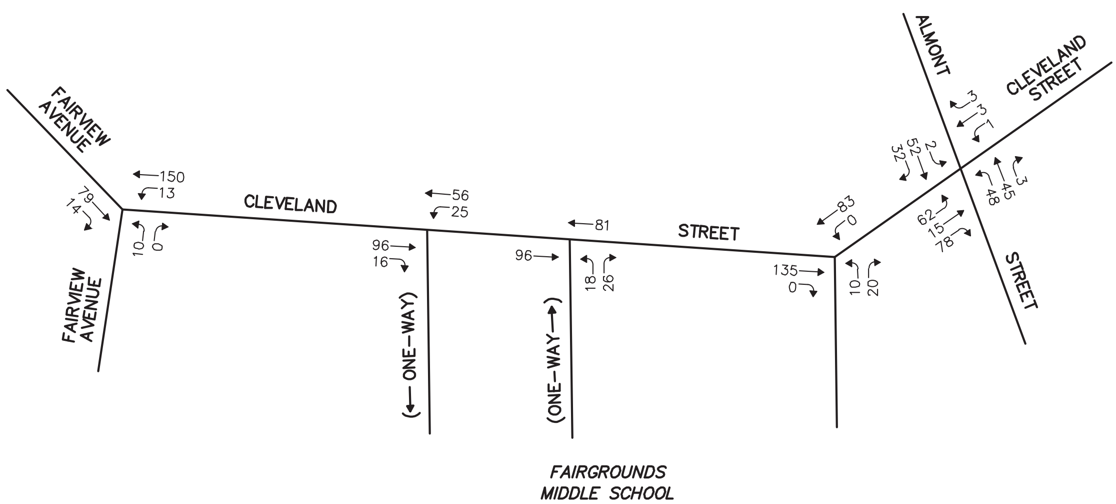
Traffic Analysis for Middle School Construction and/or Renovations - Nashua, New Hampshire

WEEKDAY MORNING PEAK HOUR 7:15 AM - 8:15 AM



WEEKDAY EVENING PEAK HOUR 2:00 PM - 3:00 PM



Not To Scale

Figure 8

Vanasse & Associates, Inc.
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2019 Existing Peak Hour Traffic Volumes

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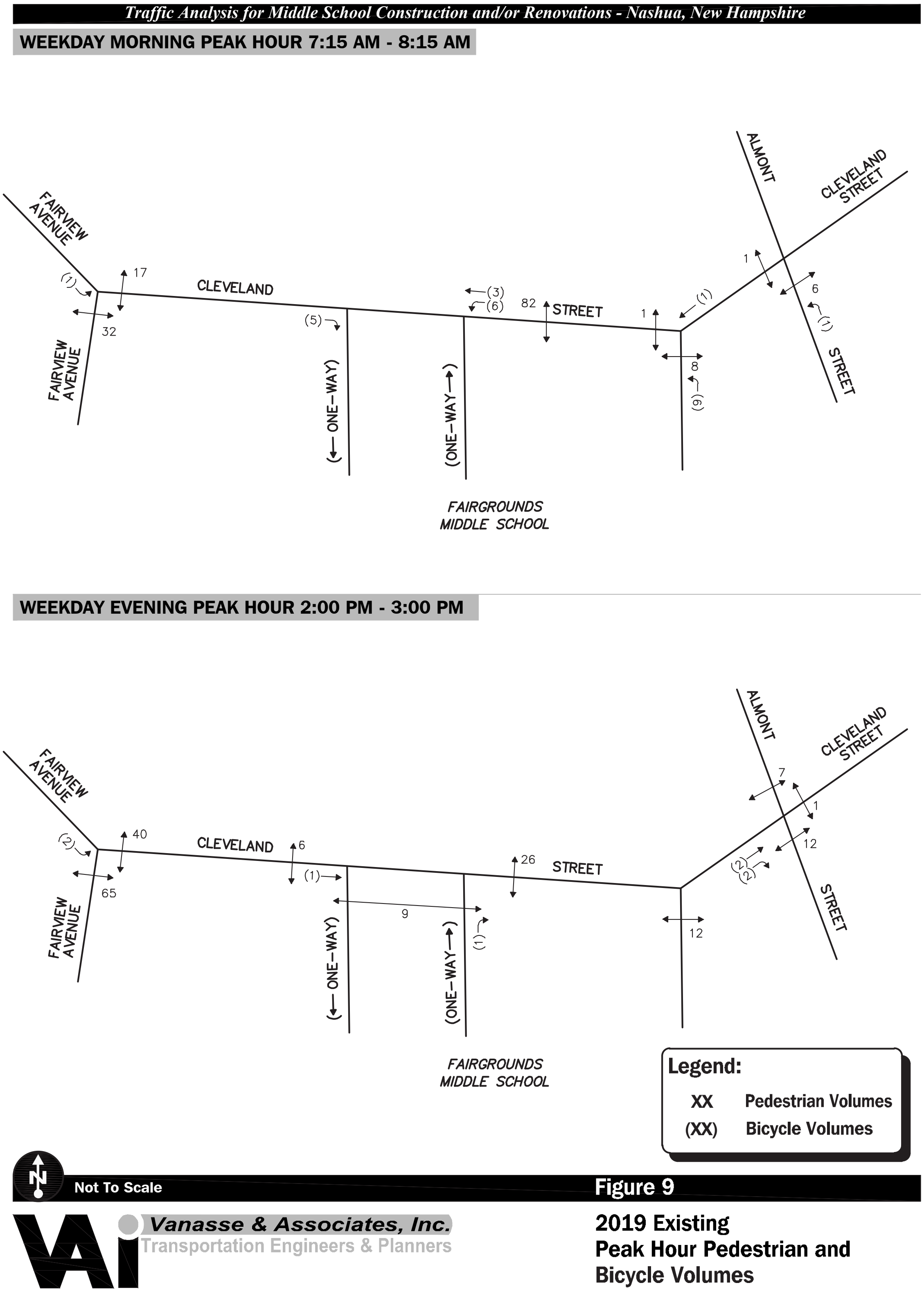

Figure 9
2019 Existing Peak Hour Pedestrian and Bicycle Volumes

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As can be seen from Table 1, the expansion is expected to generate 68 new vehicle trips (37 vehicles entering and 31 exiting) during the weekday morning peak hour. During the weekday afternoon peak hour, the expansion is expected to generate 34 new vehicle trips (16 vehicles entering and 18 exiting). Overall, the increase in traffic will not result in a significant change in traffic operation

.

Table 1
TRIP-GENERATION

Time Period/ Directional Distribution	Fairground Middle School[a] 703 to 800 Student Increase
Weekday Morning Peak Hour:	
Entering	37
Exiting	31
Total	68
Weekday Afternoon Peak Hour:	
Entering	16
Exiting	18
Total	34

[a]Based on ITE LUC 522, Middle School/Junior High School.

Proposed Modifications

The proposed renovations will include changing the drop-off and pick-up operations on-site and upgrading the school zone signage. Based on good engineering principles the buses will have a separate drop-off and pick-up area from the parents drop-off and pick-up area. Cleveland Street should be restriped to accommodate two 12-foot lanes and 8-foot shoulders on either side of the roadway. The shoulders will allow for drop-off and pick-ups to be completed without blocking through traffic on Cleveland Street. The shoulder areas should be signed "no parking student loading zone driver must remain in vehicle". The shoulder area on the school side and eastbound may need to be no parking such that during the afternoon period this can be utilized for the parent pick-up queueing area. Based on the review of the exiting middle school signage, it was determined that the signage does not meet the Manual on Uniform Traffic Devices (MUTCD)[2] standards for school signage. The signage at the school will be upgraded to meet MUTCD standards. Figure 6 lists the MUTCD standard signage for schools.

PENNICHUCK MIDDLE SCHOOL

The Pennichuck Middle School is located at 207 Manchester Street and is bounded by Manchester Street to the west, Henri A Burque Highway (Route 3) to the south, and by open and wooded areas to the north and east. The school has approximately 112 staff employees and approximately 639 students enrolled. The school uses 11 buses to transport approximately 435 students to and from school while another 228 students walk to and from school. The study area is listed below and graphically depicted in Figure 10.

- Route 3 at Manchester Street

[2]*Manual on Uniform Traffic Control Devices,* 2009 Edition; Federal Highway Administration; 2009

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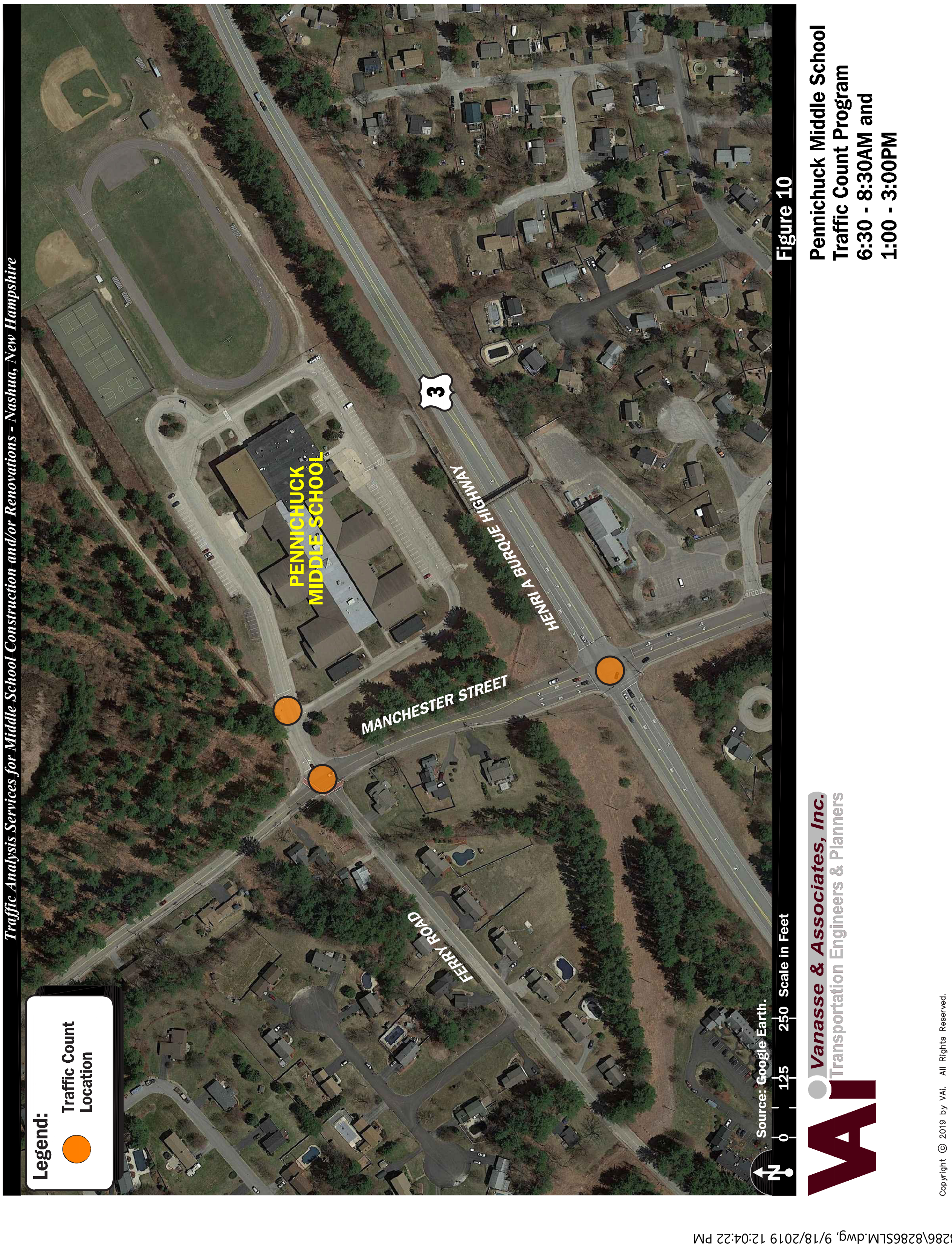

Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
PENNICHUCK MIDDLE SCHOOL
HENRI A BURQUE HIGHWAY
MANCHESTER STREET
FERRY ROAD
3
Legend:
Traffic Count Location
Source: Google Earth.
0 125 250 Scale in Feet
Figure 10
Pennichuck Middle School
Traffic Count Program
6:30 - 8:30AM and
1:00 - 3:00PM
VAI
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Transportation Engineers & Planners
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- Manchester Street at Ferry Road and School Driveway
- School Driveway at Internal Drive

Existing Traffic Volumes

In order to establish base traffic-volume conditions within the study area, manual turning movement counts (TMCs) were completed in June 2019. Counts included vehicles, pedestrians, and cyclists. The TMCs were conducted during the weekday morning (6:30 to 8:30 AM) and weekday afternoon (1:00 to 3:00 PM) peak periods, which represent the peak periods for school traffic. The existing weekday morning and weekday afternoon vehicular volumes for all the study area intersections are graphically depicted in Figure 11. The existing weekday morning and weekday afternoon pedestrian and bicycle volumes for all the study area intersections are graphically depicted in Figure 12.

Parking Demand

Parking observations were conducted on-site to determine the parking demand rate for the school. The number of parked vehicles was recoded at 8:10 AM and 1:30 PM. At 8:10 AM, 75 vehicles were parked on-site and at 1:30 PM 84 vehicles were parked on-site.

Queue Observations

Vehicle queue observations were conducted during the weekday morning drop-off and weekday afternoon pick-up periods on-site where drop-offs and pick-ups are designated. Based on these observation, the maximum vehicle queue was 32 vehicles which queue in two rows in the afternoon period.

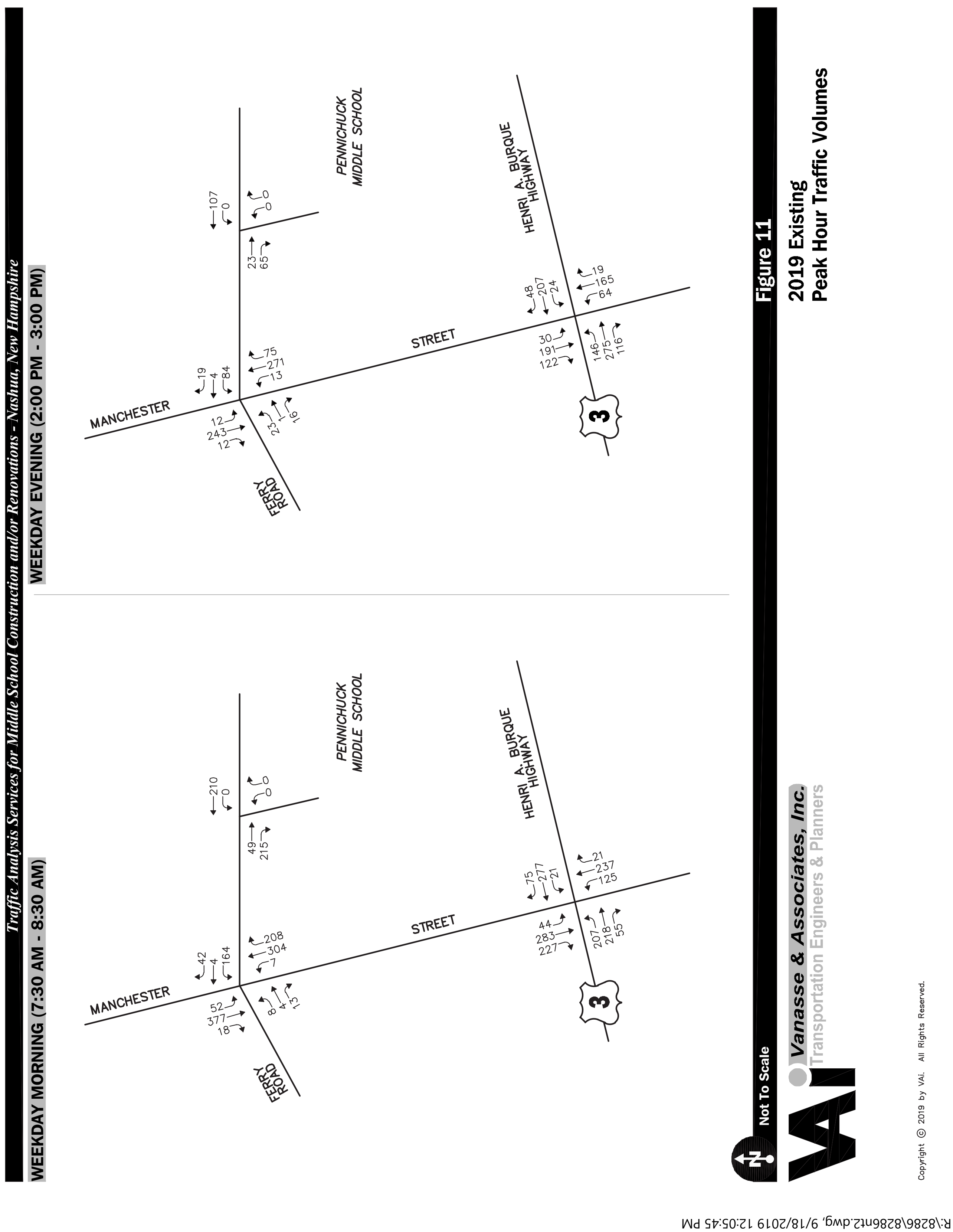
Trip Generation

The school is set up such that the drops-off and pick-up area is on the internal roadway that circles the school. Therefore the schools trip generation can be estimated based on the traffic counts that were conducted at the intersection of the School Driveway at Internal Drive. Table 2 summarizes the peak hour traffic volumes.

Table 2
TRIP-GENERATION

Time Period/ Directional Distribution	Pennichuck Middle School[a]
Weekday Morning Peak Hour:	
Entering	264
Exiting	210
Total	474
Weekday Afternoon Peak Hour:	
Entering	88
Exiting	107
Total	195

[a]Based on counts conducted by VAI in June 2019.


Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
WEEKDAY MORNING (7:30 AM - 8:30 AM)
MANCHESTER
STREET
FERRY ROAD
PENNICHUCK MIDDLE SCHOOL
HENRI A. BURQUE HIGHWAY
3
42 4 164
208 304 7
52 377 18
8 4 13
210 0
0 0
49 215
75 277 21
21 237 125
44 283 227
207 218 55
WEEKDAY EVENING (2:00 PM - 3:00 PM)
MANCHESTER
STREET
FERRY ROAD
PENNICHUCK MIDDLE SCHOOL
HENRI A. BURQUE HIGHWAY
3
19 4 84
75 271 13
12 243 12
23 1 16
107 0
0 0
23 65
48 207 24
19 165 64
30 191 122
146 275 116
Not To Scale
Figure 11
2019 Existing
Peak Hour Traffic Volumes
Vanasse & Associates, Inc.
Transportation Engineers & Planners
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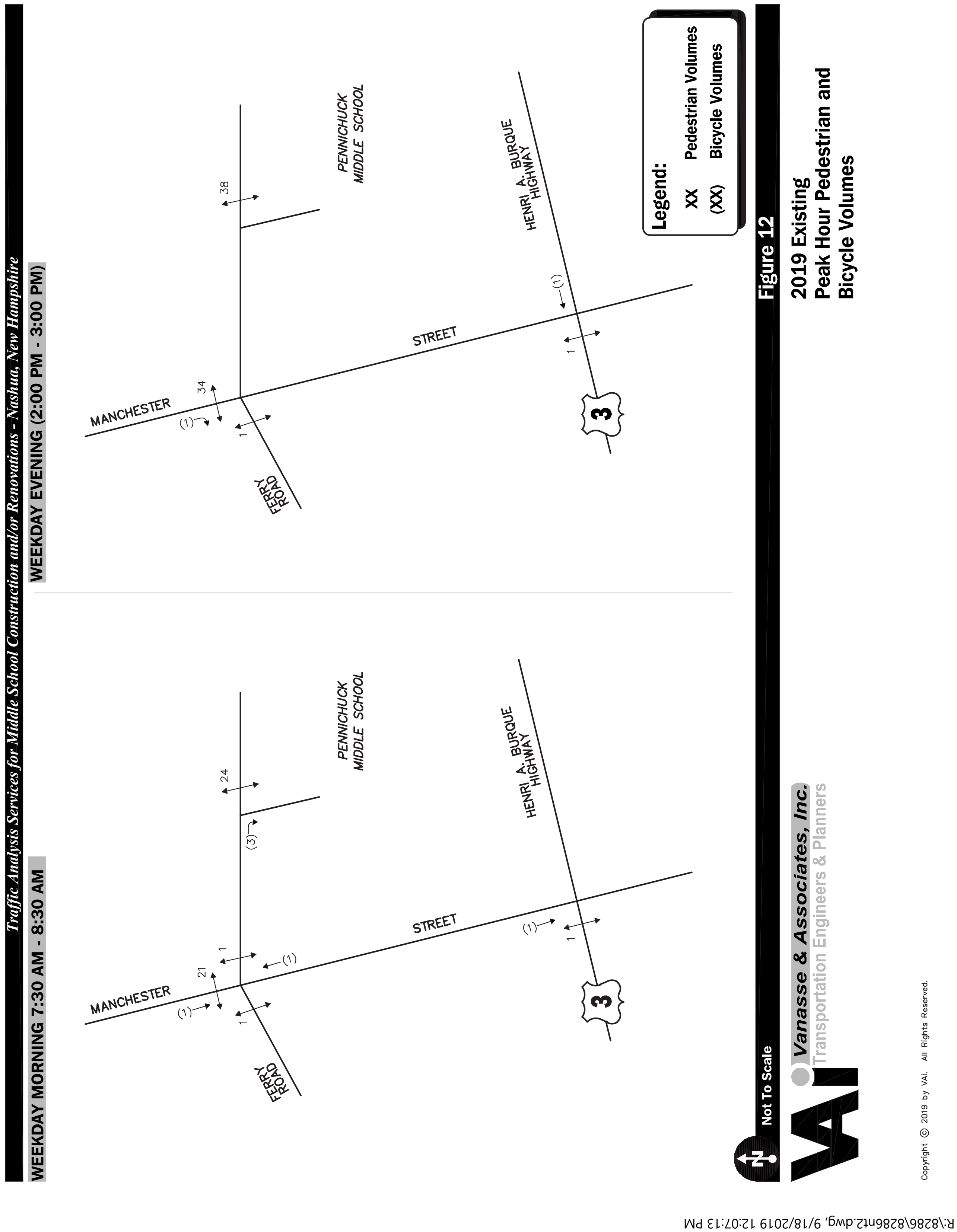
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
WEEKDAY MORNING 7:30 AM - 8:30 AM
WEEKDAY EVENING (2:00 PM - 3:00 PM)
MANCHESTER
STREET
FERRY ROAD
PENNICHUCK MIDDLE SCHOOL
HENRI A. BURQUE HIGHWAY
3
Legend:
XX Pedestrian Volumes
(XX) Bicycle Volumes
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
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Figure 12
2019 Existing
Peak Hour Pedestrian and
Bicycle Volumes
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As can be seen in Table 2, the school generates 474 vehicle trips with 264 vehicles entering and 210 exiting during the weekday morning peak hour. During the weekday afternoon peak hour the school generates 195 vehicle trips with 88 vehicles entering and 107 exiting.

Overall, traffic conditions at this school are as expected. During the observation periods, no crossing guard was located at Manchester Street. This location should be considered for a traffic signal. School zone signage needs to be upgraded.

Whether the new middle school is built or not, this school will have its student population increase from 639 students to approximately 800 students. To estimate the traffic increase due to the increase in enrolment, trip rates developed from the counts conducted by VAI in June were used. Table 3 summarizes the existing trip rates and proposed trip generation of the school expansion.

Table 3
TRIP-GENERATION

	Pennichuck Middle School			
Time Period/ Directional Distribution	Existing[a] (639 Students)	Trip Rates[b]	Proposed[c] (800 Students)	Increase
Weekday Morning Peak Hour:				
Entering	264	0.41	328	64
Exiting	210	0.33	264	54
Total	474	0.74	592	118
Weekday Afternoon Peak Hour:				
Entering	88	0.14	112	24
Exiting	107	0.17	136	29
Total	195	0.31	248	53

[a]From Table 1.
[b]Based on existing trip generation divided by the existing student enrollment.
[c]Based on trip rates multiplied by the propose number of enrolled students.

As can be seen from Table 3, the expansion is expected to generate 118 new vehicle trips (64 vehicles entering and 54 exiting) during the weekday morning peak hour. During the weekday afternoon peak hour, the expansion is expected to generate 53 new vehicle trips (24 vehicles entering and 29 exiting).

Proposed Modifications

The proposed renovations will include changing the drop-off and pick-up operations on-site, redesigning the intersection of Manchester Street at Ferry Road/School Driveway, constructing a second entrance only driveway from Manchester Street, and upgrading the school zone signage. Based on good engineering principles the buses will have a separate drop-off and pick-up area from the parents srop-off and pick-up area. The entrance only driveway will connect to Manchester Street approximately 370 feet south of the existing driveway and an exclusive right-turn lane will be striped on Manchester Street. The intersection of Manchester Street at Ferry Road/School Driveway will be redesigned to accommodate a traffic signal and a southbound left-turn lane on Manchester Street, a northbound right-turn lane on Manchester Street, and an exclusive left-turn lane and exclusive right turn lane exiting the school. The internal intersection exiting traffic will be placed under traffic signal control such that exiting traffic can alternate traffic flow. A conceptual design plan for the proposed changes is depicted in Figure 13. Based on the review of the exiting middle school signage, it was determined that the signage does not meet the Manual on Uniform Traffic

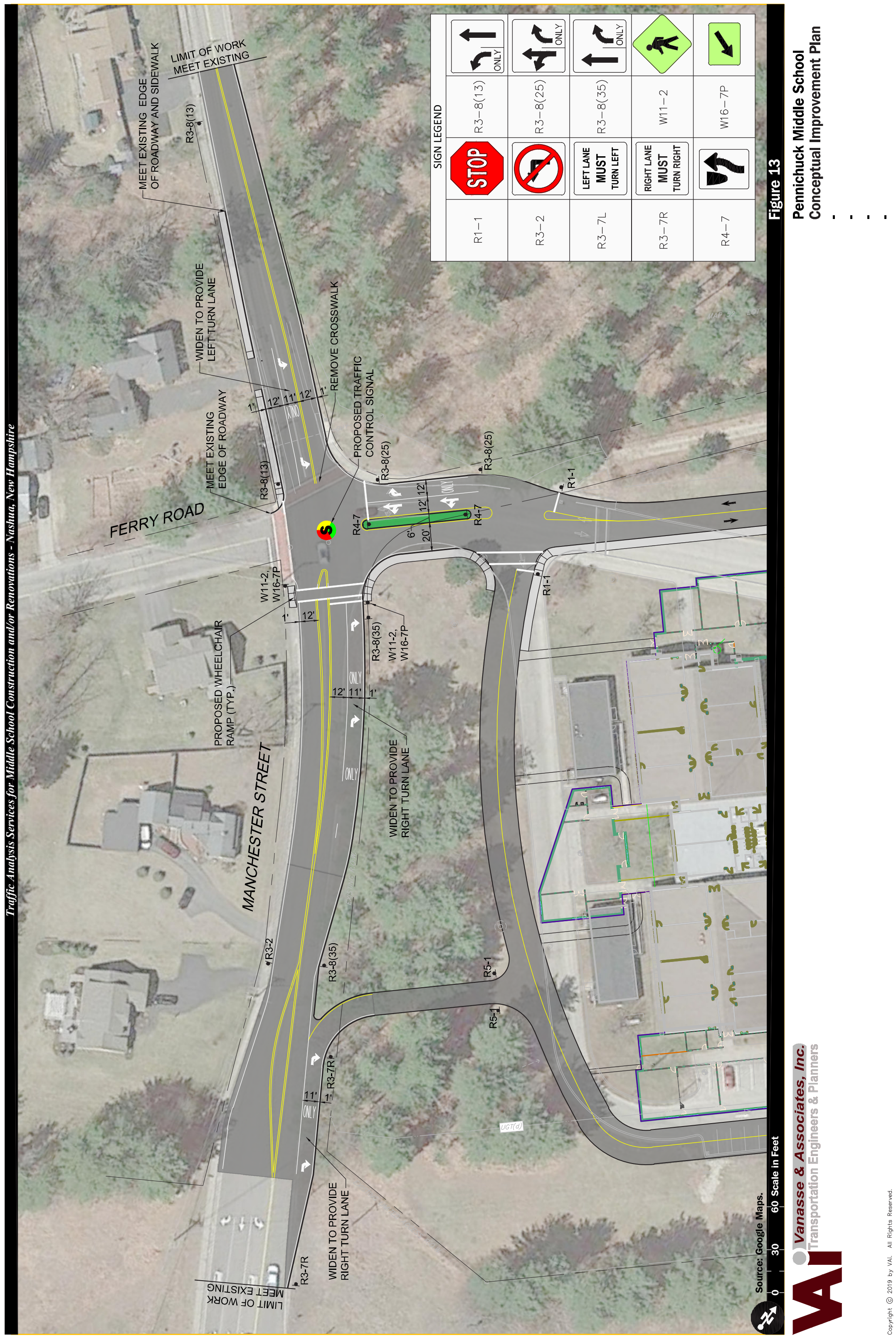

Figure 13

Pennichuck Middle School Conceptual Improvement Plan

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Devices (MUTCD)[3] standards for school signage. The signage at the school will be upgraded to meet MUTCD standards. Figure 6 lists the MUTCD standard signage for schools.

PROPOSED NEW MIDDLE SCHOOL

The proposed new middle school would be bounded by Buckmeadow Road to the west, Cherrywood Drive to the north and east, and by Medallion Court to the south. The study area is listed below and graphically depicted in Figure 14

- Main Dunstable Road (Route 111A) at Buckmeadow Road/Gilson Road
- Ridge Road at Buckmeadow Road/ Winn Road
- Ridge Road at Cherrywood Drive/Covey Road
- Cherrywood Drive at Medallion Court
- Cherrywood Drive at Hibiscus Way

Existing Traffic Volumes

In order to establish base traffic-volume conditions within the study area, manual turning movement counts (TMCs) were completed in June 2019. Counts included vehicles, pedestrians, and cyclists. The TMCs were conducted during the weekday morning (6:30 to 8:30 AM) and weekday afternoon (1:00 to 3:00 PM) peak periods, which represent the peak periods for school traffic. The existing weekday morning and weekday afternoon vehicular volumes for all the study area intersections are graphically depicted in Figure 15 and Figure 16, respectively. The existing weekday morning and weekday afternoon pedestrian and bicycle volumes for all the study area intersections are graphically depicted in Figure 17 and Figure 18, respectively.

Trip Generation

The proposed middle school would have approximately 800 enrolled students. To estimate the traffic for the new middle school, trip generation rates published by the Institute of Transportation Engineers (ITE) Trip Generation manual for Land Use Codes (LUC) 522 – Middle School/Junior High School were used. A summary of the expected vehicle trip generation is summarized in Table 4.

As can be seen in Table 4, the school is estimated to generate 560 vehicle trips with 308 vehicles entering and 252 exiting during the weekday morning peak hour. During the weekday afternoon peak hour the school is expected to generate 280 vehicle trips with 129 vehicles entering and 151 exiting.

[3] *Manual on Uniform Traffic Control Devices,* 2009 Edition; Federal Highway Administration; 2009

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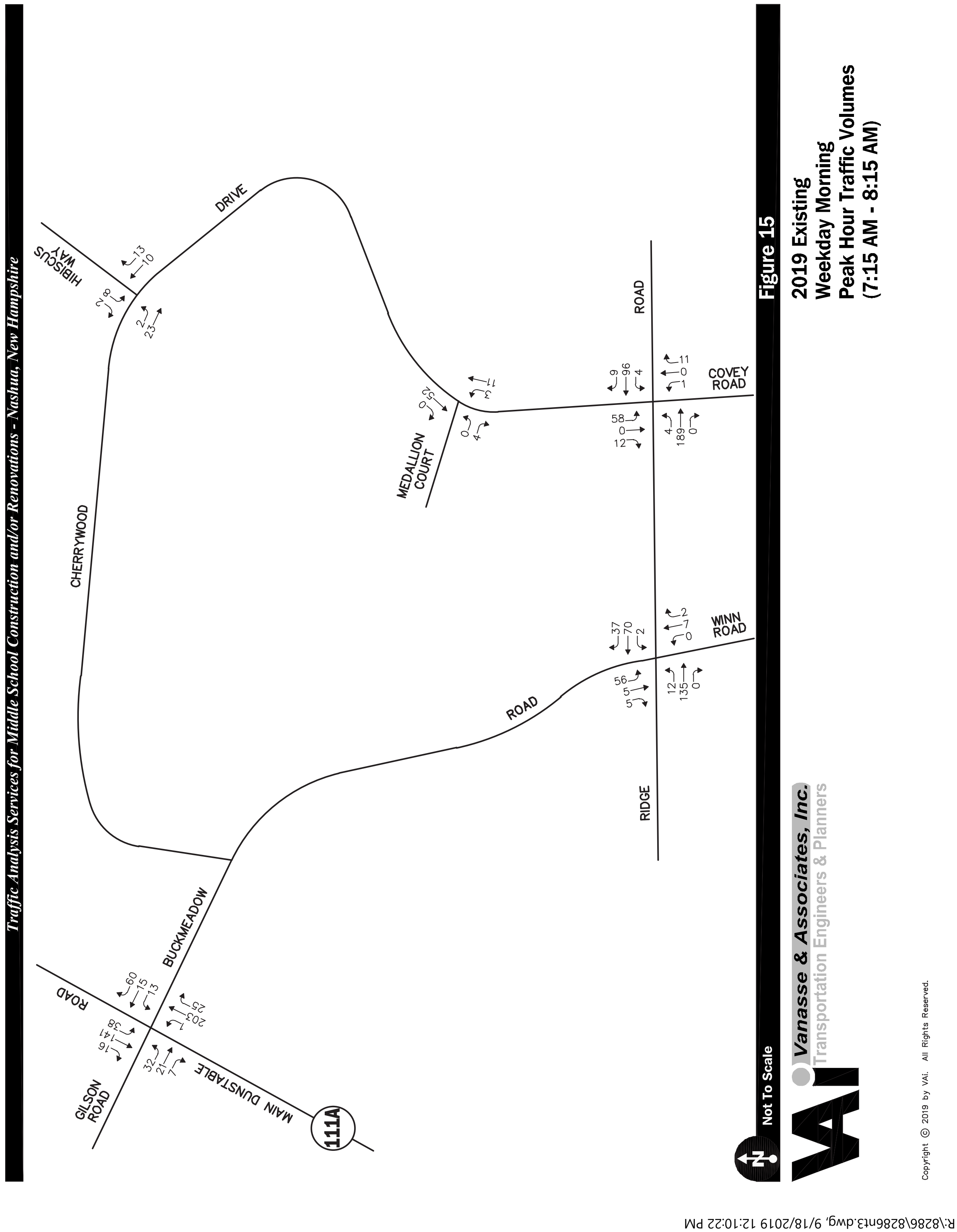
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
Figure 15
2019 Existing
Weekday Morning
Peak Hour Traffic Volumes
(7:15 AM - 8:15 AM)
HIBISCUS WAY
DRIVE
CHERRYWOOD
MEDALLION COURT
ROAD
COVEY ROAD
WINN ROAD
RIDGE
BUCKMEADOW
ROAD
GILSON ROAD
MAIN DUNSTABLE
111A
Not To Scale
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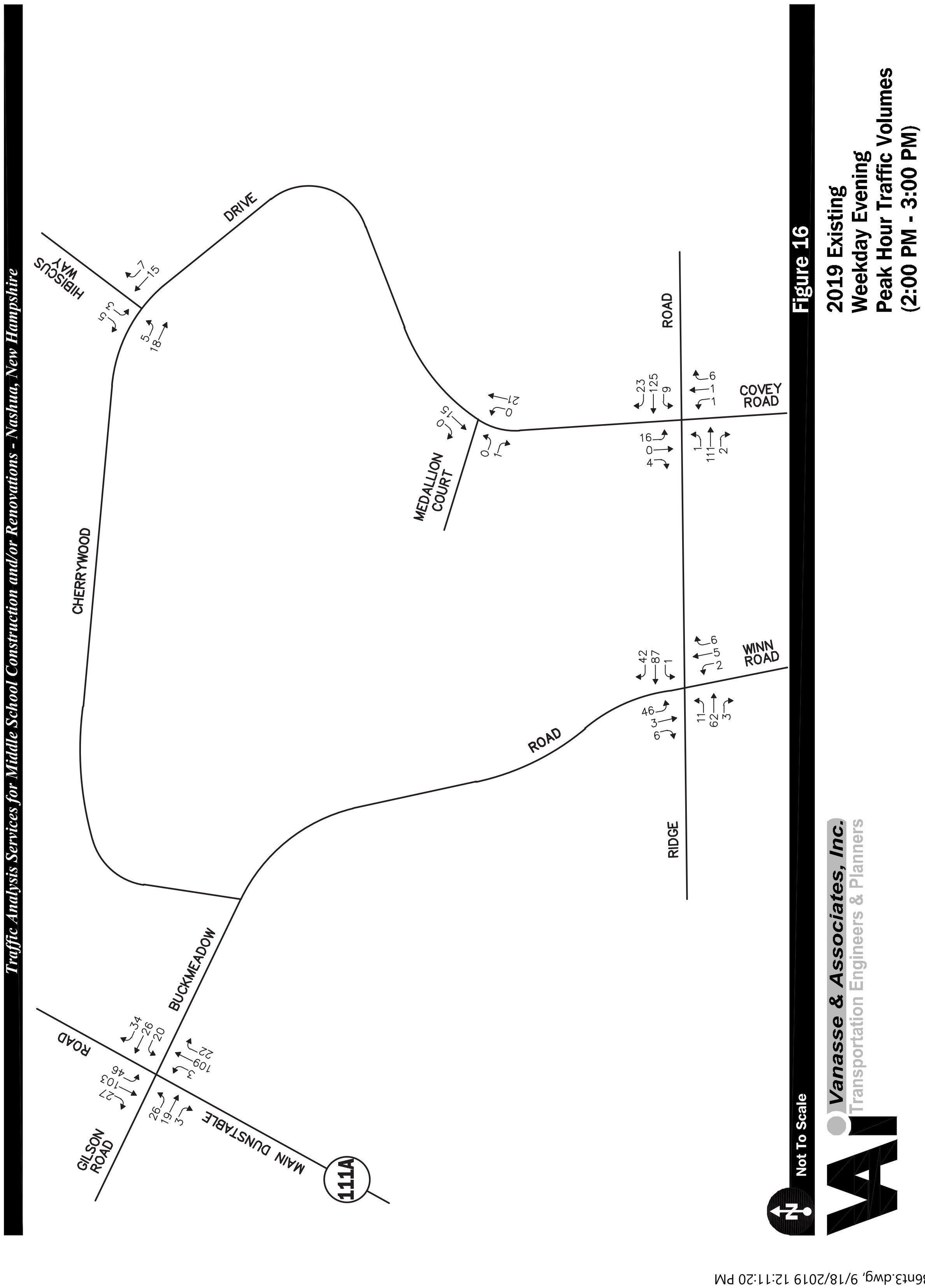
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
HIBISCUS WAY
DRIVE
CHERRYWOOD
MEDALLION COURT
ROAD
COVEY ROAD
WINN ROAD
ROAD
RIDGE
BUCKMEADOW
ROAD
GILSON ROAD
MAIN DUNSTABLE
111A
Figure 16
2019 Existing
Weekday Evening
Peak Hour Traffic Volumes
(2:00 PM - 3:00 PM)
Not To Scale
Vanasse & Associates, Inc.
Transportation Engineers & Planners
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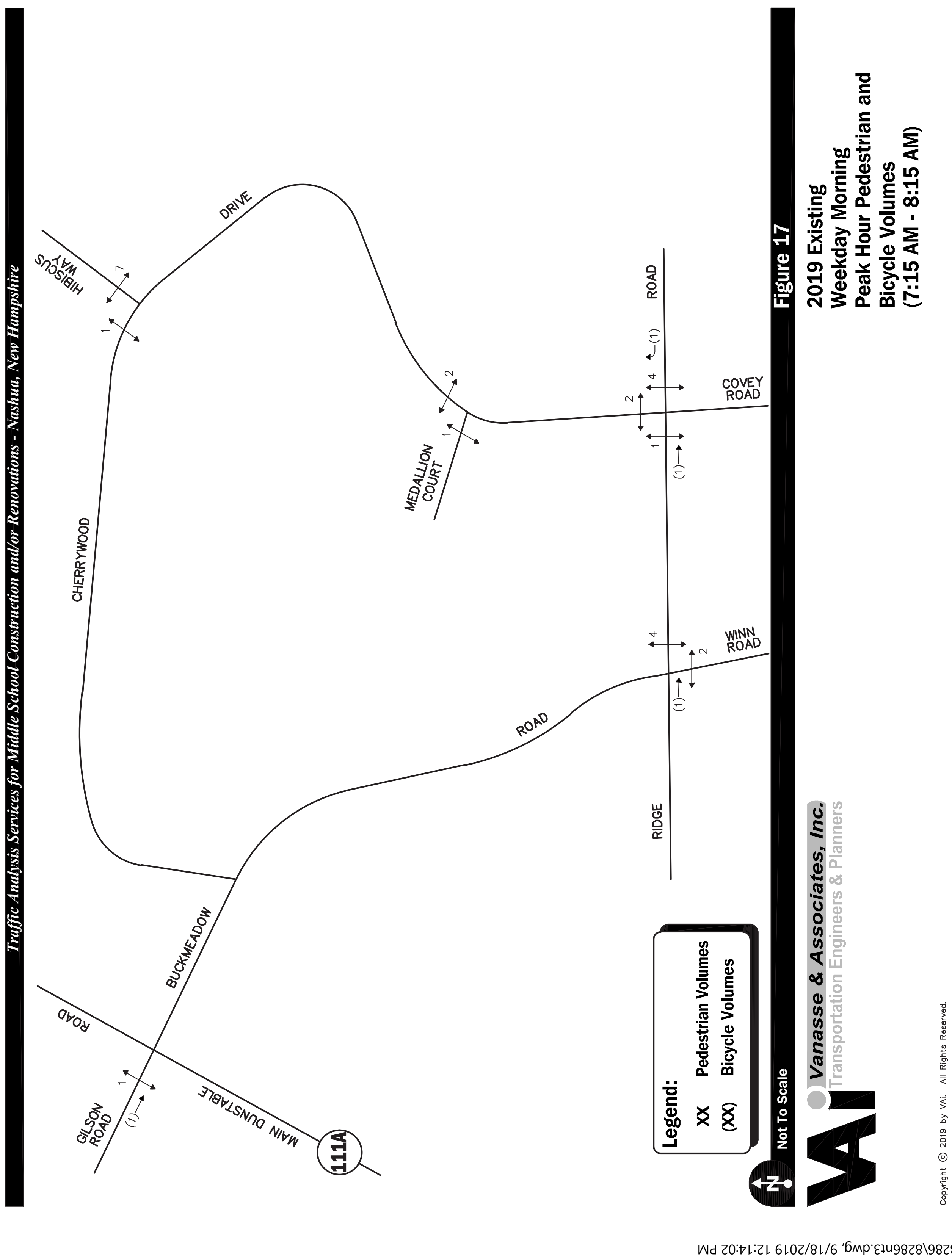
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
HIBISCUS WAY
DRIVE
CHERRYWOOD
MEDALLION COURT
COVEY ROAD
ROAD
WINN ROAD
RIDGE
ROAD
BUCKMEADOW
GILSON ROAD
MAIN DUNSTABLE ROAD
111A
Legend:
XX Pedestrian Volumes
(XX) Bicycle Volumes
Not To Scale
Vanasse & Associates, Inc.
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Figure 17
2019 Existing Weekday Morning Peak Hour Pedestrian and Bicycle Volumes (7:15 AM - 8:15 AM)
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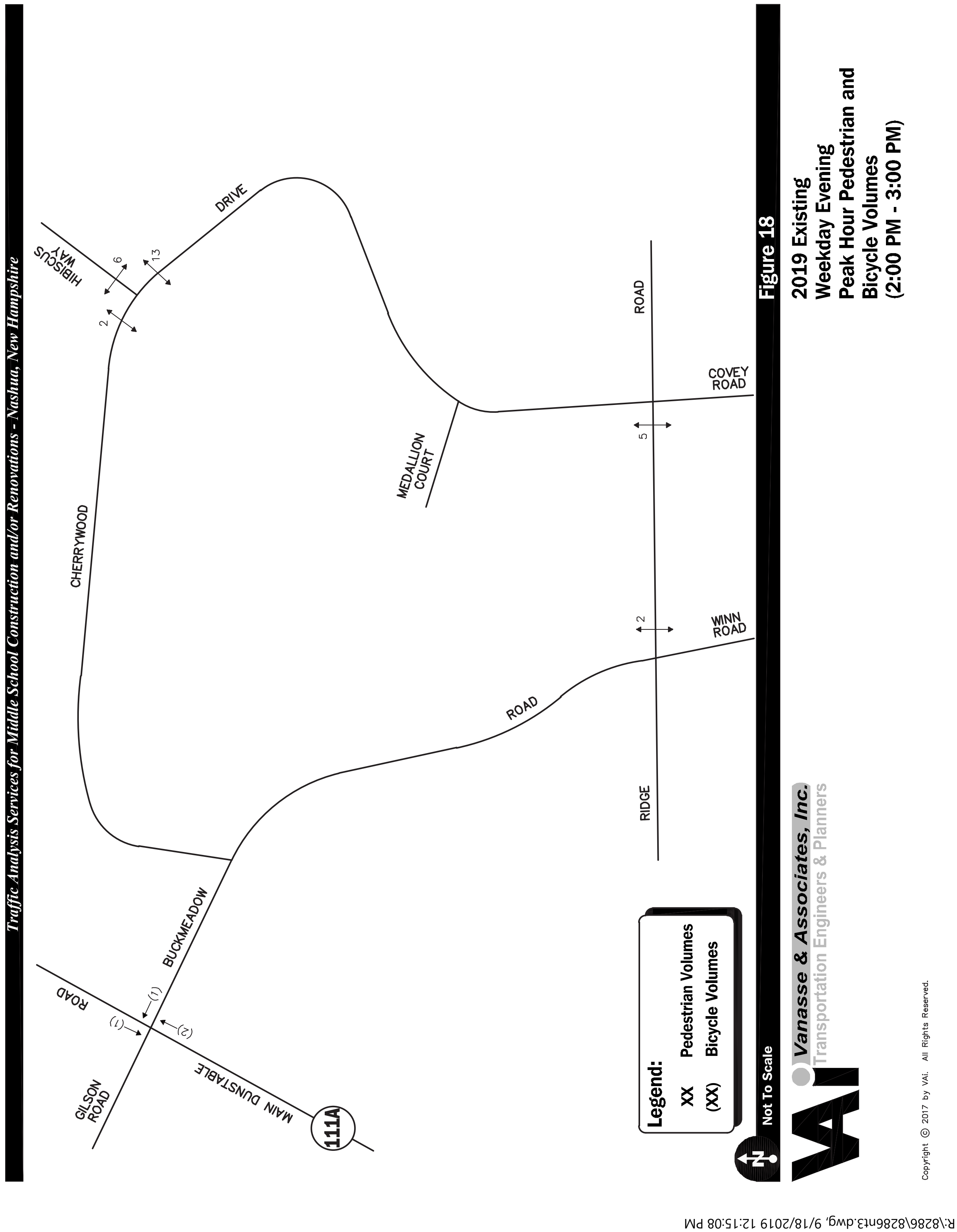
Traffic Analysis Services for Middle School Construction and/or Renovations - Nashua, New Hampshire
Figure 18
2019 Existing
Weekday Evening
Peak Hour Pedestrian and
Bicycle Volumes
(2:00 PM - 3:00 PM)
Legend:
XX Pedestrian Volumes
(XX) Bicycle Volumes
Not To Scale
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Transportation Engineers & Planners
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HIBISCUS WAY
DRIVE
CHERRYWOOD
MEDALLION COURT
COVEY ROAD
ROAD
RIDGE
WINN ROAD
ROAD
BUCKMEADOW
GILSON ROAD
MAIN DUNSTABLE
ROAD
111A
6
13
2
5
2
(1)
(1)
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Table 4
TRIP-GENERATION

Time Period/ Directional Distribution	New Middle School[a] (800 Students)
Weekday Morning Peak Hour:	
Entering	308
Exiting	252
Total	560
Weekday Afternoon Peak Hour:	
Entering	129
Exiting	151
Total	280

[a]Based on ITE LUC 522, Middle School/Junior High School.

New School Design

If the Elm Street School is closed then a new school will be built. The new school will be constructed with full access from Buckmeadow Road and emergency access from Medallion Court. The new school will have a separate drop-off and pick-up location for buses and parents. The newly created intersection of Buckmeadow Road at the School Driveway will have an exclusive left-turn lane on Buckmeadow Road southbound, and exclusive right-turn lane on Buckmeadow Road northbound, and an exclusive left-turn lane and exclusive right-turn lane exiting the school. A traffic signal is proposed at the new driveway and a traffic signal warrant analysis should be conducted at this location.

cc: File

Roof Trac

Nashua School District (SAU #42)

Bicentennial Elementary School

Elm Street Middle School

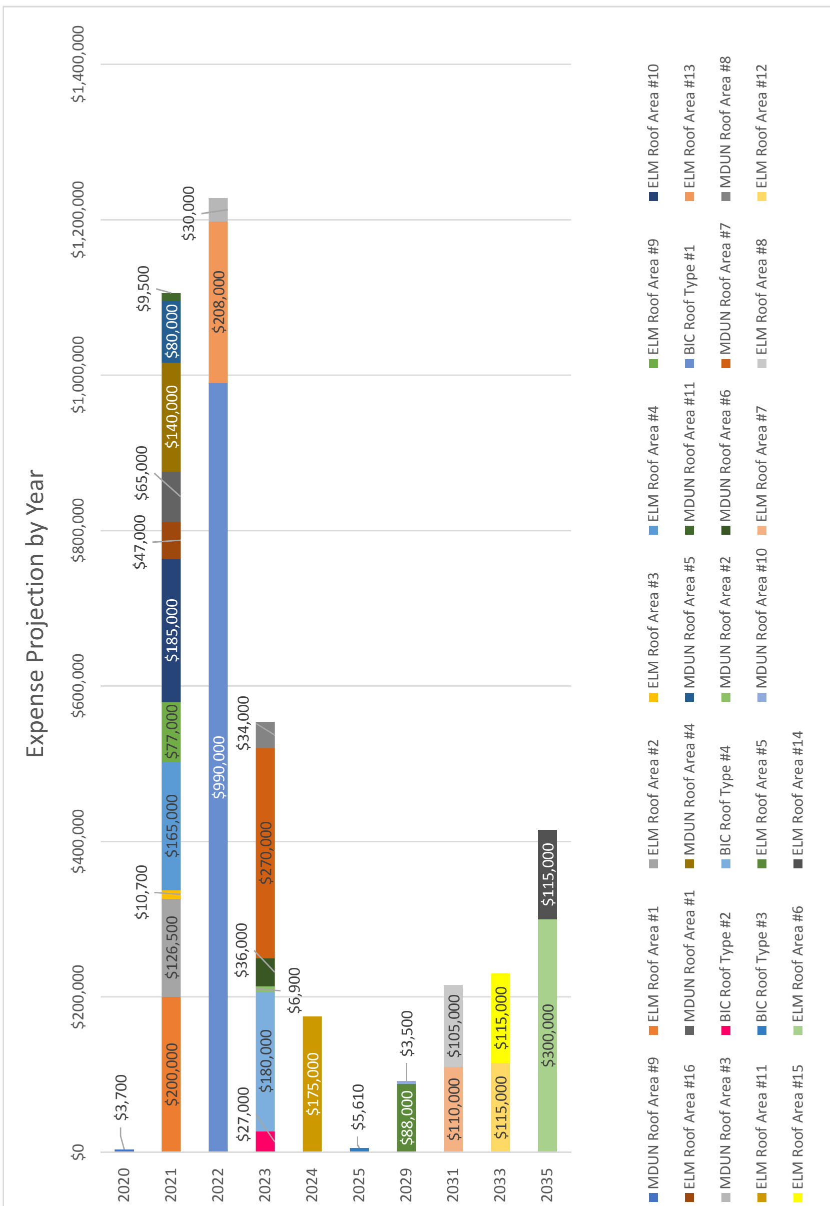
Main Dunstable Elementary School

Created By:

ARM Consultants LLC
PO Box 4
Chester, NH 03036

Nashua School District (SAU #42) - Roof Condition Forecast 2019

Building Name	Building Address	Inspection Date	Approx. Area (SF)	Remedial Maintenance	Current Estimated Replacement Cost	Approximate Age (at time of report)	Remaining Life Expectancy (Years)
Bicentennial Elementary School							
Roof Type #1	296 E. Dunstable Rd	7/16/2019	57,728	$1,500	**$990,000**	22	**3-4**
Roof Type #2	296 E. Dunstable Rd	7/16/2019	1,648	$500	**$27,000**	22	**4-5**
Roof Type #3	296 E. Dunstable Rd	7/16/2019	330	$0	**$5,610**	22	**6-8**
Roof Type #4	296 E. Dunstable Rd	7/16/2019	11,780	$500	**$180,000**	22	**4-5**
BUILDING TOTAL			**71,486**	**$2,500**	**$1,202,610**		
Elm Street Middle School							
Roof Area #1	117 Elm Street	7/16/2019	11,715	$0	**$200,000**	22	**2-4**
Roof Area #2	117 Elm Street	7/16/2019	6,015	$500	**$126,500**	22	**2-3**
Roof Area #3	117 Elm Street	7/16/2019	535	$500	**$10,700**	22	**2-3**
Roof Area #4	117 Elm Street	7/16/2019	8,600	$2,500	**$165,000**	22	**2-4**
Roof Area #5	117 Elm Street	7/16/2019	3,518	$150	**$88,000**	8	**10-12**
Roof Area #6	117 Elm Street	7/16/2019	24,542	$0	**$300,000**	4	**16-18**
Roof Area #7	117 Elm Street	7/16/2019	5,270	$0	**$110,000**	8	**12-14**
Roof Area #8	117 Elm Street	7/16/2019	5,100	$0	**$105,000**	8	**12-14**
Roof Area #9	117 Elm Street	7/16/2019	4,256	$250	**$77,000**	16	**2-4**
Roof Area #10	117 Elm Street	7/16/2019	10,084	$850	**$185,000**	16	**2-4**
Roof Area #11	117 Elm Street	7/16/2019	10,825	$0	**$175,000**	17	**5-7**
Roof Area #12	117 Elm Street	7/16/2019	7,164	$300	**$115,000**	8	**14-16**
Roof Area #13	117 Elm Street	7/16/2019	9,885	$150	**$208,000**	17	**3-5**
Roof Area #14	117 Elm Street	7/16/2019	7,035	$700	**$115,000**	4	**16-18**
Roof Area #15	117 Elm Street	7/16/2019	7,098	$300	**$115,000**	7	**14-16**
Roof Area #16	117 Elm Street	7/16/2019	2,593	$150	**$47,000**	16	**2-4**
BUILDING TOTAL			**124,235**	**$6,350**	**$2,142,200**		
Main Dunstable Elementary School							
Roof Area #1	20 Whitford Rd	7/16/2019	3,206	$200	**$65,000**	27	**2-4**
Roof Area #2	20 Whitford Rd	7/16/2019	572	$300	**$6,900**	27	**4-6**
Roof Area #3	20 Whitford Rd	7/16/2019	1,873	$300	**$30,000**	27	**3-5**
Roof Area #4	20 Whitford Rd	7/16/2019	8,615	$2,200	**$140,000**	27	**2-4**
Roof Area #5	20 Whitford Rd	7/16/2019	4,957	$200	**$80,000**	27	**2-4**
Roof Area #6	20 Whitford Rd	7/16/2019	2,965	$300	**$36,000**	27	**4-6**
Roof Area #7	20 Whitford Rd	7/16/2019	16,625	$1,200	**$270,000**	27	**4-6**
Roof Area #8	20 Whitford Rd	7/16/2019	2,800	$300	**$34,000**	27	**4-6**
Roof Area #9	20 Whitford Rd	7/16/2019	227	$200	**$3,700**	27	**1-2**
Roof Area #10	20 Whitford Rd	7/16/2019	266	$0	**$3,500**	17	**10-12**
Roof Area #11	20 Whitford Rd	7/16/2019	228	$200	**$9,500**	40	**2-4**
BUILDING TOTAL			**42,334**	**$5,400**	**$678,600**		


Expense Projection by Year
$0
$200,000
$400,000
$600,000
$800,000
$1,000,000
$1,200,000
$1,400,000
2020
2021
2022
2023
2024
2025
2029
2031
2033
2035
$3,700
$200,000
$126,500
$10,700
$165,000
$77,000
$185,000
$47,000
$65,000
$140,000
$80,000
$9,500
$990,000
$208,000
$30,000
$27,000
$180,000
$6,900
$36,000
$270,000
$34,000
$175,000
$5,610
$88,000
$3,500
$110,000
$105,000
$115,000
$115,000
$300,000
$115,000
MDUN Roof Area #9
ELM Roof Area #1
ELM Roof Area #2
ELM Roof Area #3
ELM Roof Area #4
ELM Roof Area #9
ELM Roof Area #10
ELM Roof Area #16
MDUN Roof Area #1
MDUN Roof Area #4
MDUN Roof Area #5
MDUN Roof Area #11
BIC Roof Type #1
ELM Roof Area #13
MDUN Roof Area #3
BIC Roof Type #2
BIC Roof Type #4
MDUN Roof Area #2
MDUN Roof Area #6
MDUN Roof Area #7
MDUN Roof Area #8
ELM Roof Area #11
BIC Roof Type #3
ELM Roof Area #5
MDUN Roof Area #10
ELM Roof Area #7
ELM Roof Area #8
ELM Roof Area #12
ELM Roof Area #15
ELM Roof Area #6
ELM Roof Area #14

Roof: Type #1	**Building: Bicentennial Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 296 E. Dunstable Rd Nashua, NH 03062**	

Roof area square footage: **57,728 +/- SF**

Remaining Service Life: **3-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$1,500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Open flashings, shaling ballast stone, etc**

Roofing Contractor/Installer: **AJ Desjardins Roofing Co Inc**
Approx. Year Installed: **1997**
Manufacturer: **Carlisle**

Assembly (from the top down):
Surfacing: **Stone Ballast**
Membrane: **.045 EPDM (Loose Laid)**
Insualtion: **1 1/2" Polyisocyanurate(Loose Laid)**
Membrane #2: **Asphalt Built up roof (With gravel surface still intact)**
Insulation #2: **2" Foam**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$990,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$17.15 SF**

Nashua School District
EDUCATE. INSPIRE. EMPOWER.

Roof: Type #2	**Building: Bicentennial Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 296 E. Dunstable Rd Nashua, NH 03062**	

Roof area square footage: **1,648 +/- SF**
Remaining Service Life: **4-5 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Open flashings, shaling ballast stone, etc**

Roofing Contractor/Installer: **AJ Desjardins Roofing Co Inc**
Approx. Year Installed: **1997**
Manufacturer: **Carlisle**

Assembly (from the top down):
Surfacing: **Stone Ballast**
Membrane: **.045 EPDM (Loose Laid)**
Insualtion: **1 1/2" Polyisocyanurate(Loose Laid)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$27,000**	Approximate square foot cost: **$16.38 SF**

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Roof: Type #3	**Building: Bicentennial Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 296 E. Dunstable Rd Nashua, NH 03062**	

Roof area square footage: **330 +/- SF**
Remaining Service Life: **6-8 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and in fair condition**

Roofing Contractor/Installer: **AJ Desjardins Roofing Co Inc**
Approx. Year Installed: **1997**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.045 EPDM (Fully Adhered)**
Insualtion: **1 1/2" Polyisocyanurate(Mechanically Fastened)**
Membrane #2: **1" thick Asphalt Built up roof (With gravel surface still intact)**
Insulation #2: **2" Foam**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **Sloped to other roof area**

Replacement Cost: **$5,610** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$17.00 SF**

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Roof: Type #4	**Building: Bicentennial Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 296 E. Dunstable Rd Nashua, NH 03062**	

Roof area square footage: **11,780 +/- SF**
Remaining Service Life: **4-5 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Open flashings, shaling ballast stone, etc**

Roofing Contractor/Installer: **AJ Desjardins Roofing Co Inc**
Approx. Year Installed: **1997**
Manufacturer: **Carlisle**

Assembly (from the top down):
Surfacing: **Stone Ballast**
Membrane: **.045 EPDM (Loose Laid)**
Insualtion: **3" Polyisocyanurate(Loose Laid)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$180,000**	Approximate square foot cost: **$15.32 SF**

NO.	ACTION	NO.	ACTION	NO.	ACTION	NO.	ACTION
1	Fill / Repair pitch pocket	11	Secure insulation fasteners	21	Repair / replace sagged / fallen flashing sheet	32	Install fasteners at unit
2	Install caulking M=metal C=concrete	12	Repair membrane puncture			33	Replace drain strainer
3	Clear drain and/or gutter	13	Remove and replace brittle membrane	23	Seal metal edge joints/laps	34	Open pipe boot
4	Remove debris	14	Cut, relax, terminate & repair field sheet	24	Re-secure or replace metal edge	35	Cover patch "tented" fasteners
5	Apply reflective aluminum coating	15	Repair open field seam	25	Rework or replace metal flashing	36	Caulk open masonry joint
5 a	Apply bitumous coating-broadcast aggregate	16	Add drain to eliminate ponding water	26	Correct improper penetrations	37	Damaged skylight
6	Repair / Coat brittle membrane	17	Repair flashing splits or holes	27	Repair holes in metal edge	38	Low flashing height
7	Repair cracks or splits	18	Seal / Repair flashing vertical laps	28	Repair / rework / replace existing repair	39	Repair parapet wall
8	Cut & repair membrane ridges	19	Terminate flashing	29	Replace drain assembly	40	Investigate reported or active leak
9	Cut & repair membrane blisters	20	Seal flashing termination	30	Reflash drain assembly	41	Other: Electrical boxes with holes
10	Divert ponding water with tapered insulation	21	Strip in metal edge	31	Install missing drain hardware		

NOTES:
ROOF AREA TYPE #1:.......57,728 SQ FT
ROOF AREA TYPE #2:........1,648 SQ FT
ROOF AREA TYPE #3:...........330 SQ FT
ROOF AREA TYPE #4:.......11,780 SQ FT
TOTAL ROOF AREA:..........71,486 SQ FT

#	DATE	BY	DESCRIPTION

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ARM Consultants LLC
P.O. Box 4
Chester, NH 03036
(603) 234 6030

PROJECT NAME: BICENTENNIAL ELEMENTARY SCHOOL
PROJECT LOCATION: 296 EAST DUNSTABLE ROAD, NASHUA, NH 03062
SHEET TITLE: ROOF PLAN FOR REMEDIAL MAINTENANCE
DRAWN BY: TEA — CHECKED BY: TEA
DATE ISSUED: 07/16/2019
SCALE: NTS — SITE #: #2
DRAWING: RT-1

Roof area: #1	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **11,715 +/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Membrane is brittle and difficult to weld to. Warranty expired in 2017.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1997**
Manufacturer: **Sarnafil**

Assembly (from the top down):
Membrane: **.072 S327 PVC (Fully Adhered)**
Insualtion: **2.7" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **Unknown (no access to the roof area)**
Insulation #2: **Unknown**
Deck Type: **3" +/- Tectum**

Drainage Type: **Sloped to edges**

Replacement Cost: **$200,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$17.07 SF**

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Roof area: #2	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **6,015 +/- SF**
Remaining Service Life: **2-3 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Membrane is brittle and difficult to weld to. Warranty expired in 2017.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1997**
Manufacturer: **Sarnafil**

Assembly (from the top down):
Membrane: **.072 S327 PVC fleece back (Fully Adhered)**
Insualtion: **2.7" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **Asphalt built up roof (no gravel surface)**
Insulation #2: **none**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$126,500** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$21.03 SF**

Roof area: #3	Building: Elm Street Middle School	Owner: Nashua School District - SAU #42
Date of inspection: 7-16-19	Address: 117 Elm Street Nashua, NH 03062	

Roof area square footage: **535 +/- SF**
Remaining Service Life: **2-3 years**

Action:	Approximate Cost:	Description:
Remedial maintenance:	$500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Membrane is brittle and difficult to weld to. Warranty expired in 2017.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1997**
Manufacturer: **Sarnafil**

Assembly (from the top down):
Membrane: **.072 S327 PVC fleece back (Mechanically attached)**
Insualtion: **2.7" Polyisocyanurate (Mechanically Fastened)**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost:	Approximate square foot cost:
$10,700	$20.00 SF

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Roof area: #4	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **8,600 +/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$2,500	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 22 years old and showing signs of its age. Membrane is brittle and difficult to weld to. Warranty expired in 2017. There is a drain missing in one of the alley ways.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1997**
Manufacturer: **Sarnafil**

Assembly (from the top down):
Membrane: **.072 S327 PVC fleece (Fully Adhered)**
Insualtion: **2.7" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **2 layers of asphalt built up roofing**
Insulation #2: **None**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$165,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$19.18 SF**

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Roof area: #5	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **3,518 +/- SF**
Remaining Service Life: **10-12 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$150	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 8 years old and in fair condition. There is no warranty information availble from Carlisle**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2011**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" min 1/4" per foot tapered polyisocyanurate**
Seperation layer: **Loose felt**
Vapor Barrier: **Self adhered synthetic**
Membrane #2: **Asphalt built up roof (2 layers)**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$88,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$25.02 SF**

Roof area: #6	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **24,542 +/- SF**
Remaining Service Life: **16-18 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 4 years old and in good condition. The seams are stripped in as designed by Noblen & Assoc..**

Roofing Contractor/Installer: **A&M Roofing and Sheetmetal**
Approx. Year Installed: **2015**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Membrane #2: **Asphalt built up roof**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$300,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$12.22 SF**

Roof area: #7	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **5,270+/- SF**
Remaining Service Life: **12-14 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 8 years old and in fair condition. There is no warranty information availble from Carlisle**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2011**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Thermal Barrier: **5/8" Dens Deck**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$110,000**	Approximate square foot cost: **$20.87 SF**

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Roof area: #8	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **5,100+/- SF**
Remaining Service Life: **12-14 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 8 years old and in fair condition. There is no warranty information availble from Carlisle**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2011**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Thermal Barrier: **5/8" Dens Deck**
Deck Type: **Wood**

Drainage Type: **4" diameter internal**

Replacement Cost: **$105,000**	Approximate square foot cost: **$20.59 SF**

Roof area: #9	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **4,256+/- SF**
Remaining Service Life: **2-4 years**

Action:	Approximate Cost:	Description:
Remedial maintenance:	$250	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 16 years old and in poor condition. Ponding water and cover tape starting to delaminate.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2003**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insulation: **1 1/4" + 1 3/4" = 3" total polyisocyanurate**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$77,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$18.09 SF**

Roof area: #10	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **10,084+/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$850	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 16 years old and in poor condition. Ponding water and cover tape starting to delaminate.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2011**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insulation: **1 1/2" + 1 1/2" = 3" total polyisocyanurate (Mopped down)**
Vapor Barrier: **Asphaltic membrane**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost:	Approximate square foot cost:
$185,000 **Price does not include any potential asbestos abatement.**	**$18.35 SF**

Roof area: #11	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **10,825 +/- SF**
Remaining Service Life: **5-7 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 17 years old and in fair condition. The defects in the membrane were repaired at the time of the inspection.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2002**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insulation: **1 1/2" + 1 1/2" = 3" total polyisocyanurate (Mechanically fastened)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" diameter internal**

Replacement Cost: **$175,000**	Approximate square foot cost: **$16.17 SF**

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Roof area: #12	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **7,164+/- SF**
Remaining Service Life: **14-16 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 8 years old and in good condition.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2011**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" diameter internal**

Replacement Cost: **$115,000**	Approximate square foot cost: **$16.05 SF**

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Roof area: #13	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **9,885 +/- SF**
Remaining Service Life: **3-5 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$150 (clean off debris)	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 17 years old and in fair condition. All of the defects were repaired at the time of the inspection.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2002**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insulation: **1 1/2" + 1 1/2" = 3" total polyisocyanurate (Mopped down)**
Membrane #2: **Coal tar pitch built up roof (with gravel surface)**
Deck Type: **Concrete (poured in place pans)**

Drainage Type: **4" diameter internal**

Replacement Cost: **$208,000** **Price does not include any potential asbestos abatement**	Approximate square foot cost: **$21.04 SF**

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Roof area: #14	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **7,035 +/- SF**
Remaining Service Life: **16-18 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$700	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 4 years old and in good condition. All seams are stripped in as designed by Noblen & Assoc..**

Roofing Contractor/Installer: **A&M Roofing and Sheetmetal**
Approx. Year Installed: **2015**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Thermal Barrier: **5/8" Dens Deck**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" diameter internal**

Replacement Cost: **$115,000**	Approximate square foot cost: **$16.35 SF**

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Roof area: #15	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **7,098 +/- SF**
Remaining Service Life: **14-16 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 7 years old and in good condition.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2012**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Thermal Barrier: **5/8" Dens Deck (Mechanically Fastened)**
Insulation: **2" + 2" = 4" total polyisocyanurate**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" diameter internal**

Replacement Cost: **$115,000**	Approximate square foot cost: **$16.20 SF**

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Roof area: #16	**Building: Elm Street Middle School**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 117 Elm Street Nashua, NH 03062**	

Roof area square footage: **2,593 +/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$150	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 16 years old and in poor condition. Ponding water and strip ins are delaminating.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2003**
Manufacturer: **Carlisle**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insulation: **1 1/2" + 1 1/2" = 3" total polyisocyanurate (mechanically fastened)**
Membrane #2: **Asphalt built up roof (with gravel surface)**
Deck Type: **Concrete**

Drainage Type: **4" diameter internal**

Replacement Cost: **$47,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$18.13 SF**

ELM STREET MIDDLE SCHOOL
117 ELM STREET
NASHUA, NH 03062
ROOF PLAN FOR REMEDIAL MAINTENANCE

DRAWN BY: TEA | CHECKED BY: TEA | DATE ISSUED: 07/16/2019 | SCALE: NTS | SITE #: #3 | DRAWING: RT-1

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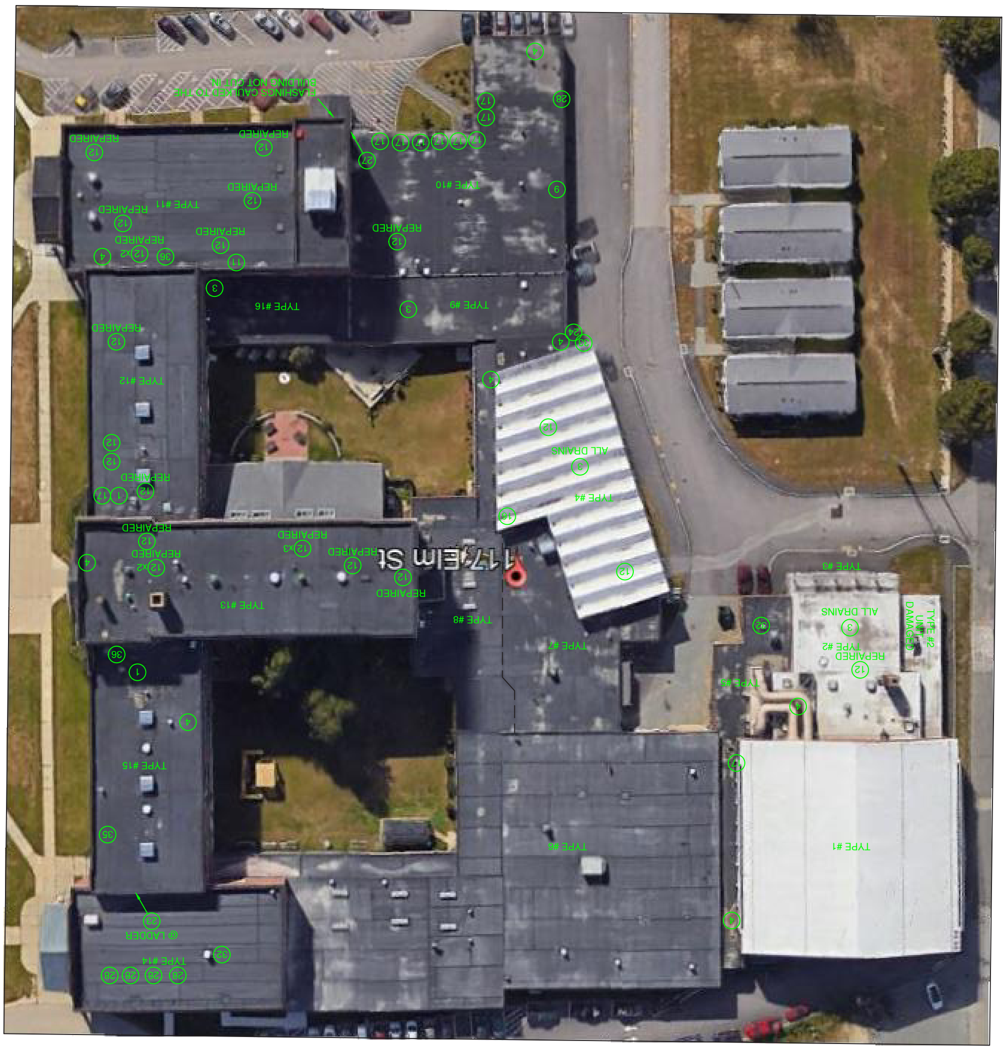

NOTES:
ROOF AREA TYPE #1:.......11,715 SQ FT
ROOF AREA TYPE #2:.........6,015 SQ FT
ROOF AREA TYPE #3:............535 SQ FT
ROOF AREA TYPE #4:.........8,600 SQ FT
ROOF AREA TYPE #5:.........3,518 SQ FT
ROOF AREA TYPE #6:.......24,542 SQ FT
ROOF AREA TYPE #7:.........5,270 SQ FT
ROOF AREA TYPE #8:.........5,100 SQ FT
ROOF AREA TYPE #9:.........4,256 SQ FT
ROOF AREA TYPE #10:.....10,084 SQ FT
ROOF AREA TYPE #11:.....10,825 SQ FT
ROOF AREA TYPE #12:.......7,164 SQ FT
ROOF AREA TYPE #13:.......9,885 SQ FT
ROOF AREA TYPE #14:.......7,035 SQ FT
ROOF AREA TYPE #15:.......7,098 SQ FT
ROOF AREA TYPE #16:.......2,593 SQ FT
TOTAL ROOF AREA:........124,235 SQ FT

NO.	ACTION	NO.	ACTION	NO.	ACTION	NO.	ACTION
1	Fill / Repair pitch pocket	11	Secure insulation fasteners	21	Repair / replace sagged / fallen flashing sheet	32	Install fasteners at unit
2	Install caulking M=metal C=concrete	12	Repair membrane puncture			33	Replace drain strainer
3	Clear drain and/or gutter	13	Remove and replace brittle membrane	23	Seal metal edge joints/laps	34	Open pipe boot
4	Remove debris	14	Cut, relax, terminate & repair field sheet	24	Re-secure or replace metal edge	35	Cover patch "tented" fasteners
5	Apply reflective aluminum coating	15	Repair open field seam	25	Rework or replace metal flashing	36	Caulk open masonry joint
5 a	Apply bitumous coating-broadcast aggregate	16	Add drain to eliminate ponding water	26	Correct improper penetrations	37	Damaged skylight
6	Repair / Coat brittle membrane	17	Repair flashing splits or holes	27	Repair holes in metal edge	38	Low flashing height
7	Repair cracks or splits	18	Seal / Repair flashing vertical laps	28	Repair / rework / replace existing repair	39	Repair parapet wall
8	Cut & repair membrane ridges	19	Terminate flashing	29	Replace drain assembly	40	Investigate reported or active leak
9	Cut & repair membrane blisters	20	Seal flashing termination	30	Reflash drain assembly	41	Other: Electrical boxes with holes
10	Divert ponding water with tapered insulation	21	Strip in metal edge	31	Install missing drain hardware		

Roof area: #1	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **3,206 +/- SF**

Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing significant signs of its age. It has only lasted this long due to the stone ballast.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **Unknown**
Manufacturer: **Firestone**

Assembly (from the top down):
Surfacing: **Stone Ballast**
Membrane: **.045 EPDM (Loose Laid)**
Insualtion: **1 1/2" Polyisocyanurate(Loose Laid)**
Membrane #2: **1" thick Asphalt built up roof (With gravel surface still intact)**
Insulation #2: **1 1/2"Polyisocyanurate**
Membrane #3: **3 ply Asphalt built up roof**
Insulation #3: **1 1/2" Perlite**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$65,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$20.28 SF**

Roof area: #2	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **572 +/- SF**
Remaining Service Life: **4-6 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is 27 years old and showing signs of its age. Currently out of warranty (ended in 2007).**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **2" Top + 1 1/2" Bottom = 3 1/2" total Polyisocyanurate (Mechanically Fastened)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$6,900** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$12.06 SF**

Roof area: #3	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **1,873 +/- SF**
Remaining Service Life: **3-5 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 3/4" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **1" thick Asphalt built up roof (no gravel surface)**
Insulation #2: **1 1/2"Polyisocyanurate**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$30,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$16.02 SF**

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Roof area: #4	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **8,615 +/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$2,200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age. All of the skylights are in poor shape.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 1/2" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **1" thick Asphalt built up roof (no gravel surface)**
Insulation #2: **1 1/2"Polyisocyanurate top + 3/4" Perlite bottom = 2 1/4" total**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$140,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$16.25 SF**

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Roof area: #5	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **4,957 +/- SF**
Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing significant signs of its age. It has only lasted this long due to the stone ballast.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **25+ years (Estimated)**
Manufacturer: **Firestone**

Assembly (from the top down):
Surfacing: **Stone Ballast**
Membrane: **.045 EPDM (Loose Laid)**
Insualtion: **1" Polyisocyanurate(Loose Laid)**
Membrane #2: **1" thick Asphalt built up roof (With gravel surface still intact)**
Insulation #2: **2"Polyisocyanurate**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$80,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$16.14 SF**

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Roof area: #6	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **2,965 +/- SF**
Remaining Service Life: **4-6 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 1/2" + 1 1/2" = 3" total Polyisocyanurate (Mechanically Fastened)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$36,000**	Approximate square foot cost: **$12.14 SF**

Roof area: #7	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **16,625 +/- SF**

Remaining Service Life: **4-6 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$1,200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 1/2" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **1" thick Asphalt built up roof (no gravel surface)**
Insulation #2: **1 1/2" Polyisocyanurate top + 3/4" Perlite bottom = 2 1/4" total**
Vapor Barrier: **Self adhering synthetic**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$270,000** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$16.24 SF**

Roof area: #8	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **2,800 +/- SF**
Remaining Service Life: **4-6 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$300	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 1/2" + 1 1/2" = 3" Polyisocyanurate total (Mechanically Fastened)**
Deck Type: **1 1/2" type "B" steel**

Drainage Type: **4" Internal drains**

Replacement Cost: **$34,000**	Approximate square foot cost: **$12.14 SF**

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Roof area: #9	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **227 +/- SF**
Remaining Service Life: **1-2 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is very old and showing signs of its age. Insulation is crushed and wet.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1992**
Manufacturer: **Firestone**

Assembly (from the top down):
Membrane: **.060 EPDM (Fully Adhered)**
Insualtion: **1 1/2" Polyisocyanurate (Mechanically Fastened)**
Membrane #2: **1" thick Asphalt built up roof (with gravel surface)**
Deck Type: **Plywood**

Drainage Type: **4" Internal drains**

Replacement Cost: **$3,700** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$16.30 SF**

Roof area: #10	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **266 +/- SF**
Remaining Service Life: **10-12 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$0	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roof is in good condition.**

Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **2002**
Manufacturer: **Unknown**

Assembly (from the top down):
Membrane: **Standing seam steel decking (Face fastened with grommeted fasteners)**

Drainage Type: **Over edge**

Replacement Cost: **$3,500** Price does not include any potential asbestos abatement.	Approximate square foot cost: **$13.16 SF**

Roof areas: #11	**Building: Main Dunstable Elementary**	**Owner: Nashua School District - SAU #42**
Date of inspection: 7-16-19	**Address: 20 Whitford Rd Nashua, NH 03062**	

Roof area square footage: **2 x 114 = 228 +/- SF**

Remaining Service Life: **2-4 years**

Action:	**Approximate Cost:**	**Description:**
Remedial maintenance:	$200	See attached drawing
Short term maintenance:		
Long term maintenance:		

Comments: **Roofs are very old and showing signs of its age. Tie ins to the EPDM are in poor shape.**

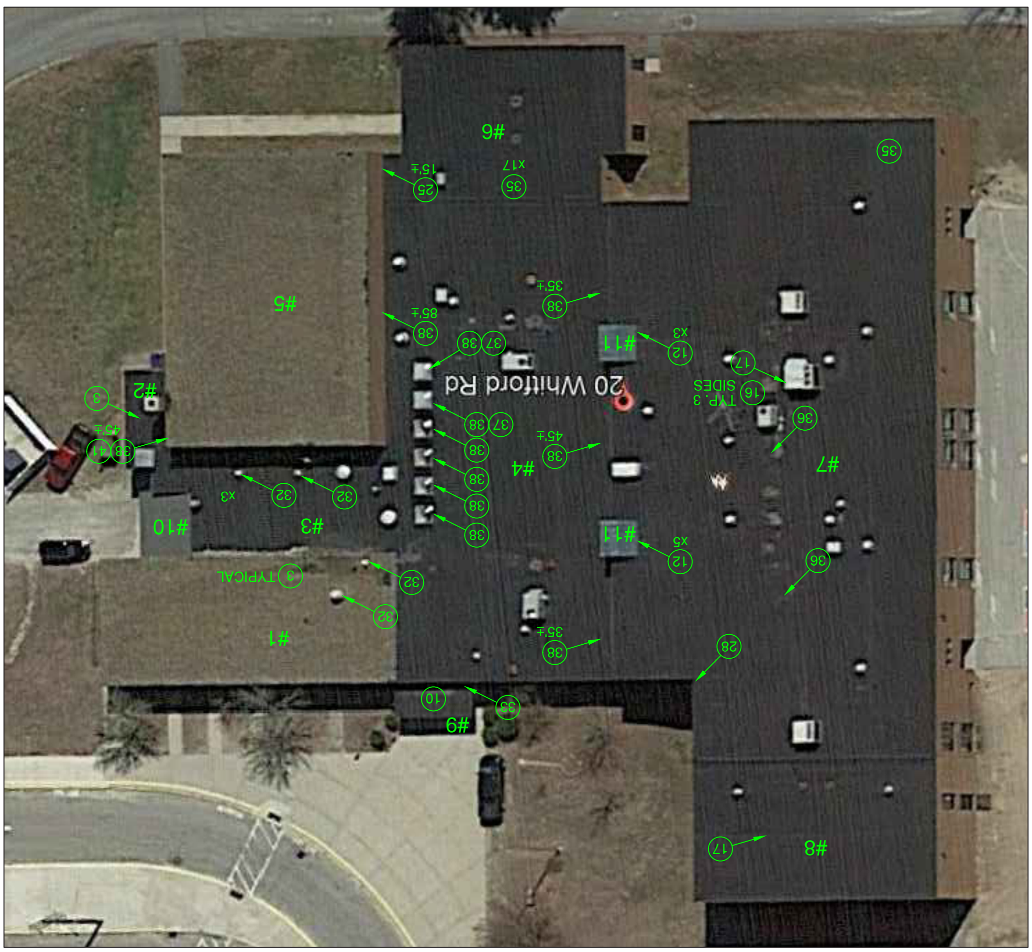
Roofing Contractor/Installer: **Unknown**
Approx. Year Installed: **1980 +/-**
Manufacturer: **Shop fabricated**

Assembly (from the top down):
Membrane: **16oz Red Copper standing seam (Hidden fasteners)**
Vapor Barrier: **15# felt paper**
Deck Type: **Plywood**

Drainage Type: **Sloped to other roof areas**

Replacement Cost: **$9,500** **Price does not include any potential asbestos abatement.**	Approximate square foot cost: **$41.67 SF**

NO.	ACTION	NO.	ACTION	NO.	ACTION	NO.	ACTION
1	Fill / Repair pitch pocket	11	Secure insulation fasteners	21	Repair / replace sagged / fallen flashing sheet	32	Install fasteners at unit
2	Install caulking M=metal C=concrete	12	Repair membrane puncture			33	Replace drain strainer
3	Clear drain and/or gutter	13	Remove and replace brittle membrane	23	Seal metal edge joints/laps	34	Open pipe boot
4	Remove debris	14	Cut, relax, terminate & repair field sheet	24	Re-secure or replace metal edge	35	Cover patch "tented" fasteners
5	Apply reflective aluminum coating	15	Repair open field seam	25	Rework or replace metal flashing	36	Cut membrane larger at drain
5 a	Apply bitumous coating-broadcast aggregate	16	Add drain to eliminate ponding water	26	Correct improper penetrations	37	Damaged skylight
6	Repair / Coat brittle membrane	17	Repair flashing splits or holes	27	Repair holes in metal edge	38	Low flashing height
7	Repair cracks or splits	18	Seal / Repair flashing vertical laps	28	Repair / rework / replace existing repair	39	Repair parapet wall
8	Cut & repair membrane ridges	19	Terminate flashing	29	Replace drain assembly	40	Investigate reported or active leak
9	Cut & repair membrane blisters	20	Seal flashing termination	30	Reflash drain assembly	41	Other: Blocked weep holes, clean
10	Divert ponding water with tapered insulation	21	Strip in metal edge	31	Install missing drain hardware		



NOTES:
ROOF AREA #1:...................3,206 SQ FT
ROOF AREA #2:......................572 SQ FT
ROOF AREA #3:...................1,873 SQ FT
ROOF AREA #4:...................8,615 SQ FT
ROOF AREA #5:...................4,957 SQ FT
ROOF AREA #6:...................2,965 SQ FT
ROOF AREA #7:.................16,625 SQ FT
ROOF AREA #8:...................2,800 SQ FT
ROOF AREA #9:......................227 SQ FT
ROOF AREA #10:....................266 SQ FT
ROOF AREA #11:....................228 SQ FT (TOTAL)
TOTAL ROOF AREA:.........42,334 SQ FT

RT-1 | NTS | 07/16/2019 | #1 | TEA | TEA

PROJECT NAME: MAIN DUNSTABLE ELEMENTARY SCHOOL
PROJECT LOCATION: 20 WHITFORD ROAD, NASHUA, NH 03062
SHEET TITLE: ROOF PLAN FOR REMEDIAL MAINTENANCE

#	DATE	BY	DESCRIPTION

Nashua School District — EDUCATE. INSPIRE. EMPOWER.

ARM Consultants LLC
P.O. Box 4
Chester, NH 03036
(603) 234 6030

NDT CORPORATION
Concrete & Geophysical Testing

NDT CORPORATION
153 Clinton Road, Sterling, MA 01564
Main: 978-563-1327 | Fax: 978-563-1340
eMail: Info@NDTCorporation.com

August 23, 2019

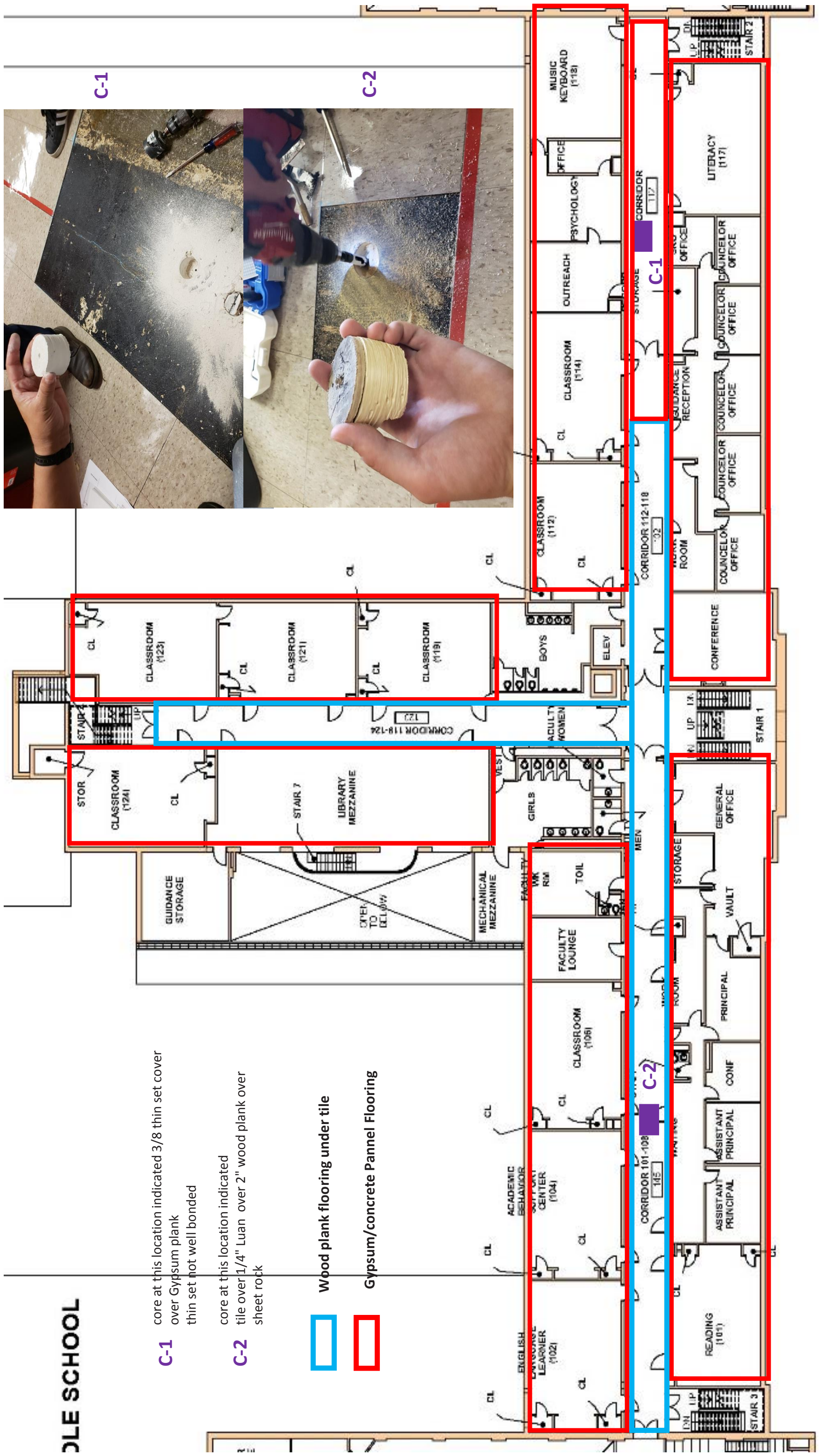
Mr. Shawn Smith
Nashua NH School Committee

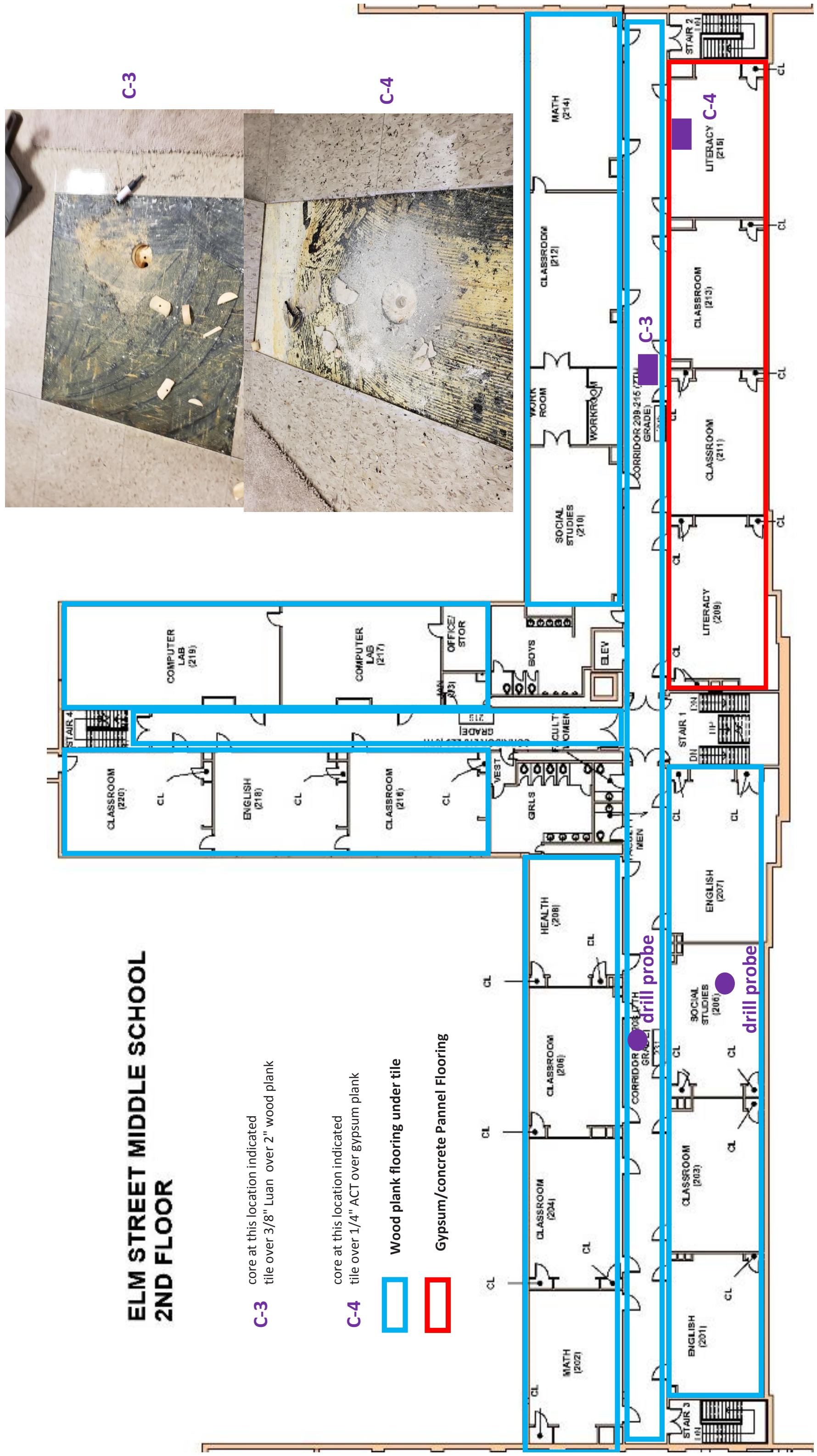
Elm Street Middle School, Nashua, New Hampshire
Floor Cores and Ceiling Panel Removal for inspection

NDT Corporation conducted post GPR survey evaluation of results at the Elm Street Middle School located in Nashua, New Hampshire. This evaluation was conducted on August 23rd, 2019. Included in this investigation the Nashua Maintenance Department conduct floor tile removal and ceiling panel removal to assess the floor condition.

Several cores were conducted where floor tile was removed to observe the condition of the flooring. Results indicated that the large majority of the floor tested with GPR was in fact tile over wood planking flooring. The attached figures show the location of the core locations.

The attached Figures and Photographs show the results of this evaluation.


C-1
C-2
C-1 core at this location indicated 3/8 thin set cover over Gypsum plank thin set not well bonded
C-2 core at this location indicated tile over1/4" Luan over 2" wood plank over sheet rock
Wood plank flooring under tile
Gypsum/concrete Pannel Flooring


C-3
C-4
ELM STREET MIDDLE SCHOOL
2ND FLOOR
C-3 core at this location indicated tile over 3/8" Luan over 2" wood plank
C-4 core at this location indicated tile over 1/4" ACT over gypsum plank
Wood plank flooring under tile
Gypsum/concrete Pannel Flooring
drill probe
drill probe

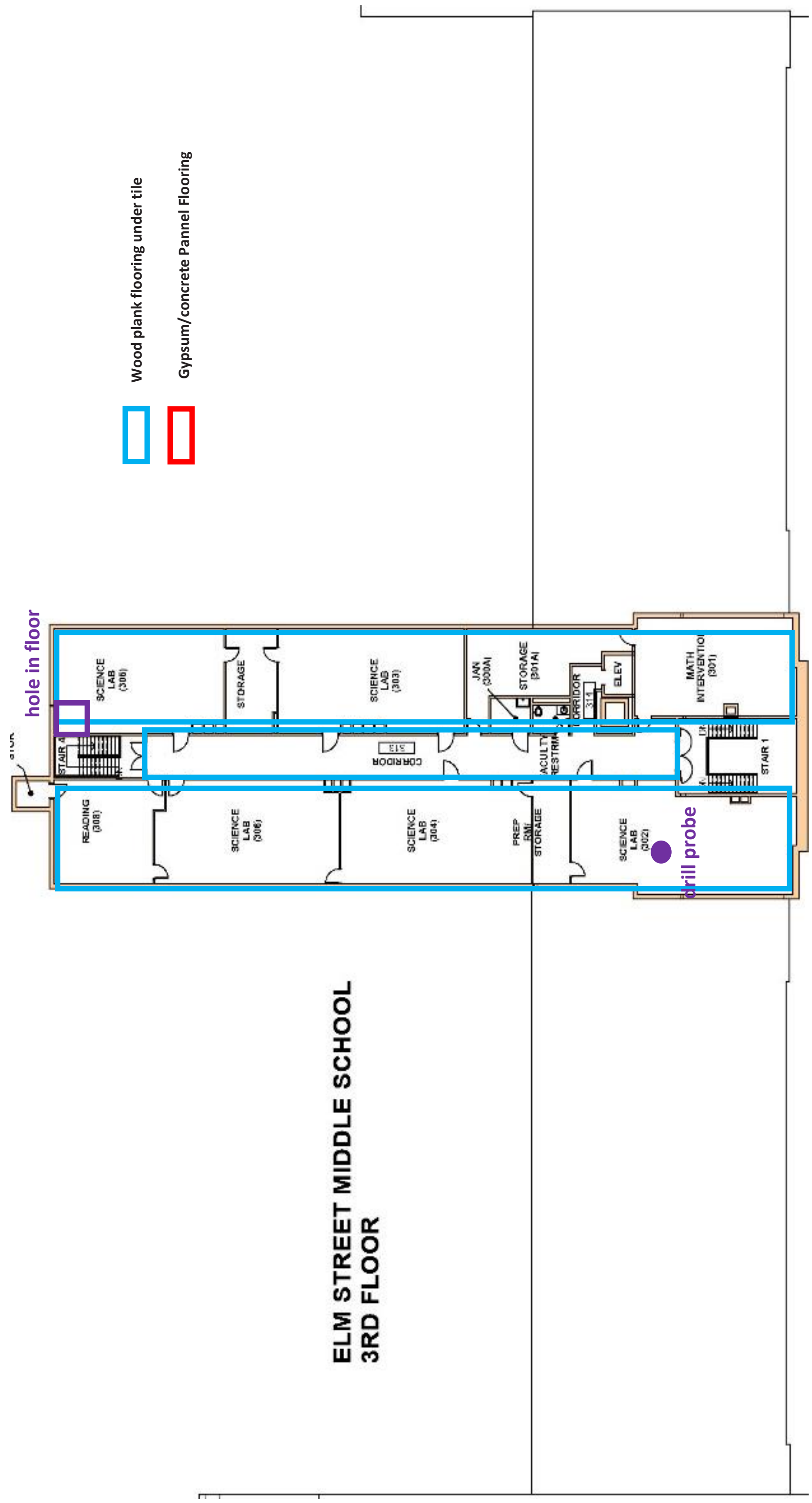

Wood plank flooring under tile
Gypsum/concrete Pannel Flooring
hole in floor
drill probe
SCIENCE LAB (305)
STORAGE
SCIENCE LAB (303)
STORAGE (301A)
ELEV
MATH INTERVENTION (301)
CORRIDOR
STAIR 4
STAIR 1
READING (308)
SCIENCE LAB (306)
SCIENCE LAB (304)
PREP RM/ STORAGE
SCIENCE LAB (302)
ELM STREET MIDDLE SCHOOL
3RD FLOOR

Figure 1 ACT Top Layer Present in Classroom

Figure 2 Wood Bore Hole

Figure 3 Hallway Wood Core with Luan top layer

Figure 4 Gypsum Panel Bore hole

Figure 5 Gypsum Core with Gypsum Top Layer

Figure 6 Room 12 Ceiling

Figure 7 Room 12 Ceiling

Figure 8 Room 12 Ceiling

Figure 9 Room 12 Ceiling

Figure 10 Room 12 Ceiling

Figure 11 Room 12 Ceiling

Figure 12 Room 7 Ceiling

Figure 13 Room 7 Ceiling

Figure 14 Room 7 Ceiling w/ Drill Holes

Figure 15 Room 7 Ceiling w/ Drill Holes

Figure 16 Room 7 Ceiling w/ Spall

Figure 17 Room 7 Ceiling

Figure 18 Room 7 Ceiling

Figure 19 Room 3 Ceiling

Figure 20 Room 3 Ceiling

Figure 21 Room 3 Ceiling

Figure 22 Room 3 Ceiling

Figure 23 Room 3 Ceiling

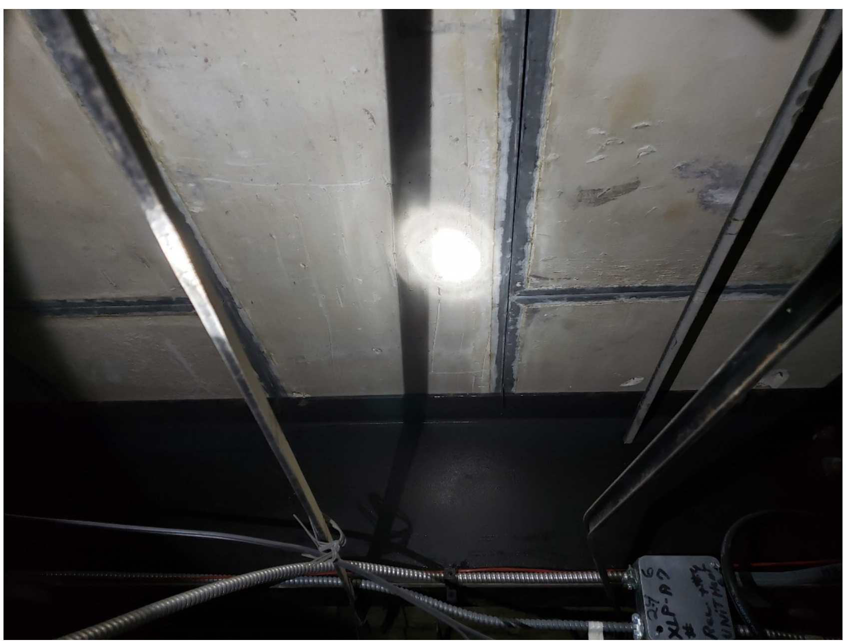


Figure 24 Room 3 Ceiling w/ Minor Spalling

Figure 25 Room 3 Ceiling

Figure 26 Tongue and Grove over I-Beam Room 305

Figure 27 Tongue and Grove over I-Beam Room 305

Figure 28 Example of Wood Plank Flooring

Figure 29 Example of Wood Plank Flooring and Gypsum Panel near Vent Shaft (2nd floor looking up)

Fairgrounds Junior High School — Nashua, NH

Dates of Construction: 1961: Areas 1-8
(refer to keyplan) 1995: Areas 9-15

Description by Plan Area (see key plan) and Structural Systems:

Area 1	Tectum plank on steel plate girders.
Area 2:	Tectum plank on open web steel joists with steel and/or masonry substructure
Areas 4, 10, 11, 14, 15:	Cold-formed steel deck on open web steel joists with steel and/or masonry substructure
Area 3, 5, 6, 8:	Deep long span cold-formed steel deck on steel beam and/or masonry substructure
Area 7:	Cold-formed steel deck on rolled steel beams.
Areas 9, 12, 13:	Plywood deck on metal plate connected wood scissor trusses.

Roof Type:

Areas 1-8, 10, 11, 14, 15:	Adhered single ply membrane (various types) on flat roofs
Area 9, 12, 13:	Asphalt shingles, pitched roofs

Design Snow Load Summaries (psf):

Description	Construction Date	Original Plans Design Loads	Code Design Load at Time	Snow Drift Provisions?	Present Code Design Load
Original School	1961	40	30*	No	47
First Addition	1995	42±	42	Yes	47

*Code requirements prior to 1965 are uncertain.

Rated Snow Load Capacities (psf):

Description	Construction Date	Limiting	Average	Range
Original School (1, 4)	1961	53	58	53-60
Original School (2)	1961	59	59	59
Original School (3, 5-8)	1961	37	58	37-86
First Addition (10,11,14,15)	1995	82	107	82-124
First Addition (9,12,13)	1995	[2]	[2]	[2]

See "Limiting Components" below for references shown in brackets.

Limiting Components:

1. The limiting components in the original building and first addition are the open web steel joists or the deep rib metal decking.
2. The metal plate connected scissor trusses in areas 9, 12 and 13 were visually inspected but not analyzed. Access to these trusses was limited.

Observations:

1. In Area 8, some of the roof drains are clogged and/or loose. The adhered membrane had become unattached in places near the middle and on the west side.

Fairgrounds Junior High School **Nashua, NH**

2. There is no uplift bridging on the bottom chords of the open web steel joists in the original areas (1, 2, 4) or the new Media Center (10).
3. The original design and construction did not include provisions for snow drift conditions on low roof areas adjacent to higher walls (not required by the Building Code in effect at that time).

Recommendations (numbers are keyed to Observations above):

1. FBE recommends replacement and/or repair of all roof drain covers. Drains should be cleared of debris that may clog the drainage system. This should be done on a regularly scheduled basis, 2 or 3 times a year. The roof membrane in Area 8 should be re-secured to the roof to prevent further damage from wind.
2. Consideration should be given to adding uplift bridging to the open web steel joists in the original areas due to the reduced roofing dead load (new adhered roof membrane installed in the early 1990s to replace the old tar and gravel roof) and the increased wind uplift loads specified in the present Building Code. This is a low priority upgrade item. FBE recommends that this be addressed during the next remodeling or reroofing.
3. FBE recommends shoveling of drifted snow on low roofs adjacent to higher areas of the building. Generally, this should be done when and where the depth of the drift exceeds 27 inches. In the area around the rotunda (7), the depth of drifted snow should not be allowed to exceed 18 inches.

Building Specific Qualifications:

1. Joist weights and load capacities were obtained from the appropriate edition of the Steel Joist Institutes (SJI) *Standard Specifications, Load Tables and Weight Tables for Steel Joist and Joist Girders.*
2. Maximum snow depth calculations were based on a snow density of 24 pcf.
3. The roof members of Area 5 and Area 7 were not inspected because they are inaccessible due to the hard ceiling paneling.
4. Limited access to the scissor trusses (areas 9, 12, 13) prohibits a detailed analysis of the truss capacity, however considering the date of construction and condition of the inspected trusses, FBE sees no reason why the trusses would not adequately support the code mandated design loads.
5. Masonry bearing walls and foundations were not rated in this study and would not limit roof snow load capacity.

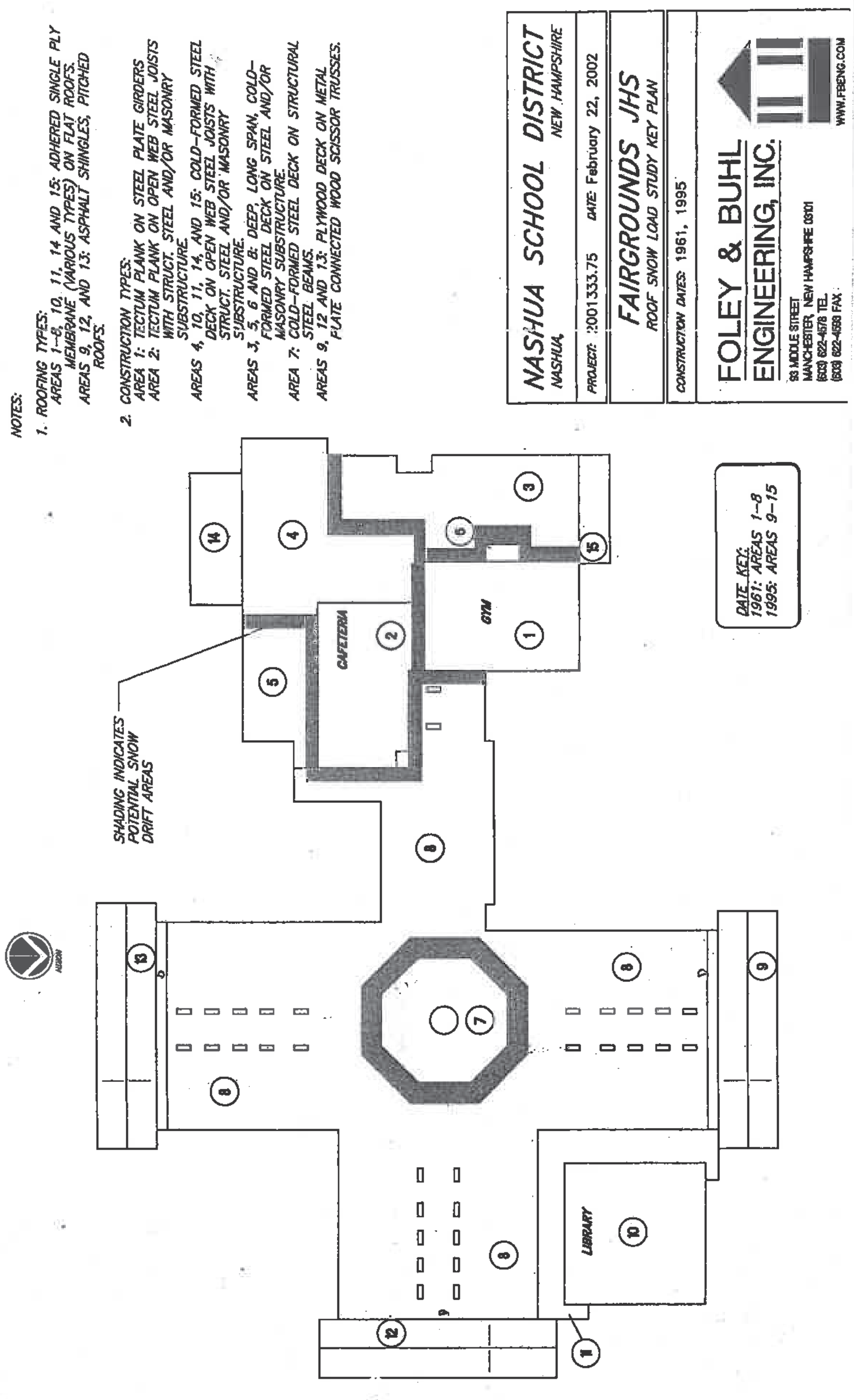
Maximum Recommended Snow Load (non-drift areas): 27 inches (all areas except the low roof in Area 8 immediately around the Rotunda (7), where snow load should not exceed 18 inches).

Commentary:

Low roof areas surrounding the cafeteria, gymnasium and rotunda are potential drift areas which should be monitored for snow buildup and cleared of snow to limit maximum snow depths.

The lower capacity of the Area 8 roof surrounding the Rotunda (7) was based on the deck gauge shown on the original construction drawings. The deck span in this area reaches a maximum span of 28 feet. Similar span lengths are common in the surrounding wings of Area 8. However, the surrounding wings used a 14 gauge deck, while deck surrounding the Rotunda is only 16 gauge. (See architectural drawing 16 and structural drawing S-4 from the 1961 construction drawings.)

FBE notes that these long deck spans around the Rotunda do pass over non-load bearing masonry partition walls below. These non-load bearing masonry partitions have an expansion head detail, designed to prevent the roof from transmitting loads to the walls. We suspect that under heavy snow conditions these long deck spans would simply deflect to the point where the expansion head detail would close up and be ineffective and the deck would eventually bear on these partitions. This provides some measure of unintended safety and redundancy in this area and makes the 16 gauge deck much less of a concern than it would be if the area beneath this deck was entirely open space. Therefore, FBE is not recommending any corrective repairs in this area.


NOTES:
1. ROOFING TYPES:
AREAS 1–8, 10, 11, 14 AND 15: ADHERED SINGLE PLY MEMBRANE (VARIOUS TYPES) ON FLAT ROOFS.
AREAS 9, 12, AND 13: ASPHALT SHINGLES, PITCHED ROOFS.
2. CONSTRUCTION TYPES:
AREA 1: TECTUM PLANK ON STEEL PLATE GIRDERS
AREA 2: TECTUM PLANK ON OPEN WEB STEEL JOISTS WITH STRUCT. STEEL AND/OR MASONRY SUBSTRUCTURE.
AREAS 4, 10, 11, 14, AND 15: COLD-FORMED STEEL DECK ON OPEN WEB STEEL JOISTS WITH STRUCT. STEEL AND/OR MASONRY SUBSTRUCTURE.
AREAS 3, 5, 6 AND 8: DEEP, LONG SPAN, COLD-FORMED STEEL DECK ON STEEL AND/OR MASONRY SUBSTRUCTURE.
AREA 7: COLD-FORMED STEEL DECK ON STRUCTURAL STEEL BEAMS.
AREAS 9, 12 AND 13: PLYWOOD DECK ON METAL PLATE CONNECTED WOOD SCISSOR TRUSSES.
NASHUA SCHOOL DISTRICT
NASHUA, NEW HAMPSHIRE
PROJECT: 2001333.75 DATE: February 22, 2002
FAIRGROUNDS JHS
ROOF SNOW LOAD STUDY KEY PLAN
CONSTRUCTION DATES: 1961, 1995
FOLEY & BUHL ENGINEERING, INC.
93 MIDDLE STREET
MANCHESTER, NEW HAMPSHIRE 03101
(603) 622-4578 TEL.
(603) 622-4593 FAX
WWW.FBENG.COM
DATE KEY:
1961: AREAS 1–8
1995: AREAS 9–15
SHADING INDICATES POTENTIAL SNOW DRIFT AREAS
CAFETERIA
GYM
LIBRARY
NORTH

Elm Street Junior High School — Nashua, NH

Dates of Construction:
(refer to keyplan)

1937: Areas 1-6
1961: Areas 7-15
1991: Areas 2, 16-19

Description by Plan Area (see key plan) and Structural Systems:

Areas 1, 1a, 1b, 6:	Gypsum plank on rolled steel framing, on masonry and /or steel columns.
Area 2:	Metal decking over rolled steel purlins, steel trusses on masonry substructure
Area 3, 4:	(Areas are inaccessible for inspection)
Area 5:	Gypsum plank over rolled steel purlins, steel trusses on masonry bearing walls.
Areas 7, 8, 11, 13b-15:	2½" concrete slab on corrugated steel form deck over open web steel joists. Rolled steel beams on masonry and/or steel substructure
Area 9:	4" precast concrete beams on precast columns.
Area 10:	4.5" Concrete slab on masonry and/or timber substructure
Area 12:	Tectum panels on box subpurlins over steel beam purlins, on fabricated steel trusses. Rolled steel columns.
Area 13a:	6" concrete slab on precast tees and precast concrete columns
Areas 16, 17:	Wood rafters with plywood roof sheathing and/or standing seam metal roofing. Primary framing is rolled steel rolled shapes with a masonry and/or steel substructure
Area 18:	Parallel chord wood trusses on a masonry and/or steel substructure
Area 19:	Metal plate connected wood truss on a masonry and/or steel substructure

Roof Type:

Area 5-7, 10, 11:	Tar and Gravel (appears original in areas 5 and 6)
Area 9,12-15:	White PVC adhered membrane
Area 1, 2, 10, 11, 16, 17, 19:	EPDM Black Adhered Membrane
Area 3,4,18:	Standing seam metal roof

Design Snow Load Summaries (psf):

Description	Construction Date	Original Plans Design Loads	Code Design Load at Time	Snow Drift Provisions?	Present Code Design Load
Original School (1-6)	1937	NP*	None	No	47
First Addition (7-15)	1961	NL**	30?	No	47
Second Addition (16-19)	1991	42	42	Yes	47

*NP = No plans of original construction available.
**NL = Not listed on original construction drawings.

Elm Street Junior High School — Nashua, NH

Rated Snow Load Capacities (psf):

Description	Construction Date	Limiting	Average	Range
Original School (Area 1, 1a, 1b)	1937	75	112	75-158
Original Auditorium (Area 5, 6)	1937	30	[2]	30-47
First Addition (Area 7, 8, 11, 13b-15)	1961	40	57	40-89
First Addition (Area 9, 13a)	1961	Unknown	[3]	-
First Addition Gym (Area 12)	1961	30	30	30
First Addition Corridor (Area 10)	1961	90	90	90
Second Addition (Areas 16-17)	1991	55	55	55
Second Addition (Areas 18-19)	1991	97	97	97

Numbers in brackets thus [1] refer to comments under "Limiting Components" below.

Limiting Components:

1. The limiting components in the original building (area 1, 1a, 1b) are the steel roof beams.
2. The limiting components in the Auditorium roof structure are the web diagonals in the end panels of the long span steel truss (the panels nearest the bearings). Strengthening of the end diagonals would increase the snow load capacity of the truss to approximately 45 psf.
3. The reinforcement in the precast-prestressed concrete girders (area 9) and Tees (area 13a) is unknown. Extensive destructive testing would be required to establish the reinforcing patterns. Since these concrete elements display no obvious signs of overload or distress, we do not recommend that this testing be done.
4. The limiting components on the new gym (area 12) roof trusses are the end diagonals, knee brace and columns.
5. The parallel chord wood trusses in area 18 were not analyzed. Accessibility in this area was limited to the area over the computer room. Visually, the framing in this area appears to be well constructed and in good condition.

Observations:

1. The toggle bolts used to fasten the EPDM roofing membrane in Areas 1, 1a and 1b have penetrated all the way through the gypsum roof deck and caused some spalling on the underside of the plank at every bolt. Otherwise, the underside gypsum plank appeared to be in good condition except for a small area behind the parapet at the east end of Area 1, where there was some evidence of earlier water penetration. It appears that this damage may have preceded the current roofing membrane.
2. The Auditorium (area 5) still has the original tar-and-gravel roofing. There are no toggle bolts and therefore no spalling of the gypsum plank in this area, but the underside of the plank in this area was in fair to good condition, with some minor corrosion of the steel channel plank frames.
3. The underside of the gypsum roof plank over the Stage Fly (Area 6) was badly discolored, cracked and deteriorated.
4. Analysis of the auditorium truss indicates that the diagonal web members in the end panels (nearest the supports) limit the capacity of the roof trusses to approximately 30 psf.

Elm Street Junior High School **Nashua, NH**

5. Joist bridging in area 8 is not properly terminated at the east end wall adjacent to the original building.
6. Visual inspection of the precast-prestressed concrete girders (9) and Tees (13a) showed no signs of an overload condition. All prestressed elements were in good condition with no visible cracking or deflection.
7. Protective coating on the exterior of the cafeteria prestressed concrete beams and Vees is peeling and flaking off in some areas.
8. Analysis of the roof truss and columns in the new gym (12) indicates that the columns, knee brace and second panel web diagonals (at both ends) limit the capacity of the roof system to approximately 30 psf.
9. Inspection of the parallel chord wood trusses in the library (18) did not reveal any indications that the trusses were not performing adequately. No sag or other evidence of overstressing was apparent.
10. The original and first addition design and construction did not include provisions for snow drift conditions on low roof areas adjacent to higher walls (not required by original Codes prior to 1975). The shaded areas shown on the Key Plan would be subject to snow drift provisions in the current building code.

Recommendations (numbers are keyed to Observations above):

1. The bolting used to secure the existing membrane (installed circa 1988) did damage the gypsum plank. However, the damage is limited to a 3 to 6 inch diameter around each bolt, and the bolt spacing is such that damaged areas are typically separated by undamaged gypsum. Furthermore, these planks derive much of their span capability from the steel channel frames. Finally, the plank spans in Areas 1, 1a and 1b are typically no more than 4 feet, which is a short span for this type of plank. Accordingly, FBE does not recommend any remedial work to repair or replace this gypsum roof plank at this time. However, it is very important that an alternative means be used to secure the roofing when this membrane is repaired or replaced. The condition of the plank at the east end of Area 1 (behind the parapet) should be assessed from the top side via removal of test patches of the existing roofing prior to reroofing of this area.
2. The School District is planning to remove patches of the existing roofing this Spring in order to inspect the condition of the top side of the planks in this area. If the condition of the top surface is similar to the appearance of the underside, then deck replacement should not be required. Reroofing of this area will be done in the Spring or Summer of 2002.
3. FBE recommends that the gypsum roof deck over the stage fly be wholly replaced with new steel deck. This work should be given a fairly high priority.
4. Auditorium Trusses (Area 5): The capacity of this roof can be upgraded relatively easily (up to approximately 40 to 47 psf) by adding steel reinforcing plates to the web diagonals in the end bays of each truss. Alternatively, this roof should be monitored and shoveled to keep the maximum snow depth to no more than 15 inches.
5. Joist bracing is primary used to temporarily brace the joists during construction and provide bracing of the chords in reverse bending situations such as uplift on the roof. The obstructed nature of the area in question would dictate that uplift loads on the roof are unlikely and therefore the lack of bracing terminations is not a concern.
6. FBE has no reason to be concerned about the capacity of the prestressed elements and does not recommend further testing (required to establish material properties and reinforcing patterns for further analysis) at this time.

Elm Street Junior High School **Nashua, NH**

7. FBE recommends blast cleaning and recoating exposed concrete beams where peeling and flaking has occurred. Appropriate finish products should be specified by an Architect or Engineer.
8. New Gym (Area 12) roof trusses: After extensive analysis, FBE concludes that these trusses were originally designed as simply-supported elements, with the knee braces added solely to provide resistance to lateral (wind and seismic) loads. These are sometimes known as "smart" members, since the knee brace is supposed to function to resist wind and seismic forces, but is not considered functional with respect to gravity loads. This was an accepted design practice at the time this gym was built. However, the computer analysis done for this study reveals the actual situation: the knee braces will try to act as the principal load path carrying gravity roof loads from the truss to the supporting columns. The result is high loads in the column, knee brace and the second panel web diagonal that effectively limit the capacity of this roof system to about 30 psf. Reinforcement or augmentation is difficult due to the nature and arrangement of these components (particularly the columns, since they are enclosed in the masonry walls). Further study of the feasibility of reinforcing this truss-column-brace system is recommended. For now, FBE recommends limiting accumulated snow depths on this roof to 15 inches. Consideration might also be given to removing the folding partition in this gym, which adds a significant dead load to these trusses.
9. Analysis of the other areas constructed in 1991 indicates that the roofs have been designed for snow and drift loads equivalent to the code mandated loads of today. Coupled with the visual inspection, FBE concludes that the library roof (18) is adequate for the current design loads.
10. FBE recommends shoveling of drifted snow on low roofs adjacent to higher areas of the building when and where the depth of the drift exceeds 24 inches.

Building Specific Qualifications:

1. Joist weights and load capacities were obtained from the appropriate edition of the Steel Joist Institutes (SJI) *Standard Specifications, Load Tables and Weight Tables for Steel Joist and Joist Girders.*
2. All structural steel not designated on the available drawings was assumed to have yield strength of 36 ksi. Structural steel for the original building was assumed to have a yield strength of 33 ksi and an allowable of 20 ksi based on the AISC *Historical Record Dimensions and Properties of Rolled Shapes.*
3. The 2x wood truss framing in the second addition (16 and 17) was visually judged to be roughly equivalent to Hem-Fir North No.2 grade.
4. The top chord for the metal plate connected truss in area 19 was stamped Spruce-Pine-Fir machine stress rated (MSR) with an Fb of 1650 psi and E of 1.5 ksi. The bottom chord and web members were visually judged to be roughly equivalent to Spruce-Pine-Fir No. 2 grade.
5. Maximum snow depth calculations were based on a snow density of 24 pcf.
6. Masonry bearing walls and foundations were not rated in this study and are not expected to control roof snow load capacities.
7. The roof structure of the original gym (area 2) was replaced during the 1991 renovations. This structure was visually inspected from the gym floor and observed to be in very good condition. No rating was performed on this gym roof.
8. The entry roofs (areas 3 and 4) were inaccessible and were not inspected or rated in this study.

Elm Street Junior High School **Nashua, NH**

Maximum Recommended Snow Load (non-drift areas):

Auditorium (Area 5)	15 inches
New Gym (Area 12)	15 inches
All other areas:	24 inches.

Commentary and Summary:

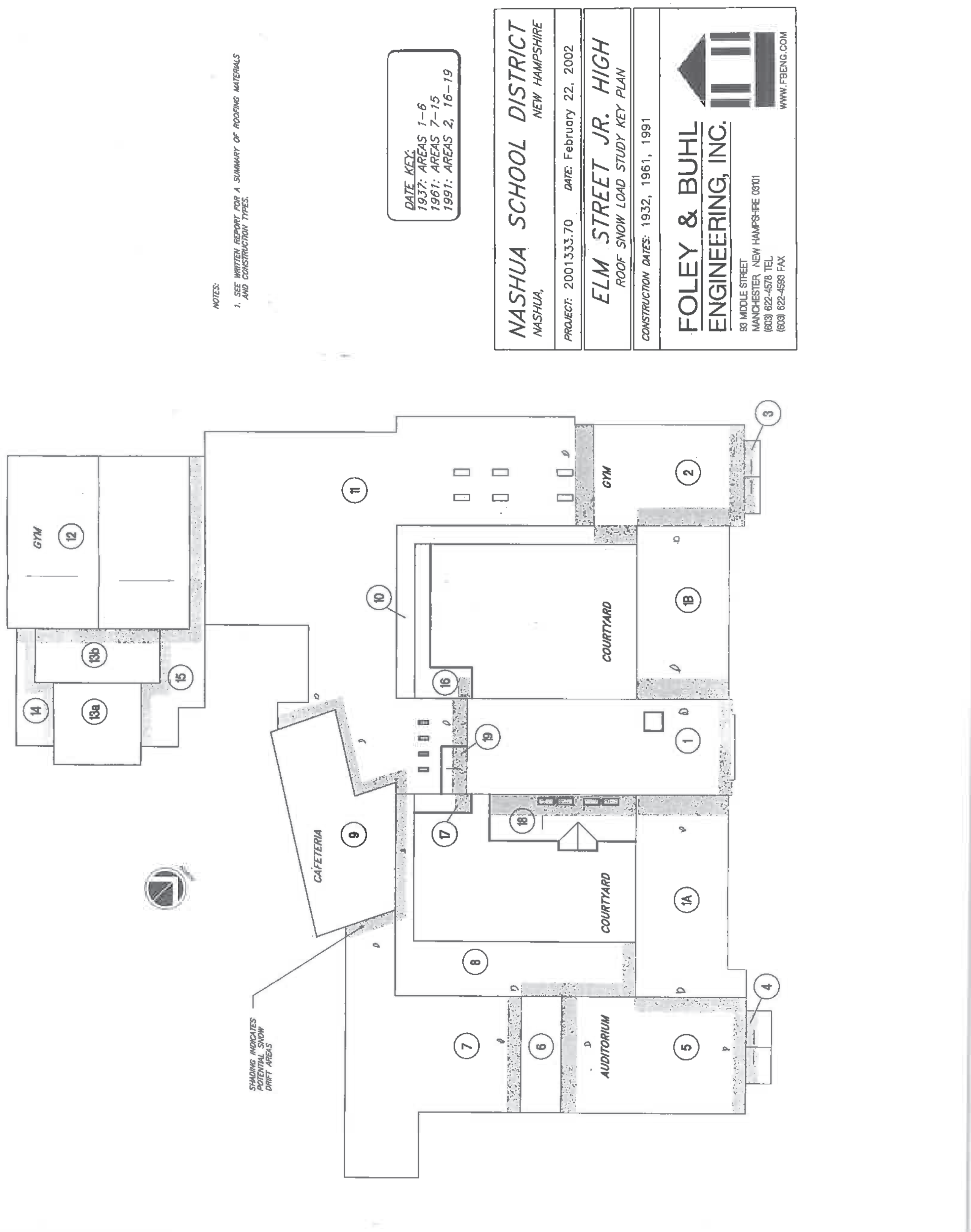
Replacement of the roof deck on the Stage Fly (Area 6) should be a fairly high priority.

The Auditorium roof deck will be subject to a topside inspection to review the condition of the gypsum plank from the top side prior to the planned reroofing, scheduled for this Summer. The inspection will involve removing test patches of the existing roofing. FBE will participate in inspection of this roof deck when these patches are removed. This work is scheduled for March 2002.

The spalls on the underside of the gypsum plank roof deck (Areas 1, 1a and 1b) were caused by the hardware used to secure the 1988 reroofing. While the decks have been damaged, we do not believe replacement of the deck is warranted at this time. However, it is critical that this type of roofing attachment (i.e., using toggle bolts or threaded inserts) NOT be permitted in the future.

Analysis shows that the snow load capacity of the Auditorium roof (Area 5) is limited to 30 psf by the size of the web diagonals in the end panels of the roof trusses. These members are relatively accessible, and there are relatively few of them. Upgrading these web members by welding on steel plates is a feasible option that the School District may want to consider. This upgrade would raise the capacity of the entire area to 40-47 psf.

The capacity of the New Gym roof (Area 12) is limited by truss-column-knee brace interaction that was not considered in the original design of this structure. As a result, FBE rates the snow load capacity in this gym at around 30 psf. Upgrades are difficult due to the number of members involved, the connection details of the existing structure, and the accessibility of the columns. This condition is somewhat mitigated by the fact that this is a high roof area (and therefore it has no drift potential) and that this roof has a 3:12 pitch. The feasibility of reinforcing this system requires further study that is beyond the scope of this report. One possible way to marginally improve the situation would be to remove the existing folding partition in the gym.


NOTES:
1. SEE WRITTEN REPORT FOR A SUMMARY OF ROOFING MATERIALS AND CONSTRUCTION TYPES.
DATE KEY:
1937: AREAS 1–6
1961: AREAS 7–15
1991: AREAS 2, 16–19
NASHUA SCHOOL DISTRICT
NASHUA, NEW HAMPSHIRE
PROJECT: 2001333.70 DATE: February 22, 2002
ELM STREET JR. HIGH
ROOF SNOW LOAD STUDY KEY PLAN
CONSTRUCTION DATES: 1932, 1961, 1991
FOLEY & BUHL ENGINEERING, INC.
93 MIDDLE STREET
MANCHESTER, NEW HAMPSHIRE 03101
(603) 622-4578 TEL.
(603) 622-4593 FAX
WWW.FBENG.COM
GYM
COURTYARD
CAFETERIA
AUDITORIUM
SHADING INDICATES POTENTIAL SNOW DRIFT AREAS

NASHUA SCHOOL DISTRICT
ROOF SNOW LOAD SURVEY

Location	Description	Year Built	Limiting (psf)	* Limiting Snow Depth (ft)	Maximum Snow Load per FBE	Average	Range	Drift Conditions	Drift Comment
Amherst St	First Addition (2)	1964	30	1.25	1.25	30	30	Yes	NE corner, abutting Music Classroom
Amherst St	Second Addition (4)	1978	50	2.08	2.00	60	50-71	No	
Amherst St	Second Addition (5)	1978	50	2.08	2.00	60	50-71	No	
Amherst St	Second Addition (6)	1978	50	2.08	2.00	60	50-71	No	
Amherst St	Third Addition (7)	1998	71	2.96	3.00	75	71-81	No	
Amherst St	Third Addition (8)	1998	71	2.96	3.00	75	71-81	No	
Amherst St	Second Addition (3)	1978	130	5.42	4.00	132	130-135	Yes	Abutting cafeteria and 1892 building
Amherst St	Third Addition (16)	1998	166	6.92	4.00	166	166	Yes	SE & SW corners
Amherst St	Original School (1)	1892	--	1.25	1.25	--	--	No	
Amherst St	Third Addition (9)	1998	--		2.00	--	--	Yes	Abutting gym and clock tower
Amherst St	Third Addition (10)	1998	--		2.00	--	--	No	
Amherst St	Third Addition (11,12,13)	1998	--		2.00	--	--	Yes	Abutting 1978 Addition
Amherst St	Third Addition (14,15)	1998	--		2.00	--	--	No	
Bicentennial	Original School (4)	1976	44	1.83	2.00	46	44-50	Yes	Abutting gym
Bicentennial	Original School (5)	1976	46	1.92	2.00	46	46	No	
Bicentennial	Original School (7)	1976	46	1.92	2.00	46	46	No	
Bicentennial	Addition (8, 9)	1996	46	1.92	2.00	46	46	No	
Bicentennial	Original School (6)	1976	46	1.92	2.00	48	46-50	No	
Bicentennial	Original School (2, 3)	1976	52	2.17	2.00	52	52	No	
Bicentennial	Original School (1)	1976	46	1.92	2.00	80	46-134	Yes	Abutting gym, cafeteria and 10
Birch Hill	Original School (1)	1971	42	1.75	2.00	42	42	No	
Birch Hill	Original School (4)	1971	42	1.75	2.00	50	42-58	No	
Birch Hill	Original School (3)	1971	51	2.13	2.00	51	51	No	
Birch Hill	Addition (5)	1992	52	2.17	2.00	52	52	No	
Birch Hill	Addition (6)	1992	55	2.29	2.00	57	55-59	Yes	Abutting Gym

Based on Foley Buhl Report Dated February 22, 2002
Roof Snow Loads - School Sort - Drifting 2005

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NASHUA SCHOOL DISTRICT

ROOF SNOW LOAD SURVEY

Location	Description	Year Built	Limiting (psf)	* Limiting Snow Depth (ft)	Maximum Snow Load per FBE	Average	Range	Drift Conditions	Drift Comment
Birch Hill	Original School (2)	1971	53	2.21	2.00	84	53-128	Yes	Abutting Gym & South Addition
Birch Hill	Addition (7)	1992	66	2.75	2.00	126	66-121	Yes	Abutting Gym
Broad Street	Original School (3) Canopy	1965	30	1.25	1.50		30	Yes	Abutting Building
Broad Street	Original School(6, 8, 10, 12, 14)	1965	40	1.67	2.00		40	No	
Broad Street	Original School (7, 9, 11, 13)	1965	40	1.67	2.00		40	No	
Broad Street	Original School (4) Office	1965	45	1.88	2.00		45	Yes	Abutting Gym
Broad Street	First Addition (15-19)	1990	45	1.88	2.00		45	No	
Broad Street	Original School (1) Gym	1965	Unknown		2.00		--	Yes	West end
Charlotte Ave	Original School (1, 2, 4)	1954	38	1.58	2.00	42	38-48	Yes	In "wells" & abutting Cafeteria
Charlotte Ave	First Addition (5)	1965	42	1.75	2.00	42	42	Yes	All four sides
Charlotte Ave	Second Addition (7-10)	1990	47	1.96	2.00	50	47-57	Yes	Abutting Gym
Charlotte Ave	First Addition (6)	1965	54	2.25	2.00	54	54	Yes	In "well"
Charlotte Ave	Original School (3)	1954	62	2.58	2.00	62	62	No	
Dr. Crisp	First Addition (3)	1996	40	1.67	2.00		88	Yes	Abutting Entrance Canopy
Dr. Crisp	First Addition (5)	1996	54	2.25	2.00		54-107	No	
Dr. Crisp	First Addition (4)	1996	88	3.67	2.00		88-119	Yes	Abutting Cafeteria
Dr. Crisp	Original School (1,2)	1980	120	5.00	5.00		>=120	Yes	Abutting Cafeteria & Gym
Elm Street	First Addition Gym (Area 12)	1961	30	1.25	1.25	30	30	No	
Elm Street	Second Addition (Areas 16-17)	1991	55	2.29	2.00	55	55	Yes	NE side, abutting classroom wings
Elm Street	First Addition (Area 7, 8, 11)	1961	40	1.67	2.00	57	40-89	Yes	Abutting Auditorium & Cafeteria
Elm Street	First Addition (Area 13B-15)	1961	40	1.67	2.00	57	40-89	Yes	Abutting Gym & Classroom Wing
Elm Street	First Addition Corridor (Area 10)	1961	90	3.75	2.00	90	90	Yes	Abutting Gym

Based on Foley Buhl Report Dated February 22, 2002
Roof Snow Loads - School Sort - Drifting 2005

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NASHUA SCHOOL DISTRICT
ROOF SNOW LOAD SURVEY

Location	Description	Year Built	Limiting (psf)	* Limiting Snow Depth (ft)	Maximum Snow Load per FBE	Average	Range	Drift Conditions	Drift Comment
Elm Street	Second Addition (Areas 18-19)	1991	97	4.04	2.00	97	97	Yes	Abutting Center Classroom Wing
Elm Street	Original School (Area 1, 1A, 1B)	1937	75	3.13	2.00	112	75-158	Yes	Abutting Gym, Aud * Ctr Class Wing
Elm Street	Original Auditorium (Area 5)	1937	30	1.25	1.25	--	30-47	Yes	Abutting Fly, Classroom Wing
Elm Street	Original Auditorium Fly (Area 6)	1937	30	1.25	2.00	--	30-47	No	
Elm Street	First Addition (Area 9, 13A)	1961	Unknown		2.00	--	--	No	
Fairgrounds El.	First Addition (5)	1964	42	1.75	2.00	42	42	Yes	All four sides
Fairgrounds El.	Original School (1, 2, 4)	1954	44	1.83	2.00	49	44-56	Yes	In "wells" & abutting Cafeteria
Fairgrounds El.	Second Addition (7-10)	1990	47	1.96	2.00	53	47-59	Yes	Abutting Gym
Fairgrounds El.	Original School (3)	1954	62	2.58	2.00	62	62	No	
Fairgrounds El.	First Addition (6)	1964	62	2.58	2.00	62	62	Yes	In "well"
Fairgrounds Jr.	Original School (3)	1961	37	1.54	2.25	58	37-86	Yes	Abutting Gym, South & East Ends
Fairgrounds Jr.	Original School (5-7)	1961	37	1.54	2.25	58	37-86	Yes	Abutting Cafeteria
Fairgrounds Jr.	Original School (8)	1961	37	1.54	1.5 (Rotunda)	58	37-86	Yes	Abutting Rotunda, End Wings
Fairgrounds Jr.	Original School (1, 4)	1961	53	2.21	2.25	58	53-60	No	
Fairgrounds Jr.	Original School (2)	1961	59	2.46	2.25	59	59	No	
Fairgrounds Jr.	First Addition (10, 11, 14, 15)	1995	82	3.42	2.25	107	82-124	No	
Fairgrounds Jr.	First Addition (9, 12, 13)	1995	--		2.25	--	--	No	
Ledge Street	Original School (1, 2, 4)	1957	35	1.46	2.00	40	35-48	Yes	In "wells" & abutting Cafeteria
Ledge Street	First Addition (5)	1965	42	1.75	2.00	42	42	Yes	All four sides
Ledge Street	Second Addition (7-10)	1990	47	1.96	2.00	50	47-57	Yes	Abutting Gym & Gym entrance canopy

Based on Foley Buhl Report Dated February 22, 2002
Roof Snow Loads - School Sort - Drifting 2005

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NASHUA SCHOOL DISTRICT
ROOF SNOW LOAD SURVEY

Location	Description	Year Built	Limiting (psf)	* Limiting Snow Depth (ft)	Maximum Snow Load per FBE	Average	Range	Drift Conditions	Drift Comment
Ledge Street	Original School (3)	1957	62	2.58	2.00	62	62	No	
Ledge Street	First Addition (6)	1965	62	2.58	2.00	62	62	Yes	In "well"
Main Dunstable	Original School (1)	1971	42	1.75	2.00	42	42	No	
Main Dunstable	Original School (4)	1971	42	1.75	2.00	50	42-58	No	
Main Dunstable	Original School (3)	1971	51	2.13	2.00	51	51	No	
Main Dunstable	Addition (5)	1992	52	2.17	2.00	52	52	No	
Main Dunstable	Addition (6)	1992	55	2.29	2.00	57	55-59	Yes	Area abutting gym
Main Dunstable	Original School (2)	1971	53	2.21	2.00	84	53-128	Yes	West end abutting area 4 and gym
Main Dunstable	Addition (7)	1992	66	2.75	2.00	126	66-121	Yes	Abutting Gym
Mt. Pleasant	First Addition Gym (3)	1986	47	1.96	2.00		47-72	No	
Mt. Pleasant	First Addition Classroom (4-5)	1986	51	2.13	2.00		51-65	No	
Mt. Pleasant	Original Building (1-2)	1924	59	2.46	2.50		59-136	Yes	Abutting Parapets
New Searles	Original School (2)	1968	30	1.25	1.50	30	30	No	
New Searles	Original School (3)	1968	40	1.67	2.00	44	40-46	Yes	Abutting gym and tower
New Searles	Original School (4)	1968	46	1.92	2.00	46	46	No	
New Searles	Original School (5)	1968	44	1.83	2.00	47	44-50	No	
New Searles	Addition (6)	1994	44	1.83	2.00	52	44-68	No	
New Searles	Addition (7)	1994	47	1.96	2.00	55	47-68	Yes	Abutting gym
New Searles	Original School (1A)	1968	49	2.04	2.00	60	49-81	Yes	Abutting gym and 1B
New Searles	Original School (1B)	1968	49	2.04	2.00	60	49-81	Yes	Abutting gym
Sunset Heights	Original School (1)	1964	30	1.25	1.50		30	No	
Sunset Heights	First Addition (6)	1965	30	1.25	1.50		30	No	
Sunset Heights	Original School (2, 3, 4)	1964	37	1.54	2.00		37-73	Yes	Abutting Cafeteria
Sunset Heights	Third Addition (9-11, 13)	1990	40	1.67	2.00		40-50	No	
Sunset Heights	Third Addition (14)	1990	40	1.67	2.00		40-75	Yes	Abutting Gym & Cafeteria
Sunset Heights	Second Addition (7-8)	1967	43	1.79	2.00		43-72	No	

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Roof Snow Loads - School Sort - Drifting 2005

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NASHUA SCHOOL DISTRICT
ROOF SNOW LOAD SURVEY

Location	Description	Year Built	Limiting (psf)	* Limiting Snow Depth (ft)	Maximum Snow Load per FBE	Average	Range	Drift Conditions	Drift Comment
Sunset Heights	Third Addition (12)	1190	47	1.96	2.00		47	No	
Sunset Heights	First Addition (5)	1965	67	2.79	2.00		67	No	
NHS North	All areas	2002	47	1.96	2.00			Yes	
NHS South	All areas	2004	47	1.96	2.00			Yes	
Pennichuck	Pitched/Shingled	2001	50	2.08	2.00			Yes	
Pennichuck	Flat Sections	1988	40	1.67	2.00			Yes	

* Note: Limiting snow depth assumes snow density of 24 lbs/cubic foot.

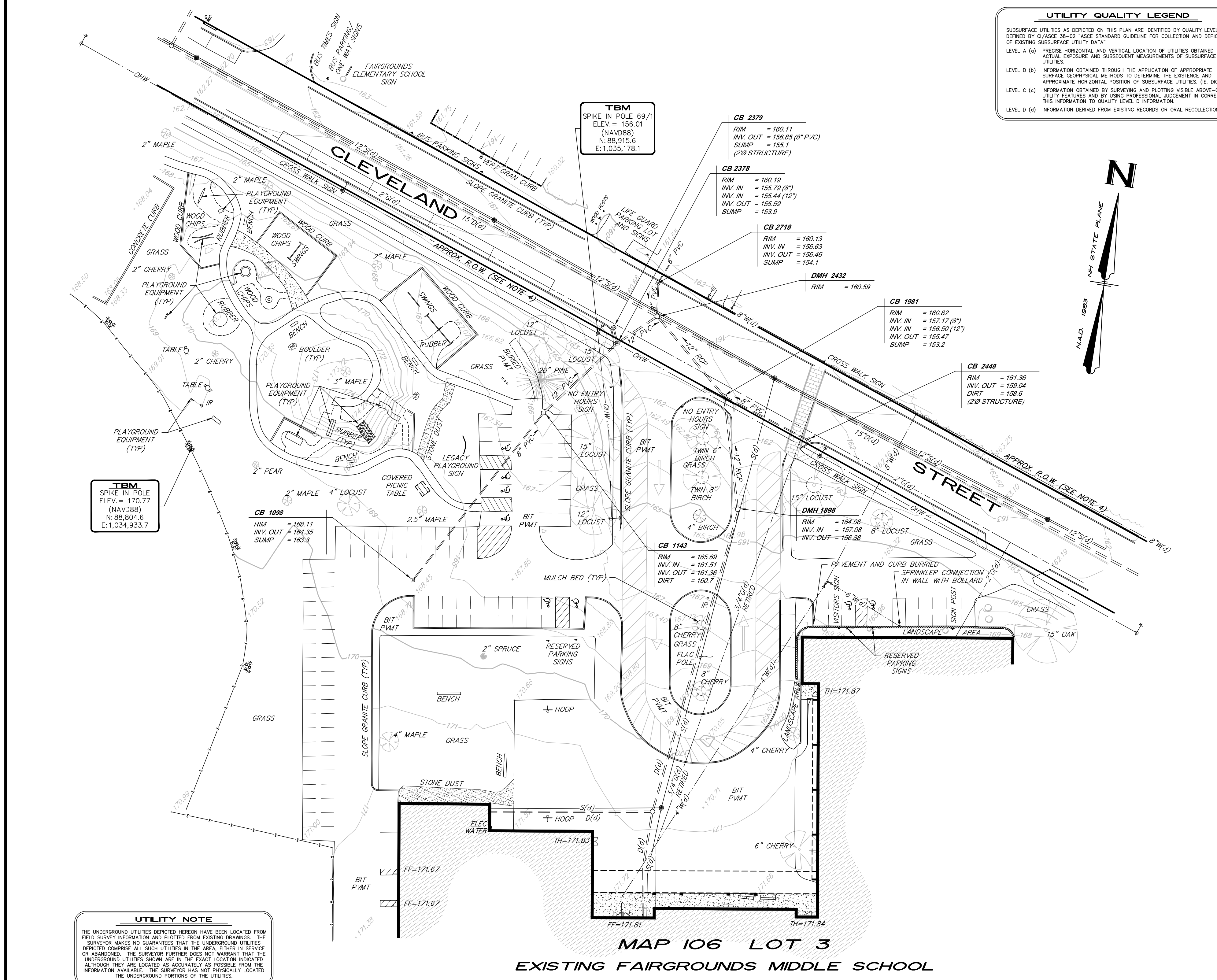
Based on Foley Buhl Report Dated February 22, 2002
Roof Snow Loads - School Sort - Drifting 2005

FAIRGROUNDS MIDDLE SCHOOL

The following information can be found in this section.

- / AHERA
- / Hazardous Material Report
- / Site Survey
- / Traffic Study
- / Snow Load Report

AHERA information for Fairgrounds Middle School can be found in the compiled report beginning on page 172 of this document.



LEGEND

- EXISTING GROUND CONTOUR
- EXISTING SPOT ELEVATION
- STORM DRAIN & CATCH BASIN
- STORM DRAIN & MANHOLE
- SANITARY SEWER & MANHOLE
- WATER MAIN & HYDRANT
- WATER MAIN & GATE VALVE
- GAS LINE & GATE VALVE
- UTILITY POLE WITH GUY SUPPORT
- STREET LIGHT
- OVERHEAD ELECTRIC & TELEPHONE
- UNDERGROUND ELEC/TEL & MANHOLES
- SIGN
- CHAINLINK FENCE
- SLOPE GRANIT CURB
- VERTICAL GRANITE CURBING
- HANDICAP PARKING SPACE
- CONIFEROUS TREE
- DECIDUOUS TREE
- SHRUBS
- THRESHOLD ELEVATION

UTILITY QUALITY LEGEND

SUBSURFACE UTILITIES AS DEPICTED ON THIS PLAN ARE IDENTIFIED BY QUALITY LEVELS DEFINED BY CI/ASCE 38-02 "ASCE STANDARD GUIDELINE FOR COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA"

LEVEL A (a) PRECISE HORIZONTAL AND VERTICAL LOCATION OF UTILITIES OBTAINED BY ACTUAL EXPOSURE AND SUBSEQUENT MEASUREMENTS OF SUBSURFACE UTILITIES.

LEVEL B (b) INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. (IE. DIGSAFE)

LEVEL C (c) INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE-GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGEMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.

LEVEL D (d) INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS.

UTILITY NOTE

THE UNDERGROUND UTILITIES DEPICTED HEREON HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND PLOTTED FROM EXISTING DRAWINGS. THE SURVEYOR MAKES NO GUARANTEES THAT THE UNDERGROUND UTILITIES DEPICTED COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND PORTIONS OF THE UTILITIES.

PLAN REFERENCES:

1. PLAN OF FAIR GROUNDS IN NASHUA, NEW HAMPSHIRE, DATED JULY 1950 AND COMPILED FROM PLANS IN CITY ENGINEERS OFFICE.
RECORDED AS H.C.R.D. PLAN 1427
2. LAND OF NILES J. MERRILL, LAKE AND ALMONT STREET, NASHUA, DATED NOV. 1890.
RECORDED AS H.C.R.D. PLAN 134
3. NASHUA SCHOOLS, FAIRGROUNDS JUNIOR HIGH SCHOOL, NASHUA, NEW HAMPSHIRE, SCALE: 1" = 50', DATED: 11/22/95 AND PREPARED BY THE H.L. TURNER GROUP INC.
ON FILE WITH THE CITY OF NASHUA: NR-1828

NOTES:

1. PURPOSE OF PLAN:
TO DEPICT THE RESULTS OF A LIMITED TOPOGRAPHIC SURVEY CONDUCTED BY THIS OFFICE IN APRIL THROUGH JUNE OF 2019.
2. PRESENT ZONING: ***R9;*** C SUBURBAN RESIDENCE
3. LOT NUMBERS REFER TO THE CITY OF NASHUA ASSESSORS MAP 106.
4. NO LAYOUT OR ACCEPTANCE PROVIDING A RECORD LOCATION OR WIDTH EXISTS FOR THIS SECTION OF CLEVELAND STREET. CLEVELAND STREET IS A PUBLIC WAY PER NH RSA 229:1. THE APPROXIMATE RIGHT OF WAY DEPICTED HEREON IS BASED ON A 50' WIDE WIDTH ESTABLISHED 25 FEET OFF CENTERLINE OF THE ROAD AS CONSTRUCTED.
5. THE PARCEL IS LOCATED IN AN AREA DESIGNATED AS "ZONE X" AS DETERMINED FROM THE FLOOD INSURANCE RATE MAP (FIRM), HILLSBOROUGH COUNTY, CITY OF NASHUA, NEW HAMPSHIRE, COMMUNITY No. 330097, PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, MAP NUMBER: 33011C0651D, HAVING AN EFFECTIVE DATE OF SEPTEMBER 25, 2009.
6. SURVEY CONTROL INFORMATION:
CONTROLLED BY TRIMBLE R-10 GPS RECEIVER RTK CORRECTIONS VIA KEYNET VRS
HORIZONTAL DATUM: NAD83(2011)
VERTICAL DATUM: NAVD88
HORIZONTAL PROJECTION: NH STATE PLANE
UNITS: US SURVEY FEET
7. OWNER OF RECORD:
MAP 106 LOT 3
CITY OF NASHUA
PO BOX 2019
229 MAIN STREET
NASHUA, NH 03061
BK. 1271, PG. 41

TOPOGRAPHIC WORKSHEET
(MAP 106 LOT 3)

FAIRGROUNDS MIDDLE SCHOOL

27 CLEVELAND STREET
NASHUA, NEW HAMPSHIRE
PREPARED FOR

JOINT SPECIAL SCHOOL BUILDING COMMITTEE

CITY OF NASHUA 141 LEDGE STREET NASHUA, NEW HAMPSHIRE 03060

SCALE: 1"=30 Feet
1"=9.144 Meters

12 JUNE 2019

HSI
Hayner/Swanson, Inc.
3 Congress Street Nashua, NH 03062 (603) 883-2057
131 Middlesex Turnpike Burlington, MA 01803 (781) 203-1501
www.hayner-swanson.com

FIELD BOOK: 1232	DRAWING NAME: 5640-EC31	5640	1 OF 1
DRAWING LOCATION: Q:\5640 FAIRGROUNDS\DWG		File Number	Sheet

The Fairgrounds Middle School Traffic Study can be found in the compiled report beginning on page 275 of this document.

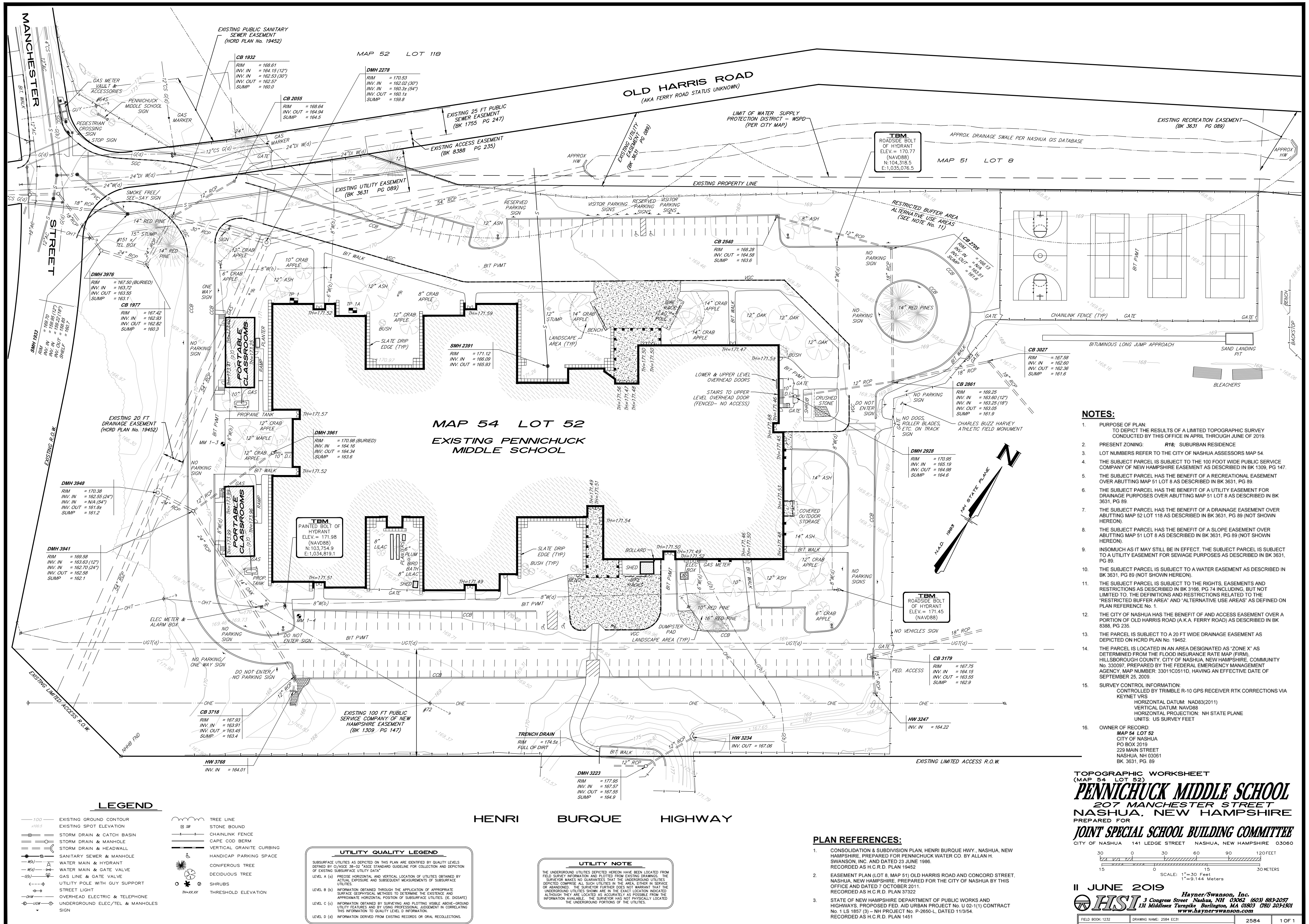
The Fairgrounds Middle School Snow Load Report can be found in the compiled report beginning on page 359 of this document.

PENNICHUCK MIDDLE SCHOOL

The following information can be found in this section.

- / AHERA (not available for Pennichuck Middle School)
- / Hazardous Materials Report
- / Site Survey
- / Traffic Study
- / Geotechnical Exploration

AHERA information is not available for Pennichuck Middle School.


MANCHESTER STREET
OLD HARRIS ROAD
(AKA FERRY ROAD STATUS UNKNOWN)
MAP 52 LOT 118
MAP 51 LOT 8
MAP 54 LOT 52
EXISTING PENNICHUCK MIDDLE SCHOOL
PORTABLE CLASSROOMS
EXISTING PROPERTY LINE
EXISTING LIMITED ACCESS R.O.W.
HENRI BURQUE HIGHWAY
BLEACHERS
SAND LANDING PIT
NOTES:
1. PURPOSE OF PLAN:
TO DEPICT THE RESULTS OF A LIMITED TOPOGRAPHIC SURVEY CONDUCTED BY THIS OFFICE IN APRIL THROUGH JUNE OF 2019.
2. PRESENT ZONING: R18; SUBURBAN RESIDENCE
3. LOT NUMBERS REFER TO THE CITY OF NASHUA ASSESSORS MAP 54.
4. THE SUBJECT PARCEL IS SUBJECT TO THE 100 FOOT WIDE PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE EASEMENT AS DESCRIBED IN BK 1309, PG 147.
5. THE SUBJECT PARCEL HAS THE BENEFIT OF A RECREATIONAL EASEMENT OVER ABUTTING MAP 51 LOT 8 AS DESCRIBED IN BK 3631, PG 89.
6. THE SUBJECT PARCEL HAS THE BENEFIT OF A UTILITY EASEMENT FOR DRAINAGE PURPOSES OVER ABUTTING MAP 51 LOT 8 AS DESCRIBED IN BK 3631, PG 89.
7. THE SUBJECT PARCEL HAS THE BENEFIT OF A DRAINAGE EASEMENT OVER ABUTTING MAP 52 LOT 118 AS DESCRIBED IN BK 3631, PG 89 (NOT SHOWN HEREON).
8. THE SUBJECT PARCEL HAS THE BENEFIT OF A SLOPE EASEMENT OVER ABUTTING MAP 51 LOT 8 AS DESCRIBED IN BK 3631, PG 89 (NOT SHOWN HEREON).
9. INSOMUCH AS IT MAY STILL BE IN EFFECT, THE SUBJECT PARCEL IS SUBJECT TO A UTILITY EASEMENT FOR SEWAGE PURPOSES AS DESCRIBED IN BK 3631, PG 89.
10. THE SUBJECT PARCEL IS SUBJECT TO A WATER EASEMENT AS DESCRIBED IN BK 3631, PG 89 (NOT SHOWN HEREON).
11. THE SUBJECT PARCEL IS SUBJECT TO THE RIGHTS, EASEMENTS AND RESTRICTIONS AS DESCRIBED IN BK 3166, PG 74 INCLUDING, BUT NOT LIMITED TO, THE DEFINITIONS AND RESTRICTIONS RELATED TO THE "RESTRICTED BUFFER AREA" AND "ALTERNATIVE USE AREAS" AS DEFINED ON PLAN REFERENCE No. 1.
12. THE CITY OF NASHUA HAS THE BENEFIT OF AND ACCESS EASEMENT OVER A PORTION OF OLD HARRIS ROAD (A.K.A. FERRY ROAD) AS DESCRIBED IN BK 8388, PG 235.
13. THE PARCEL IS SUBJECT TO A 20 FT WIDE DRAINAGE EASEMENT AS DEPICTED ON HCRD PLAN No. 19452.
14. THE PARCEL IS LOCATED IN AN AREA DESIGNATED AS "ZONE X" AS DETERMINED FROM THE FLOOD INSURANCE RATE MAP (FIRM), HILLSBOROUGH COUNTY, CITY OF NASHUA, NEW HAMPSHIRE, COMMUNITY No. 330097, PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, MAP NUMBER: 33011C0511D, HAVING AN EFFECTIVE DATE OF SEPTEMBER 25, 2009.
15. SURVEY CONTROL INFORMATION:
CONTROLLED BY TRIMBLE R-10 GPS RECEIVER RTK CORRECTIONS VIA KEYNET VRS
HORIZONTAL DATUM: NAD83(2011)
VERTICAL DATUM: NAVD88
HORIZONTAL PROJECTION: NH STATE PLANE
UNITS: US SURVEY FEET
16. OWNER OF RECORD:
MAP 54 LOT 52
CITY OF NASHUA
PO BOX 2019
229 MAIN STREET
NASHUA, NH 03061
BK. 3631, PG. 89
PLAN REFERENCES:
1. CONSOLIDATION & SUBDIVISION PLAN, HENRI BURQUE HWY., NASHUA, NEW HAMPSHIRE, PREPARED FOR PENNICHUCK WATER CO. BY ALLAN H. SWANSON, INC. AND DATED 23 JUNE 1986. RECORDED AS H.C.R.D. PLAN 19452
2. EASEMENT PLAN (LOT 8, MAP 51) OLD HARRIS ROAD AND CONCORD STREET, NASHUA, NEW HAMPSHIRE, PREPARED FOR THE CITY OF NASHUA BY THIS OFFICE AND DATED 7 OCTOBER 2011. RECORDED AS H.C.R.D. PLAN 37322
3. STATE OF NEW HAMPSHIRE DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS, PROPOSED FED. AID URBAN PROJECT No. U 02-1(1) CONTRACT No. 1 LS 1857 (3) – NH PROJECT No. P-2650-L, DATED 11/3/54. RECORDED AS H.C.R.D. PLAN 1451
LEGEND
UTILITY QUALITY LEGEND
UTILITY NOTE
TOPOGRAPHIC WORKSHEET
(MAP 54 LOT 52)
PENNICHUCK MIDDLE SCHOOL
207 MANCHESTER STREET
NASHUA, NEW HAMPSHIRE
PREPARED FOR
JOINT SPECIAL SCHOOL BUILDING COMMITTEE
CITY OF NASHUA 141 LEDGE STREET NASHUA, NEW HAMPSHIRE 03060
SCALE: 1"=30 Feet
1"=9.144 Meters
11 JUNE 2019
Hayner/Swanson, Inc.
3 Congress Street Nashua, NH 03062 (603) 883-2057
131 Middlesex Turnpike Burlington, MA 01803 (781) 203-1501
www.hayner-swanson.com
FIELD BOOK: 1232
DRAWING NAME: 2584 EC31
DRAWING LOCATION: R:\2584 NASHUA PMS\DWG
2584
File Number
1 OF 1
Sheet

The Pennichuck Middle School Traffic Study can be found in the compiled report beginning on page 275 of this document.

Geotechnical Report
Proposed Middle School Addition

Pennichuck Middle School
Nashua, New Hampshire
May 22, 2019

Prepared for:
City of Nashua – Joint Special School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

MMI #6119-03-01-1

Prepared by:
MILONE & MACBROOM, INC.
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
(603) 668-1654
www.mminc.com

MILONE & MACBROOM
ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

MILONE & MACBROOM

May 22, 2019

Mr. Shawn Smith, Director of Plant Operations
Joint Special School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

RE: Design-Phase Geotechnical Engineering Report
Proposed Addition
Pennichuck Middle School
207 Manchester Street
Nashua, New Hampshire

Dear Shawn:

Milone & MacBroom, Inc. (MMI) is pleased to submit herewith our Geotechnical Engineering Report for the above-referenced project. We trust that our findings and recommendations outlined in this report will be responsive to your needs at this time.

We appreciate the opportunity to be of service to your office and will be available for contact to discuss any questions you may have. Please do not hesitate to contact the undersigned should you have any questions or if we can be of further assistance.

Very truly yours,

Milone & MacBroom, Inc.

Erich A Adler, EIT
Project Engineer - Geotechnical

Charles E. Teale, PE, LSP, LEP
Manager of Geotechnical Engineering & Environmental Services

b:\6119-03 city of nashua elm street school\pms\6119 geo report.docx

2 Cote Lane, Suite 1, Bedford, NH 03110 | Tel: 603.668.1654 | Fax: 603.668.0608 | www.MMInc.com
CT | MA | ME | NH | NY | VT

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1.0 INTRODUCTION

This report presents the results of a design-phase geotechnical engineering study performed by Milone & MacBroom (MMI) at the site of the proposed Pennichuck Middle School Addition located at 207 Manchester Street, Nashua, New Hampshire. A Locus Plan is enclosed as Figure 1.

This report has been prepared for The City of Nashua – Joint Special School Building Committee. Included in this report is a summary of subsurface explorations performed, subsurface conditions observed and the geotechnical implications of these conditions with respect to the initial design and preliminary construction considerations for the proposed development. Please note that this report is subject to the limitations contained in Appendix A.

It is important that the Design Team (Owner, Engineers and Architects), and Contractors read and understand this Report and all attachments (Tables, Figures and Appendices) in its entirety in order to fully understand MMI's initial geotechnical engineering recommendations. As the various geotechnical engineering recommendations are comingled and inter-dependent, they cannot be taken as stand-alone or out of context.

Additionally, it is important to note that this report and the subsurface conditions outlined herein pertain only to those immediate areas where subsurface explorations were performed and should not be considered to be representative of soil conditions throughout the rest of the site, or in areas where test borings were not performed.

1.1 Objective of Study

The objective of our services was to explore subsurface conditions within the proposed structure vicinity, and to develop geotechnical engineering recommendations for the design and construction of the proposed building. This report is based on the City of Nashua Joint Special School Building Committee RFP for Geotechnical Services for Middle School Construction and/or Renovation and comments by Harriman in reference to the RFP dated April 2, 2019.

1.2 Scope of Services

The scope of services performed by MMI to meet the above stated objectives included the following:

a. Performance of a site reconnaissance by a MMI geotechnical engineer.

b. Review of published geologic data.

c. Review of the proposed possible addition areas, and coordination and observation of a subsurface exploration program consisting five test borings, designated as MMI-1 to MMI-5 and one test pit, designated as TP-1; at the approximate locations shown on enclosed Figure 2, entitled "Subsurface Exploration Location Plan". The explorations were observed and documented by a geotechnical engineer from our office. Also, preparation of a test boring exploration summary table which is enclosed as Table 1.

d. Preparation of recommendations for foundation support for the proposed structure; including allowable bearing pressures, bearing depths and estimated settlements.

e. Frost depth considerations and effects are discussed.

f. Preparation of recommendations for slab support.

g. A discussion of groundwater conditions including seasonal variations was prepared including its impact on construction activities. The implications of groundwater were evaluated and recommendations regarding construction-phase dewatering, and subdrainage systems were developed.

h. Preparation of recommendations for soil subgrades, gradation and material specifications for fill and backfill, compaction requirements and earthwork considerations.

i. Specific recommendations regarding soil excavation and reuse considerations are given.

j. Flexible pavement designs were developed for parking lots and truck traffic areas based on the test boring data.

k. Seismic considerations regarding foundation design are given based on the 2009 International Building Code and include an assessment of liquefaction potential and determination of the Site Class per IBC Section 1613.

l. Recommended lateral earth pressures (i.e. active, at-rest and passive) against walls below grade with active and passive soil coefficients are presented along with soil sliding coefficients for use in wall design.

m. Construction considerations regarding excavation and earthwork to be considered during the construction-phase of this project have been provided.

n. Preparation of this geotechnical engineering report summarizing our findings and recommendations.

Services with respect to preparation of plans and specifications, performance of additional subsurface explorations, vibrating equipment support considerations, sidewalk support recommendations, pavement design, uplift resisting anchor design, soil laboratory testing, monitoring well installations, attendance at meetings, construction phase quality control, environmental services, vibration studies, and any other services not specifically outlined herein were not included in our current work scope.

1.3 Site and Project Description

Knowledge of the site is based on our site reconnaissance during the current subsurface explorations and review of utility plans and site plans for the construction of additions to the Pennichuck Junior High School.

The development site is occupied by the Pennichuck Middle School, a single story brick clad slab on grade structure dating to the mid-1980s. Surrounding the school are paved walk and driveways as well as landscaped areas. Site topography is generally flat.

MMI understands that the proposed addition(s) location is not yet set but will consist of the construction of a 2-story slab-on-grade addition with a finish floor (FF) elevation planned to match the existing school. This proposed FF grade will result in nominal cuts and fills.

Although structural loadings for the proposed building have not yet been determined, it is anticipated that the proposed development will liekly result in column loads of up to about 25± kips, continuous wall loads of up to 3± kips per lineal foot, and slab-on-grade loads averaging 150± pounds per square foot.

1.4 Existing Structures

Based on discussion review of existing school drawings, and our site observations, MMI understands that the existing school will have additions added either to its north, west, or south side. Existing foundations plans for the school were reviewed with the structure noted to be founded on spread footings supported on underlying natural soil deposits or fill.

2.0 SUBSURFACE EXPLORATIONS

As part of our current scope of work, MMI coordinated and observed a subsurface exploration program consisting of five test borings designated MMI-1 to MMI-5 and one test pit designated as TP-1. Proposed subsurface exploration locations were marked in the field by MMI. The as-drilled/excavated exploration locations and their respective designations are approximately shown on Figure 2. Accordingly, the boring locations and elevations should be considered accurate to the degree implied by the measuring method used.

2.1 Test Borings

The five test borings, designated as MMI-1 through MMI-5, were performed by New England Boring Contractors of Derry, New Hampshire on April 26, 2019. Logs of these explorations, as prepared by MMI, are enclosed in Appendix B.

The test borings were drilled using standard hollow stem auger boring drilling techniques to depths of 22± feet to 27±. Standard Penetration Tests (SPTs) were performed in general accordance with ASTM D 1586 in each test boring, with split spoon samples recovered generally at five-foot intervals. The SPT consists of driving a 1-3/8 inch I.D. split spoon sampler with a 140-pound hammer falling 30 inches. The blows for each 6 inches of penetration are recorded for a total of 18 or 24-inches. The sum of the blows required to drive the sampler from 6 inches to 18 inches penetration is referred to as the Standard Penetration Resistance or N-value which is an index measure of in-situ soil density or consistency.

The explorations were performed under the observation of a MMI geotechnical engineer. Soil samples from the test borings were classified in the field by MMI in general accordance with the

Burmister Soil Classification System. A copy of the Burmister Soil Classification system is enclosed with the MMI boring logs at the end of Appendix B.

2.1 Test Pit

The test pit, designated as TP-1 was performed by TDD Earth Tech of Hudson, New Hampshire on May 7, 2019. A log of this exploration, as prepared by MMI, is enclosed in Appendix B.

The test pit was excavated with a CAT 304 mini-excavator to a depth of 4.6± feet.

The exploration was performed under the observation of a MMI geotechnical engineer. Soil samples from the test borings were classified in the field by MMI in general accordance with the Burmister Soil Classification System. Measurements of the existing foundation system encountered are included on the log.

3.0 SUBSURFACE CONDITIONS

The surface and near-surface shallow soil conditions at the site consist largely of granular fill to depths of up to about 10± feet.

The existing natural overburden soils encountered in the explorations below the fill materials generally consist of medium dense glacial outwash which in turn are underlain by glacial till that was encountered at a depth of about 18± feet below ground surface (bgs).

3.1 Fill Materials

Miscellaneous granular fill consisting fine to coarse sand with varying quantities of silt and gravel were encountered in each exploration to depths of up to 10± feet.

3.2 Glacial Outwash Deposits

Each test boring encountered loose to dense glacial outwash deposits below the fill. These deposits consist of brown to grey fine to medium sand with trace to little silt.

3.3 Glacial Till Deposits

Glacial Till consisting of dense brown fine to coarse sand, little to some gravel, trace Silt. With N-values ranging from 34 to 46 this deposit is considered to be dense.

3.4 Groundwater

Groundwater was encountered in each test boring except MMI-1 at depths ranging from 19± to 26± feet below ground surface.

4.0 IMPLICATIONS OFSUBSURFACE CONDITIONS

4.1 Fill Materials

The existing fill materials and underlying topsoil are not considered suitable for direct or indirect support of the proposed structure footings, and should therefore be completely removed from below the respective foundation bearing zones. Portions of the fill materials, upon removal of visible vegetation, organic matter, roots and any deleterious fractions, may potentially be reused in landscape areas for the proposed development or as structural fill provided it meets the gradation requirements referenced in Section 6.5 or is approved by the engineer.

4.2 Glacial Outwash Deposits

Glacial outwash deposits were encountered in each test boring with thicknesses varying from 15± feet to greater than 25.5± feet. These outwash are suitable for direct or indirect support of lightly loaded spread footings and floor slabs after proof-compaction as recommended in Section 6.6.

4.3 Glacial Till Deposits

Glacial till deposits consisting of coarse to fine sand with varying amounts of gravel and silt, were encountered beneath the outwash in MMI-2. The N-values for these deposits ranged from 34 to 45 corresponding to dense in-situ density. These glacial till deposits are suitable for direct or indirect support of spread footings after proof-compaction as recommended herein.

4.4 Groundwater

Groundwater was encountered in each test boring, except MMI-1, at depths of 19± to 24± feet below existing grades at the time of exploration.

It should be noted that long term equilibrated groundwater measurements were not obtained in any of the explorations and that fluctuations in water conditions and groundwater levels should be anticipated to occur with variations in precipitation, snowmelt, site development, and other factors not present during the exploration program. Groundwater levels should be anticipated to vary and perched water conditions may occur during and after periods of intense precipitation and snowmelt due to shallow bedrock and low permeability glacial till.

The project building FF grade is expected to approximately match the existing building slab, Based on observed field conditions at the time of the exploration program, groundwater will likely not be encountered during excavation for foundations or for utility/drainage structure excavations. However, depending on groundwater and climatic conditions at the time of construction, the Contractor should be prepared to provide for local filtered dewatering using a method that is familiar to him and that is acceptable to the Engineer.

Given the potential for temporary perched groundwater conditions, MMI recommends the installation of building exterior perimeter subdrains, as identified on Figure 3 and as discussed in Section 5.60 of this report. The actual layout of the subdrainage system should be determined based on field conditions at the time of construction in conjunction with final design grades and addition(s) footprint locations. The final design of the subdrainage system should be performed by the site-civil engineer in coordination with the foundation and plumbing plans.

5.0 DESIGN CONDITIONS

5.1 Foundation Support

Based on the test boring data developed as part of this geotechnical engineering study, MMI recommends that the proposed buildings be supported on regular spread footing foundations as outlined herein. Generalized sections depicting recommended foundation support are illustrated on Figure 3.

All spread footing foundations should be supported directly on suitable new compacted structural fill placed directly over suitable undisturbed natural glacial outwash deposits, or directly on suitable undisturbed glacial outwash deposits in accordance with the recommendations outlined herein.

All existing fill, woody debris and any other deleterious materials (i.e. roots, stumps, woodchips, organic matter, etc.), including all existing foundation remnants, underground utilities, septic systems, wells, etc. should be completely removed where located below all footings, and the footing bearing zones, and be replaced with new compacted structural fill. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural glacial deposits are encountered.

Footings bearing on new compacted structural fill placed over suitable undisturbed natural glacial outwash deposits, or directly on suitable natural glacial outwash may be proportioned for a net allowable soil bearing pressure of 2,500 pounds per square foot (psf). All replacement and raise-in-grade compacted structural fill, as well as the upper 12 inches of the natural glacial outwash deposits, should be compacted to a minimum of 95 percent maximum dry density per ASTM D 1557.

Estimated total settlements are not anticipated to exceed about 1± inch with differential settlements of less than half this value for footings founded as recommended herein. Angular distortions of not more than about 1/200 are anticipated along continuous spread footing foundations when supported as recommended herein. Angular distortion represents the differential vertical movement between two points divided by the horizontal distance between the points.

For frost protection, exterior footings should be founded at least 4 feet below finished exterior grades. Interior footings below heated areas may be founded a minimum of 24 inches below the top of floor slab or finished grade.

A slope of 1H:1V should be maintained between the bottom edges of adjacent underground utility trenches and between adjacent footings. Footings should be stepped, as required, in transition areas where different footing levels occur.

It is further recommended that the minimum width of isolated spread footings be 36 inches and that the minimum width of continuous footings be 24 inches

5.2 Floor Slab-on-Grade

Floor slabs should be supported on a minimum 9-inch thick crushed aggregate base course (meeting NH-DOT 304.33; Crushed Gravel for Shoulders) placed and compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557. Excavated on site fill materials and glacial outwash deposits should not be reused as floor slab base course material. The floor slab base course should be placed directly over new compacted structural fill, proof rolled in-situ granular fill or suitable undisturbed glacial outwash deposits in accordance with the recommendations outlined herein.

As with footings, all existing topsoil and any other deleterious materials (i.e. roots, stumps, woodchips, organic matter, etc.) including all existing foundation remnants, underground utilities, septic systems, wells, etc. should be completely removed where located below all floor slabs, and be replaced with new compacted structural fill where necessary.

A vapor barrier should be placed below the slab to protect against capillary moisture impact to the concrete and limit the transmission of moisture into the floor slab. The Architect and/or Structural Engineer should specify the location of the vapor barrier placement relative to the base course material and take the placement of this vapor barrier into account in the concrete slab design curing specifications for the project. It is recommended that a heavy-duty vapor barrier consisting of a single layer of Griffolyn® Type-65G high performance high density reinforced polyethylene, Stego Wrap (www.stegoindustries.com) or an approved similar product be used.

A modulus of subgrade reaction, k_{sl} of no greater than 75 pounds per cubic inch (pci) should be used for design of the slab. Note, however, that the value of k_{sl} is for a 1 square foot area. The k_{sl} value should be adjusted for larger areas using the following equation:

Modulus of Subgrade Reaction (k_s) = k_{sl} (B+1/2B)^2

Where: k_s = Coefficient of vertical subgrade reaction for loaded area

k_{sl} = Coefficient of vertical subgrade reaction for 1 x 1 square foot area

B = Width of area loaded, in feet

Please note that limited cracking of slabs-on-grade is normal and should be expected. Cracking may occur not only as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for floor slab cracking, it is recommended that the measures listed below should be followed during construction:

- The installation of floor slab construction joints as recommended by the American Concrete Institute (ACI) between the columns and walls and between columns to account for differential settlements.
- All backfill in areas supporting slabs should be moisture conditioned and compacted. Backfill in all utility trenches should be carefully compacted.
- Exterior slabs should be structurally isolated from the building.

- A minimum 6-inches of compacted structural fill should be placed between the bottom of floor slabs and the top of footings, to serve as a cushion layer.

5.3 Sidewalks

Entrance slabs and sidewalks adjacent to the building should be designed to reduce the effects of differential frost action between adjacent pavement, doorways and entrances. Although preparation of recommendations for sidewalk support was not part of our work scope for this project, it should be noted that sidewalk performance and stability can be jeopardized by frequent de-icing applications as well as the infiltration of surface water, precipitation and snow melt through joints, where it can then freeze below the concrete resulting in frost heaves.

The existing underlying fill materials and glacial outwash deposits are considered to be moderately frost susceptible. Accordingly, MMI recommends that a non-frost susceptible material, such as NHDOT Item 304.4 crushed stone –fine) or similar be provided to a frost penetration depth of 4 feet below the top of entrance slabs and all sidewalks. This thickness of crushed aggregate should extend the full width of the entrance slab and all sidewalks, and outward at least 4 feet, thereafter transitioning up to the bottom of the adjacent pavement subbase course materials at a 1H:1V or flatter slope.

Additionally, MMI suggests the following be included as part of the design considerations for sidewalks:

1) sealing all sidewalk surface joints (e.g., against walls, curbing, etc.) with a 30+ year water-stop caulk of sufficient durability and elongation without failure;

2) diversion of roof and other runoff away from sidewalks;

3) the placement of plantings through or adjacent to sidewalks should be avoided as they provide entrance points for surface water infiltration; and

4) steel reinforcement doweling of sidewalks to foundation walls and continuous steel reinforcement across sidewalk construction joints to prevent differential movement between sidewalk sections and door jams.

Excavated existing fill or glacial outwash materials are not anticipated to be suitable for reuse as slab or sidewalk base course material.

5.4 Seismic Considerations

MMI has evaluated the site seismic Site Class in accordance with the 2009 International Building Code (IBC) Section 1613 and ASCE 7. Based on the existing subsurface soil profile encountered in the borings, the site meets the general parameters of Site Class D.

An evaluation of the liquefaction potential for the existing subsurface soils was performed and is included in Appendix C. Liquefaction denotes a condition where a soil undergoes continued deformation during the course of cyclic stress (i.e. earthquake induced) applications where the pore-water pressure becomes equal to the confining pressure (i.e. effective stress approaches zero) and large deformations occur. Significant factors influencing liquefaction include grain size distribution of sand, in-situ density, and vibration characteristics (i.e. design earthquake and acceleration coefficient). Results of the liquefaction analysis indicate that these dense granular soils have a factor of safety of greater than one and liquefaction is not likely.

5.5 Walls below Grade

Retaining walls or unbalanced load condition foundation walls should be designed to resist the combined lateral forces resulting from earth pressures as well as those posed by any surcharge loading. Backfill materials behind these walls should consist of new compacted structural fill except that a 2-foot thick chimney drain should be placed behind the wall as shown on Figure 4. Considering the recommended backfill soil, it is recommended that earth pressures be calculated based upon an equivalent fluid weight of 40 pounds per cubic foot (pcf) for the active condition (i.e. unbraced top of wall), 60 pcf for the at-rest condition (i.e. braced top of wall), and 225 psf for passive pressures; with any surcharge loadings applied over the face of the wall at an intensity equal to 0.3, 0.5 and 3 times the surcharge loading for the active, at-rest and passive conditions, respectively.

Where the calculated earth pressure behind walls is less than 200 pounds per square foot (psf), it should be increased to 200 psf to account for stresses created by compaction within 5-feet of the wall. The minimum design factors of safety for sliding and overturning under static loads should be 1.5 and 2, respectively. Passive pressure at the toe of retaining walls subject to freeze/thaw conditions should not be included as a resisting force when analyzing for overturning and sliding. A coefficient of sliding friction of 0.35 between mass concrete and existing in-place glacial deposits or compacted structural fill and may be considered for wall design.

The above-referenced lateral earth loads do not include hydrostatic forces, as they are based on construction of a subdrainage system behind all walls to collect and discharge any potential groundwater, perched water or water from sub-slab utilities that could leak or become damaged, as illustrated on Figure 4.

Equivalent seismic lateral loading against walls may be defined as $0.045Y_tH^2$ where Y_t is the total weight of the soil acting against the wall and H is the height over which the backfill soil acts. Considering the existing subsurface conditions, an equivalent fluid weight of 18 pounds per cubic foot psf, as illustrated on Figure 6, should be considered.

Where modular block retaining walls are proposed, both the internal stability of the wall (usually designed by the supplier/vendor's Engineer) and the overall global stability (usually analyzed by the Owner's Engineer) will need to be performed in order to result in a complete, well-coordinated and satisfactorily designed wall system.

5.6 Subdrainage Systems

The existing site topography and groundwater depths encountered during the exploration program indicate that perched groundwater may occur and tend to collect around building foundations. Accordingly, exterior perimeter footing subdrains, as shown on Figure 3, are recommended to limit accumulation of water and fugitive moisture near the addition(s).

Subdrains should consist of slotted corrugated polyethylene tubing of 4-inch minimum diameter, meeting the requirements of ASTM F 405 or AASHTO M252, surrounded by NHDOT Item #67 Aggregate(¾-inch stone), and be entirely enveloped by non-woven geotextile, as detailed on Figure 3. The use of geotextile will limit the migration of fines from fills and natural soils into the coarse aggregate, thus reducing long term clogging. The subdrain inverts should be set a minimum of 4 feet below adjacent exterior grades to protect against frost penetration. Cleanouts should be provided at every other 90-degree bend, in order to provide for future flushing of the system in the event that siltation or other clogging of the piping should occur.

Subdrains should generally be installed at a minimum 0.5 percent slope and discharge to a suitable system outlet. The system should be gravity drained, if possible, to storm water catch basins or other suitable discharge locations. Subdrain inverts into catch basins should be at least 1½ feet higher than catch basin outlet inverts. If gravity draining of the subdrain system is not possible, a suitable sized holding tank with integral sump pump, including a backup sump pump, will be required. A sump invert at a minimum 18 inches below the lowest subdrain pipe invert elevation should be maintained if a sump is used. No subdrain system should be connected to roof drain systems.

The final outlet of all subdrainage systems must be designed by the Project Site-Civil Engineer in consideration of all City of Nashua, State of New Hampshire and Federal regulations. The final design site plans should be provided to MMI for our review to determine the actual extent of the various subdrainage systems particularly after project final design grades and addition(s) footprint locations have been selected. Additionally, it will be further necessary for the Engineer to determine actual subdrainage requirements in the field during construction based on his/her observations.

5.7 Pavement Considerations

Prior to placement of any required new raise-in-grade compacted structural fill within proposed pavement areas, all existing loam fill, woody debris, former foundation remnants, underground utilities, and all other deleterious materials (i.e. roots, stumps, woodchips, organic matter, etc.) and any excessively loose or soft surficial in-place fill materials should be removed. All resultant subgrade surfaces to potentially remain below pavement areas should then be assessed by proofrolling under the observation of the Engineer prior to placement of any new raise-in-grade materials and pavement support materials.

Evaluation of the necessity for this proofrolling, and interpretation of the results to ascertain suitability of these subgrade materials for support of new raise-in-grade materials and proposed pavement support materials should be made by the Engineer during construction. Proofrolling should be performed with at least 4 passes of a steel drum compactor weighing at least 10 tons, without the use of vibratory compaction.

After proofrolling operations have been completed to the satisfaction of the Engineer, the upper 12 inches of all subgrade soils to remain in place should be compacted to at least 95% of ASTM D 1557.

The subgrade soil for support of pavement sections should consist of suitable proofrolled fill materials, glacial outwash deposits or compacted structural fill (CSF) placed over suitable subgrade surfaces. Depending upon final grading plan cuts and fills, and as determined by the Engineer during construction, it may also be necessary to place a geotextile stabilization layer over subgrade surfaces prior to placement of pavement support materials. Although traffic loadings are not currently developed, based on typical school campus vehicular traffic, MMI has considered the following ranges of pavement sections:

	STANDARD DUTY PAVEMENT SECTION	HEAVY DUTY PAVEMENT SECTION
BITUMINOUS CONCRETE:		
Top Course Thickness	1.5 inches	2.0 inches
Binder Course Thickness	2.0 inches	2.5 inches
SUPPORT MATERIALS:		
Base Course Thickness (NHDOT 304.4)	6 inches	9 inches
Subbase Course Thickness (NHDOT 304.3)	12 inches	15 inches

The base course and subbase should be compacted to at least 95% of the optimum dry density per ASTM D 1557. Underlying raise in grade CSF, where required, should be compacted to at least 95% of the optimum dry density per ASTM D 1557.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Spread Footings

All spread footing foundations should be supported directly on suitable natural glacial outwash deposits, or on compacted structural fill placed directly over suitable natural glacial outwash materials, in accordance with the recommendations outlined herein.

All existing unsuitable soils should be completely removed from below all footings, and the footing bearing zones and be replaced with new compacted structural fill. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural outwash deposits are encountered. All replacement structural fill required below footings should meet the requirements given in Section 6.5.1.

The contractor should be required to maintain a dry (dewatered, if necessary) stable-working soil subgrade bottom during footing construction. Subgrades should slope to sumps as necessary. Footing subgrades should be constructed essentially level prior to placement of reinforcing steel and concrete. It is recommended that all footings be excavated and concrete placed the same day in order to avoid ponding of any surface water runoff in the excavations. Disturbed, frozen or loosened soils should be removed prior to placement of concrete. The footing subgrades should be free of water for the final observation and during placement of concrete. Ground surface grades in the vicinity of the excavations should be graded to promote positive drainage away from the open excavations.

6.2 Floor Slab-on Grade

Floor slabs should be supported on a minimum 9-inch-thick base course of NHDOT 304.33 (Crushed Aggregate for Shoulders) placed and compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557. Excavated on site materials should not be reused as floor slab base course material. The floor slab base course should be placed directly on new compacted structural fill, on proof-rolled and compacted existing granular fill materials or suitable natural in-place glacial outwash deposits in accordance with the recommendations outlined herein.

The recommended vapor barrier should be placed below the slab to protect against capillary moisture impact to the concrete and limit the transmission of moisture into the floor slab. All vapor barrier joints should be glued or taped in accordance with the manufacturer's recommendations. Additionally, the vapor barrier should be similarly affixed to the sides of the footing, column or basement wall concrete in order to provide for a water/moisture tight barrier.

Prior to placement of new compacted structural fill, the in-situ subgrade soils should be assessed for proofrolling. This will allow the Engineer to evaluate for the presence of any soft or weaving unsuitable existing subgrade materials. Any such soft or weaving unsuitable existing subgrade materials should be locally over-excavated and replaced with new compacted structural fill.

As with footings, all existing topsoil and any other unsuitable materials should be completely removed from below all floor slabs and be replaced with compacted structural fill where necessary. Raise-in-grade structural fill required for below the floor slabs should consist of suitable non-plastic granular material generally meeting the requirements given in Section 6.5.1.

6.3 Subgrade Stabilization

Due to the moderately sensitive nature of the natural glacial outwash deposits; excessive snowmelt, precipitation, runoff, perched water, subgrade disturbance or other construction-phase conditions may result in areas of subgrade instability (i.e. weaving, pumping, etc.). No geotextile or crushed gravel replacement materials should be placed over unstable subgrade surfaces. Should an area of unstable subgrade be encountered, the area should either:

a. Be locally over-excavated as necessary and replaced with a layer woven geotextile stabilization fabric and crushed gravel; or

b. Be locally over-excavated as necessary and a minimum 4 inch thick lean concrete mud mat placed; or

c. Be allowed to dry and be re-proofrolled.

The need for excavation and replacement of unstable subgrade soils should be assessed by the Engineer.

6.4 Materials Reuse

It is anticipated that limited portions of the excavated existing on-site (non-organic containing) fill may potentially be suitable for reuse as new structural fill, provided that they meet the gradation requirements of Section 6.5.1 and/or are approved by the Engineer. The Contractor should consider additional efforts that will be required to screen out boulders and cobbles, and to reduce the moisture content of excessively wet excavated soils prior to placement and compaction.

Loam fill and in-place fill not able to be used in proposed landscape areas should be removed from the site. All potentially re-usable materials should be segregated and reused only following approval by the Engineer. All boulders, excessively silty material, organic and foreign debris should be removed from all material prior to approval for reuse.

6.5 Materials Placement & Compaction

6.5.1 Compacted Structural Fill

Compacted Structural Fill to be used for raise-in-grade fill, below footings and floor slabs (except for the floor slab base course material), should have a liquid limit and plastic limit not exceeding 40 and 15, respectively, and meeting the following gradation requirements:

STRUCTURAL FILL	
SIEVE SIZE	PERCENT FINER BY WEIGHT
4 inch	100
No. 4	50-85
No. 10	25-75
No. 40	10-50
No. 100	8-35
No. 200	4-10 (total)

6.5.2 Crushed Aggregate for Shoulders (NHDOT 304.33)

Crushed Aggregate to be used the recommended 9-inch-thick slab base course, for chimney drains behind retaining walls, should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and consist of crushed aggregate conforming to New Hampshire Department of Transportation (NHDOT) Item 304.33 (Crushed Aggregate for Shoulders), and meeting the following gradation requirements:

CRUSHED AGGREGATE (NHDOT Item 304.33)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
1 ½ inch	100
1 inch	90-100
No. 4	30-65
No. 200	0-10 (total)

6.5.3 Crushed Stone (3/4")

Crushed stone to be used for utility construction, subdrainage systems or for use as a stabilization material over wet and sensitive subgrades should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and should consist of hard durable sand and gravel conforming to the NHDOT #67 Stone as follows:

¾" CRUSHED STONE (NHDOT #67 Stone)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5

6.5.4 Crushed Stone Fine

Crushed stone (fine) to be used as sidewalk subbase material should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and consist of crushed aggregate conforming to New Hampshire Department of Transportation (NHDOT) Item 304. (Crushed Stone (Fine)), and meeting the following gradation requirements:

CRUSHED AGGREGATE (NHDOT Item 304.4)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
2 inch	100
1 ½ inch	85-100
¾ inch	45-75
No. 4	10-45
No. 200	0-5 (total)

6.5.5 Material Placement

All compacted structural fill, crushed gravel, and stone material should be placed in loose lifts not exceeding 12 inches in thickness, unless recommended elsewhere herein, and should be compacted to a minimum of 95% of maximum dry density per ASTM D 1557, Method C, with the moisture content no less than 3 percent below or 1 percent above the optimum moisture content as determined by ASTM D 1557.

Backfill within a zone defined by a 45 degree (1H: 1V) from vertical extending upward and outward from the bottom edge of frost walls should be placed in maximum 6-inch loose lifts and compacted using manually operated equipment to avoid damaging the frost walls.

6.5.6 Geotextile

Geotextile for use in subdrain construction or subgrade stabilization should consist nonwoven geotextile fabric such as Mirafi 140N or similar.

6.5.7 Vapor Barrier

Vapor Barrier material to be placed below the floor slab should consist of 15 mil Griffolyn Type-65G, Stego Wrap or a similar product, approved by the Engineer meeting the following requirements:

VAPOR BARRIER (ASTM E 1745: Class A)		
PROPERTY	**TEST METHOD**	**MIN. AVG. ROLL VALUE**
Water Vapor Permeance	ASTM E 96	0.037 grains/hr/ft^2/in
Tensile Strength	ASTM D 882	240 lbs
PPT Resistance	ASTM D 2582	51 lbs
Puncture Strength	ASTM D 4833	185 lbs
Drop Dart	ASTM D 1709	3,500 g
Weight	ASTM D 3776	76 lbs/1,000 ft^2

6.6 Proofrolling

Prior to placement of new raise in grade materials over existing subgrade surfaces to be potentially left in-place should be assessed by proofrolling. This will allow the Engineer to evaluate for the presence of any soft or weaving unsuitable existing subgrade materials. Any such soft or weaving unsuitable existing subgrade materials assessed by proofrolling should be locally over-excavated and replaced with new compacted structural fill.

Evaluation of the necessity for this proofrolling, and interpretation of the results to ascertain suitability of these subgrade materials for support of new compacted structural fill should be made by the Engineer during construction. Proofrolling should be performed with at least 4 passes of a steel drum compactor weighing at least 10 tons, without the use of vibratory compaction.

After proofrolling operations have been completed to the satisfaction of the Engineer, the upper 12 inches of all subgrade soils, including exposed glacial, outwash deposits, to remain in place should be compacted to at least 95% of ASTM D 1557.

6.7 Freezing Conditions

During freezing conditions, additional care must be exercised during construction to prevent disturbance of the soil subgrades and to achieve the required degree of fill compaction. The subgrades and each lift of backfill should be compacted before the water in the subgrade or backfill can freeze.

Frozen material should not be placed as backfill, nor should backfill or foundations be placed on frozen soil. If, during construction, the top layer of soil becomes frozen, the frozen soil should be removed before backfill or foundations are placed on it. When the air temperature is below 32° F, the contractor should not be allowed to place fill or expose final subgrades unless special procedures, approved by a qualified Engineer, are used to prevent freezing. If foundations are built and left exposed during the winter season, precautions should be implemented to prevent damage due to frost heave.

6.8 Removal of Unsuitable Materials

All fill, topsoil, building remnants, abandoned utilities and any other deleterious materials within the proposed foundation bearing zones should be completely removed and disposed of in a legal manner off-site. However, to the extent practicable, all excess soil should remain on-site otherwise additional costs will be incurred for off-site disposal. All potentially reusable materials should be segregated and assessed by the engineer.

All resulting excavations should be backfilled with new structural fill and be compacted to a minimum of 95% of maximum dry density per ASTM D 1557. All suitable existing glacial material which becomes loose or disturbed as a result of earthwork operations should be re-compacted to a minimum 95% of maximum dry density per ASTM D 1557.

6.9 Deep Excavations

Deep excavations may be necessary for construction of the proposed attendant underground utilities. As an alternative to temporary slopes, vertical excavations can be temporarily shored. The Contractor or the Contractor's specialty subcontractor should be responsible for the design and adequacy of any temporary shoring in accordance with all applicable regulatory requirements. The Owner and Contractor should make themselves aware of and become familiar with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations.

The Contractor should be aware that slope height, slope inclination, and excavation depths, including utility trench excavations, should in no case exceed those specified in local, state or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, and all successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors may be liable for substantial penalties. MMI is providing this information solely as a service to the City of Nashua. Under no circumstances should the information provided herein be interpreted to mean that MMI is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

7.0 CONSTRUCTION MONITORING

It is recommended that MMI be retained to provide construction observation services, including observation and monitoring of all operations involving soil excavation, removal of unsuitable materials and overburden soils, assessment of existing in-situ soils as potentially may be considered to remain in place or be reused, and for inspection of subgrade surfaces/material to potentially remain below the proposed structures.

The purpose of these observations and testing is to verify that construction is being performed in accordance with the intent of the recommendations given in this report and to observe any changes in subsurface conditions which may warrant modification to the foundation systems recommended herein.

If MMI is not retained to provide full-time observation of earthwork during the construction-phase of this project, we cannot be held responsible if unforeseen conditions are not identified and addressed, or if conditions identified in this report are not addressed as we intended.

8.0 REVIEW OF FINAL PLANS

It is strongly recommended that once final site, grading and foundation plans have been developed, that the plans be reviewed by MMI in order to assess whether any of the recommendations outlined herein will require revision, or if additional explorations, subdrainage, or other recommendations are required based on proposed final grades and structural layouts. The recommendations provided herein shall not be considered valid unless MMI is provided the opportunity to review the final site, grading, and foundation plans.

TABLES

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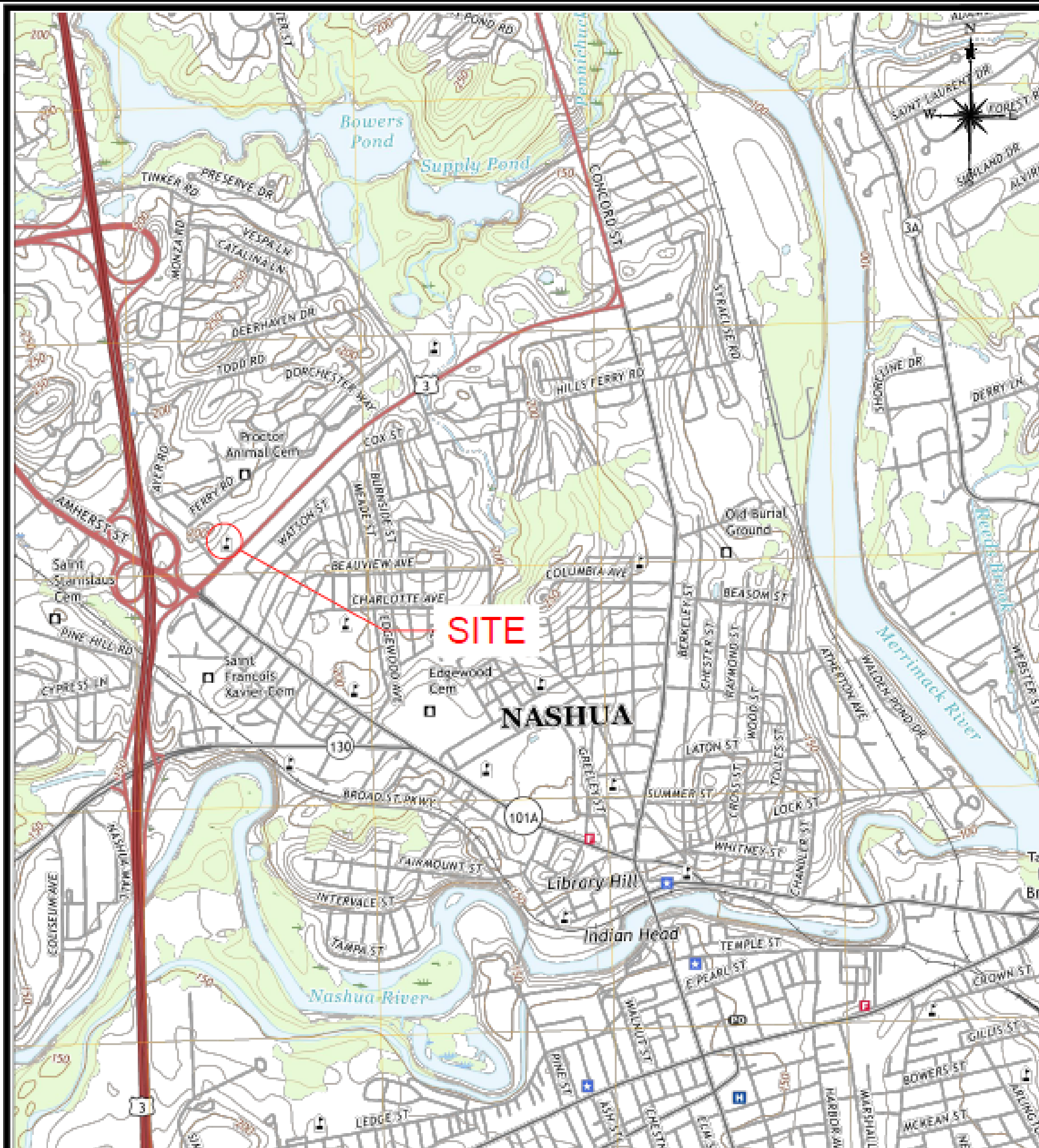
TABLE 1
SUMMARY OF SUBSURFACE EXPLORATIONS
PROPOSED PENNICHUCK MIDDLE SCHOOL ADDITION
207 MANCHETSTER ST, NASHUA, NEW HAMPSHIRE
PROJECT NO. 6119-03-01-1

EXPLORATION DESIGNATION	BOTTOM OF FILL	TOP OF OUTWASH DEPOSITS	TOP OF GLACIAL TILL DEPOSITS	BOTTOM OF EXPLORATION	OBSERVED GROUNDWATER LEVELS DURING DRILLING OPERATIONS
	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)
MMI-1	10.0 ±	10.0 ±	NE ±	22.0 ±	NE ±
MMI-2	3.0 ±	3.0 ±	18.0 ±	27.0 ±	24.0 ±
MMI-3	8.0 ±	8.0 ±	NE ±	27.0 ±	26.0 ±
MMI-4	1.5 ±	1.5 ±	NE ±	27.0 ±	19.0 ±
MMI-5	5.5 ±	5.5 ±	NE ±	27.0 ±	20.0 ±
TP-1	4.6 ±	NE ±	NE ±	4.6 ±	NE ±

Notes:
1) Test Borings were performed on April 26, 2019 by New England Boring Contractors of Derry, New Hampshire.
2) Test Pit was performed by TDD Earth Tech, Inc. of Hudson, New Hampshire
3) Groundwater levels were measured during exploration advancement and therefore are not indicative of stabilized groundwater conditions.
4) "NE" indicates not encountered.

B:\6119-03 City of Nashua Elm Street School\PMS\6119 Table 1.xlsx

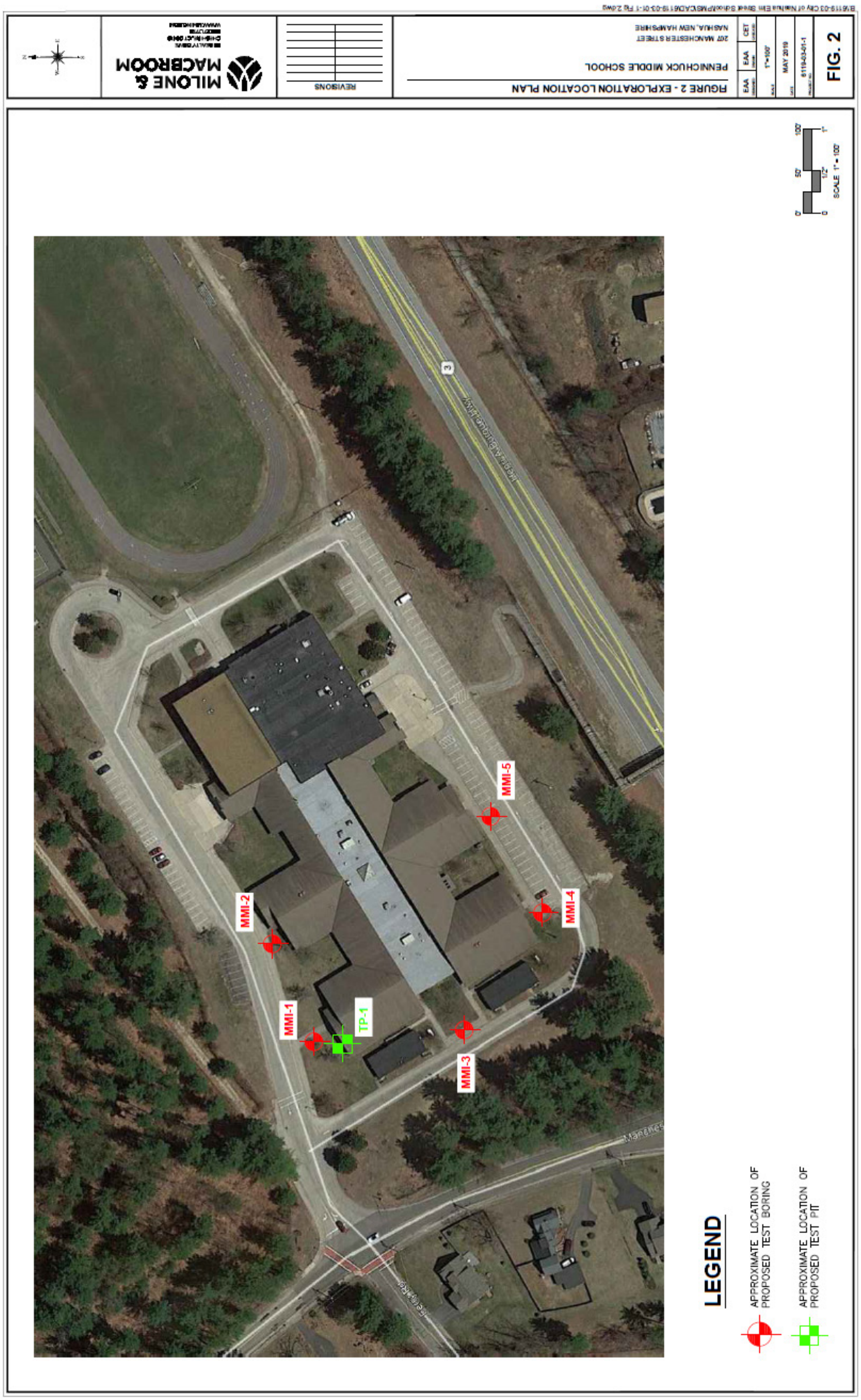
FIGURES

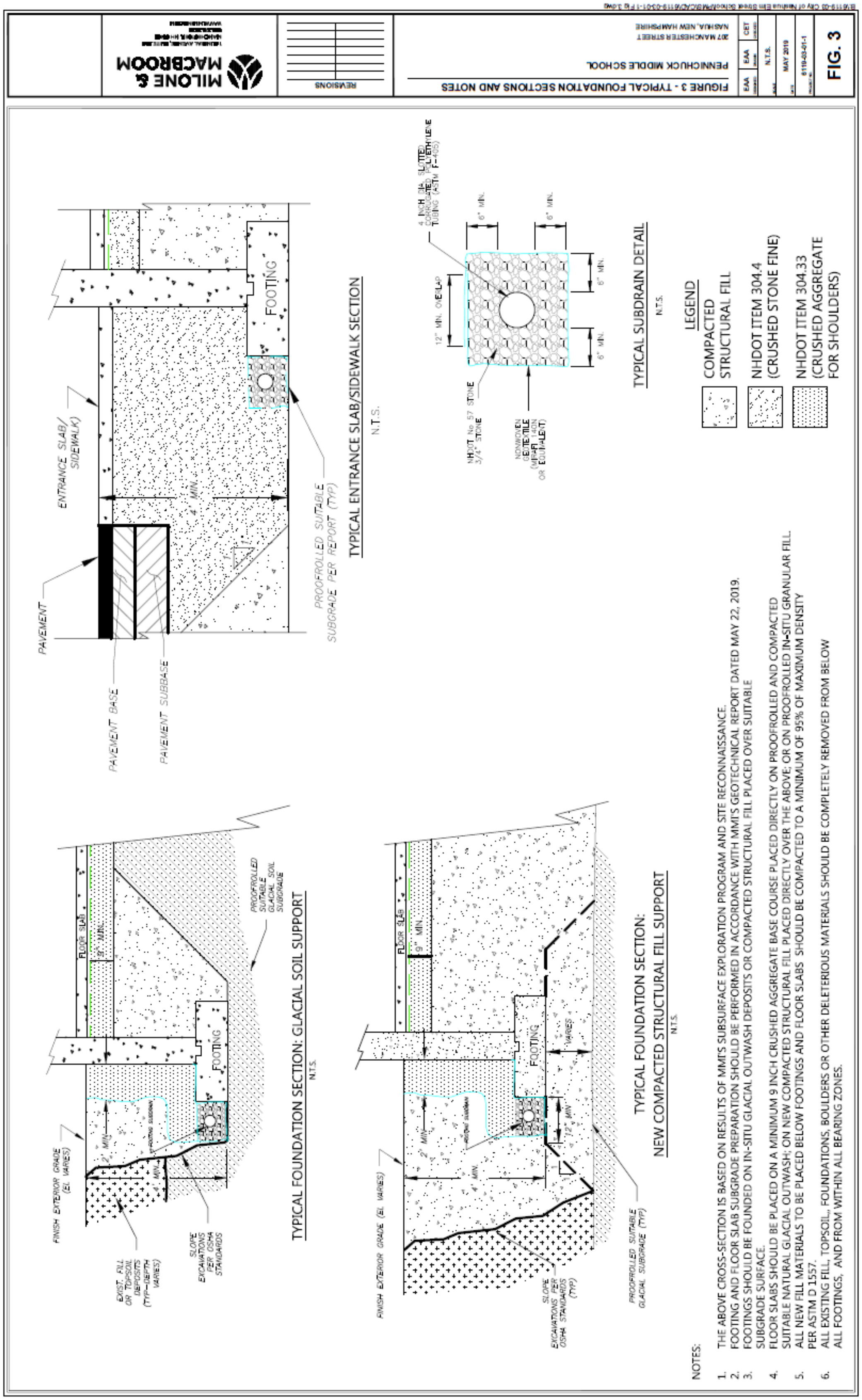


SOURCE: 2018 USGS NASHUA NORTH (NH), 7.5 MINUTE SERIES.

MILONE & MACBROOM	**FIGURE 1 - SITE LOCUS** PENNICHUCK MIDDLE SCHOOL 207 MANCHESTER STREET NASHUA, NEW HAMPSHIRE	DATE: MAY 2019 SCALE: 1" = ±2000' PROJ. NO. 6119-03-01-1 DESIGNED: EAA / DRAWN: EAA / CHECKED: CET DRAWING NAME: FIG. 1
	PROJECT PHASE: GEOTECHNICAL REV: —	

B:\6119-03 City of Nashua Elm Street School\PMS\CAD\6119-03-01-1 Fig 1.dwg


MILONE & MACBROOM
REVISIONS
FIGURE 2 - EXPLORATION LOCATION PLAN
PENNICHUCK MIDDLE SCHOOL
207 MANCHESTER STREET
NASHUA, NEW HAMPSHIRE
EAA
EAA
CET
1"=100'
MAY 2019
FIG. 2
SCALE 1" = 100'
MMI-1
MMI-2
MMI-3
MMI-4
MMI-5
TP-1
LEGEND
APPROXIMATE LOCATION OF PROPOSED TEST BORING
APPROXIMATE LOCATION OF PROPOSED TEST PIT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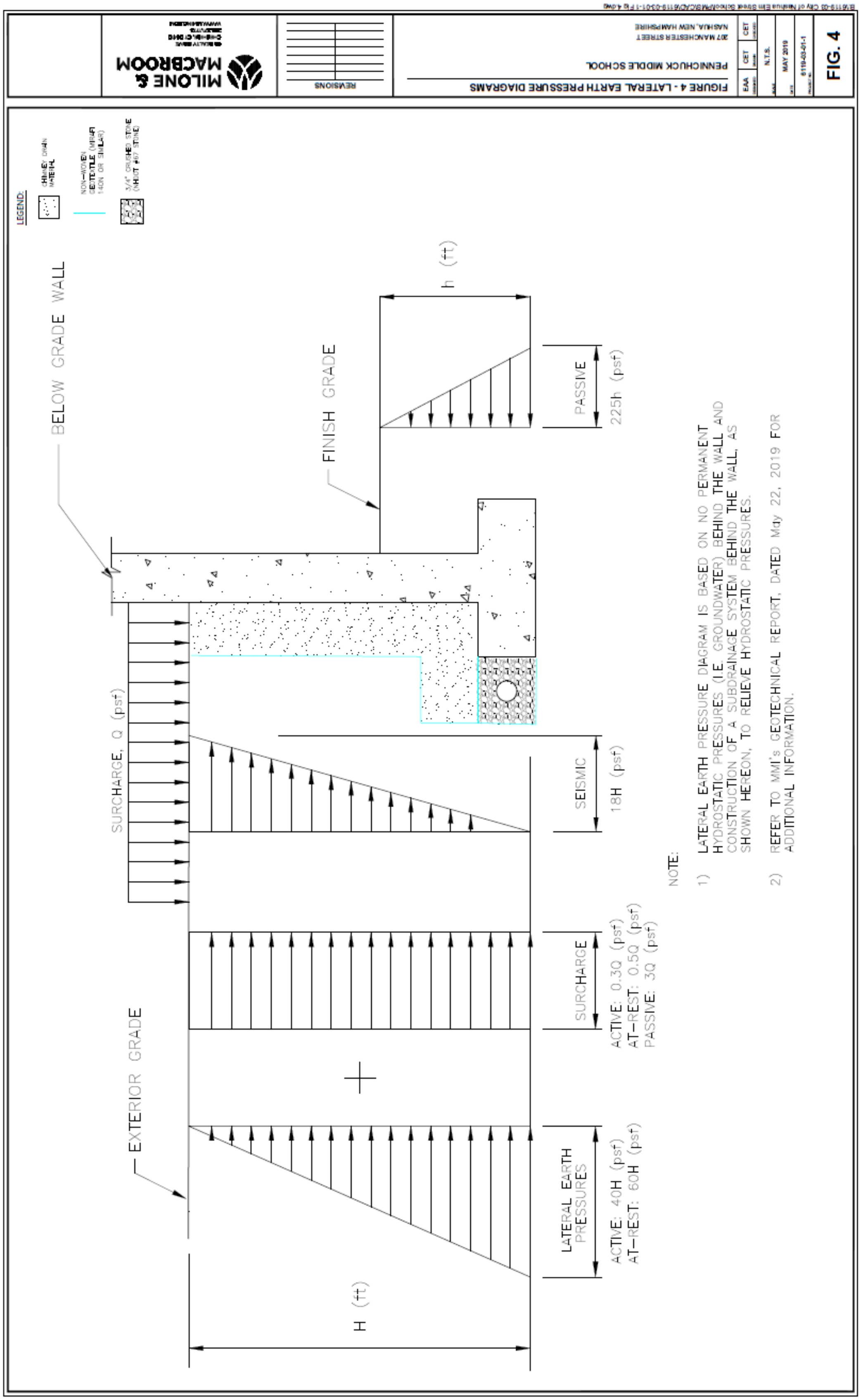
REVISIONS
FIGURE 3 - TYPICAL FOUNDATION SECTIONS AND NOTES
PENNICHUCK MIDDLE SCHOOL
207 MANCHESTER STREET
NASHUA, NEW HAMPSHIRE
EAA
EAA
CET
N.T.S.
MAY 2019
6119-03-01-1
FIG. 3
FINISH EXTERIOR GRADE (EL VARIES)
EXIST. FILL OR TOPSOIL DEPOSITS (TYP—DEPTH VARIES)
SLOPE EXCAVATIONS PER OSHA STANDARDS
FLOOR SLAB
9" MIN.
2' MIN.
4' MIN.
FOOTING
PROOFROLLED SUITABLE GLACIAL SOIL SUBGRADE
TYPICAL FOUNDATION SECTION: GLACIAL SOIL SUPPORT
N.T.S.
PAVEMENT
ENTRANCE SLAB/ SIDEWALK)
PAVEMENT BASE
PAVEMENT SUBBASE
4' MIN.
FOOTING
PROOFROLLED SUITABLE SUBGRADE PER REPORT (TYP)
TYPICAL ENTRANCE SLAB/SIDEWALK SECTION
N.T.S.
FINISH EXTERIOR GRADE (EL VARIES)
FLOOR SLAB
9" MIN.
2' MIN.
4' MIN.
FOOTING
12" MIN
VARIES
SLOPE EXCAVATIONS PER OSHA STANDARDS (TYP)
PROOFROLLED SUITABLE GLACIAL SUBGRADE (TYP)
TYPICAL FOUNDATION SECTION:
NEW COMPACTED STRUCTURAL FILL SUPPORT
N.T.S.
4 INCH DIA. SLOTTED CORRUGATED POLYETHYLENE TUBING (ASTM F-405)
12" MIN. OVERLAP
NHDOT No. 57 STONE 3/4" STONE
NONWOVEN GEOTEXTILE (MIRAFI 140N OR EQUIVALENT)
6" MIN.
6" MIN.
6" MIN.
6" MIN.
TYPICAL SUBDRAIN DETAIL
N.T.S.
LEGEND
COMPACTED STRUCTURAL FILL
NHDOT ITEM 304.4 (CRUSHED STONE FINE)
NHDOT ITEM 304.33 (CRUSHED AGGREGATE FOR SHOULDERS)
NOTES:
1. THE ABOVE CROSS-SECTION IS BASED ON RESULTS OF MMI'S SUBSURFACE EXPLORATION PROGRAM AND SITE RECONNAISSANCE.
2. FOOTING AND FLOOR SLAB SUBGRADE PREPARATION SHOULD BE PERFORMED IN ACCORDANCE WITH MMI'S GEOTECHNICAL REPORT DATED MAY 22, 2019.
3. FOOTINGS SHOULD BE FOUNDED ON IN-SITU GLACIAL OUTWASH DEPOSITS OR COMPACTED STRUCTURAL FILL PLACED OVER SUITABLE SUBGRADE SURFACE.
4. FLOOR SLABS SHOULD BE PLACED ON A MINIMUM 9 INCH CRUSHED AGGREGATE BASE COURSE PLACED DIRECTLY ON PROOFROLLED AND COMPACTED SUITABLE NATURAL GLACIAL OUTWASH; ON NEW COMPACTED STRUCTURAL FILL PLACED DIRECTLY OVER THE ABOVE; OR ON PROOFROLLED IN-SITU GRANULAR FILL.
5. ALL NEW FILL MATERIALS TO BE PLACED BELOW FOOTINGS AND FLOOR SLABS SHOULD BE COMPACTED TO A MINIMUM OF 95% OF MAXIMUM DENSITY PER ASTM D 1557.
6. ALL EXISTING FILL, TOPSOIL, FOUNDATIONS, BOULDERS OR OTHER DELETERIOUS MATERIALS SHOULD BE COMPLETELY REMOVED FROM BELOW ALL FOOTINGS, AND FROM WITHIN ALL BEARING ZONES.


MILONE & MACBROOM
REVISIONS
FIGURE 4 - LATERAL EARTH PRESSURE DIAGRAMS
PENNICHUCK MIDDLE SCHOOL
207 MANCHESTER STREET
NASHUA, NEW HAMPSHIRE
EAA
CET
CET
N.T.S.
MAY 2019
FIG. 4
LEGEND:
3/4" CRUSHED STONE (NHDOT #67 STONE)
BELOW GRADE WALL
FINISH GRADE
h (ft)
PASSIVE
225h (psf)
SURCHARGE, Q (psf)
SEISMIC
18H (psf)
EXTERIOR GRADE
SURCHARGE
ACTIVE: 0.3Q (psf)
AT-REST: 0.5Q (psf)
PASSIVE: 3Q (psf)
LATERAL EARTH PRESSURES
ACTIVE: 40H (psf)
AT-REST: 60H (psf)
H (ft)
NOTE:
1) LATERAL EARTH PRESSURE DIAGRAM IS BASED ON NO PERMANENT HYDROSTATIC PRESSURES (I.E. GROUNDWATER) BEHIND THE WALL AND CONSTRUCTION OF A SUBDRAINAGE SYSTEM BEHIND THE WALL, AS SHOWN HEREON, TO RELIEVE HYDROSTATIC PRESSURES.
2) REFER TO MMI's GEOTECHNICAL REPORT, DATED May 22, 2019 FOR ADDITIONAL INFORMATION.

APPENDIX A
Limitations

MILONE & MACBROOM

APPENDIX A

LIMITATIONS ON WORK PRODUCT

Site Observations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from limited subsurface observations. The nature and extent of subsurface variations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. 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 limited observations (no engineering subsurface samples were obtained; actual soil and bedrock transitions are probably more erratic.

3. Water level readings have been made under conditions stated. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of groundwater may occur due to variations in rainfall, temperature and other factors occurring since the time observations were made.

4. In the event that any changes in the proposed general project development are planned (e.g. floor slab on grade elevations, column and wall loads, building footprint size and location, etc.), 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 Milone & MacBroom, Inc. (MMI). It is recommended that this firm be provided the opportunity to review the final design plans and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented.

Construction

5. It is also recommended that this firm be provided the opportunity to perform the recommended construction phase monitoring services to verify that the intent of our recommendations is being properly implemented in the field during construction. The recommendations given in this report shall not be considered valid unless we are given the opportunity to perform in this capacity.

Topographic Data

6. Site topographic data was not available for our review during the performance of our current geotechnical engineering services.

Use of Report

7. This Geotechnical Engineering Report has been prepared for the exclusive use of the City of Nashua relative to the proposed addition(s) planned for the Pennichuck Middle School located in Nashua, New Hampshire and is intended to be in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied is made.

8. This Geotechnical Engineering Report has been prepared for this project by Milone & MacBroom, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it only with the authorization of the owner and then with the understanding that its scope is limited to design considerations only.

APPENDIX B

MMI Exploration Logs

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	**Proposed Middle School Addition**	**BORING NO.:**	**MMI-1** — **SHEET:** 1 of 1
LOCATION:	207 Manchester Street, Nashua, NH	**CONTRACTOR:**	New England Boring Contractors
PROJ. NO:	6119-03-01	**FOREMAN:**	M. Mattarozzo
CLIENT:	City of Nashua	**INSPECTOR:**	E. Adler
DATE:	April 26, 2019	**GROUND SURFACE ELEVATION:**	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	16	2	4" Loam Fill	0.3	
1			6 11 11	Medium dense brown coarse to fine SAND, little Gravel, trace Silt, no structure, no odor, moist.	**FILL**	
2						
3						
4						
5	S2	16	12 18 22 19	Dense grey-brown coarse to fine SAND, some Gravel, trace Silt, no structure, no odor, moist.	**FILL**	
6						
7						
8						
9					10	
10	S3	14	28 45 23 19	Very dense brown coarse to fine SAND, trace Gravel, trace Silt, layered, no odor, moist.	**OUTWASH**	
11						
12						
13						
14						
15	S4	16	10 16 15 11	Dense brown coarse to fine SAND, trace (+) Gravel, trace Silt, layered, no odor, moist.	**OUTWASH**	
16						
17						
18						
19						
20	S5	14	8 11 12 12	Medium dense brown coarse to fine SAND, trace Gravel, trace Silt, layered, moist.	**OUTWASH** 22	
21						
22				Bottom of Exploration at ± 22'		

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MI

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-2	SHEET:	1 of 2
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors		
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo		
CLIENT:	City of Nashua	INSPECTOR:	E. Adler		
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----		

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0			☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	25			☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	24			☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	13	1	4" Loam Fill	0.3	
1			5	Medium dense yellow-brown coarse to fine SAND, little Gravel,	FILL	
			8	trace Silt, no structure, no odor, moist.		
2			8			
				Auger action indicates strata change at ±3'	3	
3						
4						
5	S2	20	8	Medium dense tan medium to fine SAND, trace Silt, layered,	OUTWASH	
6			9	no odor, moist.		
			10			
7			10			
8						
9						
10	S3	18	2	Loose tan medium to fine SAND, trace Gravel, trace Silt, layered,	OUTWASH	
11			4	no odor, moist.		
			5			
12			4			
13						
14						
15	S4	18	2	medium dense tan medium to fine SAND, trace Gravel, trace	OUTWASH	
16			7	Silt, layered, no odor, moist		
			6			
17			4			
				Auger action indicates gravel or cobbles at ±18'	18	
18						
19						
20	S5	18	6	Dense brown coarse to fine SAND, little Gravel, trace Silt, no	TILL	
21			18	structure, no odor, moist.		
			28			
22			20			
				Auger action indicates cobbles from ±22' to ±24'		

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MM	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-2 — SHEET: 2 of 2
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0			☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	25			☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	24			☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			28 / 20	Dense brown coarse to fine SAND, little Gravel, trace Silt, no structure, no odor, moist.	TILL	
22					22	
23				Auger action indicates cobbles from ±22' to ±24'		
24					24	
25	S6	16	8 / 15 / 19 / 17	Dense brown coarse to fine SAND, some Gravel, trace (+) Silt, no structure, no odor, wet.	TILL	
26						
27				Bottom of Exploration at ± 27'	27	
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: i119-03 City of Nashua Elm Street School\PMS\J6119 TBLog.xls]MI	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	**BORING NO.:**	MMI-3 — **SHEET:** 1 of 2
LOCATION:	207 Manchester Street, Nashua, NH	**CONTRACTOR:**	New England Boring Contractors
PROJ. NO:	6119-03-01	**FOREMAN:**	M. Mattarozzo
CLIENT:	City of Nashua	**INSPECTOR:**	E. Adler
DATE:	April 26, 2019	**GROUND SURFACE ELEVATION:**	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL	GROUNDWATER OBSERVATIONS		
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0	☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	25	☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	26	☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED		☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
0–2	S1	14	2 8 14 11	3" Asphalt Medium dense brown coarse to fine SAND, little Gravel, trace Silt, no structure, no odor, moist.	0.3 **FILL**	
5–7	S2	3	8 24 27 10	Very dense brown coarse to fine SAND, little Gravel, trace Silt, no structure, no odor, moist.	**FILL**	
8				Auger action indicates strata change at ±8'	8	
10–12	S3	18	3 5 5 6	Medium dense brown coarse to fine SAND, trace (-) Gravel, trace Silt, layered, no odor, moist.	**OUTWASH**	
15–17	S4	19	3 4 4 10	Loose brown coarse to fine SAND, trace (-) Gravel, trace (+) Silt, layered, no odor, moist.	**OUTWASH**	
20–22	S5	18	5 5 7 6	Medium dense brown coarse to fine SAND, trace (-) Gravel, trace Silt, redoximorphic staining to ±20.5', trending to grey fine SAND, some Silt, layered no odor, moist.	**OUTWASH**	

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MI

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-3 — SHEET: 2 of 2
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0		
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	25		
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	26		
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED			

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			7	Medium dense brown coarse to fine SAND, trace (-) Gravel, trace Silt, redoximorphic staining to ±20.5', trending to grey fine SAND, some Silt, layered no odor, moist.	OUTWASH	
22			6			
23						
24						
25	S6	16	1	Loose grey brown fine SAND, little Silt, layered with redoximorphic staining within fine sand layers, no odor, wet.	OUTWASH	
26			4			
			4			
			6		27	
27				Bottom of Exploration at ± 27'		
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MM

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-4 — SHEET: 1 of 1
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	20			☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	19			☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	7		4" Asphalt	0.3	
1			5	Very dense brown coarse to fine SAND and Gravel, trace Silt,	**FILL**	
			56	no structure, no odor, moist.	1.5	
2			50/0"	Auger action indicates cobble at 1.5'		
3						
4						
5	S2	18	5	Medium dense light brown fine SAND, trace (+) Silt, faint	**OUTWASH**	
6			6	redoximorphic mottling from ±5' to ±6', layered, no odor, moist.		
			7			
7			5			
8						
9						
10	S3	17	3	Loose fine SAND, trace (-) Silt, layered, no odor, dry.	**OUTWASH**	
11			4			
			5			
12			4			
13						
14						
15	S4	16	3	Medium dense grey-brown fine SAND, little Silt, redoximorphic	**OUTWASH**	
16			6	layers, no odor, wet.		
			4			
17			4			
18						
19						
20	S5	14	3	Loose grey-brown fine SAND, little (-) Silt, layered, no odor,	**OUTWASH**	
21			3	wet.		
			4			
22			5			

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MI

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-4 — SHEET: 2 of 2
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS		
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0	☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	20	☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	19	☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED		☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S5	14	4 5	Loose grey-brown fine SAND, little (-) Silt, layered, no odor, wet.	OUTWASH	
22						
23						
24						
25	S6	23	2 4 6 5	Medium dense grey-brown fine SAND, little (-) Silt, layered, no odor, wet.	OUTWASH	
26						
27				Bottom of Exploration at ± 27'	27	
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\J6119 TBLog.xls]MI

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 - 15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.: MMI-5	SHEET: 1 of 1
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0			☐ FIELD TESTING
SIZE ID (IN)	2 1/4	--	1 3/8	--	CASING AT (FT)	25			☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	20			☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	12	1	2" Asphalt	0.2	
1			9	Medium dense brown coarse to fine SAND, little Gravel, trace	**FILL**	
			12	Silt, well blended, no odor, moist.		
2			10			
3						
4						
5	S2	12	16	Medium dense, Similar to above.	5.5	
6			23	Dense brown fine SAND, trace (+) Silt, layered, no odor, moist.	**OUTWASH**	
			11			
7			14			
8						
9						
10	S3	18	2	Medium dense brown fine SAND, trace (+) Silt, layered, no	**OUTWASH**	
11			5	odor, moist to dry.		
			6			
12			7			
13						
14						
15	S4	19	4	Medium dense grey-brown coarse to fine SAND, trace (-) Silt,	**OUTWASH**	
16			4	layered, with redoximorphic features, no odor, dry.		
			7			
17			11			
18						
19						
20	S5	17	2	Medium dense grey medium to fine SAND, trace Silt, layered,	**OUTWASH**	
21			4	redoximorphic features, no odor, wet.		
			6			
22			6			

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: i119-03 City of Nashua Elm Street School\PMS\[6119 TBLog.xls]MM	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	Proposed Middle School Addition	BORING NO.:	MMI-5 — SHEET: 2 of 2
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-01	FOREMAN:	M. Mattarozzo
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.
TYPE	HSA	--	S	--
SIZE ID (IN)	2 1/4	--	1 3/8	--
HAMMER WT (LB)	--	--	140	--
HAMMER FALL (IN)	--	--	30	--

GROUNDWATER OBSERVATIONS			
ELAPSED TIME (HR)	0		
CASING AT (FT)	25		
DEPTH (FT)	20		
☐ NO GROUNDWATER ENCOUNTERED			

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING
☐

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S5	17	7 11	Medium dense grey medium to fine SAND, trace Silt, layered, redoximorphic features, no odor, wet.	OUTWASH	
22						
23						
24						
25	S6	23	2 4	Medium dense olive brown fine SAND, trace Silt, layered, no odor, wet.	OUTWASH	
26			6 6		27	
27				Bottom of Exploration at ± 27'		
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:
1) TYPE OF RIG: Mobile Drill B-47, Truck Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: i119-03 City of Nashua Elm Street School\PMS\6119 TBLog.xls]MM

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST PIT LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
(603) 668-1654

PROJECT:	Proposed Middle School Addition	TEST PIT NO.: TP-1	SHEET: 1 of 1
LOCATION:	207 Manchester Street, Nashua, NH	CONTRACTOR:	TDD Earth Tech, Inc
PROJ. NO:	6119-03-01	FOREMAN:	J. Ayer
CLIENT:	City of Nashua	INSPECTOR:	E. Adler
DATE:	May 7, 2019	GROUND SURFACE ELEVATION:	----

EQUIPMENT		TEST PIT DIMENSIONS (FT)		GROUNDWATER OBSERVATIONS	OTHER
TYPE	Excavator				☐ FIELD TESTING
MAKE/MODEL	CAT304	LENGTH	5	ELAPSED TIME (HR)	☐ LABORATORY TESTING
REACH (FT)	12	WIDTH	2	DEPTH (FT)	☐ PID SCREENING
CAPACITY (CY)	0.2	DEPTH	4.6	☒ NO GROUNDWATER ENCOUNTERED	☐

Depth (FT)	EXCAVATION EFFORT	BOULDER COUNT (QTY/CLASS)	REMARK NUMBER	STRATUM SYMBOL	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
					3" Loam Fill		
1	E				Brown coarse to fine SAND, little Gravel, trace cobbles, trace (-) boulders, trace Silt, no structure, no odor, moist. (43"; 5"; 12")	FILL	
2							
3	E						
4							
5					Bottom of Exploration at ± 4.6'		
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Remarks:

BOULDER DESIGNATION		EXCAVATION EFFORT	PROPORTIONS
SIZE (IN)	DESIGNATION		
6 to 18	A	E = EASY	trace = 0% to 10%
18 to 36	B	M = MODERATE	little = 10% to 20%
36+	C	D = DIFFICULT	some = 20% to 35%
			and = 35 to 50%

MILONE & MACBROOM

BURMISTER SOIL CLASSIFICATION SYSTEM

A. CLASSIFICATION OF SOIL COMPONENTS

PRINCIPAL COMPONENT	DESCRIPTIVE PARTICLE SIZE	SMALLEST DIAMETER OF ROLLED THREAD (IN.)	SIEVE SIZE	OVERALL PLASTICITY AND PLASTICITY INDEX
GRAVEL	Coarse Fine	---- ----	3/4" to 3" No. 4 to 3/4"	---- ----
SAND	Coarse Medium Fine	---- ---- ----	No. 10 to No. 4 No. 40 to No. 10 No. 200 to No. 40	---- ---- ----
SILT	----	----	Passing No. 200	Non-Plastic 0
Clayey Silt	----	1/4	Passing No. 200	Slight 1 to 5
SILT and CLAY	----	1/8	Passing No. 200	Low 5 to 10
CLAY and SILT	----	1/16	Passing No. 200	Medium 10 to 20
Silty Clay	----	1/32	Passing No. 200	High 20 to 40
CLAY	----	1/64	Passing No. 200	Very High 40 and greater
PEAT	Partially decomposed fibrous organic matter without living fibers			

B. INDENTIFICATION OF DESCRIPTION TERMS

DESCRIPTION OF SOIL COMPONENTS	PERCENTAGE OF SAMPLE BY WEIGHT
PRINCIPAL COMPONENT	
GRAVEL, SAND, SILT CLAY, etc.	50 or more
MINOR COMPONENTS	
and fine to coarse SAND, and GRAVEL etc.	35 to 50
some some Gravel, some Silt etc.	20 to 35
little little Gravel, little Silt, etc.	10 to 20
trace trace Gravel, trace Silt etc.	1 to 10

C. DEFINITION OF TERMS IDENTIFYING THE GRADATION OF THE GRANULAR COMPONENT

GRADATION DESIGNATIONS FOR IDENTIFICATION	DEFINING PROPORTIONS
fine to coarse	all fractions greater than 10 percent
medium to coarse	less than 10 percent fine
fine to medium	less than 10 percent coarse
medium	less than 10 percent coarse and fine
fine	less than 10 percent coarse and medium

D. DENSITY OR CONSISTENCY

GRANULAR SOILS

Standard Penetration Resistance (N value) blows/foot	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
50+	Very dense

PLASTIC SOILS

Standard Penetration Resistance (N value) Blows/foot	Consistency
0 - 2	Very soft
2 - 4	Soft
4 - 8	Medium
8 - 15	Stiff
15 - 30	Very stiff
30+	Hard

E. GLOSSARY OF MISCELLANEOUS TERMS

PLUS (+) NEARER THE UPPER LIMIT OF THE PROPORTION OR OVERALL PLASTICITY
MINUS (-) NEARER THE LOWER LIMIT OF THE PROPORTION OR OVERALL PLASTICITY
NO SIGN - MIDDLE RANGE OF THE PROPORTION OR OVERALL PLASTICITY
COBBLES - ROUNDED PIECES OR ROCK BETWEEN 3 TO 6 INCHES
BOULDERS - ROUNDED PIECES OF ROCK LARGER THAN 6 INCHES
ROCK FRAGMENTS - ANGULAR PIECES OF ROCK WHICH HAVE SEPARATED FROM PARENT ROCK AND ARE PRESENT IN A SOIL MATRIX
QUARTZ - A HARD SILICA MINERAL OFTEN FOUND IN SOME GLACIAL LAYERS
IRONITE - CEMENTED DEPOSITS OF IRON OXIDE WITHIN A SOIL LAYER
CEMENTED SAND - VARIOUS SIZED AND GRAINS CEMENTED BY CALCIUM CARBONATE OR OTHER MINERALS WITHIN THE SOIL DEPOSIT
VARVED DEPOSITS - ALTERNATING LIGHT AND DARK LAYERS OF COHESIVE CLAYS AND SILTS DEPOSITED AS GLACIAL LAKE SEDIMENTATION
FISSURED CLAYS - COHESIVE SOILS AND EXHIBITING A JOINT STRUCTURE. GENERALLY SLIGHTLY TO HIGHLY OVER CONSOLIDATED

ORGANIC MATTER (EXCLUDING PEAT):
TOPSOIL - SURFICIAL SOILS THAT SUPPORT PLANT LIFE AND WHICH CONTAIN CONSIDERABLE AMOUNTS OF ORGANIC MATTER
DECOMPOSED VEGETATION - PARTIALLY DECOMPOSED ORGANIC MATTER WHICH RETAINS ITS ORIGIANAL CHARACTER;
LIGNITE - IMMATURE COALS WITH LOW FIXED CARBON CONTENT GENERALLY EXHIBITING DISTINCT TEXTURE OF WOOD;
HUMUS - COMPLETELY DECOMPOSED ORGANICMATTER
FILL - MAN MADE DEPOSIT CONTAINING SOIL, ROCK OR FOREIGN MATTER
PROBABLE FILL - SOILS WHICH CONTAIN NO VISUALLY DETECTABLE FOREIGN MATTER BUT WHICH ARE SUSPECT WITH RESPECT TO ORIGIN
LENSES - LAYER LESS THAN 1/2 INCH LAYERS - 1/2 TO 12 INCH THICK LAYER
POCKET - DISCONTINUOUS LAYERS LESS THAN 12 INCHES
STRATUM - CONTINUOUS LAYERS GREATER THAN 12 INCHES
COLOR SHADING - LIGHT OR DARD TO INIDCATE SUBSTANTIAL DIFFERENCE IN COLOR
MOISTURE CONDITIONS - WET, MOIST, OR DRY PER VISUAL OBSERVATION

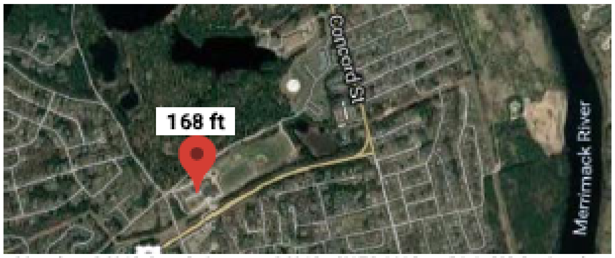
APPENDIX C

Liquefaction Analysis

ATC Hazards by Location

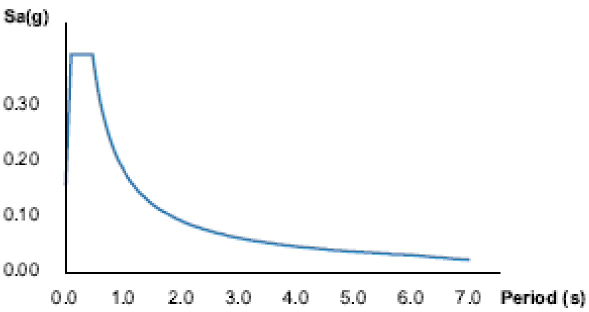
Search Information

Address:	207 Manchester St, Nashua, NH 03064, USA
Coordinates:	42.7850675, -71.47798560000001
Elevation:	168 ft
Timestamp:	2019-05-17T18:40:43.213Z
Hazard Type:	Seismic
Reference Document:	IBC-2012
Risk Category:	II
Site Class:	D

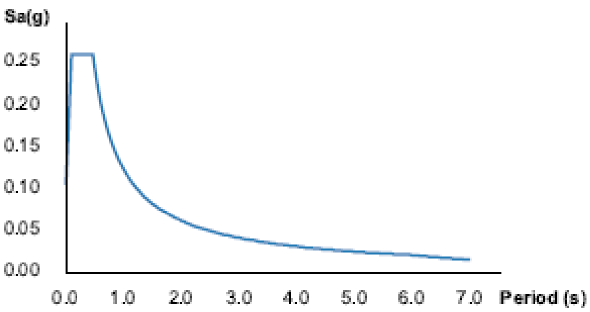


Map data ©2019 Google Imagery ©2019 , CNES / Airbus, DigitalGlobe, Landsat / Copernicus, MassGIS, Commonwealth of Massachusetts EOEA, USDA Farm
Report a map error

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.243	MCE_R ground motion (period=0.2s)
S_1	0.076	MCE_R ground motion (period=1.0s)
S_{MS}	0.389	Site-modified spectral acceleration value
S_{M1}	0.183	Site-modified spectral acceleration value
S_{DS}	0.259	Numeric seismic design value at 0.2s SA
S_{D1}	0.122	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s

CR_S	0.891	Coefficient of risk (0.2s)
CR_1	0.898	Coefficient of risk (1.0s)
PGA	0.133	MCE_G peak ground acceleration
F_{PGA}	1.534	Site amplification factor at PGA
PGA_M	0.204	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	0.243	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.273	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.076	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.085	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.6	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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MILONE & MACBROOM

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www.mminc.com

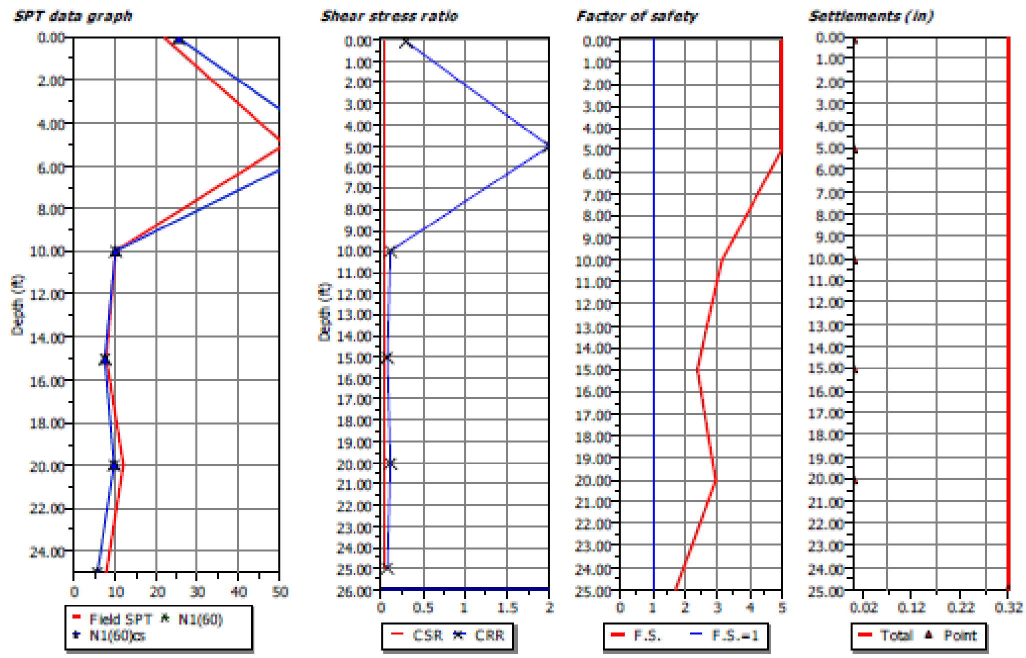
LIQUEFACTION ANALYSIS REPORT

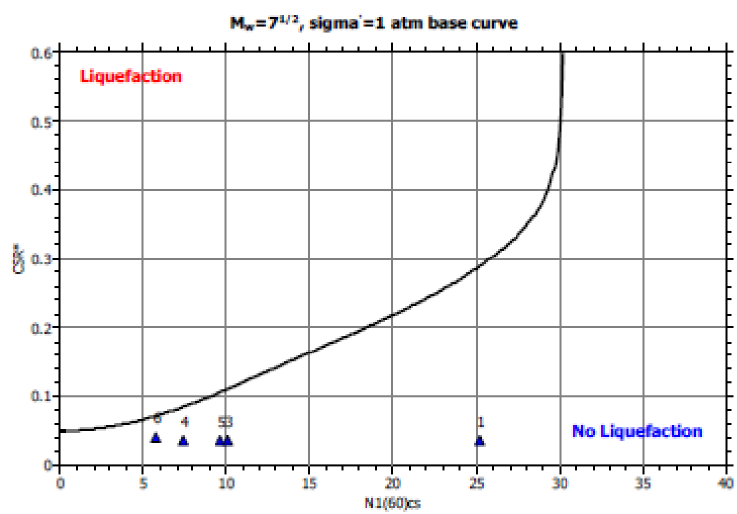
Project title : Proposed Pennichuck Middle Schoo lAddition

Project subtitle : MMI-3

Input parameters and analysis data

In-situ data type:	Standard Penetration Test	Depth to water table:	26.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	5.97
Analysis method:	NCEER 1998	Peak ground accelaration:	0.10 g
Fines correction method:	Idriss & Seed	User defined F.S.:	1.00





:: Field input data ::

Point ID	Depth (ft)	Field N_{SPT} (blows/feet)	Unit weight (pcf)	Fines content (%)
1	0.10	22.00	125.00	5.00
2	5.00	51.00	120.00	5.00
3	10.00	10.00	120.00	5.00
4	15.00	8.00	120.00	0.00
5	20.00	12.00	120.00	5.00
6	25.00	8.00	120.00	5.00

Depth : Depth from free surface, at which SPT was performed (ft)
Field SPT : SPT blows measured at field (blows/feet)
Unit weight : Bulk unit weight of soil at test depth (pcf)
Fines content : Percentage of fines in soil (%)

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Point ID	Depth (ft)	Sigma (tsf)	u (tsf)	Sigma' (tsf)	r_d	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*
1	0.10	0.01	0.00	0.01	1.00	0.06	1.79	0.04	1.00	0.04
2	5.00	0.30	0.00	0.30	0.99	0.06	1.79	0.04	1.00	0.04
3	10.00	0.60	0.00	0.60	0.98	0.06	1.79	0.04	1.00	0.04
4	15.00	0.90	0.00	0.90	0.97	0.06	1.79	0.03	1.00	0.03
5	20.00	1.20	0.00	1.20	0.95	0.06	1.79	0.03	0.97	0.04
6	25.00	1.50	0.16	1.34	0.94	0.07	1.79	0.04	0.93	0.04

Depth : Depth from free surface, at which SPT was performed (ft)
Sigma : Total overburden pressure at test point, during earthquake (tsf)
u : Water pressure at test point, during earthquake (tsf)
Sigma' : Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
CSR : Cyclic Stress Ratio
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$ CSR adjusted for M=7.5
K_{sigma} Effective overburden stress factor
CSR^* CSR fully adjusted

:: Cyclic Resistance Ratio calculation $CRR_{7.5}$ ::

Point ID	Field SPT	C_N	C_E	C_B	C_R	C_S	$N_{1(60)}$	DeltaN	$N_{1(60)cs}$	$CRR_{7.5}$
1	22.00	1.70	0.90	1.00	0.75	1.00	25.25	0.00	25.25	0.29
2	51.00	1.70	0.90	1.00	0.80	1.00	62.42	0.00	62.42	2.00
3	10.00	1.32	0.90	1.00	0.85	1.00	10.09	0.00	10.09	0.11
4	8.00	1.08	0.90	1.00	0.95	1.00	7.37	0.00	7.37	0.08
5	12.00	0.93	0.90	1.00	0.95	1.00	9.57	0.00	9.57	0.11
6	8.00	0.83	0.90	1.00	0.95	1.00	5.71	0.00	5.71	0.07

C_N : Overburden corretion factor
C_E : Energy correction factor
C_B : Borehole diameter correction factor
C_R : Rod length correction factor
C_S : Liner correction factor
$N_{1(60)}$: Corrected N_{SPT}
DeltaN : Addition to corrected N_{SPT} value due to the presence of fines
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines
$CRR_{7.5)}$: Cyclic resistance ratio for M=7.5

:: Settlements calculation for saturated sands ::

Point ID	$N_{1(60)}$	N_1	FS_L	e_v (%)	Settle. (in)
1	25.25	21.04	5.00	0.00	0.00
2	62.42	52.02	5.00	0.00	0.00
3	10.09	8.41	3.12	0.00	0.00
4	7.37	6.14	2.40	0.00	0.00
5	9.57	7.97	2.96	0.00	0.00

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:: Settlements calculation for saturated sands ::

Point ID	$N_{1(60)}$	N_1	FS_L	e_v (%)	Settle. (in)
6	5.71	4.76	1.73	0.07	0.32

Total settlement : 0.32

$N_{1,(60)}$: Stress normalized and corrected SPT blow count
N_1: Japanese equivalent corrected value
FS_L: Calculated factor of safety
e_v: Post-liquefaction volumentric strain (%)
Settle.: Calculated settlement (in)

:: Liquefaction potential according to Iwasaki ::

Point ID	F	w_z	I_L
1	0.00	9.98	0.00
2	0.00	9.24	0.00
3	0.00	8.48	0.00
4	0.00	7.71	0.00
5	0.00	6.95	0.00
6	0.00	6.19	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

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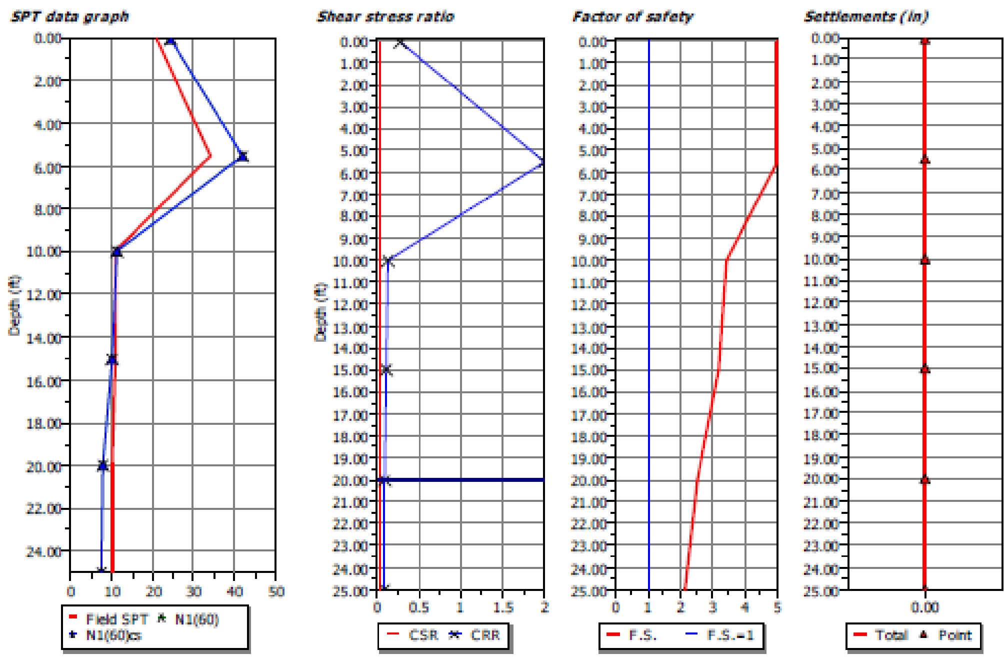
LIQUEFACTION ANALYSIS REPORT

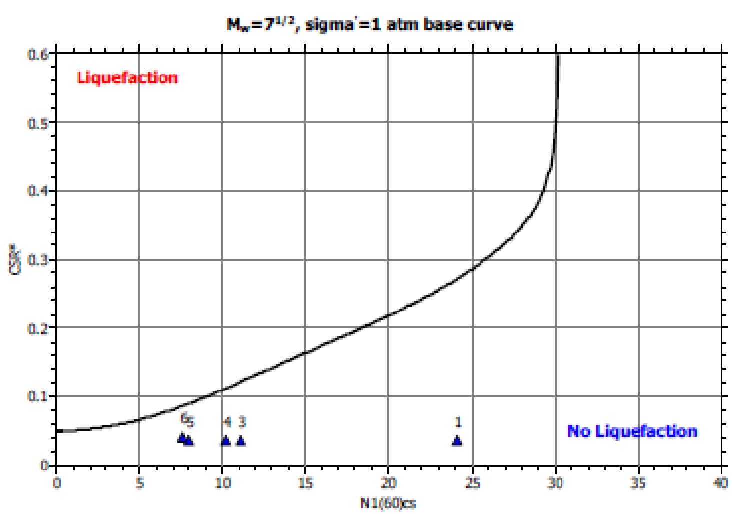
Project title : Proposed Pennichuck Middle Schoo lAddition

Project subtitle : MMI-5

Input parameters and analysis data

In-situ data type:	Standard Penetration Test	Depth to water table:	20.00 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	5.97
Analysis method:	NCEER 1998	Peak ground accelaration:	0.10 g
Fines correction method:	Idriss & Seed	User defined F.S.:	1.00





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:: Field input data ::

Point ID	Depth (ft)	Field N_{SPT} (blows/feet)	Unit weight (pcf)	Fines content (%)
1	0.10	21.00	125.00	5.00
2	5.50	34.00	120.00	5.00
3	10.00	11.00	120.00	5.00
4	15.00	11.00	120.00	0.00
5	20.00	10.00	120.00	5.00
6	25.00	10.00	120.00	5.00

Depth : Depth from free surface, at which SPT was performed (ft)
Field SPT : SPT blows measured at field (blows/feet)
Unit weight : Bulk unit weight of soil at test depth (pcf)
Fines content : Percentage of fines in soil (%)

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Point ID	Depth (ft)	Sigma (tsf)	u (tsf)	Sigma' (tsf)	r_d	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*
1	0.10	0.01	0.00	0.01	1.00	0.06	1.79	0.04	1.00	0.04
2	5.50	0.33	0.00	0.33	0.99	0.06	1.79	0.04	1.00	0.04
3	10.00	0.60	0.00	0.60	0.98	0.06	1.79	0.04	1.00	0.04
4	15.00	0.90	0.00	0.90	0.97	0.06	1.79	0.03	1.00	0.03
5	20.00	1.20	0.00	1.20	0.95	0.06	1.79	0.03	0.97	0.04
6	25.00	1.50	0.16	1.34	0.94	0.07	1.79	0.04	0.95	0.04

Depth : Depth from free surface, at which SPT was performed (ft)
Sigma : Total overburden pressure at test point, during earthquake (tsf)
u : Water pressure at test point, during earthquake (tsf)
Sigma' : Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
CSR : Cyclic Stress Ratio
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$ CSR adjusted for M=7.5
K_{sigma} Effective overburden stress factor
CSR^* CSR fully adjusted

:: Cyclic Resistance Ratio calculation $CRR_{7.5}$ ::

Point ID	Field SPT	C_n	C_e	C_b	C_r	C_s	$N_{1(60)}$	DeltaN	$N_{1(60)cs}$	$CRR_{7.5}$
1	21.00	1.70	0.90	1.00	0.75	1.00	24.10	0.00	24.10	0.27
2	34.00	1.70	0.90	1.00	0.80	1.00	41.62	0.00	41.62	2.00
3	11.00	1.32	0.90	1.00	0.85	1.00	11.10	0.00	11.10	0.12
4	11.00	1.08	0.90	1.00	0.95	1.00	10.13	0.00	10.13	0.11
5	10.00	0.93	0.90	1.00	0.95	1.00	7.97	0.00	7.97	0.09
6	10.00	0.88	0.90	1.00	0.95	1.00	7.54	0.00	7.54	0.09

C_n : Overburden corretion factor
C_e : Energy correction factor
C_b : Borehole diameter correction factor
C_r : Rod length correction factor
C_s : Liner correction factor
$N_{1(60)}$: Corrected N_{SPT}
DeltaN : Addition to corrected N_{SPT} value due to the presence of fines
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines
$CRR_{7.5}$: Cyclic resistance ratio for M=7.5

:: Settlements calculation for saturated sands ::

Point ID	$N_{1(60)}$	N_1	FS_L	e_v (%)	Settle. (in)
1	24.10	20.08	5.00	0.00	0.00
2	41.62	34.68	5.00	0.00	0.00
3	11.10	9.25	3.43	0.00	0.00
4	10.13	8.44	3.17	0.00	0.00
5	7.97	6.65	2.52	0.00	0.00

LiqIT v.4.7.7.5 - Soil Liquefaction Assesment Software 2

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:: Settlements calculation for saturated sands ::

Point ID	$N_{1(60)}$	N_1	FS_L	e_v (%)	Settle. (in)
6	7.54	6.28	2.13	0.00	0.00

Total settlement : 0.00

$N_{1,(60)}$: Stress normalized and corrected SPT blow count
N_1: Japanese equivalent corrected value
FS_L: Calculated factor of safety
e_v: Post-liquefaction volumentric strain (%)
Settle.: Calculated settlement (in)

:: Liquefaction potential according to Iwasaki ::

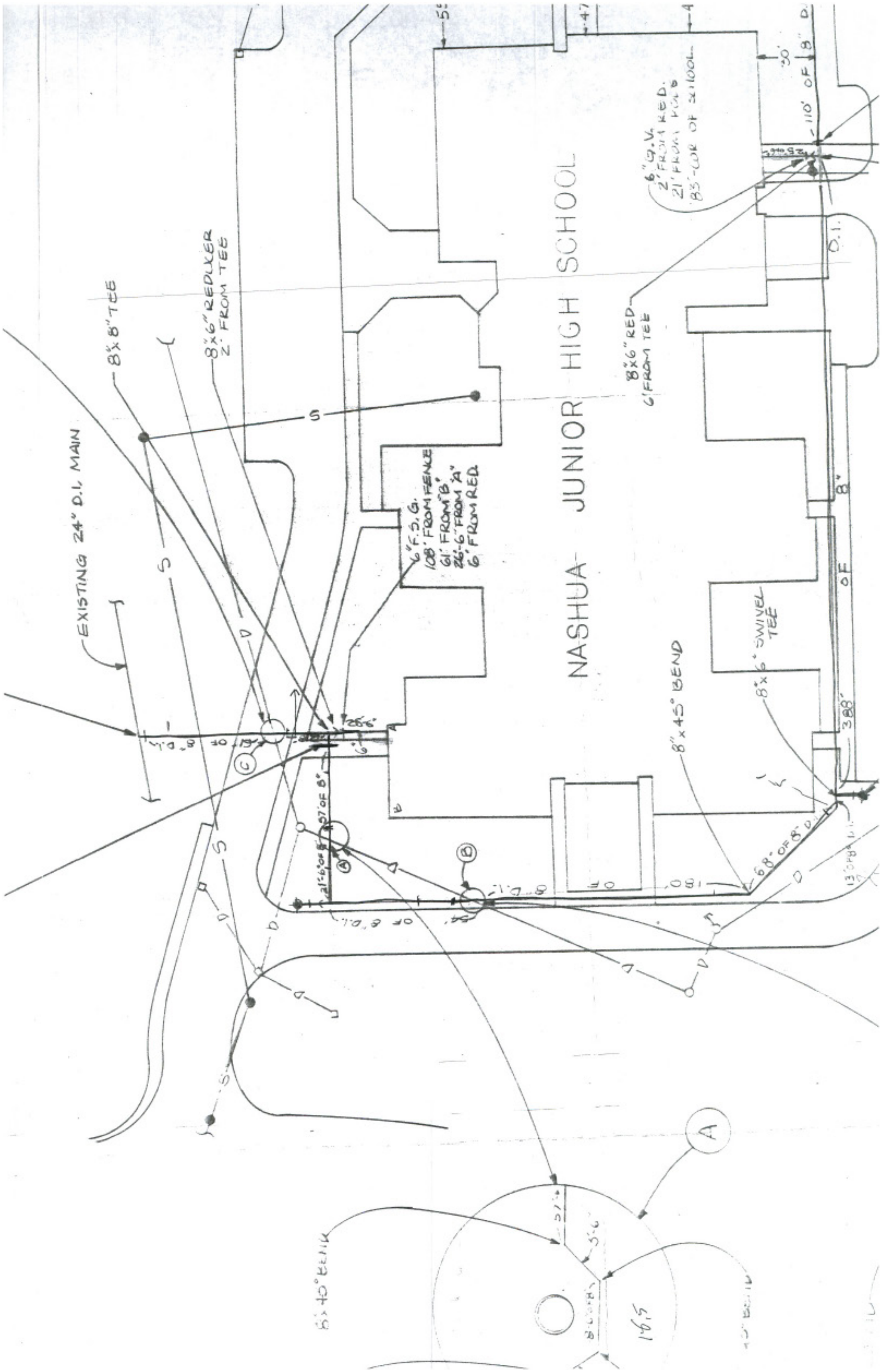
Point ID	F	w_z	I_L
1	0.00	9.98	0.00
2	0.00	9.16	0.00
3	0.00	8.48	0.00
4	0.00	7.71	0.00
5	0.00	6.95	0.00
6	0.00	6.19	0.00

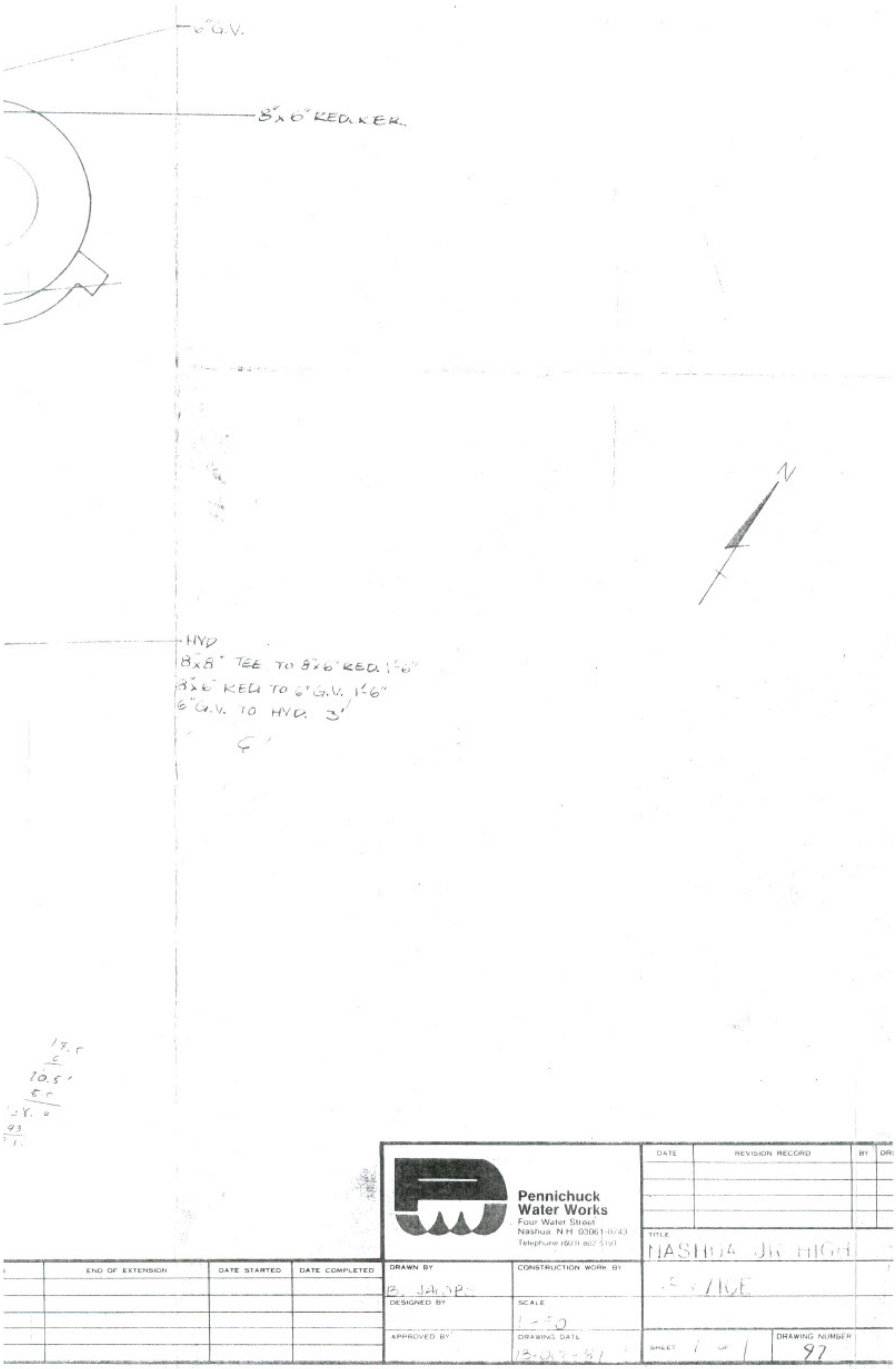
Overall potential I_L : 0.00

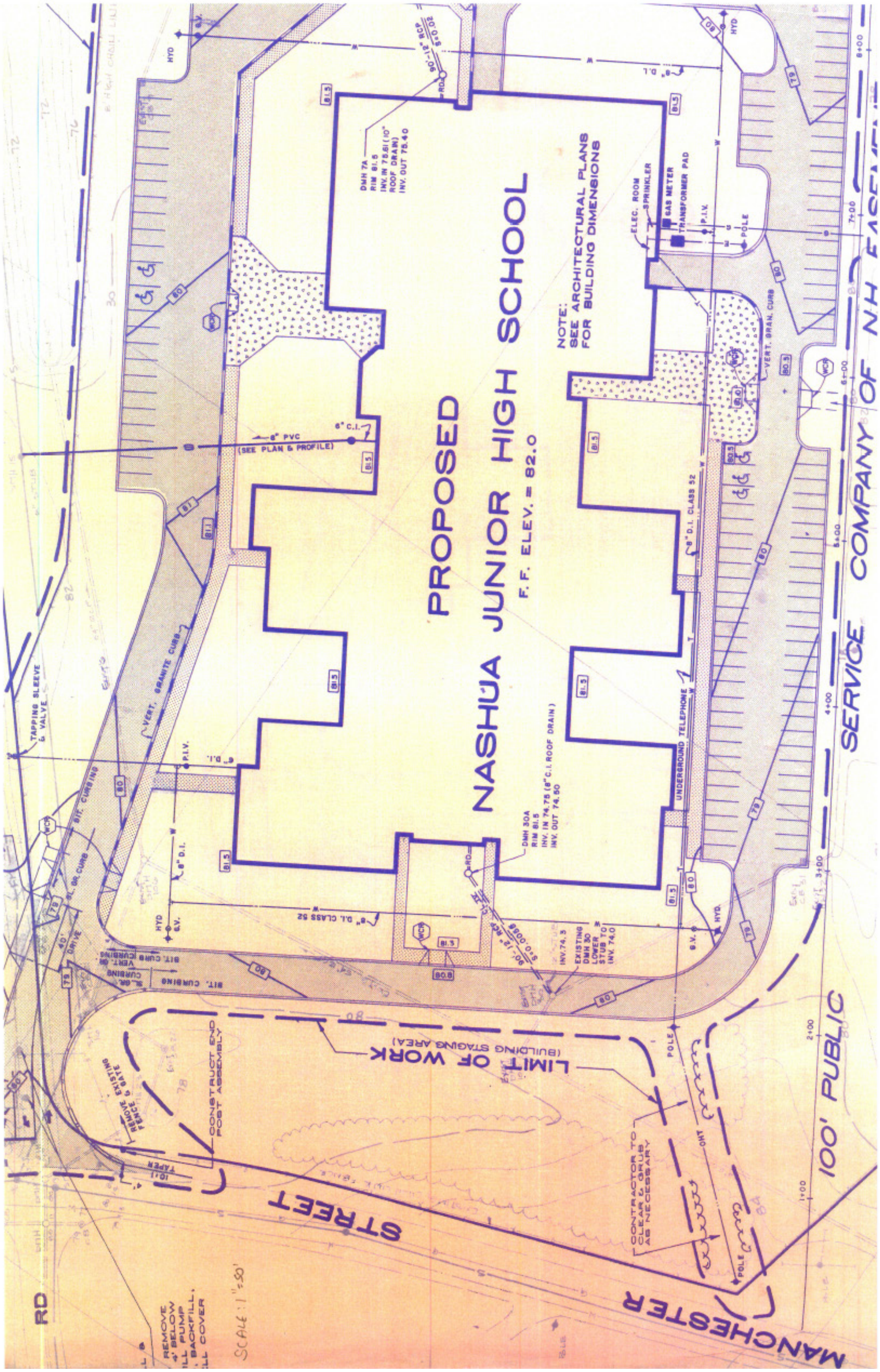
I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

APPENDIX D

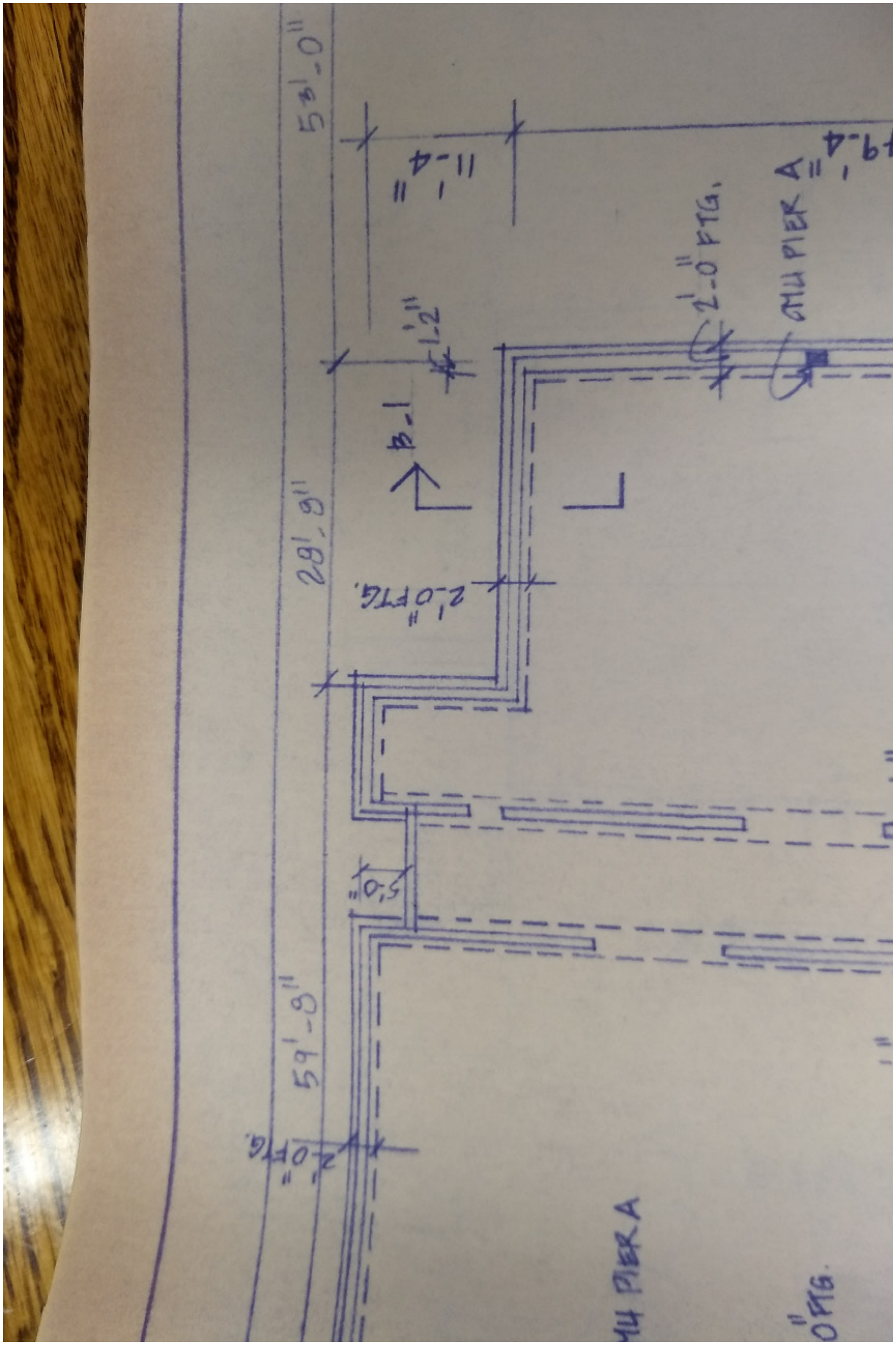
Excerpts of selected Plans.

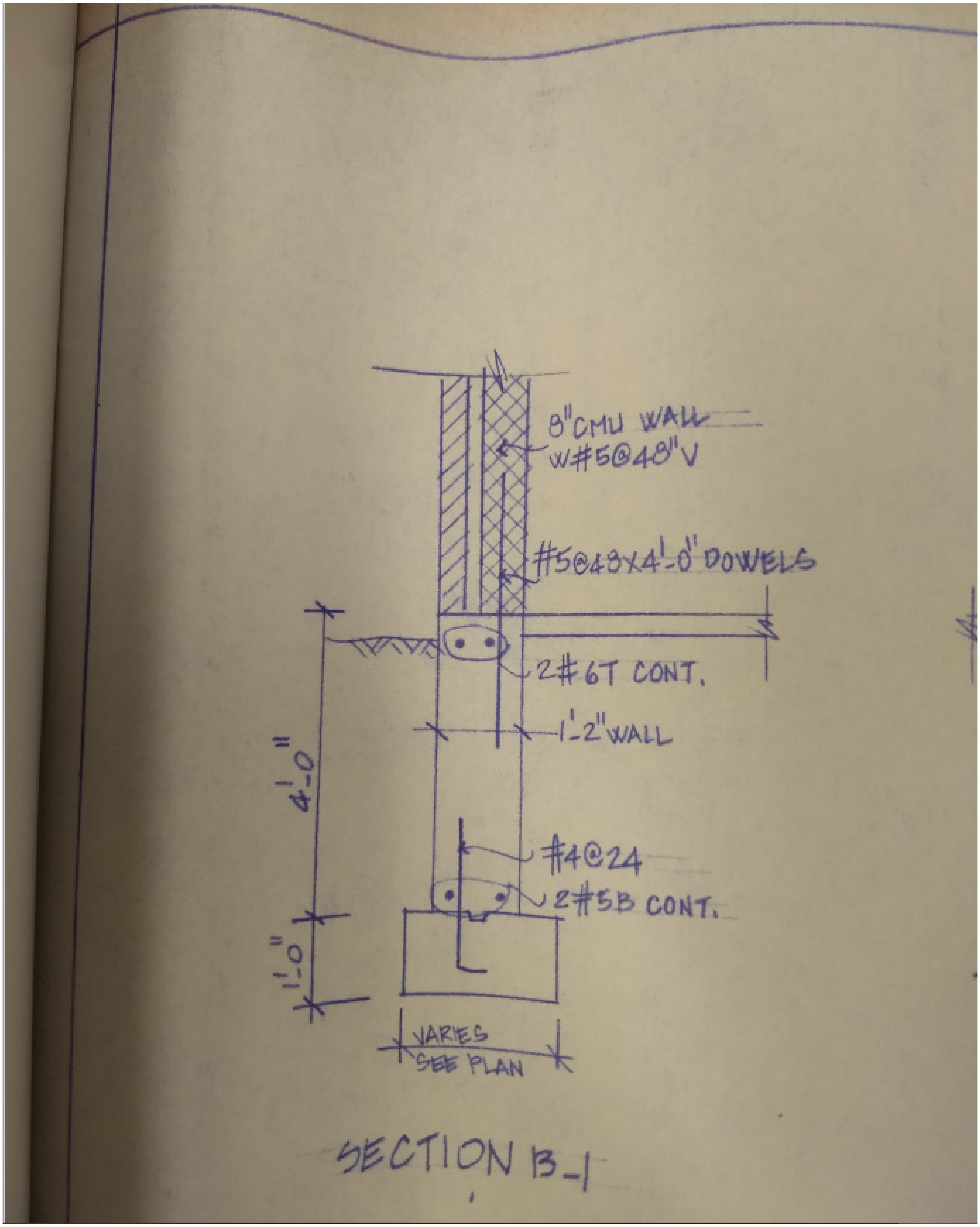

NASHUA JUNIOR HIGH SCHOOL
EXISTING 24" D.I. MAIN
8"x8" TEE
8"x6" REDUCER
2' FROM TEE
8"x6" RED
6' FROM TEE
8"x45° BEND
8"x6" SWIVEL TEE
A
B
C

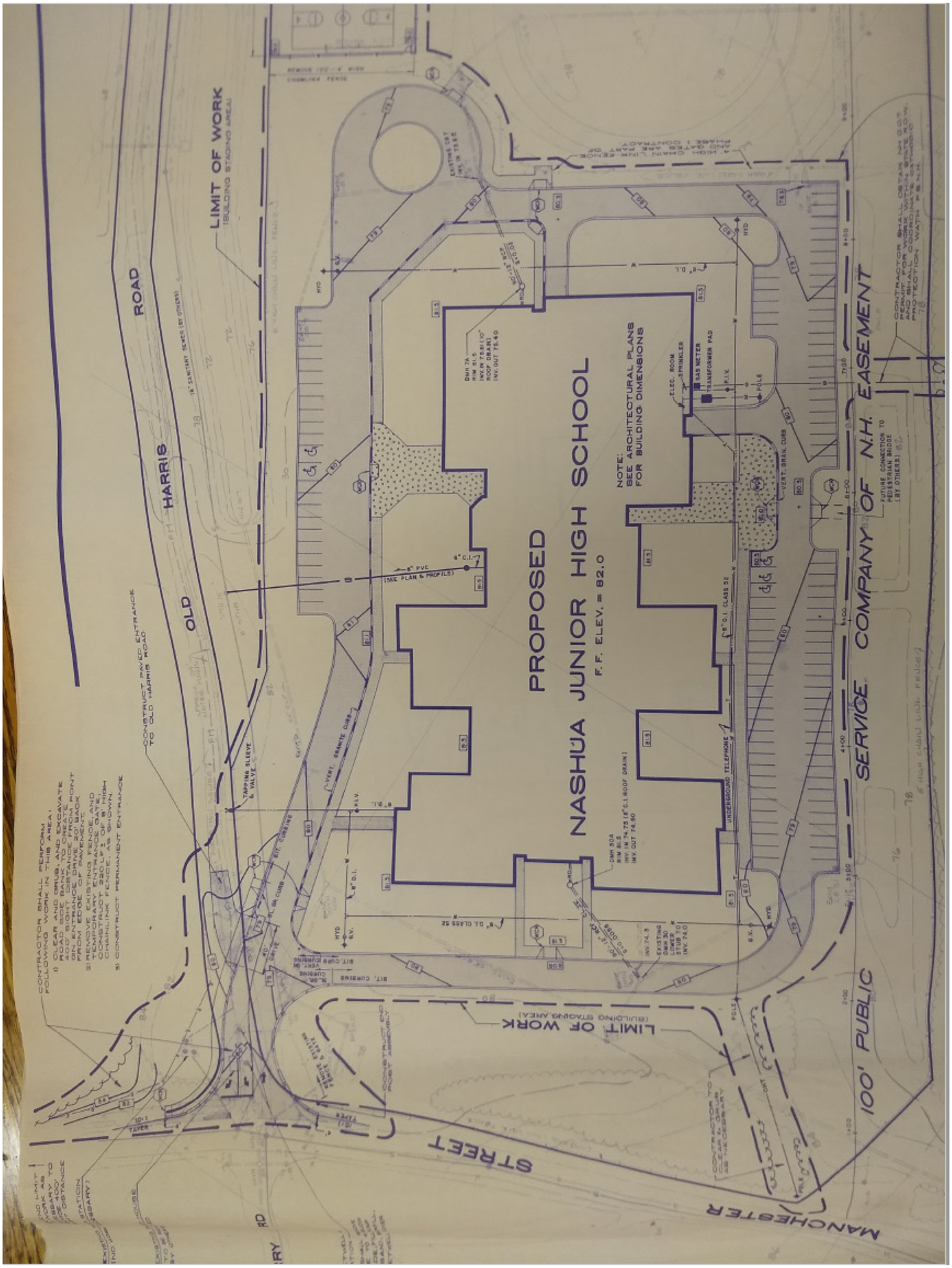

6"G.V.
HYD
8x8" TEE TO 8x6" RED. 1'-6"
8x6" RED TO 6"G.V. 1'-6"
6"G.V. TO HYD. 3'
N
Pennichuck
Water Works
Four Water Street
DATE
REVISION RECORD
BY
TITLE
NASHUA JR HIGH
END OF EXTENSION
DATE STARTED
DATE COMPLETED
DRAWN BY
CONSTRUCTION WORK BY
DESIGNED BY
SCALE
APPROVED BY
DRAWING DATE
SHEET 1 OF 1
DRAWING NUMBER
97

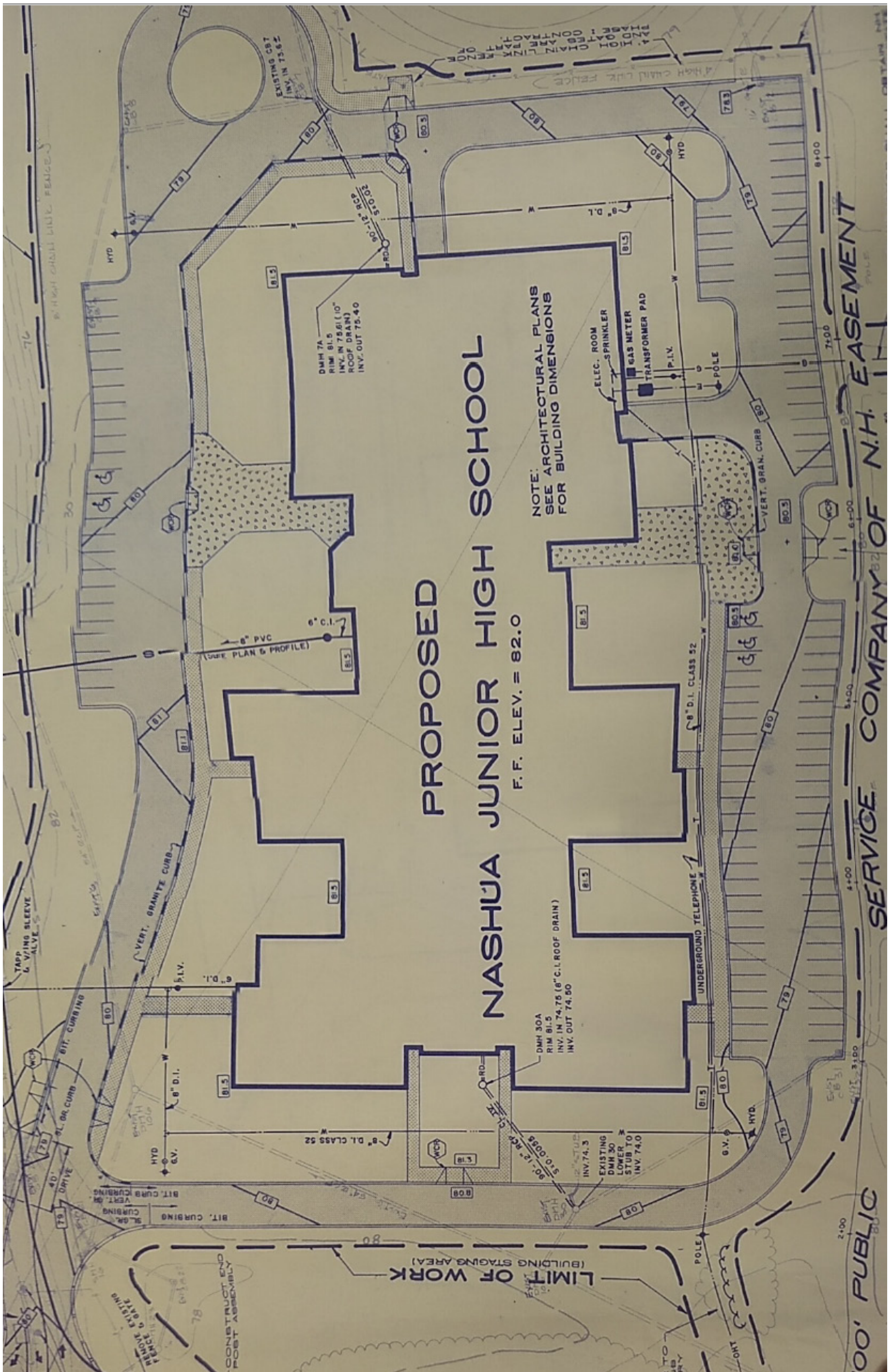


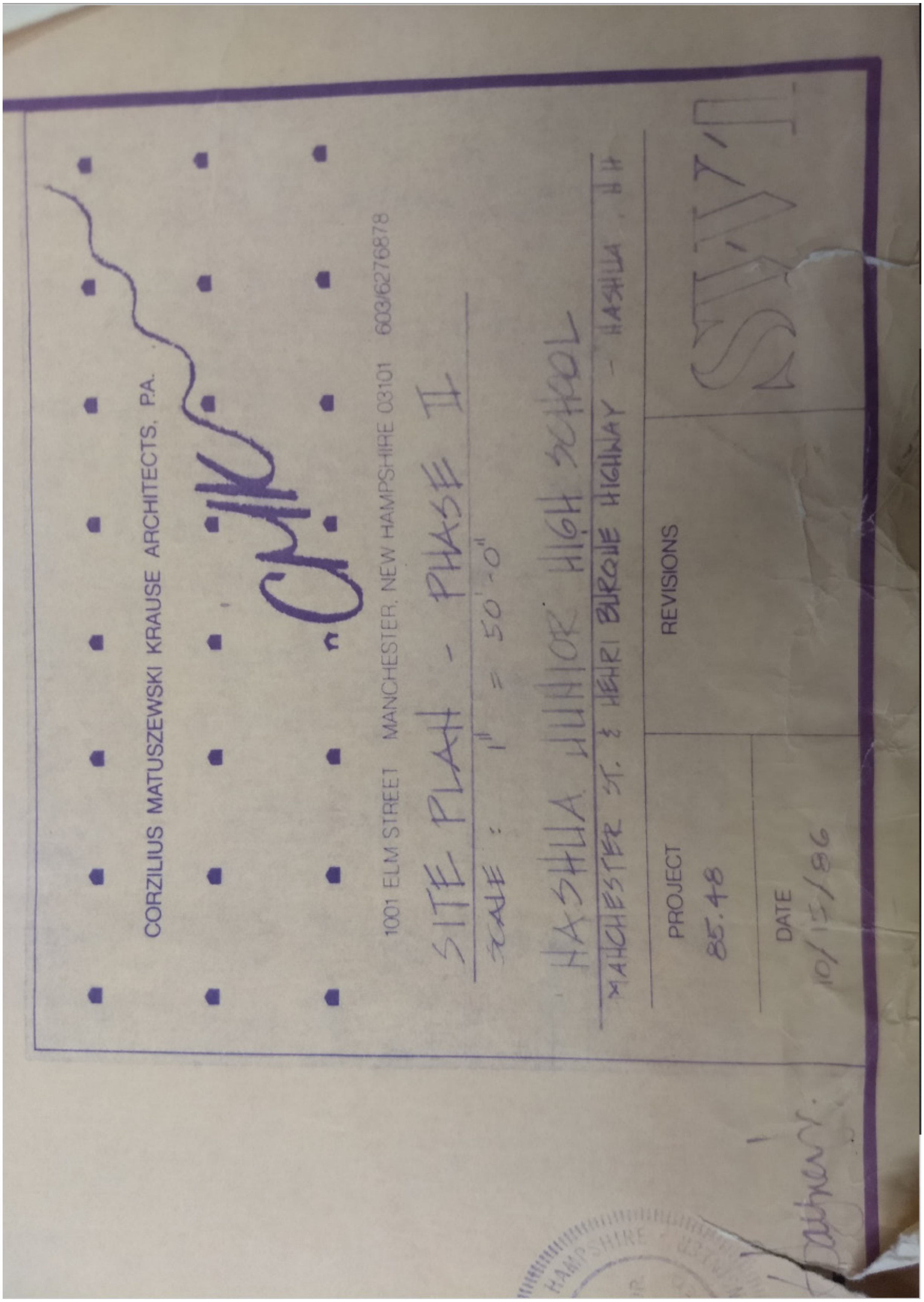
PROPOSED
NASHUA JUNIOR HIGH SCHOOL
F. F. ELEV. = 82.0
NOTE:
SEE ARCHITECTURAL PLANS
FOR BUILDING DIMENSIONS
MANCHESTER STREET
100' PUBLIC SERVICE COMPANY OF N.H. EASEMENT
LIMIT OF WORK
(BUILDING STAGING AREA)
RD

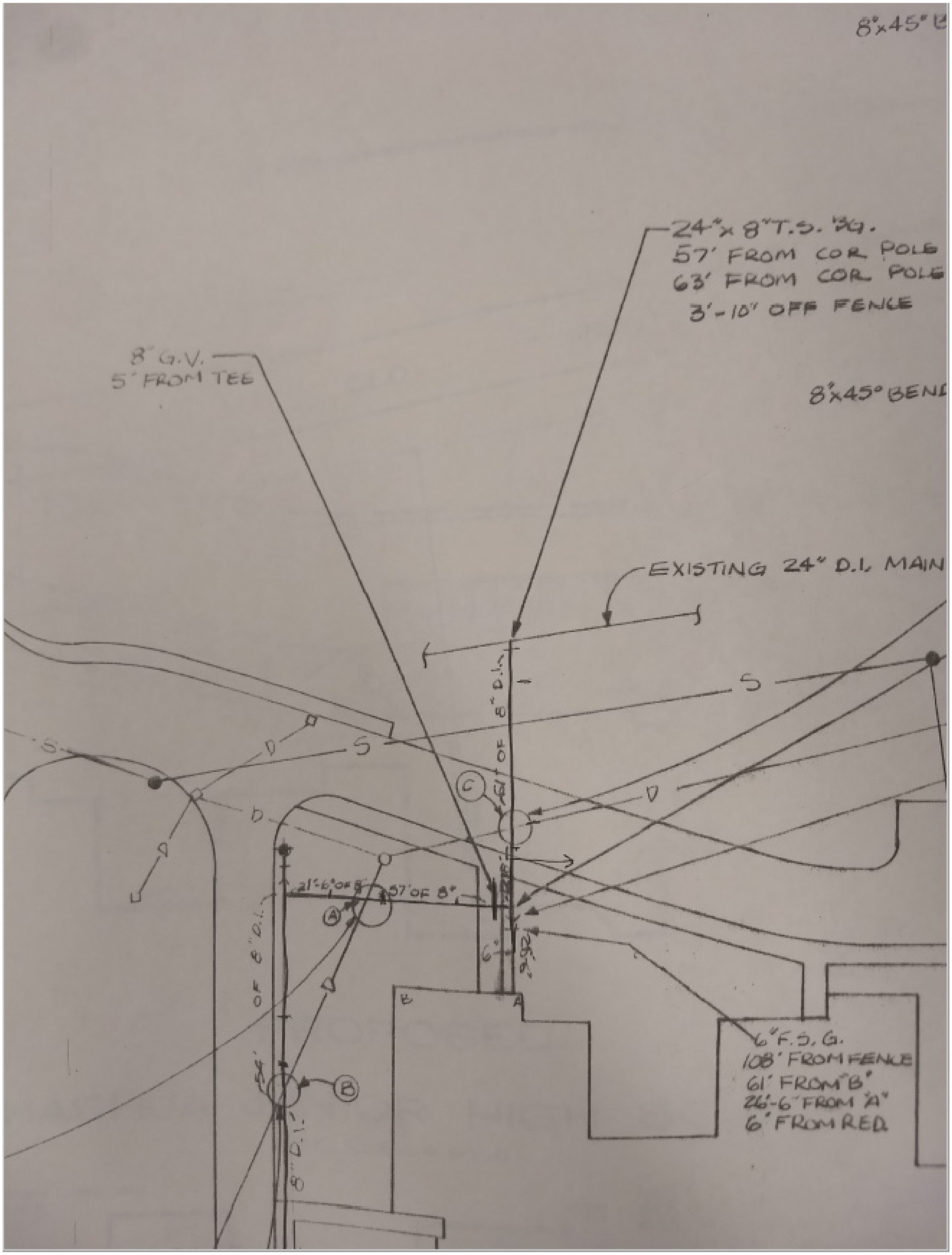

53'-0"
28'-9"
59'-8"
2'-0" FTG.
B.1
PIER A

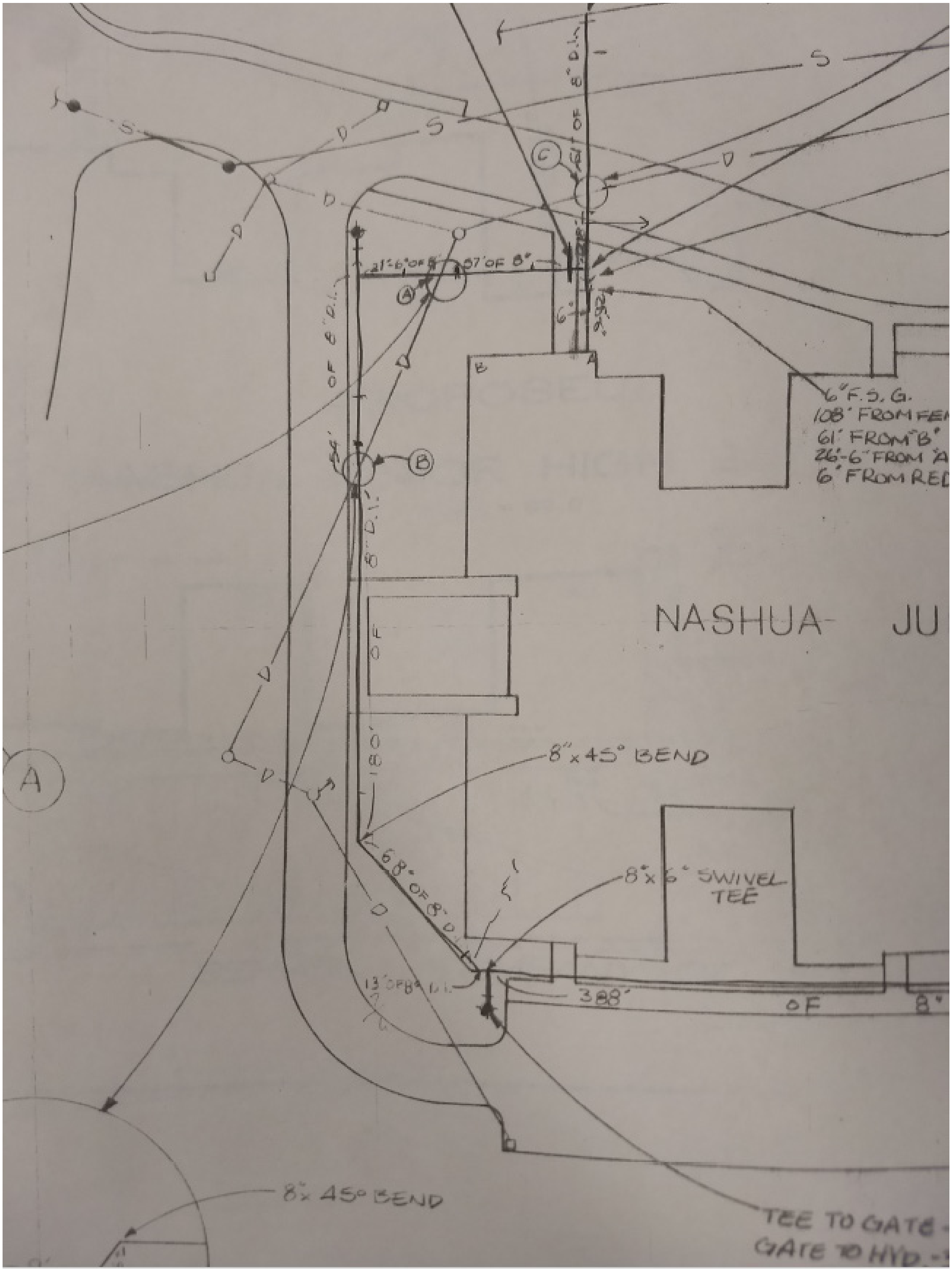

8" CMU WALL
W/#5@48"V
#5@48x4'-0" DOWELS
2#6T CONT.
1'-2" WALL
4'-0"
#4@24
2#5B CONT.
1'-0"
VARIES
SEE PLAN
SECTION B-1

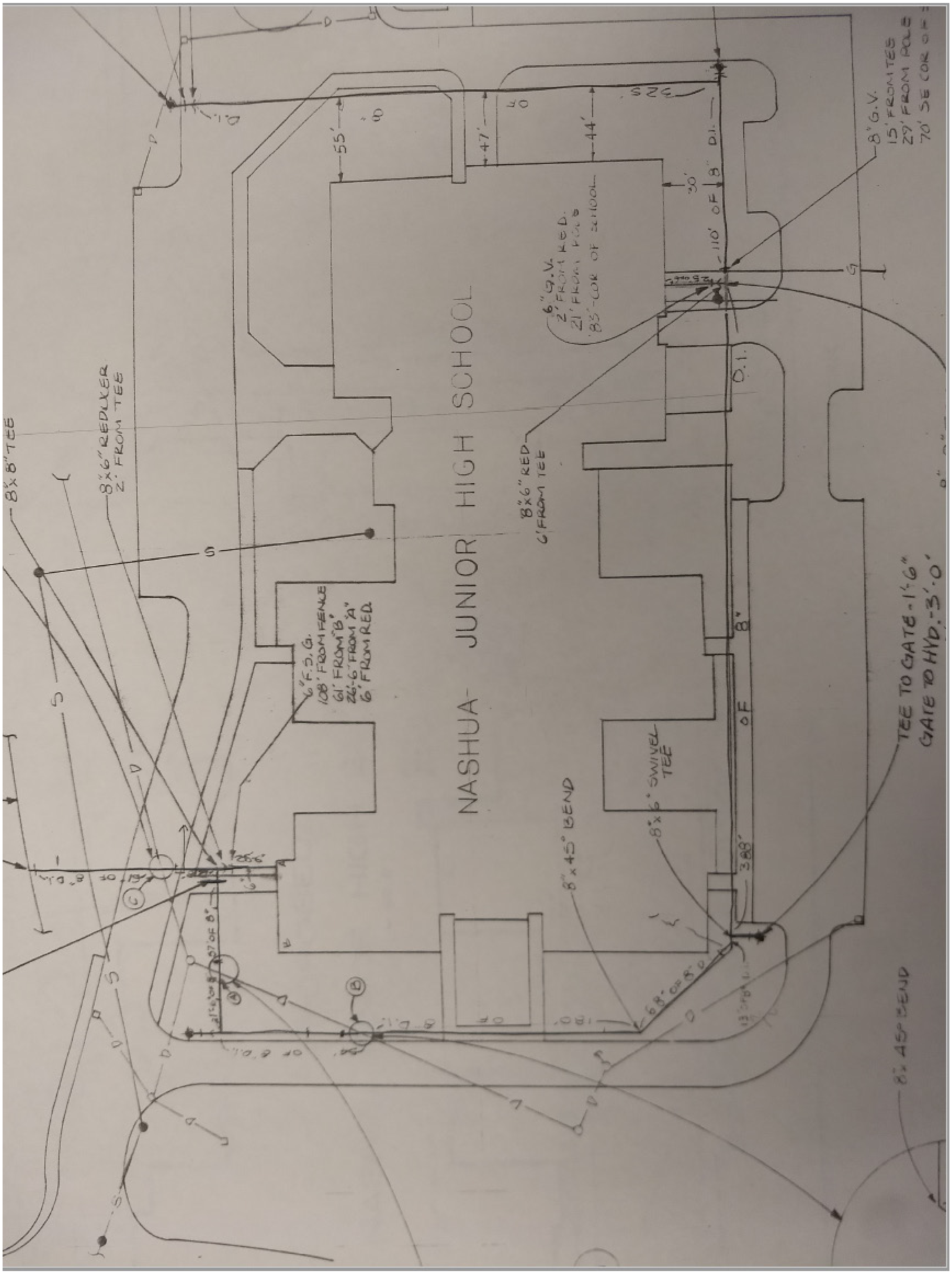

PROPOSED
NASHUA JUNIOR HIGH SCHOOL
F.F. ELEV. = 82.0
NOTE:
SEE ARCHITECTURAL PLANS
FOR BUILDING DIMENSIONS
OLD HARRIS ROAD
MANCHESTER STREET
100' PUBLIC SERVICE COMPANY OF N.H. EASEMENT
LIMIT OF WORK
(BUILDING STAGING AREA)

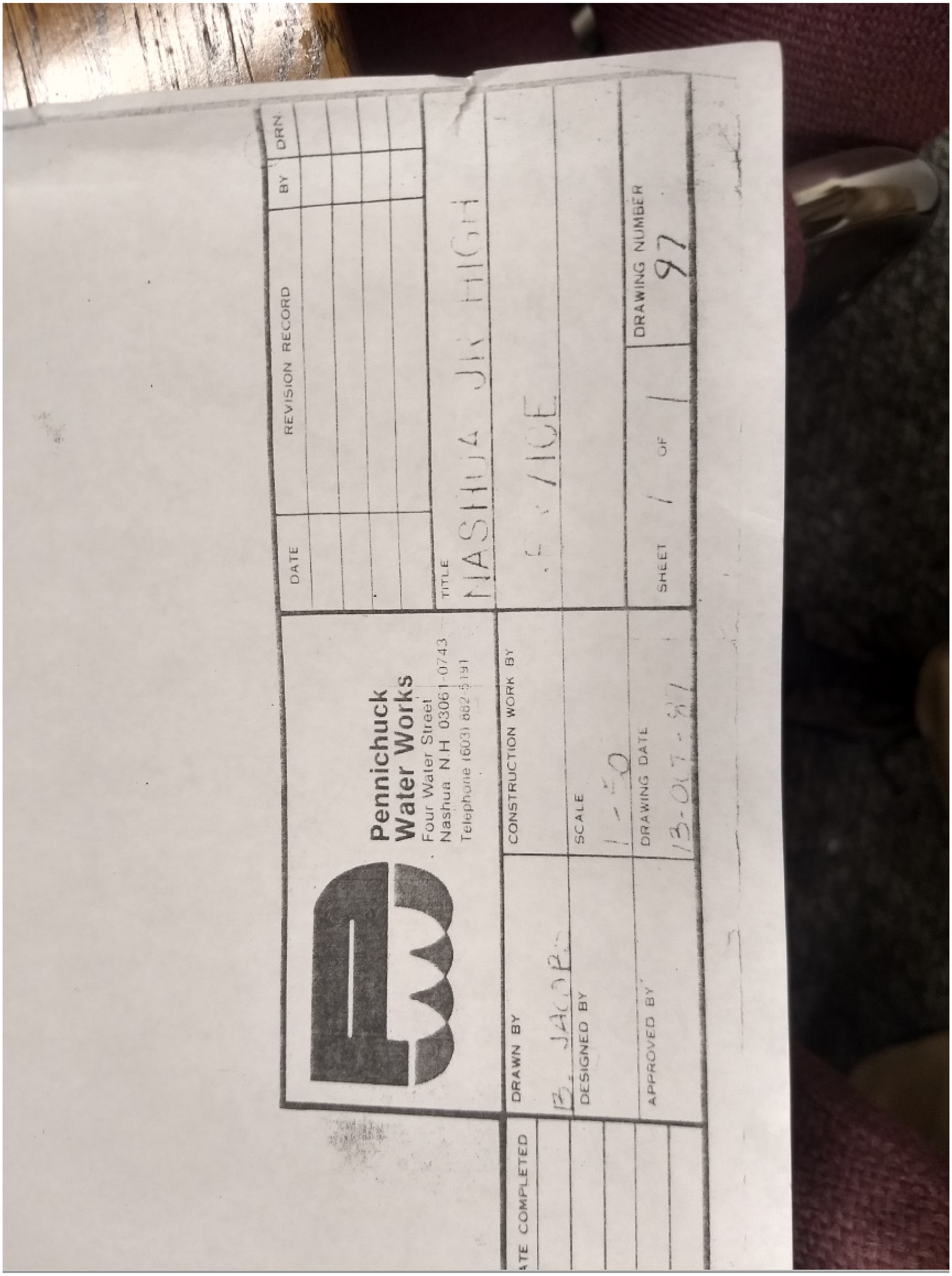

PROPOSED
NASHUA JUNIOR HIGH SCHOOL
F. F. ELEV. = 82.0
NOTE:
SEE ARCHITECTURAL PLANS
FOR BUILDING DIMENSIONS
100' PUBLIC SERVICE COMPANY OF N.H. EASEMENT
LIMIT OF WORK
(BUILDING STAGING AREA)

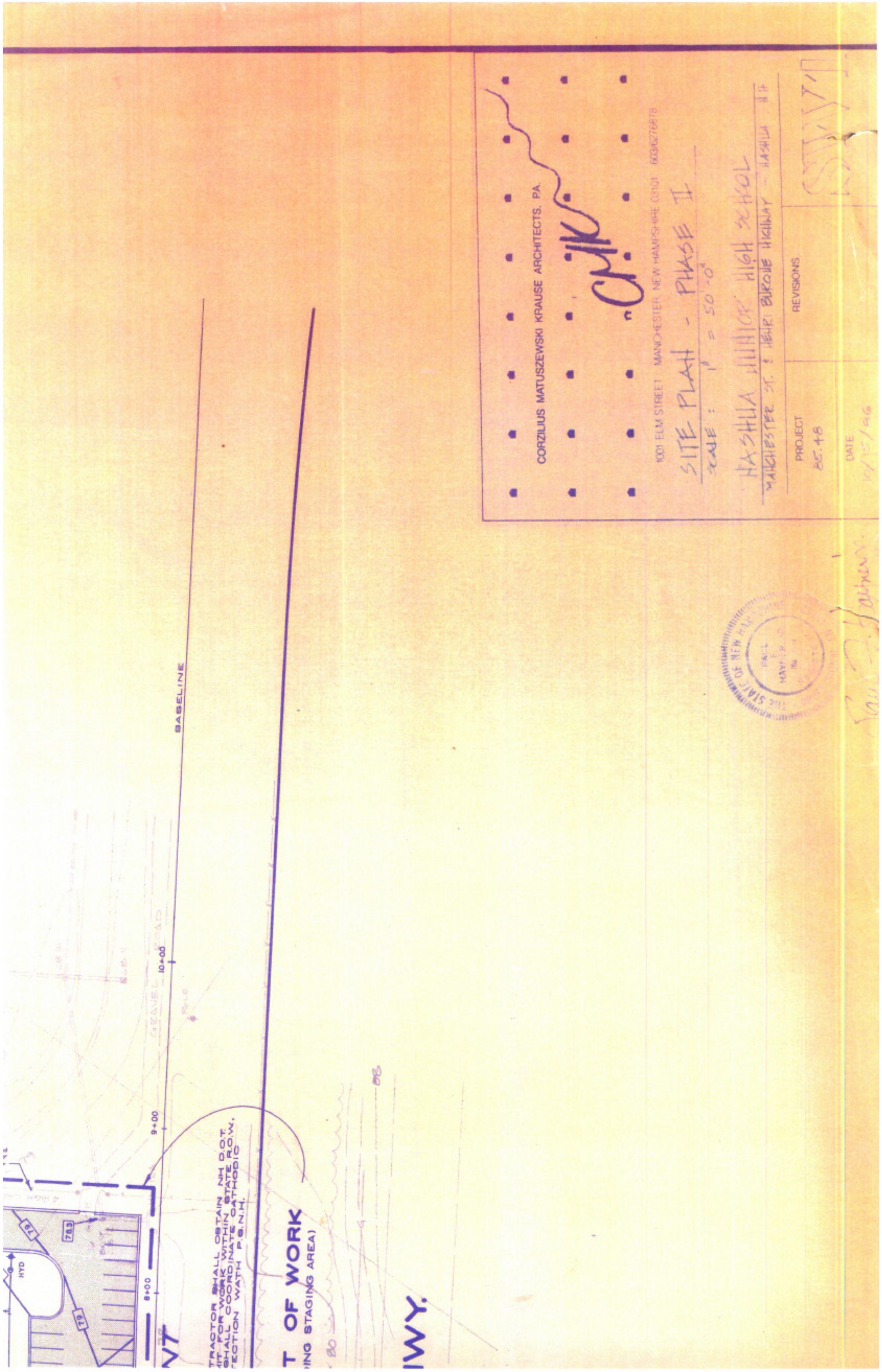

CORZILIUS MATUSZEWSKI KRAUSE ARCHITECTS, P.A.
1001 ELM STREET MANCHESTER, NEW HAMPSHIRE 03101 603/6276878
SITE PLAN - PHASE II
SCALE : 1" = 50'-0"
NASHUA JUNIOR HIGH SCHOOL
MANCHESTER ST. & HENRI BURQUE HIGHWAY - NASHUA, NH
PROJECT
85.48
DATE
10/15/86
REVISIONS


8"x45° B
24"x 8" T.S. & G.
57' FROM COR. POLE
63' FROM COR. POLE
3'-10" OFF FENCE
8" G.V.
5' FROM TEE
8"x45° BEND
EXISTING 24" D.I. MAIN
S
D
C
A
B
57' OF 8"
6"
26'-6"
54'
6" F.S.G.
108' FROM FENCE
61' FROM "B"
26'-6" FROM "A"
6' FROM RED


S
D
C
A
B
21'-6" OF 8"
57' OF 8"
6"F.S.G.
108' FROM FE
61' FROM "B"
26'-6" FROM "A
6' FROM RE
NASHUA JU
8" x 45° BEND
8" x 6" SWIVEL TEE
68' OF 8" D.I.
388' OF 8"
8" x 45° BEND
TEE TO GATE
GATE TO HYD


NASHUA JUNIOR HIGH SCHOOL
8"x8" TEE
8"x6" REDUCER
2' FROM TEE
8"x6" RED
6' FROM TEE
8"x45° BEND
8"x6" SWIVEL TEE
TEE TO GATE - 1'-6"
GATE TO HYD. - 3'-0"
8" G.V.
8" 45° BEND

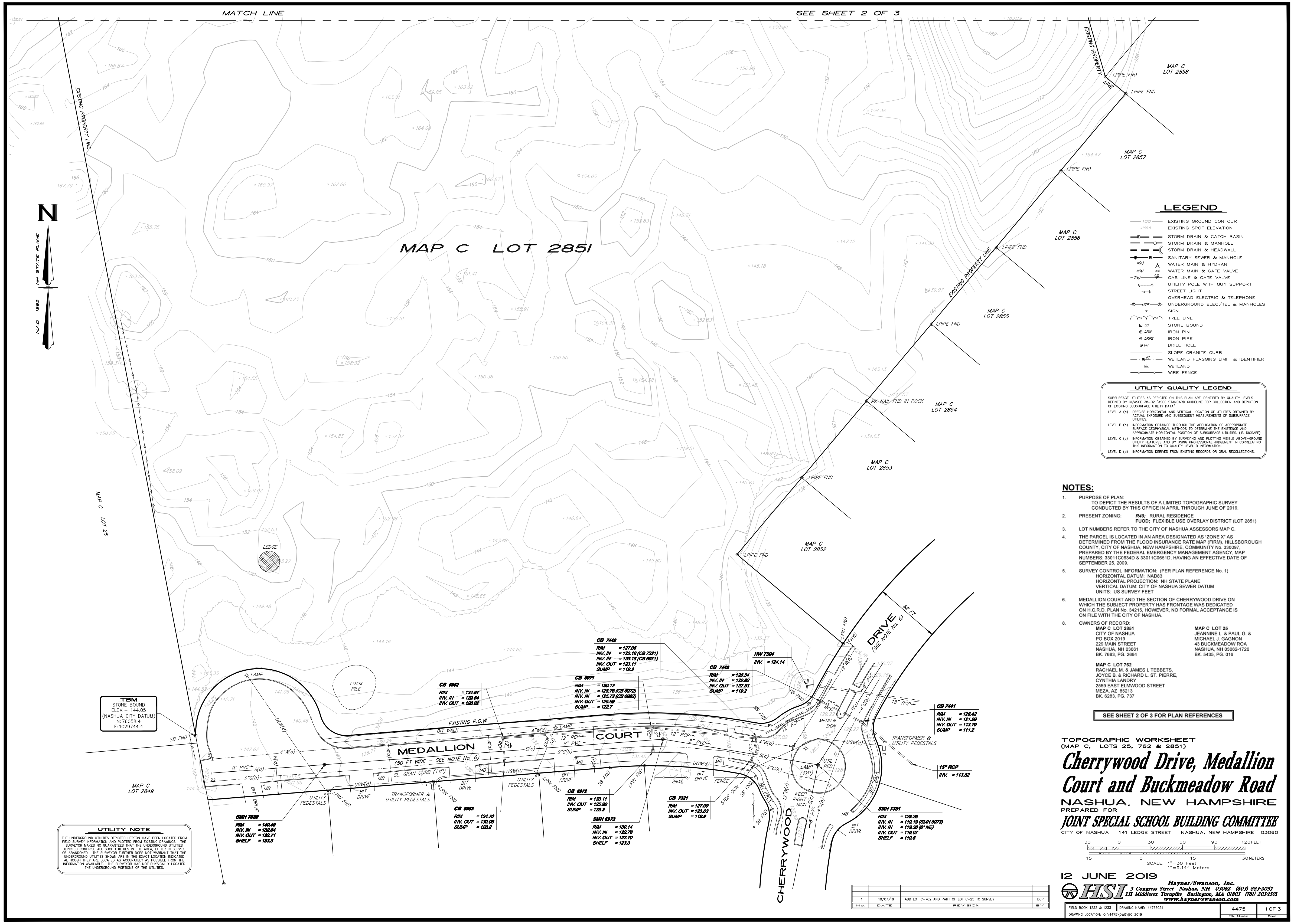

REVISION RECORD
DATE
BY
DRN.
Pennichuck
Water Works
Four Water Street
Nashua N.H. 03061-0743
TITLE
NASHUA JR HIGH
CONSTRUCTION WORK BY
DRAWN BY
DESIGNED BY
SCALE
APPROVED BY
DRAWING DATE
SHEET 1 OF 1
DRAWING NUMBER
97

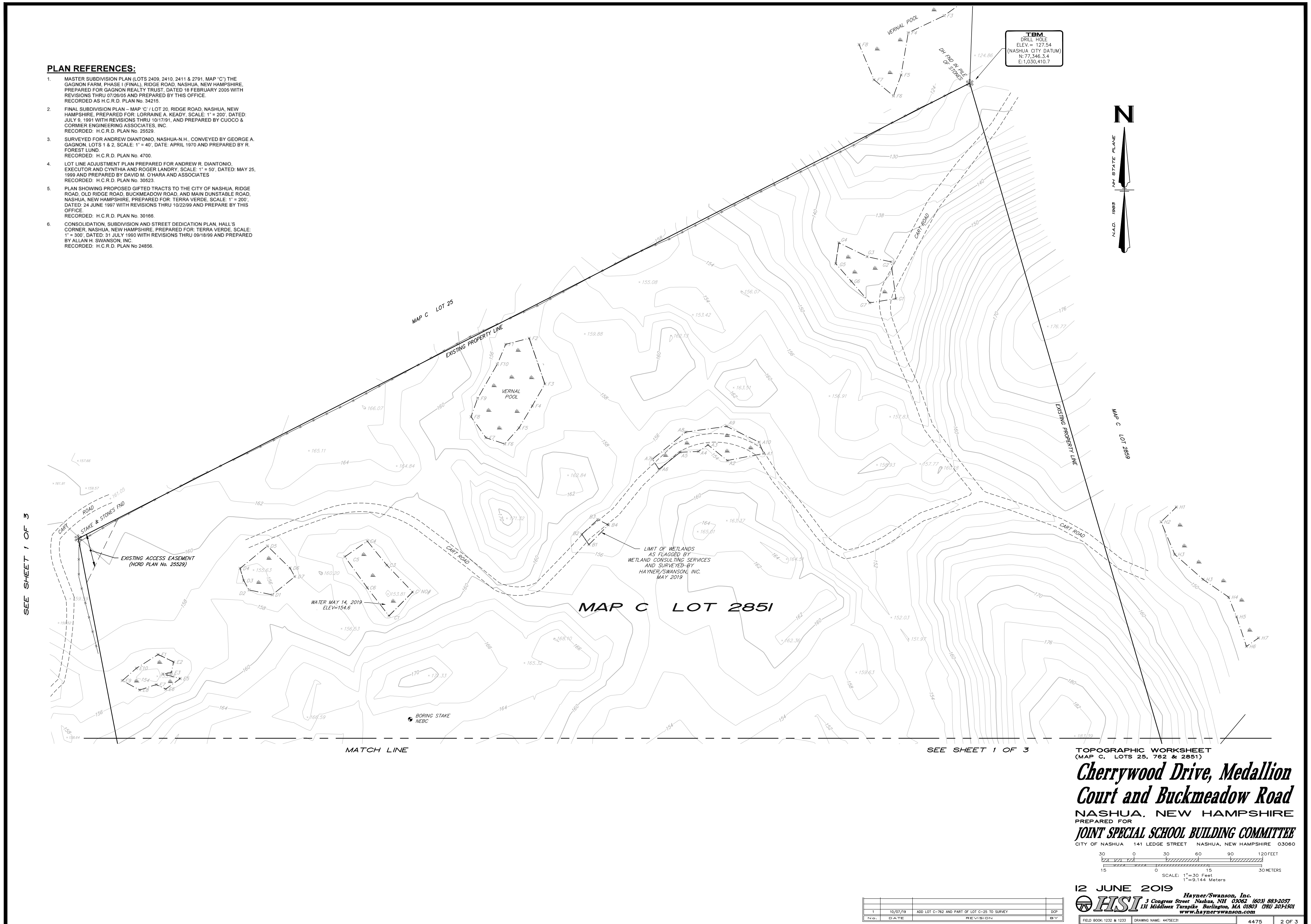

CORZILIUS MATUSZEWSKI KRAUSE ARCHITECTS, PA
1001 ELM STREET MANCHESTER NEW HAMPSHIRE 03101
SITE PLAN - PHASE II
NASHUA JUNIOR HIGH SCHOOL
REVISIONS
PROJECT
85.48
DATE
BASELINE
OF WORK
STAGING AREA

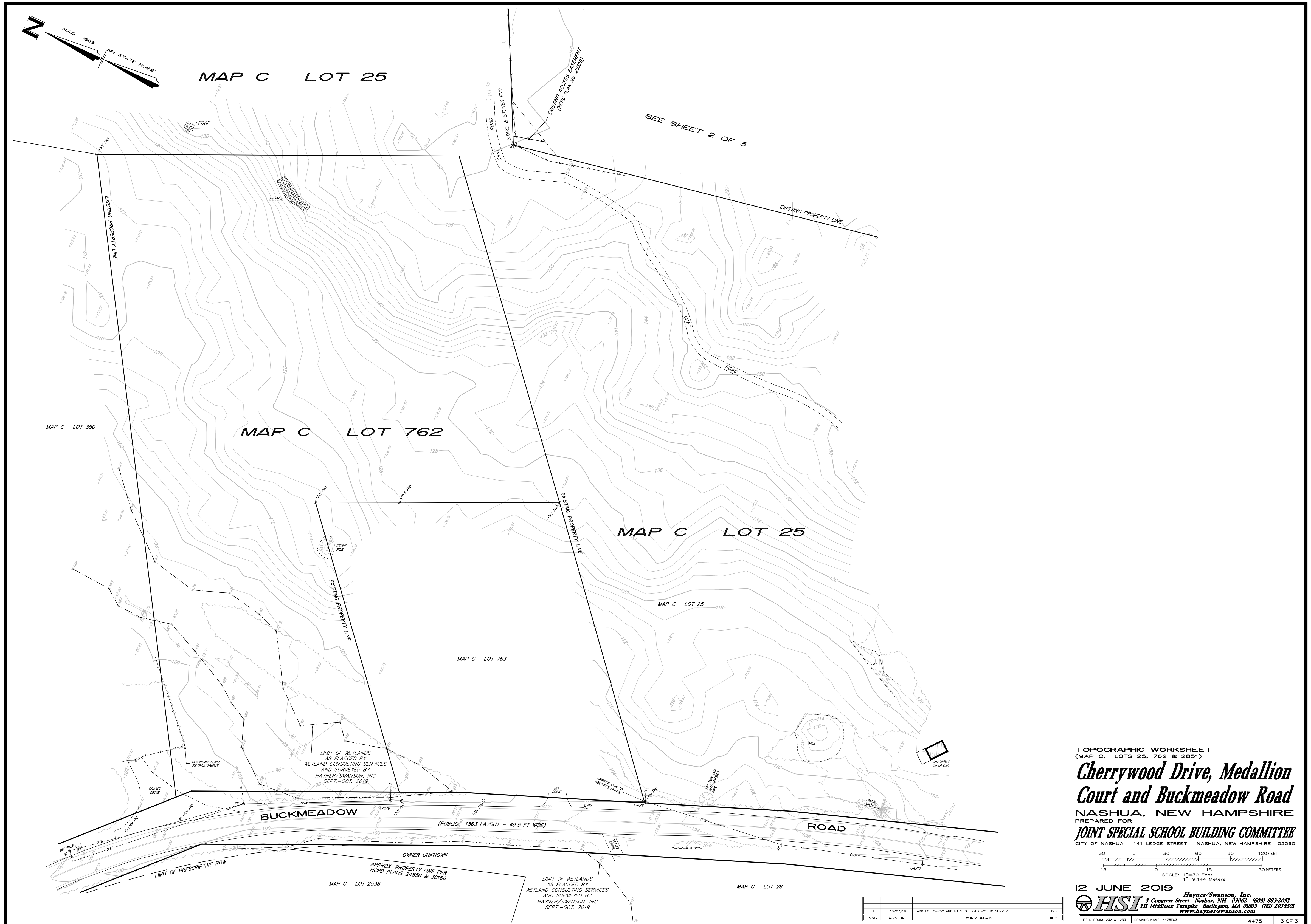
NEW NASHUA MIDDLE SCHOOL

The following information can be found in this section.

- / Site Survey
- / Traffic Study
- / Preliminary Geotechnical Engineering Report
- / Geotechnical Engineering Report


MATCH LINE
SEE SHEET 2 OF 3
MAP C LOT 2851
MAP C LOT 2858
MAP C LOT 2857
MAP C LOT 2856
MAP C LOT 2855
MAP C LOT 2854
MAP C LOT 2853
MAP C LOT 2852
MAP C LOT 25
MAP C LOT 2849
EXISTING PROPERTY LINE
MEDALLION COURT
CHERRYWOOD DRIVE
LEGEND
UTILITY QUALITY LEGEND
LEVEL B (b) INFORMATION OBTAINED THROUGH THE APPLICATION OF APPROPRIATE SURFACE GEOPHYSICAL METHODS TO DETERMINE THE EXISTENCE AND APPROXIMATE HORIZONTAL POSITION OF SUBSURFACE UTILITIES. (IE. DIGSAFE)
LEVEL C (c) INFORMATION OBTAINED BY SURVEYING AND PLOTTING VISIBLE ABOVE-GROUND UTILITY FEATURES AND BY USING PROFESSIONAL JUDGEMENT IN CORRELATING THIS INFORMATION TO QUALITY LEVEL D INFORMATION.
LEVEL D (d) INFORMATION DERIVED FROM EXISTING RECORDS OR ORAL RECOLLECTIONS.
NOTES:
1. PURPOSE OF PLAN:
TO DEPICT THE RESULTS OF A LIMITED TOPOGRAPHIC SURVEY CONDUCTED BY THIS OFFICE IN APRIL THROUGH JUNE OF 2019.
2. PRESENT ZONING: R40; RURAL RESIDENCE
FUOD; FLEXIBLE USE OVERLAY DISTRICT (LOT 2851)
3. LOT NUMBERS REFER TO THE CITY OF NASHUA ASSESSORS MAP C.
4. THE PARCEL IS LOCATED IN AN AREA DESIGNATED AS "ZONE X" AS DETERMINED FROM THE FLOOD INSURANCE RATE MAP (FIRM), HILLSBOROUGH COUNTY, CITY OF NASHUA, NEW HAMPSHIRE, COMMUNITY No. 330097, PREPARED BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY, MAP NUMBERS: 33011C0634D & 33011C0651D, HAVING AN EFFECTIVE DATE OF SEPTEMBER 25, 2009.
5. SURVEY CONTROL INFORMATION: (PER PLAN REFERENCE No. 1)
HORIZONTAL DATUM: NAD83
HORIZONTAL PROJECTION: NH STATE PLANE
VERTICAL DATUM: CITY OF NASHUA SEWER DATUM
UNITS: US SURVEY FEET
6. MEDALLION COURT AND THE SECTION OF CHERRYWOOD DRIVE ON WHICH THE SUBJECT PROPERTY HAS FRONTAGE WAS DEDICATED ON H.C.R.D. PLAN No. 34215, HOWEVER, NO FORMAL ACCEPTANCE IS ON FILE WITH THE CITY OF NASHUA.
8. OWNERS OF RECORD:
MAP C LOT 2851
CITY OF NASHUA
PO BOX 2019
229 MAIN STREET
NASHUA, NH 03061
BK. 7683, PG. 2664
MAP C LOT 25
JEANNINE L. & PAUL G. &
MICHAEL J. GAGNON
43 BUCKMEADOW ROA
NASHUA, NH 03062-1726
BK. 5435, PG. 016
MAP C LOT 762
RACHAEL M. & JAMES L TEBBETS,
JOYCE B. & RICHARD L. ST. PIERRE,
CYNTHIA LANDRY
2559 EAST ELMWOOD STREET
MEZA, AZ 85213
BK. 6283, PG. 737
SEE SHEET 2 OF 3 FOR PLAN REFERENCES
TOPOGRAPHIC WORKSHEET
(MAP C, LOTS 25, 762 & 2851)
Cherrywood Drive, Medallion Court and Buckmeadow Road
NASHUA, NEW HAMPSHIRE
PREPARED FOR
JOINT SPECIAL SCHOOL BUILDING COMMITTEE
CITY OF NASHUA 141 LEDGE STREET NASHUA, NEW HAMPSHIRE 03060
SCALE: 1"=30 Feet
1"=9.144 Meters
12 JUNE 2019
Hayner/Swanson, Inc.
3 Congress Street Nashua, NH 03062 (603) 883-2057
131 Middlesex Turnpike Burlington, MA 01803 (781) 203-1501
www.hayner-swanson.com
FIELD BOOK: 1232 & 1233
DRAWING NAME: 4475EC31
DRAWING LOCATION: Q:\4475\DWG\EC 2019
4475
File Number
1 OF 3
Sheet


PLAN REFERENCES:
1. MASTER SUBDIVISION PLAN (LOTS 2409, 2410, 2411 & 2791, MAP "C") THE GAGNON FARM, PHASE I (FINAL), RIDGE ROAD, NASHUA, NEW HAMPSHIRE, PREPARED FOR GAGNON REALTY TRUST, DATED 18 FEBRUARY 2005 WITH REVISIONS THRU 07/26/05 AND PREPARED BY THIS OFFICE. RECORDED AS H.C.R.D. PLAN No. 34215.
2. FINAL SUBDIVISION PLAN – MAP 'C' / LOT 20, RIDGE ROAD, NASHUA, NEW HAMPSHIRE, PREPARED FOR: LORRAINE A. KEADY, SCALE: 1" = 200', DATED: JULY 9, 1991 WITH REVISIONS THRU 10/17/91, AND PREPARED BY CUOCO & CORMIER ENGINEERING ASSOCIATES, INC. RECORDED: H.C.R.D. PLAN No. 25529.
3. SURVEYED FOR ANDREW DIANTONIO, NASHUA-N.H., CONVEYED BY GEORGE A. GAGNON, LOTS 1 & 2, SCALE: 1" = 40', DATE: APRIL 1970 AND PREPARED BY R. FOREST LUND. RECORDED: H.C.R.D. PLAN No. 4700.
4. LOT LINE ADJUSTMENT PLAN PREPARED FOR ANDREW R. DIANTONIO, EXECUTOR AND CYNTHIA AND ROGER LANDRY, SCALE: 1" = 50', DATED: MAY 25, 1999 AND PREPARED BY DAVID M. O'HARA AND ASSOCIATES RECORDED: H.C.R.D. PLAN No. 30523.
5. PLAN SHOWING PROPOSED GIFTED TRACTS TO THE CITY OF NASHUA, RIDGE ROAD, OLD RIDGE ROAD, BUCKMEADOW ROAD, AND MAIN DUNSTABLE ROAD, NASHUA, NEW HAMPSHIRE, PREPARED FOR: TERRA VERDE, SCALE: 1" = 200', DATED: 24 JUNE 1997 WITH REVISIONS THRU 10/22/99 AND PREPARE BY THIS OFFICE. RECORDED: H.C.R.D. PLAN No. 30166.
6. CONSOLIDATION, SUBDIVISION AND STREET DEDICATION PLAN, HALL'S CORNER, NASHUA, NEW HAMPSHIRE, PREPARED FOR: TERRA VERDE, SCALE: 1" = 300', DATED: 31 JULY 1990 WITH REVISIONS THRU 09/18/99 AND PREPARED BY ALLAN H. SWANSON, INC. RECORDED: H.C.R.D. PLAN No 24856.
TBM
DRILL HOLE
ELEV.= 127.54
(NASHUA CITY DATUM)
N
VERNAL POOL
EXISTING PROPERTY LINE
MAP C LOT 25
MAP C LOT 2859
CART ROAD
EXISTING ACCESS EASEMENT (HCRD PLAN No. 25529)
LIMIT OF WETLANDS AS FLAGGED BY WETLAND CONSULTING SERVICES AND SURVEYED BY HAYNER/SWANSON, INC. MAY 2019
WATER MAY 14, 2019 ELEV=154.6
MAP C LOT 2851
BORING STAKE NEBC
SEE SHEET 1 OF 3
MATCH LINE
SEE SHEET 1 OF 3
TOPOGRAPHIC WORKSHEET
(MAP C, LOTS 25, 762 & 2851)
Cherrywood Drive, Medallion Court and Buckmeadow Road
NASHUA, NEW HAMPSHIRE
PREPARED FOR
JOINT SPECIAL SCHOOL BUILDING COMMITTEE
CITY OF NASHUA 141 LEDGE STREET NASHUA, NEW HAMPSHIRE 03060
SCALE: 1"=30 Feet
1"=9.144 Meters
12 JUNE 2019
Hayner/Swanson, Inc.
3 Congress Street Nashua, NH 03062 (603) 883-2057
131 Middlesex Turnpike Burlington, MA 01803 (781) 203-1501
www.hayner-swanson.com
FIELD BOOK: 1232 & 1233
DRAWING NAME: 4475EC31
DRAWING LOCATION: Q:\4475\DWG\EC 2019
4475
File Number
2 OF 3
Sheet


MAP C LOT 25
SEE SHEET 2 OF 3
EXISTING ACCESS EASEMENT
EXISTING PROPERTY LINE
MAP C LOT 350
MAP C LOT 762
MAP C LOT 25
MAP C LOT 763
LIMIT OF WETLANDS AS FLAGGED BY WETLAND CONSULTING SERVICES AND SURVEYED BY HAYNER/SWANSON, INC. SEPT.-OCT. 2019
BUCKMEADOW ROAD
(PUBLIC -1863 LAYOUT - 49.5 FT WIDE)
OWNER UNKNOWN
APPROX. PROPERTY LINE PER HCRD PLANS 24856 & 30166
LIMIT OF PRESCRIPTIVE ROW
MAP C LOT 2538
MAP C LOT 28
SUGAR SHACK
TOPOGRAPHIC WORKSHEET
(MAP C, LOTS 25, 762 & 2851)
Cherrywood Drive, Medallion Court and Buckmeadow Road
NASHUA, NEW HAMPSHIRE
PREPARED FOR
JOINT SPECIAL SCHOOL BUILDING COMMITTEE
CITY OF NASHUA 141 LEDGE STREET NASHUA, NEW HAMPSHIRE 03060
SCALE: 1"=30 Feet
1"=9.144 Meters
12 JUNE 2019
HSI
Hayner/Swanson, Inc.
3 Congress Street Nashua, NH 03062 (603) 883-2057
131 Middlesex Turnpike Burlington, MA 01803 (781) 203-1501
www.haynerswanson.com
4475
3 OF 3

The New Middle School Traffic Study can be found in the compiled report beginning on page 275 of this document.

Preliminary Geotechnical Engineering Report
Potential New School

Cherrywood Drive
Nashua, New Hampshire
May 31, 2019

Prepared for:
City of Nashua – Joint Special
School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

MMI #6119-03-01-2

Prepared by:
MILONE & MACBROOM, INC.
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
(603) 668-1654
www.mminc.com

MILONE & MACBROOM
ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

MILONE & MACBROOM

ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

May 31, 2019

Mr. Shawn Smith, Director pf Plant Operations
Joint Special School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

RE: Preliminary-Phase Geotechnical Engineering Report
Proposed New School
Cherrywood Drive
Nashua, New Hampshire

Dear Shawn:

Milone & MacBroom, Inc. (MMI) is pleased to submit herewith our Preliminary Geotechnical Engineering Report for the above referenced project. We trust that our findings and recommendations outlined in this report will be responsive to your needs at this time.

We appreciate the opportunity to be of service to your office and will be available for contact to discuss any questions you may have and look forward to presenting this report to you in person in the near future.

Very truly yours,

Milone & MacBroom, Inc.

Erich A Adler, EIT
Project Engineer

Charles E. Teale, PE, LSP, LEP
Manager of Geotechnical Engineering and Environmental Services

2 Cote Lane, Suite 1, Bedford, NH 03110 | Tel: 603.668.1654 | Fax: 603.668.0608 | www.MMInc.com
CT | MA | ME | NH | NY | VT

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1.0 INTRODUCTION

This report presents the results of a preliminary screening-phase geotechnical engineering study performed by Milone & MacBroom, Inc. (MMI) at the site of a potential New School in Nashua, New Hampshire. The property which is the subject of this study currently consists of undeveloped woodland surrounded by residential structures. The property studied is located west of Cherrywood Drive and north of Medallion Court.

This report has been prepared for the City of Nashua – Joint Special School Building Committee. Included in this report is a summary of subsurface explorations performed, subsurface conditions observed and the geotechnical implications of these conditions with respect to the preliminary design and preliminary construction considerations for the proposed development. Please note that this report is subject to the limitations contained in Appendix A.

It is important that the Design Team (Owner, Engineers and Architects), and Contractors read and understand this Report and all attachments (Tables, Figures and Appendices) in its entirety in order to fully understand MMI's preliminary geotechnical engineering recommendations. As the various preliminary geotechnical engineering recommendations are comingled and inter-dependent, they cannot be taken alone or out of context.

Additionally, it is important to note that this report and the subsurface conditions outlined herein pertain only to those immediate areas where subsurface explorations were performed and may not necessarily be considered representative of soil conditions throughout the rest of the site, or in areas where test borings were not performed.

1.1 Objective of Study

The objective of our services was to perform limited screening-level subsurface conditions (i.e. four test boring locations) within the site, and to develop preliminary geotechnical engineering recommendations for conceptual design and construction of the proposed building. This report is based on the City of Nashua Joint Special School Building Committee RFP for Geotechnical Services for Middle School Construction and/or Renovation and comments by Harriman in reference to the RFP dated April 2, 2019.

1.2 Scope of Services

The scope of services performed by MMI to meet the above stated objectives included the following:

a. Performance of a site reconnaissance by a MMI geotechnical engineer.

b. Review of published geology for the proposed development site.

c. Review of preliminary topographic information, and coordination and observation of a limited screening-level subsurface exploration program consisting of four test borings, designated as MMI-1 to MMI-4, at the approximate locations shown on enclosed Figure 2, entitled "Subsurface Exploration Location Plan". The test borings were observed and documented by a geotechnical engineer from our office. Also, preparation of a test boring exploration summary table which is enclosed as Table 1.

d. Exploration logs were prepared by a MMI geotechnical engineer with soil identification in accordance with the Burmister Soils Classification System.

e. An overall discussion of site surface and subsurface conditions was be prepared based on the limited test borings. The locations where unsuitable materials and refusal depths were encountered were evaluated.

f. A discussion of groundwater conditions was prepared, based on the limited explorations, including preliminary construction-phase dewatering recommendations and the necessity of building floor slab and perimeter foundation subdrains.

g. Preliminary recommendations for shallow foundations were developed to include allowable soil and/or rock bearing pressures and estimated settlements of the typical foundation elements.

h. Preliminary recommendations for floor slab on grade support, including sub-slab subdrainage requirements as necessary, along with design modulus of subgrade reaction (K), have been developed.

i. Preliminary recommendations for subgrade soil preparation, gradation and material specifications for fill and backfill, compaction requirements, and earthwork considerations were prepared based on the exploration data.

j. Frost depth considerations and effects are discussed.

k. Preliminary recommendations regarding soil/rock excavation and reuse considerations were provided including proofrolling and compaction requirements for subgrade soils.

l. Seismic considerations regarding foundation design were given including the potential for liquefaction and the seismic Site Class per IBC Section 1613.3.2.

m. Preliminary recommended lateral earth pressures (i.e. active, at-rest and passive) against walls below grade with active and passive soil coefficients were presented along with soil sliding coefficients for use in wall design.

n. Preparation of preliminary pavement design sections for heavy duty truck and light duty passenger car areas.

o. Construction considerations regarding excavation and earthwork, including excavated soil/rock reuse potential, to be considered during the construction-phase of this project will be provided.

p. Preparation of this screening-level preliminary geotechnical engineering report summarizing our findings and recommendations.

Services with respect to performance of final geotechnical engineering explorations and reporting, preparation of plans and specifications, performance of additional subsurface explorations or more than one day of drilling effort, vibrating equipment support considerations, final pavement design considerations, sidewalk support recommendations, uplift resisting rock anchor design, utility trench backfills, soil laboratory testing, monitoring well installations, attendance at meetings, construction phase quality control, environmental services, vibration studies, and any other services not specifically outlined herein were not included in our current work scope.

1.3 Site and Project Description

Knowledge of the site is based on our review of the preliminary topographic data shown on Figure 4, our site reconnaissance and results of the four subsurface explorations.

The subject site is currently vacant, comprised of undeveloped woodland. Medallion Court borders the site to the south and Cherrywood Drive is to the east. Generally the site consists of moderate topographic relief with several low lying wet areas.

Based on discussion with Mr. Shawn Smith of the Nashua School District and review of comments provided by Harriman Associates to the RFP, MMI understands that the proposed new school design has not yet been performed awaiting results of the site screening process. Column, wall and equipment loads have not yet been developed for this preliminary geotechnical engineering report.

2.0 SUBSURFACE CONDITIONS

MMI referenced published geologic maps for the site, including the Bedrock Geologic Map of New Hampshire.

As part of our current scope of work, MMI coordinated and observed a limited subsurface exploration program consisting of four test borings; designated MMI-1 through MMI-4. Subsurface exploration locations were laid out in the field by MMI utilizing a consumer grade GPS system. Accordingly, the accuracy of the exploration locations are based on the survey method described above and should be considered approximate only to the degree implied by the method use. The as-drilled exploration locations and designations are shown on Figure 2 and are summarized on Table 1.

2.1 Published Geologic Information

MMI referenced published geologic maps for the site, including the Surficial Geologic Map of New Hampshire and the Bedrock Geologic Map of New Hampshire.

2.1.1 Surficial Geology

Based on review of the Surficial Geologic Map of New Hampshire produced by USGS and the New Hampshire Geologic Society, the following was noted:

- Surficial geology within the site is mapped as unstratified drift (glacial till).

2.1.2 Bedrock Geology

Based on review of the Bedrock Geologic Map of New Hampshire produced by USGS and the New Hampshire Geologic Society, the following was noted:

- The site is underlain by bedrock described as Merrimack Group, Berwick Formation - Purple biotite-quartz-feldspar granofels or schist and interbeds of calc-silicate granofels and minor metapelites.

2.2 Subsurface Explorations

The four test borings (designated MMI-1 through MMI-4) were performed by New England Boring Contractors, Inc. of Derry, New Hampshire on April 26, 2019. Logs of these explorations as prepared by MMI are enclosed in Appendix B.

The test borings were drilled by a track mounted Mobile Drill B-53 using standard hollow stem auger drilling techniques to depths of 4.0± feet to 10.8± feet. Borings were backfilled with drill cuttings and/or sand to ground surface upon completion.

Standard Penetration Tests (SPTs) were performed in general accordance with ASTM D1586 in each test boring, with split spoon samples recovered generally at five-foot intervals. The SPT consists of driving a 1-3/8 inch I.D. split spoon sampler with a 140-pound hammer falling 30 inches. The blows for each 6 inches of penetration are recorded for a total of 18 or 24-inches. The sum of the blows required to drive the sampler from 6 inches to 18 inches penetration is referred to as the Standard Penetration Resistance or N-value which is an index measure of in-situ soil density or consistency.

The explorations were performed under the observation of a MMI geotechnical engineer. Soil samples from the test borings were classified in the field by MMI in general accordance with the Burmister Soil Classification System. A copy of the Burmister Soil Classification system is enclosed with the MMI boring logs at the end of Appendix B. A test boring exploration summary is presented as Table 1.

3.0 SUBSURFACE CONDITIONS

A relatively thin surficial forest mat layer was encountered in each boring with variable thicknesses of about 0.3± feet to 0.5± feet overlying a deposit of fine sand subsoil encountered at thicknesses of about 1.5± feet to 3.2± feet. Underlying the fine sand subsoil materials are dense glacial till deposits to the depth investigated. Hollow stem auger refusal conditions were encountered at the bottom of each boring between 4.0± feet and 10.8± feet. The hollow stem auger refusal conditions encountered are likely indicative of weathered bedrock/bedrock encounter.

3.1 Forest Mat and Subsoil

Up to 6 inches of forest mat consisting of leaf litter and organic humus was observed in each boring. However, it should be noted that forest mat materials may be thicker elsewhere across the site. Underlying the surficial forest mat materials is a subsoil consisting of loose brown fine sand, trace to some silt with root fibers encountered in thicknesses of about 1.5± feet to 3.2± feet. The existing forest mat and subsoil are not considered suitable for support of spread footing foundations as unacceptable settlement would be anticipated.

3.2 Glacial Till

Underlying the forest mat in MMI-1 and below the subsoil in the remaining borings are glacial till deposits consisting of red brown to grey brown fine sand, little gravel, little silt. With N-values ranging from 61 to 100+ this deposit is considered to be very dense.

3.3 Refusal Conditions

Refusal conditions indicative of boulders, very dense glacial till, hard weathered bedrock or competent bedrock were encountered in all of the borings. Refusal conditions are defined herein as the inability of the 3-1/4 inch inside diameter hollow stem augers to advance any further under increasing drill rig (Mobile Drill B-53) torque and down pressure. Refusal conditions were encountered in each boring at depths of 4.0± feet to 10.8± feet.

It should be noted that rock coring, which was not included in MMI's scope of services, would be required to definitively determine top of weathered rock and top of underlying parent bedrock.

3.4 Groundwater

Groundwater was encountered only in MMI-2 at a depth of approximately 3.5± feet below ground surface. It should be noted that during the initial visit to the site, areas of ponded surface water were observed.

Additionally, it should be noted that long term equilibrated groundwater measurements were not obtained in any of the explorations and that fluctuations in water conditions and groundwater levels should be anticipated to occur with variations in precipitation, snowmelt, site development, and other factors not present during the exploration program. Groundwater levels should be anticipated to vary and perched water conditions may occur during and after periods of intense precipitation and snowmelt due to the low permeability glacial till deposits.

The new school building footprint and finish floor grades have not yet been established. Based on observed field conditions at the time of the exploration program, groundwater may potentially be encountered during excavation for the building basement and footings, and for deeper utility or drainage structure excavations, depending upon final design grades for the site. Depending on groundwater conditions and climatic conditions at the time of construction, the Contractor should be prepared to provide for local dewatering using a method that is familiar to him and that is acceptable to the Engineer.

4.0 PRELIMINARY DESIGN CONSIDERATIONS

Based on the limited test boring data developed as part of this preliminary geotechnical engineering study, MMI has developed preliminary recommendations for supporting the proposed school structure on regular spread footing foundations within the site as outlined herein. These preliminary recommendations are based on the proposed structure being sited within the general area of the current test borings. Once the actual school building footprint has been set on the site, it will be necessary to execute a site and structure-specific subsurface exploration program designed for the actual proposed school attributes.

4.1 Spread Footings Support

Spread footing foundations may be supported directly on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces, in accordance with the recommendations outlined herein.

A minimum 12-inch-thick choke layer is recommended over rock surfaces in order to chink any exposed fractures and joint sets across rock subgrades prior to placement of foundations or new CSF. The choke layer material will prevent loss of overlying soil fines from migrating into exposed bedrock fractures and joint sets.

All existing forest mat, existing fill, woody debris, subsoil and any other deleterious materials (i.e. roots, stumps, woodchips, organics, etc.) should be completely removed from below all footings, floor slabs, footing bearing zones, and be replaced with new CSF. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural glacial till deposits or bedrock are encountered.

Footings bearing on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces may be proportioned for a net allowable soil bearing pressure of 3,000 pounds per square foot (psf) to 5,000 psf (subject to results of additional building-specific borings). All replacement and raise-in-grade compacted structural fill should be compacted to a minimum of 95 percent maximum dry density per ASTM D 1557.

For frost protection, exterior footings should be founded at least 4 feet below finished exterior grades. Interior footings below heated areas may be founded a minimum of 24 inches below the top of floor slab or finished grade.

A slope of 1H:1V should be maintained between the bottom edges of adjacent underground utility trenches and between adjacent footings. Footings should be stepped, as required, in transition areas where different footing levels occur.

It is further recommended that the minimum width of isolated spread footings be 36 inches and that the minimum width of continuous footings be 24 inches

4.2 Floor Slab-On-Grade

Floor slabs should be supported on a minimum 9-inch thick crushed aggregate base course (NHDOT Item 304.33) placed and compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557. Excavated on site forest mat material, subsoil materials, glacial till deposits, and excavated weathered rock/competent rock should not be reused as floor slab base course material. The floor slab base course should be placed directly on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces in accordance with the recommendations outlined herein.

As with footings, all existing forest mat, any in-place fill, and all other deleterious materials (i.e. roots, stumps, woodchips, organics, etc.) should be completely removed from below all floor slabs and be replaced with CSF where necessary.

A vapor barrier should be placed below all slabs on grade to protect against capillary moisture impact to the concrete and limit the transmission of moisture into the floor slab. The Architect and/or Structural Engineer should specify the location of the vapor barrier placement relative to the base course material and take the placement of this vapor barrier into account in the concrete slab design curing specifications for the project. It is recommended that a heavy-duty vapor barrier consisting of a single layer of 15 mil minimum high density reinforced polyethylene be used.

A modulus of subgrade reaction, k_{sl} of 100 pounds per cubic inch (pci) to 175 pci may be considered for design of the slabs on grade (subject to results of additional building-specific borings). Note, however, that the value of k_{sl} is for a 1 square foot area. The k_{sl} value should be adjusted for larger areas using the following equation:

Modulus of Subgrade Reaction (k_s) = $k_{sl}\,(B+1/2B)^2$

Where: k_s = Coefficient of vertical subgrade reaction for loaded area

k_{sl} = Coefficient of vertical subgrade reaction for 1 x 1 square foot area

B = Width of area loaded, in feet

Please note that limited cracking of slabs-on-grade is normal and should be expected. Cracking may occur not only as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for floor slab cracking, it is recommended that the measures listed below should be followed during construction:

- The installation of floor slab construction joints as recommended by the American Concrete Institute (ACI) between the columns and walls and between columns to account for differential settlements.

- All backfill in areas supporting slabs should be moisture conditioned and compacted. Backfill in all utility trenches should be carefully compacted.

- Exterior slabs should be structurally isolated from the building.

- A minimum 6-inches of compacted Crushed Aggregate should be placed between the bottom of floor slabs and the top of footings, to serve as a cushion layer.

4.3 Seismic Considerations

MMI has evaluated the site seismic Site Class in accordance with the 2009 International Building Code (IBC) Sections 1615 and 1616. Based on the existing subsurface soil profile encountered in the borings, per 2009 IBC Section 1613.3.2, the site class preliminarily appears to meet the requirements of a seismic Site Class C.

MMI performed an analysis to evaluate the susceptibility of the in-situ material to potentially liquefy using the commercial software package "LiqIT" which is based on commonly used field data. The calculation procedure invoked includes:

- The evaluation of CRR (Cyclic Resistance Ratio), which is the soil "strength", according to the available field SPT data.
- The estimation of the induced seismic load expressed through Cyclic Strength Ratio (CSR).
- The calculation of the factor of safety against liquefaction.
- The post-liquefaction induced vertical settlements.

Input parameters include engineering estimates of groundwater depth, percentage of soil fines, soil unit weights and SPT values along with the design earthquake magnitude and peak acceleration appropriate for the project area. Based on published information obtained from the United States Geological Society (USGS), an earthquake magnitude of 5.98 with a return frequency of 100 years and a peak acceleration of 0.075g (Site Class C) with a 2% probability of exceedance in 50 years were selected for the analysis.

Results of the liquefaction analysis indicate that the general nature of the in-situ materials, their in-situ density, and absence groundwater do not render them susceptible to liquefaction. The accompanying analytical results are included in Appendix C.

4.4 Retaining Walls and Foundation Walls below Grade

Retaining walls or unbalanced load condition foundation walls should be designed to resist the combined lateral forces resulting from earth pressures as well as those posed by any surcharge loading. Backfill materials behind these walls should consist of new compacted structural fill except that a continuous 2-foot thick chimney drain should be placed behind the wall.

Considering the recommended backfill soil, it is recommended that earth pressures be calculated based upon an equivalent fluid weight of 45 pounds per cubic foot (pcf) for the active condition (i.e. unbraced top of wall), 65 pcf for the at-rest condition (i.e. braced top of wall), and 225 psf for passive pressures; with any surcharge loadings applied over the face of the wall at an intensity equal to 0.3, 0.5 and 3 times the surcharge loading for the active, at-rest and passive conditions, respectively.

Where the calculated earth pressure behind walls is less than 200 pounds per square foot (psf), it should be increased to 200 psf to account for stresses created by compaction within 5-feet of the wall. The minimum design factors of safety for sliding and overturning under static loads should be 1.5 and 2, respectively. Passive pressure at the toe of retaining walls subject to freeze/thaw conditions should not be included as a resisting force when analyzing for overturning and sliding. A coefficient of sliding friction of 0.35 between mass concrete and existing in-place glacial deposits, CSF or choke layer material and may be considered for wall design.

The above-referenced lateral earth loads do not include hydrostatic forces, as they are based on construction of a subdrainage system behind all walls to collect and discharge any potential groundwater, perched water or water from sub-slab utilities that could leak or become damaged.

Equivalent seismic lateral loading against walls represented as an inverse triangular loading may be defined as $0.045(Y_t)\ H^2$ where Y_t is the total weight of the soil acting against the wall and H is the height over which the backfill soil acts. Considering the existing subsurface conditions, an equivalent fluid weight of 18 pounds per cubic foot (pcf) should be considered.

If modular block retaining walls are proposed, both the internal stability of the wall (usually designed by the supplier/vendor's Engineer) and the overall global stability (usually analyzed by the Owner's Engineer) will need to be performed in order to result in a complete, well-coordinated and satisfactorily designed wall system.

4.5 Foundation Drainage

Depending upon final design grading (i.e. proposed cuts and fills), and in consideration of the existing site topography, the potential exists for temporary perched water over the shallow bedrock and low permeability glacial till deposits; therefor surface water runoff may collect around building foundations. Accordingly, a subsurface subdrainage system should be considered. As a minimum, exterior perimeter footing subdrains are recommended to limit accumulation of water and fugitive moisture near the building. Additionally, subdrains below floor slabs on grade may also be required to prevent concrete slabs from being impacted by subsurface water.

Subdrains should generally consist of slotted corrugated polyethylene tubing of 6-inch minimum diameter, meeting the requirements of ASTM F 405 or AASHTO M252, surrounded by ¾ inch stone, and be entirely enveloped by non-woven geotextile. The use of geotextile will limit the migration of fines from fills and natural soils into the coarse aggregate, thus reducing long term clogging. The subdrain inverts should be set a minimum of 4 feet below adjacent exterior grades to protect against frost penetration. Cleanouts should be provided at every other 90 degree bend, in order to provide for future flushing of the system in the event that siltation or other clogging of the piping should occur.

Drains should generally be installed at a minimum 0.5 percent slope and discharge to a suitable system outlet. The system should be gravity drained, if possible, to storm water catch basins or other suitable discharge locations. Subdrain inverts into catch basins should be at least 1½ feet higher than catch basin outlet inverts. If gravity draining of the subdrain system is not possible, a suitable sized holding tank with integral sump pump, including a back-up sump pump, will be required. A sump invert at a minimum 18 inches below the lowest subdrain pipe invert elevation should be maintained if a sump is used. No subdrain system should be connected to roof drain systems.

The final outlet of all subdrainage systems must be designed by the Project Site-Civil Engineer in consideration of all City of Nashua, State of New Hampshire and Federal regulations. The final design site plans should be provided to MMI for our review to determine the actual extent of the various subdrainage systems particularly after project final design grades have been selected.

Additionally, it will be further necessary for the Engineer to determine actual subdrainage requirements once final design structure-specific test borings have been completed as well as in the field during the construction-phase of this project based on his/her observations.

4.6 Pavement Considerations

Prior to placement of any required new raise-in-grade CSF within proposed pavement areas, all existing forest mat, subsoil and any excessively loose or soft surficial in-place subsoil materials should be removed. All resultant subgrade surfaces to potentially remain below pavement areas should then be assessed by proofrolling under the observation of the Engineer prior to placement of any new raise-in-grade materials and pavement support materials.

Evaluation of the necessity for this proofrolling, and interpretation of the results to ascertain suitability of these subgrade materials for support of new raise-in-grade materials and proposed pavement support materials should be made by the Engineer during construction. Proofrolling should be performed with at least 4 passes of a steel drum compactor weighing at least 10 tons, without the use of vibratory compaction.

After proofrolling operations have been completed to the satisfaction of the Engineer, the upper 12 inches of all subgrade soils to remain in place should be compacted to at least 95% of ASTM D 1557.

The subgrade soil for support of pavement sections should consist of suitable proofrolled and compacted in-place fill materials, glacial till deposits, choke layer material or CSF placed over these subgrade surfaces. Depending upon final grading plan cuts and fill and as determined by the Engineer during construction, it may also be necessary to place a geotextile stabilization layer over subgrade surfaces prior to placement of pavement support materials. Although traffic loadings are not currently developed, based on typical school vehicular loads, MMI has considered the following ranges of pavement sections:

	STANDARD DUTY PAVEMENT SECTION	HEAVY DUTY PAVEMENT SECTION
BITUMINOUS CONCRETE:		
Top Course Thickness	1.5 inches	2.0 inches
Binder Course Thickness	2.0 to 2.5 inches	2.5 to 3.0 inches
SUPPORT MATERIALS:		
Base Course Thickness (NHDOT 304.4)	6 to 12 inches	9 to 15 inches
Subbase Course Thickness (NHDOT 304.3)	12 to 18 inches	15 to 24 inches

The base course and subbase should be compacted to at least 95% of the optimum dry density per ASTM D 1557. Underlying raise in grade structural fill should be compacted to at least 95% of the optimum dry density per ASTM D 1557.

Actual asphalt thicknesses and support material thicknesses will be dependent upon the final grading plans and vehicular loads yet to be determined (subject to results of additional pavement area-specific borings).

5.0 EARTHWORK CONSIDERATIONS

All raise in grade fill placed above natural glacial materials or choke layer material should consist of new CSF fill, meeting the requirements of Section 7.5, to subgrade elevations.

All existing forest mat, subsoil, any in-place fill, boulders, foundations, building remnants and any other deleterious materials should be completely removed from below all footings and floor slab areas until encounter with suitable undisturbed natural glacial soils, suitable approved soil surfaces or weathered bedrock / bedrock.

5.1 Groundwater

Based on the in-situ depth to groundwater at the time of the exploration program (as encountered in MMI-1), the moderate site topography and low permeable glacial till and bedrock surfaces, groundwater will likely be encountered during excavation for proposed building foundations unless deep excavations are proposed based on final grading plans. However, the Contractor should be prepared to perform local dewatering and subgrade stabilization, in accordance with the recommendations outlined in Section 7.3 of this report, as necessary.

It is important to note that fluctuations in groundwater and perched water conditions should be anticipated to occur with variations in precipitation, snowmelt, site development, and other factors not present during the exploration program.

5.2 Unsuitable Soils and Subgrade Preparation

All existing unsuitable soils should be completely removed from below all footings, floor slabs and the footing bearing zones and be replaced with new CSF where spread footing foundations and floor slabs are contemplated. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural glacial deposits or bedrock is encountered. All replacement structural fill required below footings should meet the requirements given in Section 7.5.

The contractor should be required to maintain a dry (dewatered, if necessary) stable-working soil subgrade bottom during footing construction. Subgrades should slope to sumps as necessary.

Prior to placement of new CSF fill, the in-situ subgrade soils should be assessed for proofrolling. This will allow the Engineer to evaluate for the presence of any soft or weaving unsuitable existing subgrade materials. Any such soft or weaving unsuitable existing subgrade materials should be locally over-excavated and replaced with new CSF.

Footing subgrades should be constructed essentially level prior to placement of reinforcing steel and concrete. It is recommended that all footings be excavated and concrete placed the same day in order to avoid ponding of any surface water runoff in the excavations. Disturbed, frozen or loosened soils should be removed prior to placement of concrete. The footing subgrades should be free of water for the final observation and during placement of concrete. Ground surface grades in the vicinity of the excavations should be graded to promote positive drainage away from the open excavations.

5.3 Subgrade Stabilization

Due to the moderately sensitive nature of the in-situ natural glacial soils; excessive snowmelt, precipitation, runoff, high groundwater, perched water, subgrade disturbance or other construction phase conditions may result in areas of subgrade instability (i.e. weaving, pumping, etc.). No footings, floor slabs, structures, or structural fill should be placed over unstable subgrade surfaces. Should an area of unstable subgrade be encountered, the area should be either:

a. Be left undisturbed until it has dried sufficiently to allow compaction to a minimum of 95 percent of maximum dry density per ASTM D 1557 and remain in a stable condition; or

b. Be locally over-excavated as necessary and replaced with a layer of non-woven geotextile stabilization fabric and crushed stone; or

c. Be locally over-excavated as necessary and a minimum 4 inch thick lean concrete mud mat placed.

The need for excavation and replacement of unstable subgrade soils should be assessed by the Engineer.

5.4 Materials Reuse

It is anticipated that most of the excavated on-site soils will not be suitable for reuse as new structural fill; however, any limited amount of potentially reusable excavated materials that meet the gradation requirements of Section 7.60 will need to be approved by the Engineer. The Contractor should consider additional efforts that will be required to screen out boulders and cobbles, and to reduce the moisture content of excessively wet excavated soils prior to placement and compaction.

All potentially re-usable materials should be segregated and reused only following approval by the Engineer.

5.5 Materials, Placement and Compaction

Structural Fill to be used for raise-in-grade, in backfilling within the building areas, below footings and floor slabs, excluding the recommended 9 inch floor slab base course, should have a liquid limit and plastic limit not exceeding 40 and 15, respectively, and meeting the following gradation requirements:

STRUCTURAL FILL	
SIEVE SIZE	PERCENT FINER BY WEIGHT
4 inch	100
No. 4	50-85
No. 10	25-75
No. 40	10-50
No. 100	8-35
No. 200	4-10 (total)

Crushed Aggregate to be used for the recommended 9 inch thick slab base course, for choke layer material and for chimney drains behind retaining walls should consist of NHDOT Item 304.33, a fine graded crushed gravel consisting of hard, durable particles or fragments of stone or gravel. Materials that break up when alternately frozen and thawed or wetted and dried shall not be used. Fine particles should consist of natural or processed sand. The materials should be free of harmful amounts of organic material and meet the following gradation requirements:

CRUSHED AGGREGATE (NHDOT 304.33)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
1 ½ inch	100
1 inch	90-100
½ inch	65-90
No. 4	30-55
No. 200	0-10 (total)

Crushed Stone (3/4") to be used for utility construction, subdrainage systems or for use as a stabilization material over wet and sensitive subgrades should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and should consist of hard durable sand and gravel conforming to the NHDOT #67 Stone as follows:

¾" CRUSHED STONE (NHDOT #67 Stone)	
SIEVE SIZE	**PERCENT FINER BY WEIGHT**
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5

All fill should be placed in loose lifts not exceeding 12 inches in thickness and should be compacted to a minimum of 95% of maximum dry density per ASTM D 1557, Method C, with the moisture content no less than 3 percent below or 1 percent above the optimum moisture content as determined by ASTM D 1557.

Backfill within a zone defined by a 45 degree (1H: 1V) from vertical extending upward and outward from the bottom edge of frost walls should be placed in maximum 6-inch loose lifts and compacted using manually operated equipment to avoid damaging the frost walls.

Geotextile for use in subdrain construction and stabilization should consist of nonwoven geotextile fabric such as Mirafi 140N or similar.

5.6 Deep Excavations

Deep excavations may be necessary for construction of foundation elements or underground utilities. As an alternative to temporary slopes, vertical excavations can be temporarily shored. The Contractor or the Contractor's specialty subcontractor should be responsible for the design and adequacy of any temporary shoring in accordance with all applicable regulatory requirements. The Owner and Contractor should make themselves aware of and become familiar with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations.

The Contractor should be aware that slope height, slope inclination, and excavation depths, including utility trench excavations, should in no case exceed those specified in local, state or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, and all successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors may be liable for substantial penalties. MMI is providing this information solely as a service to the City of Nashua. Under no circumstances should the information provided herein be interpreted to mean that MMI is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

5.7 Rock Excavation Considerations

As indicated previously, HSA refusal conditions were encountered in each test borings at varying depths. Given this condition, rock excavation will likely be required for this project, depending on final design grading plans. It should also be noted that abrupt changes in top of rock elevations can occur over relatively short horizontal distances and should be expected on this site. Actual rock excavation depths can only be accurately determined during construction once all overburden materials have been removed. It is desirable to limit the depth of bedrock overblast, since all overblast material must be removed from below proposed building footprints and footing bearing zones.

5.7.1 Rock Removal Techniques

Controlled drilling and blasting must be carefully performed so as not to damage nearby structures. Other methods of rock excavation such as mechanical chiseling or chemical fracturing should also be considered, based on required quantities and economic considerations.

Any blasting operations should conform to State of New Hampshire and City of Nashua regulations. Additionally, all blasting should also adhere to the provisions of 29 CFR Ch. XVII Section 1910.109 for explosives and blasting agents.

Nearby properties consist of residential structures and underground utilities, all of which are potentially susceptible to blasting induced vibration damage. In order to prevent any blasting damage, all blasting should be accomplished in a safe, least disturbing manner to prevent any damage to the abutting structures, cut rock slope and utilities. Heavy blasting mats should be utilized on top of a minimum 3 foot layer of soil to prevent fly-rock and reduce destructive airblast overpressures.

Upon completion of rock excavation within proposed building footprint, all loose and over blasted materials should be completely removed from below all footing and floor slab areas prior to placement of any new fill materials.

5.7.2 Pre-Blast Survey

Existing structures and underground utilities are susceptible to damage due to seismic blasting responses. Accordingly, a pre-blast survey should be conducted at all existing structures that will be located within 500 feet of each proposed blast. Prior to blasting, the following pre-blast survey measures should be implemented:

a) Pre-blast survey requirements should be conducted in accordance with the requirements of local authorities.

b) Contact all owners likely to be impacted by the rock excavation operations and obtain legal access to these structures for survey.

c) Survey methods should entail the observation and documentation (video and still photography) of the interior and exterior features of each structure being reviewed. Documentation should also include any interior sensitive equipment and the manufacturers specified vibration tolerances if available. Landscaped features including retaining walls, decorative features (sculptures, stonewalls, patios, etc.) should be surveyed to document their present condition.

d) The condition of existing underground utilities should be verified through the local utility provider and documented.

e) Familiarize the property owners as to what will likely occur during the rock excavation activities on each individual property.

f) Obtain information from property owners regarding any existing structural defects.

g) Preparation of a written report including the aforementioned surveyed results for each structure analyzed and distribute to the City of Nashua's Fire Marshall's office.

5.7.3 Blast Design Considerations

Preliminary blast design operations in conjunction with resulting seismic response monitoring should be based on limitations of the maximum peak particle velocity versus frequency graph as established by the US Bureau of Mines. MMI recommends that an initial scaled distance of 100 be used for design of the first blast, with appropriate seismic monitoring, in order to document the seismic response. Providing that detrimental seismic responses are not obtained with the initial blast, the next detonation may be designed using a lesser scaled distance along with appropriate seismic monitoring. This procedure may be repeated, providing that detrimental seismic responses do not occur. Scaled distances of less than 50 should not be used at any time. Additionally, scaled distances of not less than 100 should be used for all blasts within 100 feet of the nearest structure or underground utility.

The following maximum recommended charge weight/delay versus distance relationships and frequency versus amplitude relationships should be followed and not exceeded at any time:

Estimated Maximum Charge Wt/Delay (lbs)	Distance (ft)
Less than 4	100
5 – 16	200
17 – 25	300
26 – 36	400
37 – 50 (maximum)	500
Frequency of Ground Vibration (Hz)	**Maximum Amplitude of Ground motion (inches)**
Up to 10	0.0305
20	0.0153
30	0.0102
40	0.0076
50	0.0061
60	0.0051
70	0.0043
80	0.0038

Lesser charge weights per delay may be required depending upon the seismic response.

Response frequencies for nearby structures are estimated to be in the range of 5 to 20 Hz, respectively. Additionally, rock excavations creating blast vibration frequencies which approach the response frequency of these structures should be avoided so that the maximum allowable peak particle velocities indicated by the U.S. Bureau of Mines are not exceeded in order to minimize the resonant effects. This US Bureau of Mines guidance should be considered as upper limit relationships only; lower response frequencies and velocities may be necessary.

Seismograph instrumentation should be set up at the nearest structure to each blast and at any structures identified during the pre-blast survey that are considered to be particularly susceptible to vibration damage. Peak particle velocity versus frequency, resultant waveform and airblast overpressures should be recorded. Monitoring results from each blast should be given to the blasting contractor as soon as possible so that he can modify his blasting program to conform to the recommendations given herein.

These guidelines are provided to assist the Blasting Contractor in the development of his blasting program. However, it is the ultimate responsibility of the Blasting Contractor to perform all blast related activities without damage to any structures and underground utilities.

6.0 FINAL DESIGN AND CONSTRUCTION

After the proposed building footprint and grading have been selected and designed, MMI recommends that additional site and structure-specific explorations be performed, and a final geotechnical engineering report prepared.

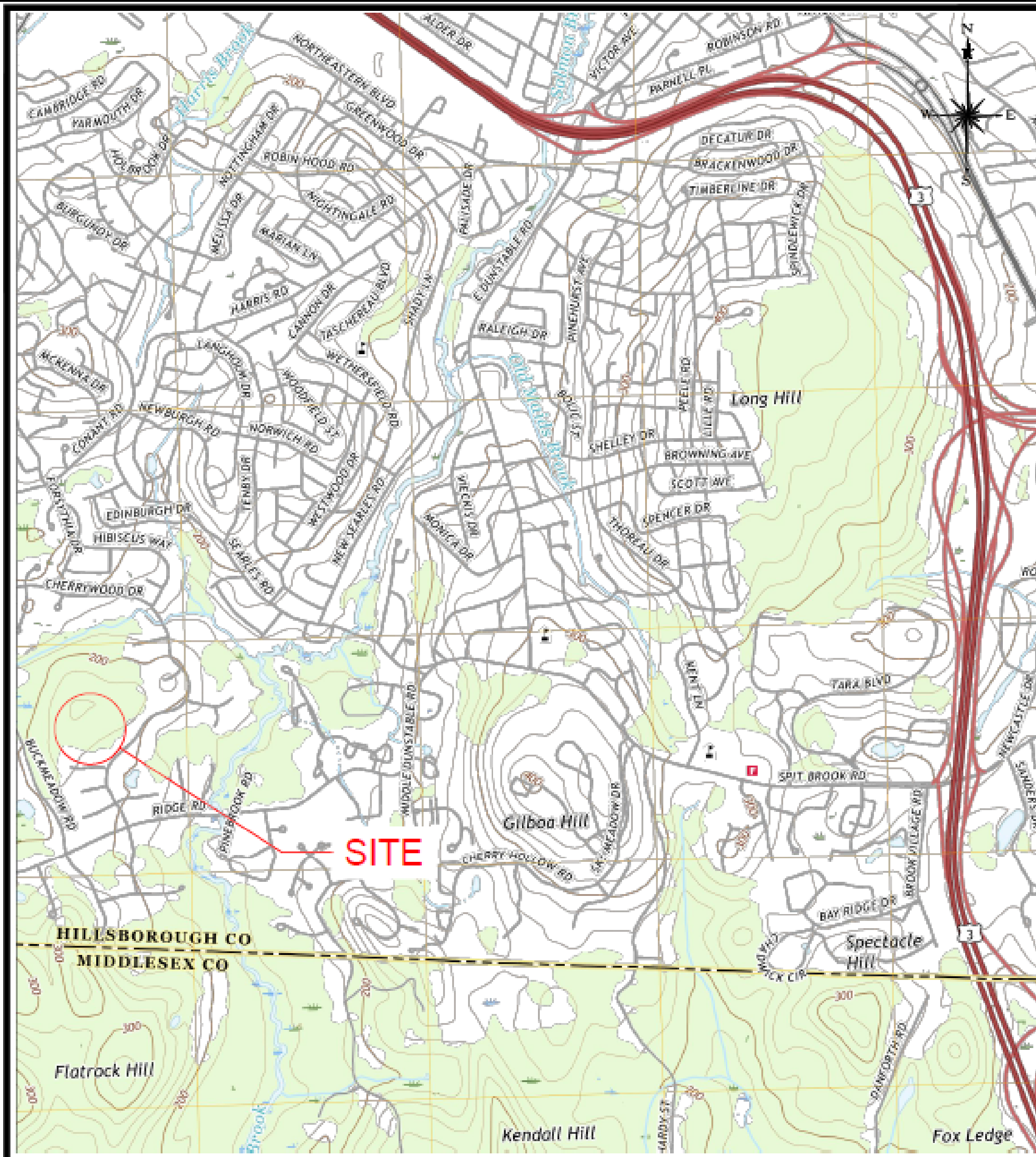
After the final geotechnical engineering report is prepared, it is recommended that MMI be retained to provide construction observation services, including observation and monitoring of all operations involving pile installations, soil/rock excavation, proofrolling, removal of unsuitable materials and overburden soils, assessment of existing in-situ soils as potentially may be considered to remain in place or be reused, and for preparation of spread footing foundation and floor slab subgrades.

Observations and testing of fill material placement and compaction should also be performed. The purpose of these observations and testing is to verify that construction is being performed in accordance with the intent of the recommendations given in this report and to observe any changes in subsurface conditions which may warrant modification to the foundation systems recommended herein.

If MMI is not retained to provide full-time observation of earthwork during the construction-phase of this project, we cannot be held responsible if unforeseen conditions are not identified and addressed, or if conditions identified in this report are not addressed as we intended.

It is also recommended that once final site, grading and foundation plans have been developed, and the final geotechnical engineering report prepared, that construction-phase plans be reviewed by MMI in order to assess whether any of our geotechnical engineering-related recommendations will require revision, or if additional explorations, subdrainage, or other recommendations are required based on proposed final grades and structural layouts. The recommendations provided herein shall not be considered valid unless MMI is provided the opportunity to review the final site, grading, and foundation plans.

FIGURES



SOURCE: 2018 USGS NASHUA SOUTH (NH), 7.5 MINUTE SERIES.

MILONE & MACBROOM

FIGURE 1 - SITE LOCUS

PROPOSED NEW SCHOOL

CHERRYWOOD DRIVE
NASHUA, NEW HAMPSHIRE

DATE	MAY 2019
SCALE	1" = ±2000'
PROJ. NO.	6119-03-01-2

DESIGNED	DRAWN	CHECKED
EAA	EAA	CET

DRAWING NAME: **FIG. 1**

PROJECT PHASE: GEOTECHNICAL REV: —

B:\6119-03 City of Nashua Elm Street School\New School\CAD\6119-03-01-2 Fig 1.dwg

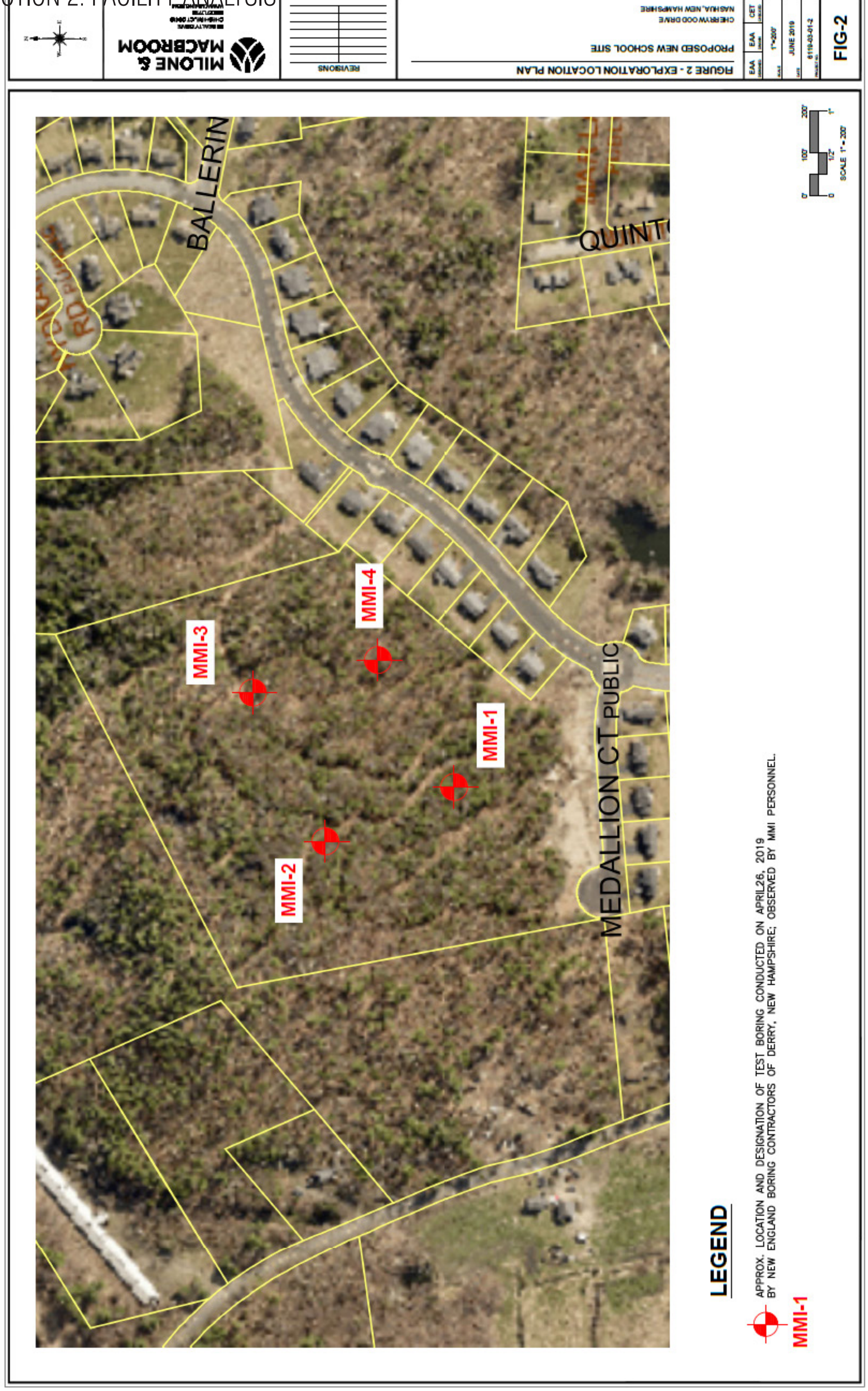


FIGURE 2 - EXPLORATION LOCATION PLAN
PROPOSED NEW SCHOOL SITE
CHERRYWOOD DRIVE
NASHUA, NEW HAMPSHIRE
MILONE & MACBROOM
REVISIONS
1"=200'
JUNE 2019
6119-03-01-2
FIG-2
SCALE 1" = 200'
BALLERIN
QUINT
MEDALLION CT PUBLIC
MMI-1
MMI-2
MMI-3
MMI-4
LEGEND
APPROX. LOCATION AND DESIGNATION OF TEST BORING CONDUCTED ON APRIL26, 2019 BY NEW ENGLAND BORING CONTRACTORS OF DERRY, NEW HAMPSHIRE; OBSERVED BY MMI PERSONNEL.

TABLES

MILONE & MACBROOM

TABLE 1
SUMMARY OF SUBSURFACE EXPLORATIONS
PROPOSED NEW SCHOOL
CHERRYWOOD DRIVE, NASHUA, NEW HAMPSHIRE
PROJECT NO. 6119-03-01-2

EXPLORATION DESIGNATION	BOTTOM OF FOREST MAT/ SUBSOIL	TOP OF GLACIAL TILL DEPOSITS	BOTTOM OF EXPLORATION	OBSERVED GROUNDWATER LEVELS DURING DRILLING OPERATIONS
	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)
MMI-1	4.0 ±	NE	4.0 ± R	NE
MMI-2	3.0 ±	3.0 ±	5.3 ± R	3.5 ±
MMI-3	3.5 ±	3.5 ±	4.9 ± R	NE
MMI-4	3.5 ±	3.5 ±	10.8 ± R	NE

Notes:
1) Test Borings were performed on April 26, 2019 by New England Boring Contractors of Derry, New Hampshire.
2) Groundwater levels were measured during exploration advancement and therefore are not indicative of stabilized groundwater conditions.
3) "NE" indicates not encountered.
4) "R" indicates auger refusal

B:\6119-03 City of Nashua Elm Street School\New School\6119 Table 1.xlsx

APPENDIX A

Limitations on Work Product

MILONE & MACBROOM

APPENDIX A

LIMITATIONS ON WORK PRODUCT

Site Observations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from limited subsurface observations. The nature and extent of subsurface variations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. 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 limited observations (no engineering subsurface samples were obtained; actual soil and bedrock transitions are probably more erratic.

3. Water level readings have been made under conditions stated. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of groundwater may occur due to variations in rainfall, temperature and other factors occurring since the time observations were made.

4. In the event that any changes in the proposed general project development are planned (e.g. floor slab on grade elevations, column and wall loads, building footprint size and location, etc.), 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 Milone & MacBroom, Inc. (MMI). It is recommended that this firm be provided the opportunity to review the final design plans and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented.

Construction

5. It is also recommended that this firm be provided the opportunity to perform the recommended construction phase monitoring services to verify that the intent of our recommendations is being properly implemented in the field during construction. The recommendations given in this report shall not be considered valid unless we are given the opportunity to perform in this capacity.

Topographic Data

6. Site topographic data was not available for our review during the performance of our current geotechnical engineering services.

Use of Report

7. This Geotechnical Engineering Report has been prepared for the exclusive use of the City of Nashua relative to the proposed new school planned to be located off Cherrywood Drive in Nashua, New Hampshire and is intended to be in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied is made.

8. This Geotechnical Engineering Report has been prepared for this project by Milone & MacBroom, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it only with the authorization of the owner and then with the understanding that its scope is limited to design considerations only.

APPENDIX B

Subsurface Exploration Logs

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-1 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.
TYPE	HSA	--	S	--
SIZE ID (IN)	3 1/4	--	1 3/8	--
HAMMER WT (LB)	--	--	140	--
HAMMER FALL (IN)	--	--	30	--

GROUNDWATER OBSERVATIONS
- ELAPSED TIME (HR)
- CASING AT (FT)
- DEPTH (FT)
- [X] NO GROUNDWATER ENCOUNTERED

- [ ] FIELD TESTING
- [ ] LABORATORY TESTING
- [ ] MONITORING WELL INSTALLED
- [ ] PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	20	1	6" Forest Mat	FOREST MAT 0.5	
1			3	Loose red brown fine SAND, some Silt.	SUBSOIL	
			2		1.5	
2			3	Loose brown fine SAND, little Silt.	SUBSOIL	
3						
4				Auger refusal at ±4'	4	
	S2	0	100/4"	Very dense, No Recovery.		
5				Offset 5' north,		
				Auger refusal at ±4'		
6				Bottom of Exploration at ± 4'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-2 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL	GROUNDWATER OBSERVATIONS			
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0		
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)	5		
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	3.5		
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED			

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	12	1	2" of very loose red-brown fine SAND, some Silt, organics.	SUB-SOIL	
			1	4" of tan fine Sand, some Silt, trace Gravel.		
			1			
2						
3					3	
				Auger Action indicates cobble/gravel from 3'-5.3'±.	▽ G.W.T. 3.5	
4					GLACIAL TILL	
5	S2	3	100/3"	Very dense red-brown fine SAND, little Silt, rock fragments.	5.3	
				Auger Refusal at 5.3±		
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-3 SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA	--	S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)			
HAMMER FALL (IN)	--	--	30	--	X NO GROUNDWATER ENCOUNTERED			

- ☐ FIELD TESTING
- ☐ LABORATORY TESTING
- ☐ MONITORING WELL INSTALLED
- ☐ PID SCREENING
- ☐

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	16	1	4" Forest Mat	FOREST MAT 0.3	
			1	Loose red-brown fine SAND, some Silt.	SUBSOIL	
1			1	Very loose brown fine SAND, little Silt.		
			3			
2						
3					3.5	
4	S2		24	Very dense grey brown rock fragments.	GLACIAL TILL	
			100/5"	Auger refusal at ±4.5'	4.9	
5				Offset ±8' west, Auger refusal at ±2.5'		
				Bottom of Exploration at ± 4.9'		
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-4	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA	--	S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	4 1/4	--	1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)			
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED			

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING
☐

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	10	1	Very loose red-brown fine SAND, little Silt, organics.	SUB-SOIL	
			2			
			6			
2						
3					3.5	
4				Auger Action indicates cobble/gravel from 3.5'-5'±.	WEATHERED GLACIAL TILL	
5			18	Very dense red-brown fine SAND, little Silt, rock fragments.		
6	S2	16	29		6	
			32	Auger Action indicates cobble/gravel from 6'-8.5'±.	GLACIAL TILL	
			37			
7						
8						
9						
10	S3	10	78	Top 5": Very dense fine sand, little Silt, rock fragments.		
			100/4"	Bottom 5": Dark gray rock fragments.	10.8	
11				Auger Refusal at 10.8'±		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted	N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl	50 + = VERY DENSE	30 + = HARD		

APPENDIX C

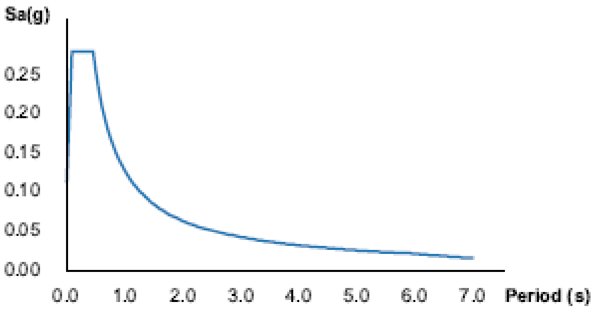
Liquefaction Analysis Results

ATC Hazards by Location

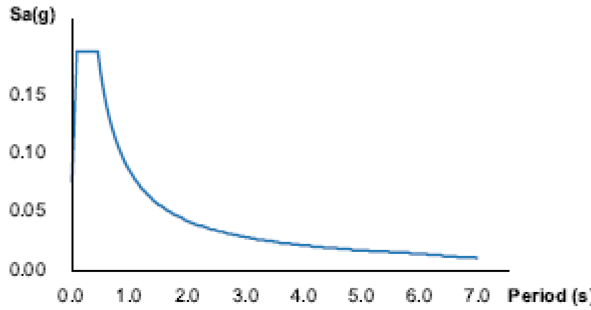
Search Information

Coordinates:	42.71006401785797, -71.49595317249145
Elevation:	246 ft
Timestamp:	2019-05-23T15:50:21.905Z
Hazard Type:	Seismic
Reference Document:	NEHRP-2009
Risk Category:	II
Site Class:	C

MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.234	MCE_R ground motion (period=0.2s)
S_1	0.075	MCE_R ground motion (period=1.0s)
S_{MS}	0.28	Site-modified spectral acceleration value
S_{M1}	0.127	Site-modified spectral acceleration value
S_{DS}	0.187	Numeric seismic design value at 0.2s SA
S_{D1}	0.085	Numeric seismic design value at 1.0s SA

▾Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	1.7	Site amplification factor at 1.0s
CR_S	0.894	Coefficient of risk (0.2s)

CR_1	0.896	Coefficient of risk (1.0s)
PGA	0.126	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.151	Site modified peak ground acceleration
T_L	6	Long-period transition period (s)
SsRT	0.234	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.262	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.075	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.083	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.6	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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Milone & MacBroom, Inc
2 Cote Lane, Suite 1
Bedford, NH 03110
www.mminc.com

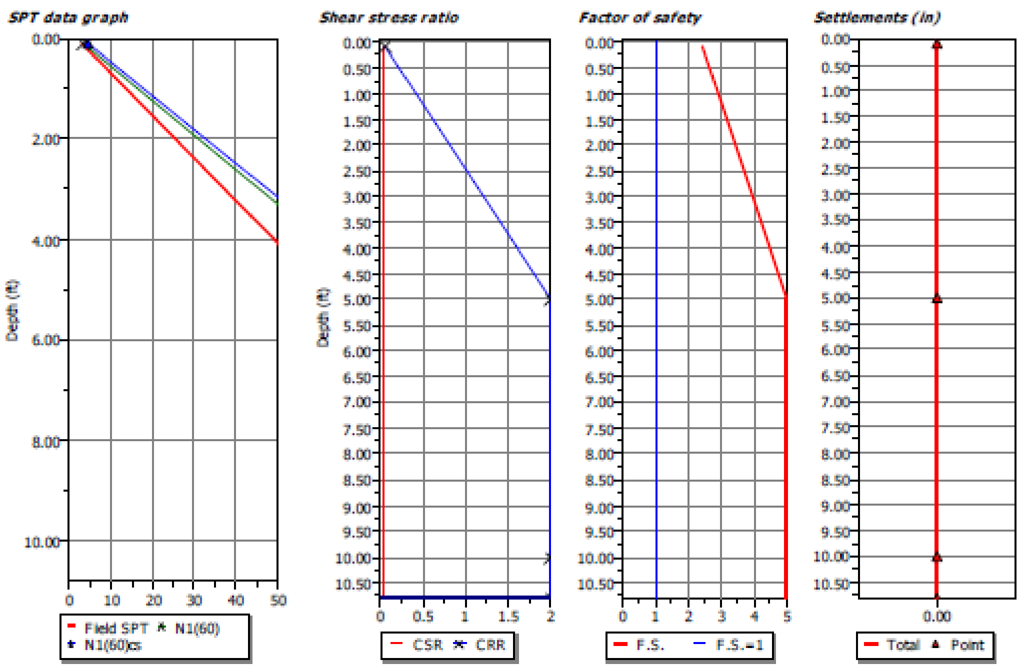
LIQUEFACTION ANALYSIS REPORT

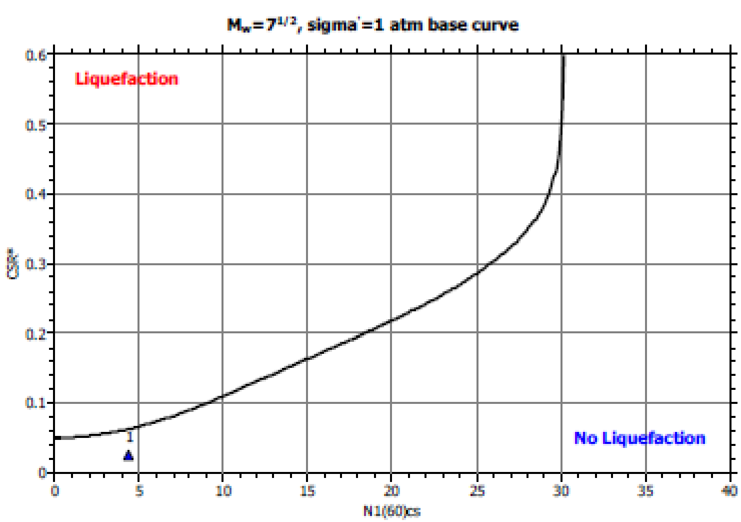
Project title : Proposed New School

Project subtitle : MMI-4

Input parameters and analysis data

In-situ data type:	Standard Penetration Test	Depth to water table:	10.80 ft
Analysis type:	Deterministic	Earthquake magnitude M_w:	5.98
Analysis method:	NCEER 1998	Peak ground accelaration:	0.07 g
Fines correction method:	Idriss & Seed	User defined F.S.:	1.00





This software is licensed to : Charles Teale

:: Field input data ::

Point ID	Depth (ft)	Field N_{SPT} (blows/feet)	Unit weight (pcf)	Fines content (%)
1	0.10	3.00	120.00	10.00
2	5.00	61.00	125.00	10.00
3	10.00	100.00	130.00	10.00
4	10.80	100.00	150.00	0.00

Depth : Depth from free surface, at which SPT was performed (ft)
Field SPT : SPT blows measured at field (blows/feet)
Unit weight : Bulk unit weight of soil at test depth (pcf)
Fines content : Percentage of fines in soil (%)

:: Cyclic Stress Ratio calculation (CSR fully adjusted and normalized) ::

Point ID	Depth (ft)	Sigma (tsf)	u (tsf)	Sigma' (tsf)	r_d	CSR	MSF	$CSR_{eq,M=7.5}$	K_{sigma}	CSR^*
1	0.10	0.01	0.00	0.01	1.00	0.05	1.79	0.03	1.00	0.03
2	5.00	0.31	0.00	0.31	0.99	0.04	1.79	0.03	1.00	0.03
3	10.00	0.64	0.16	0.48	0.98	0.06	1.79	0.03	1.00	0.03
4	10.80	0.70	0.18	0.52	0.97	0.06	1.79	0.03	1.00	0.03

Depth : Depth from free surface, at which SPT was performed (ft)
Sigma : Total overburden pressure at test point, during earthquake (tsf)
u : Water pressure at test point, during earthquake (tsf)
Sigma' : Effective overburden pressure, during earthquake (tsf)
r_d : Nonlinear shear mass factor
CSR : Cyclic Stress Ratio
MSF : Magnitude Scaling Factor
$CSR_{eq,M=7.5}$ CSR adjusted for M=7.5
K_{sigma} Effective overburden stress factor
CSR^* CSR fully adjusted

:: Cyclic Resistance Ratio calculation $CRR_{7.5}$ ::

Point ID	Field SPT	C_N	C_E	C_B	C_R	C_S	$N_{1(60)}$	DeltaN	$N_{1(60)cs}$	$CRR_{7.5}$
1	3.00	1.70	0.90	1.00	0.75	1.00	3.44	0.94	4.39	0.06
2	61.00	1.70	0.90	1.00	0.80	1.00	74.66	2.48	77.15	2.00
3	100.00	1.28	0.90	1.00	0.85	1.00	97.93	2.99	100.91	2.00
4	100.00	1.22	0.90	1.00	0.85	1.00	93.62	0.00	93.62	2.00

C_N : Overburden corretion factor
C_E : Energy correction factor
C_B : Borehole diameter correction factor
C_R : Rod length correction factor
C_S : Liner correction factor
$N_{1(60)}$: Corrected N_{SPT}
DeltaN : Addition to corrected N_{SPT} value due to the presence of fines
$N_{1(60)cs}$: Corected $N_{1(60)}$ value for fines
$CRR_{7.5)}$: Cyclic resistance ratio for M=7.5

:: Settlements calculation for saturated sands ::

Point ID	$N_{1(60)}$	N_1	FS_L	e_v (%)	Settle. (in)
1	4.39	3.66	2.45	0.00	0.00
2	77.15	64.29	5.00	0.00	0.00
3	100.91	84.09	5.00	0.00	0.00
4	93.62	78.01	5.00	0.00	0.00

Total settlement : 0.00

$N_{1,(60)}$: Stress normalized and corrected SPT blow count
N_1: Japanese equivalent corrected value
FS_L: Calculated factor of safety
e_v: Post-liquefaction volumentric strain (%)
Settle.: Calculated settlement (in)

:: Liquefaction potential according to Iwasaki ::

Point ID	F	w_z	I_L
1	0.00	9.98	0.00
2	0.00	9.24	0.00
3	0.00	8.48	0.00
4	0.00	8.35	0.00

Overall potential I_L : 0.00

I_L = 0.00 - No liquefaction
I_L between 0.00 and 5 - Liquefaction not probable
I_L between 5 and 15 - Liquefaction probable
I_L > 15 - Liquefaction certain

Geotechnical Report
Proposed New School Site

Cherrywood Drive
Nashua, New Hampshire
September 13, 2019

Prepared for:
City of Nashua – Joint Special
School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

MMI #6119-03-02

Prepared by:
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ENGINEERING | PLANNING | LANDSCAPE ARCHITECTURE | ENVIRONMENTAL SCIENCE

MILONE & MACBROOM

September 13, 2019

Mr. Shawn Smith, Director of Plant Operations
Joint Special School Building Committee
38 Riverside Street
Nashua, New Hampshire 03062

RE: Focused Design-Phase Geotechnical Engineering Report
Proposed New School Site
Cherrywood Drive
Nashua, New Hampshire

Dear Shawn:

Milone & MacBroom, Inc. (MMI) is pleased to submit herewith our Geotechnical Engineering Report for the above-referenced project. We trust that our findings and recommendations outlined in this report will be responsive to your needs at this time.

We appreciate the opportunity to be of continued service to your office and will be available for contact to discuss any questions you may have. Please do not hesitate to contact the undersigned should you have any questions or if we can be of further assistance.

Very truly yours,

Milone & MacBroom, Inc.

Erich A Adler, EIT
Project Engineer - Geotechnical

Charles E. Teale, PE, LSP, LEP
Manager of Geotechnical Engineering & Environmental Services

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1.0 INTRODUCTION

This report presents the results of a design-phase geotechnical engineering study performed by Milone & MacBroom (MMI) at the location of the proposed New School Site located off Cherrywood Drive, Nashua, New Hampshire. A Locus Plan is enclosed as Figure 1.

This report has been prepared for the City of Nashua – Joint Special School Building Committee. Included in this report is a summary of subsurface explorations performed, subsurface conditions observed and the geotechnical implications of these conditions with respect to the initial design and preliminary construction considerations for the proposed development. Please note that this report is subject to the limitations contained in Appendix A.

It is important that the Design Team (Owner, Engineers and Architects), and Contractors read and understand this Report and all attachments (Tables, Figures and Appendices) in its entirety in order to fully understand MMI's initial geotechnical engineering recommendations. As the various geotechnical engineering recommendations are comingled and inter-dependent, they cannot be taken as stand-alone or out of context.

Additionally, it is important to note that this report and the subsurface conditions outlined herein pertain only to those immediate areas where subsurface explorations were performed and should not be considered to be representative of soil conditions throughout the rest of the site, or in areas where test borings were not performed.

1.1 Objective of Study

The objective of our services was to explore subsurface conditions within the proposed structure vicinity, and to develop geotechnical engineering recommendations for the design and construction of the proposed building. This report is based on the prior May 31, 2019 "Preliminary Geotechnical Engineering Report" prepared for the City of Nashua Joint Special School Building Committee and the follow-up request for additional services based on selection of the new school footprint area.

1.2 Scope of Services

The scope of services performed by MMI to meet the above stated objectives included the following:

a. Performance of a site reconnaissance by an MMI geotechnical engineer.

b. Review of published geologic data.

c. Review of the proposed school building and athletic areas, and coordination and observation of a subsurface exploration program consisting thirteen test borings, designated as MMI-101 to MMI-113; at the approximate locations shown on enclosed Figure 2, entitled "Subsurface Exploration Location Plan". The explorations were observed and documented by a geotechnical engineer from our office. Also, preparation of a test boring exploration summary table which is enclosed as Table 1.

d. Preparation of recommendations for foundation support for the proposed structure; including allowable bearing pressures, bearing depths and estimated settlements.

e. Soil laboratory gradation tests to further classify existing soils conditions were performed per ASTMD1140/D422.

f. Frost depth considerations and effects are discussed.

g. Preparation of recommendations for slab support.

h. A discussion of groundwater conditions including seasonal variations was prepared including its impact on construction activities. The implications of groundwater were evaluated and recommendations regarding construction-phase dewatering, and subdrainage systems were developed.

i. Preparation of recommendations for soil subgrades, gradation and material specifications for fill and backfill, compaction requirements and earthwork considerations.

j. Specific recommendations regarding soil excavation and reuse considerations are given.

k. Recommendations for rock excavation including pre-construction survey and vibration monitoring requirements.

l. Flexible pavement designs were developed for parking lots and truck traffic areas based on the test boring data.

m. Seismic considerations regarding foundation design are given based on the 2009 International Building Code and include an assessment of liquefaction potential and determination of the Site Class per IBC Section 1613.

n. Recommended lateral earth pressures (i.e. active, at-rest and passive) against walls below grade with active and passive soil coefficients are presented along with soil sliding coefficients for use in wall design.

o. Construction considerations regarding excavation and earthwork to be considered during the construction-phase of this project have been provided.

p. Preparation of this geotechnical engineering report summarizing our findings and recommendations.

Services with respect to preparation of plans and specifications, performance of additional subsurface explorations, vibrating equipment support considerations, sidewalk support recommendations, pavement design, uplift resisting anchor design, soil laboratory testing, monitoring well installations, attendance at meetings, construction phase quality control, environmental services, vibration studies, and any other services not specifically outlined herein were not included in our current work scope.

1.3 Site and Project Description

Knowledge of the site is based on our review of the preliminary topographic data shown on Figure 2, our site reconnaissance and results of the subsurface explorations.

The subject site is currently vacant, comprised of undeveloped woodland. Medallion Court borders the site to the south and Cherrywood Drive is to the east. Generally, the site consists of moderate topographic relief with several low-lying wet areas.

Based on discussion with Mr. Shawn Smith of the Nashua School District and information provided by Harriman Associates, including the "Topographic Worksheet" prepared by Hayner/Swanson, Inc., MMI understands that the proposed new school design has not yet been finalized but that the approximate foot print has been selected as shown on the attached Figure 2. Column, wall and equipment loads have not yet been developed for this geotechnical engineering report.

2.0 SUBSURFACE CONDITIONS

As part of our current scope of work, MMI coordinated and observed a subsurface exploration program. Subsurface exploration locations were laid out in the field by MMI utilizing a consumer grade GPS system. Elevations were obtained by plotting the locations on the provided Hayner/Swanson, Inc "Topographic Worksheet" plan provided to MMI. Accordingly, the accuracy of the exploration locations are based on the survey method described above and should be considered approximate only to the degree implied by the method use. The as-drilled exploration locations and designations are shown on Figure 2 and are summarized on Table 1.

2.1 Published Geologic Information

MMI referenced published geologic maps for the site, including the Surficial Geologic Map of New Hampshire and the Bedrock Geologic Map of New Hampshire.

2.1.1 Surficial Geology

Based on review of the Surficial Geologic Map of New Hampshire produced by USGS and the New Hampshire Geologic Society, the following was noted:

- Surficial geology within the site is mapped as unstratified drift (glacial till).

2.1.2 Bedrock Geology

Based on review of the Bedrock Geologic Map of New Hampshire produced by USGS and the New Hampshire Geologic Society, the following was noted:

- The site is underlain by bedrock described as the Merrimack Group, Berwick Formation - Purple biotite-quartz-feldspar granofels or schist and interbeds of calc-silicate granofels and minor metapelites.

2.2 Test Borings

2.2.1 Previous Test Borings

MMI previously coordinated and documented the advancement of four test borings for an initial screening phase geotechnical study. Designated MMI-1 through MMI-4, these borings were performed by New England Boring Contractors, Inc. of Derry, New Hampshire on April 26, 2019. Logs of these explorations as prepared by MMI are enclosed in Appendix B.

2.2.2 Current Test Borings

For the current design phase, thirteen test borings, designated as MMI-101 through MMI-113, were performed by New England Boring Contractors of Derry, New Hampshire between August 21 and August 23, 2019. Logs of these explorations, as prepared by MMI, are enclosed in Appendix B.

The test borings were drilled using standard hollow stem auger boring drilling techniques to depths of 4.5± feet to 28±. Standard Penetration Tests (SPTs) were performed in general accordance with ASTM D 1586 in each test boring, with split spoon samples recovered generally at five-foot intervals. The SPT consists of driving a 1-3/8 inch I.D. split spoon sampler with a 140-pound hammer falling 30 inches. The blows for each 6 inches of penetration are recorded for a total of 18 or 24-inches. The sum of the blows required to drive the sampler from 6 inches to 18 inches penetration is referred to as the Standard Penetration Resistance or N-value which is an index measure of in-situ soil density or consistency.

The explorations were performed under the observation of a MMI geotechnical engineer. Soil samples from the test borings were classified in the field by MMI in general accordance with the Burmister Soil Classification System. A copy of the Burmister Soil Classification system is enclosed with the MMI boring logs at the end of Appendix B.

3.0 SUBSURFACE CONDITIONS

A relatively thin surficial forest mat layer was encountered in each boring with variable thicknesses of about 0.2± feet to 0.5± feet overlying a deposit of fine sand subsoil encountered at thicknesses of about 1.5± feet to 3.2± feet. Underlying the fine sand subsoil materials are dense glacial till deposits to the depth investigated. Hollow stem auger refusal conditions were encountered at the bottom of each boring between 4.0± feet and 28± feet. The hollow stem auger refusal conditions encountered are likely indicative of weathered bedrock/bedrock encounter. Three laboratory gradation tests were also conducted on selected soil samples obtained from the exploration program to further classify the in-situ soils per ASTM D1140/D422; the results of these analyses are included in Appendix C.

3.1 Forest Mat and Subsoil

Up to 6 inches of forest mat consisting of leaf litter and organic humus was observed in each boring. However, it should be noted that forest mat materials may be thicker elsewhere across the site. Underlying the surficial forest mat materials is a subsoil consisting of loose brown fine sand, trace to some silt with root fibers encountered in thicknesses of about 1.5± feet to 3.2± feet. The existing forest mat and subsoil are not considered suitable for support of spread footing foundations as unacceptable settlement would be anticipated.

3.2 Glacial Till

Underlying the subsoil are glacial till deposits consisting of red brown to grey brown fine sand, little gravel, little silt. With N-values ranging from 33 to 100+ indicating that these deposits are considered to be dense to very dense.

3.3 Weathered Bedrock Deposits

Weathered rock represents the in-situ variable decomposition of parent bedrock due to chemical and climatic effects. Weathered bedrock was encountered in MMI-103, MMI-105, MMI-106, and MMI-109 with thicknesses up to ±5.5 feet.

3.4 Refusal Conditions

Refusal conditions likely indicative of weathered bedrock/bedrock encounter were encountered in each boring. Refusal conditions are defined herein as the inability of the 3-1/4 inch inside diameter hollow stem augers to advance any further under increasing drill rig (Mobile Drill B-53) torque and down pressure. Refusal conditions were encountered in each boring at depths of 4.0± feet to 10.8± feet.

It should be noted that rock coring, which was not included in MMI's scope of services, would be required to confirm refusal conditions, and to definitively determine top of weathered rock and top of underlying parent bedrock.

3.5 Groundwater

Groundwater was encountered only in MMI-2 at a depth of approximately 3.5± feet below ground surface. It should be noted that during the initial visit to the site, areas of ponded surface water were observed.

Additionally, it should be noted that long term equilibrated groundwater measurements were not obtained in any of the explorations and that fluctuations in water conditions and groundwater levels should be anticipated to occur with variations in precipitation, snowmelt, site development, and other factors not present during the exploration program. Groundwater levels should be anticipated to vary and perched water conditions may occur during and after periods of intense precipitation and snowmelt due to the low permeability glacial till deposits.

The final building finish floor grades have not yet been established. Based on observed field conditions at the time of the exploration program, groundwater may potentially be encountered during excavation for the building basement and footings, and for deeper utility or drainage structure excavations, depending upon final design grades for the site. Depending on groundwater conditions and climatic conditions at the time of construction, the Contractor should be prepared to provide for local dewatering using a method that is familiar to him and that is acceptable to the Engineer.

4.0 IMPLICATIONS OF SUBSURFACE CONDITIONS

4.1 Forest Mat and Subsoil

The existing forest mat and underlying topsoil are not considered suitable for direct or indirect support of the proposed structure footings of floor slabs, and should therefore be completely removed from below the respective foundation bearing zones.

4.2 Glacial Till Deposits

Glacial till deposits consisting of coarse to fine sand with varying amounts of gravel and silt, were encountered in the test borings. The N-values for these deposits ranged from 33 to 100+ corresponding to very dense in-situ density. These glacial till deposits are suitable for direct or indirect support of spread footings after proof-compaction as recommended herein.

4.3 Weathered Bedrock Deposits

The undisturbed natural weathered bedrock deposits are also considered, based on their in-place density, to be suitable for direct and indirect support of structural footings, and floor slab support materials.

4.4 Refusal Conditions

The refusal conditions suggest that bedrock and boulder removal will be necessary to achieve foundation depths for building construction and for the access roadway to the south of the site. It is anticipated that a significant amount of boulders will likely be encountered throughout the excavation depths. Refusal conditions are defined herein as the inability of the hollow stem augers (2-¼ inch ID) to advance any further under increasing drill rig (Mobile Drill B-53) torque and down pressure.

Weathered bedrock is defined herein as chemically altered bedrock due to long term weathering that exhibits structural characteristics of the parent bedrock, but which can be penetrated by the HSA and split spoon sampler. It should be noted that rock coring, which was not included in

MMI's scope of services, would be required to determine refusal conditions and to definitively determine top of weathered rock and top of underlying parent bedrock.

4.5 Groundwater

Groundwater was encountered only in MMI-2 at a depth of approximately 3.5± feet below ground surface. Areas of ponded surface water were previously observed on site during MMI's initial test boring program. Due to the fines content and density of the in-situ glacial till, the relatively low permeability of the till will be conducive to slow equilibration of groundwater levels in the borings and accumulation of perched water during precipitation and snow melt events. Accordingly, it should be anticipated that groundwater may be encountered during excavations generally anywhere on the site.

Additionally, it should be noted that long term equilibrated groundwater measurements were not obtained in any of the explorations and that fluctuations in water conditions and groundwater levels should be anticipated to occur with variations in precipitation, snowmelt, site development, and other factors not present during the exploration program. Groundwater levels should be anticipated to vary and perched water conditions may occur during and after periods of intense precipitation and snowmelt due to the low permeability glacial till deposits.

The new school building footprint and finish floor grades have not yet been established. Based on observed field conditions at the time of the exploration program, groundwater may potentially be encountered during excavation for the footings, and for deeper utility or drainage structure excavations, depending upon final design grades for the site. Depending on groundwater conditions and climatic conditions at the time of construction, the Contractor should be prepared to provide for local dewatering using a method that is familiar to him and that is acceptable to the Engineer.

Given the potential for temporary perched groundwater conditions, MMI recommends the installation of building exterior perimeter subdrains, as identified on Figures 2 and 3 and as discussed in Section 5.6 of this report. The actual layout of the subdrainage system should be determined by the Engineer based on field conditions at the time of construction in conjunction with final design grades and building footprint locations. The final design of the subdrainage system should be performed by the site-civil engineer in coordination with the foundation and plumbing plans.

5.0 DESIGN CONDITIONS

5.1 Foundation Support

Spread footing foundations may be supported directly on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces, in accordance with the recommendations outlined herein.

A minimum 12-inch-thick choke layer is recommended over rock surfaces in order to chink any exposed fractures and joint sets across rock subgrades prior to placement of foundations or new CSF. The choke layer material will prevent loss of overlying soil fines from migrating into exposed bedrock fractures and joint sets.

All existing forest mat, existing fill, woody debris, subsoil and any other deleterious materials (i.e. roots, stumps, woodchips, organics, etc.) should be completely removed from below all footings, floor slabs, footing bearing zones, and be replaced with new CSF. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural glacial till deposits or bedrock are encountered.

Footings bearing on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces may be proportioned for a net allowable soil bearing pressure of 4,000 psf. All replacement and raise-in-grade compacted structural fill should be compacted to a minimum of 95 percent maximum dry density per ASTM D 1557.

For frost protection, exterior footings should be founded at least 4 feet below finished exterior grades. Interior footings below heated areas may be founded a minimum of 24 inches below the top of floor slab or finished grade.

A slope of 1H:1V should be maintained between the bottom edges of adjacent underground utility trenches and between adjacent footings. Footings should be stepped, as required, in transition areas where different footing levels occur.

It is further recommended that the minimum width of isolated spread footings be 36 inches and that the minimum width of continuous footings be 24 inches

5.2 Floor Slab-on-Grade

Floor slabs should be supported on a minimum 9-inch thick crushed aggregate base course (meeting NH-DOT 304.33; Crushed Gravel for Shoulders) placed and compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557. Excavated on site fill materials and glacial till deposits should not be reused as floor slab base course material. The floor slab base course should be placed directly over new compacted structural fill, choke layer material or suitable undisturbed glacial till deposits in accordance with the recommendations outlined herein.

As with footings, all existing topsoil and any other deleterious materials (i.e. roots, stumps, woodchips, organic matter, etc.) including all existing foundation remnants, underground utilities, septic systems, wells, etc. should be completely removed where located below all floor slabs, and be replaced with new compacted structural fill where necessary.

A 15-mil vapor barrier should be placed below the slab to protect against capillary moisture impact to the concrete and limit the transmission of moisture into the floor slab. The Architect and/or Structural Engineer should specify the location of the vapor barrier placement relative to the base course material and take the placement of this vapor barrier into account in the concrete slab design curing specifications for the project. It is recommended that a heavy-duty vapor barrier consisting of a single layer of Griffolyn® Type-65G high performance high density reinforced polyethylene, Stego Wrap (www.stegoindustries.com) or an approved similar product be used.

A modulus of subgrade reaction, k_{sl} of no greater than 125 pounds per cubic inch (pci) should be used for design of the slab. Note, however, that the value of k_{sl} is for a 1 square foot area. The k_{sl} value should be adjusted for larger areas using the following equation:

Modulus of Subgrade Reaction (k_s) = k_{sl} (B+1/2B)^2

Where: k_s = Coefficient of vertical subgrade reaction for loaded area

k_{sl} = Coefficient of vertical subgrade reaction for 1 x 1 square foot area

B = Width of area loaded, in feet

Please note that limited cracking of slabs-on-grade is normal and should be expected. Cracking may occur not only as a result of heaving or compression of the underlying soil, but also as a result of concrete curing stresses. To reduce the potential for floor slab cracking, it is recommended that the measures listed below should be followed during construction:

- The installation of floor slab construction joints as recommended by the American Concrete Institute (ACI) between the columns and walls and between columns to account for differential settlements.
- All backfill in areas supporting slabs should be moisture conditioned and compacted. Backfill in all utility trenches should be carefully compacted.
- Exterior slabs should be structurally isolated from the building.
- A minimum 6-inches of compacted structural fill should be placed between the bottom of floor slabs and the top of footings, to serve as a cushion layer.

5.3 Sidewalks

Entrance slabs and sidewalks adjacent to the building should be designed to reduce the effects of differential frost action between adjacent pavement, doorways and entrances. Although preparation of recommendations for sidewalk support was not part of our work scope for this project, it should be noted that sidewalk performance and stability can be jeopardized by frequent de-icing applications as well as the infiltration of surface water, precipitation and snow melt through joints, where it can then freeze below the concrete resulting in frost heaves.

The existing underlying fill materials and glacial outwash deposits are considered to be moderately frost susceptible. Accordingly, MMI recommends that a non-frost susceptible material, such as NHDOT Item 304.4 (crushed stone –fine) or similar be provided to a frost penetration depth of 4 feet below the top of entrance slabs and all sidewalks. This thickness of crushed aggregate should extend the full width of the entrance slab and all sidewalks, and outward at least 4 feet, thereafter transitioning up to the bottom of the adjacent pavement subbase course materials at a 1H:1V or flatter slope.

Additionally, MMI suggests the following be included as part of the design considerations for sidewalks:

1) sealing all sidewalk surface joints (e.g., against walls, curbing, etc.) with a 30+ year water-stop caulk of sufficient durability and elongation without failure;

2) diversion of roof and other runoff away from sidewalks;

3) the placement of plantings through or adjacent to sidewalks should be avoided as they provide entrance points for surface water infiltration; and

4) steel reinforcement doweling of sidewalks to foundation walls and continuous steel reinforcement across sidewalk construction joints to prevent differential movement between sidewalk sections and door jams.

Excavated existing fill or glacial till materials are not anticipated to be suitable for reuse as slab or sidewalk base course material.

5.4 Seismic Considerations

MMI has evaluated the site seismic Site Class in accordance with the 2009 International Building Code (IBC) Section 1613 and ASCE 7. Based on the existing subsurface soil profile encountered in the borings, the site meets the general parameters of Site Class C

An evaluation of the liquefaction potential for the existing subsurface soils was performed. Liquefaction denotes a condition where a soil undergoes continued deformation during the course of cyclic stress (i.e. earthquake induced) applications where the pore-water pressure becomes equal to the confining pressure (i.e. effective stress approaches zero) and large deformations occur. Significant factors influencing liquefaction include grain size distribution of sand, in-situ density, and vibration characteristics (i.e. design earthquake and acceleration coefficient).

Input parameters include engineering estimates of groundwater depth, percentage of soil fines, soil unit weights and SPT values along with the design earthquake magnitude and peak acceleration appropriate for the project area. Based on published information obtained from the United States Geological Society (USGS), an earthquake magnitude of 5.98 with a return frequency of 100 years and a peak acceleration of 0.075g (Site Class C) with a 2% probability of exceedance in 50 years were selected for the analysis.

Results of the liquefaction analysis indicate that these dense granular soils have a factor of safety of greater than one and liquefaction is not likely.

5.5 Walls below Grade

Retaining walls or unbalanced load condition foundation walls should be designed to resist the combined lateral forces resulting from earth pressures as well as those posed by any surcharge loading. Backfill materials behind these walls should consist of new compacted structural fill except that a 2-foot thick chimney drain should be placed behind the wall as shown on Figure 4. Considering the recommended backfill soil, it is recommended that earth pressures be calculated based upon an equivalent fluid weight of 40 pounds per cubic foot (pcf) for the active condition (i.e. unbraced top of wall), 60 pcf for the at-rest condition (i.e. braced top of wall), and 225 psf for passive pressures; with any surcharge loadings applied over the face of the wall at an intensity equal to 0.3, 0.5 and 3 times the surcharge loading for the active, at-rest and passive conditions, respectively.

Where the calculated earth pressure behind walls is less than 200 pounds per square foot (psf), it should be increased to 200 psf to account for stresses created by compaction within 5-feet of the wall. The minimum design factors of safety for sliding and overturning under static loads should be 1.5 and 2, respectively. Passive pressure at the toe of retaining walls subject to freeze/thaw conditions should not be included as a resisting force when analyzing for overturning and sliding. A coefficient of sliding friction of 0.35 between mass concrete and existing in-place glacial deposits or compacted structural fill and may be considered for wall design.

The above-referenced lateral earth loads do not include hydrostatic forces, as they are based on construction of a subdrainage system behind all walls to collect and discharge any potential groundwater, perched water or water from sub-slab utilities that could leak or become damaged, as illustrated on Figure 4.

Equivalent seismic lateral loading against walls may be defined as $0.045\gamma_t H^2$ where γ_t is the total weight of the soil acting against the wall and H is the height over which the backfill soil acts. Considering the existing subsurface conditions, an equivalent fluid weight of 18 pounds per cubic foot psf, as illustrated on Figure 6, should be considered.

Where modular block retaining walls are proposed, both the internal stability of the wall (usually designed by the supplier/vendor's Engineer) and the overall global stability (usually analyzed by the Owner's Engineer) will need to be performed in order to result in a complete, well-coordinated and satisfactorily designed wall system.

5.6 Subdrainage Systems

The existing site topography and groundwater depths encountered during the exploration program indicate that perched groundwater may occur and tend to collect around building foundations. Accordingly, exterior perimeter footing subdrains, as shown on Figures 2 and 3, are recommended to limit accumulation of water and fugitive moisture near the addition(s). Additionally, subdrains below floor slabs on grade may also be required to prevent concrete slabs from being impacted by subsurface water. The need for and location of subdrains below floor slabs should be determined during construction by the Engineer.

Subdrains should consist of slotted corrugated polyethylene tubing of 4-inch minimum diameter, meeting the requirements of ASTM F 405 or AASHTO M252, surrounded by NHDOT Item #67 Aggregate (¾-inch stone), and be entirely enveloped by non-woven geotextile, as detailed on Figure 3. The use of geotextile will limit the migration of fines from fills and natural soils into the coarse aggregate, thus reducing long term clogging. The subdrain inverts should be set a minimum of 4 feet below adjacent exterior grades to protect against frost penetration. Cleanouts should be provided at every other 90-degree bend, in order to provide for future flushing of the system in the event that siltation or other clogging of the piping should occur.

Subdrains should generally be installed at a minimum 0.5 percent slope and discharge to a suitable system outlet. The system should be gravity drained, if possible, to storm water catch basins or other suitable discharge locations. Subdrain inverts into catch basins should be at least 1½ feet higher than catch basin outlet inverts. If gravity draining of the subdrain system is not possible, a suitable sized holding tank with integral sump pump, including a backup sump pump, will be required. A sump invert at a minimum 18 inches below the lowest subdrain pipe invert elevation should be maintained if a sump is used. No subdrain system should be connected to roof drain systems.

The final outlet of all subdrainage systems must be designed by the Project Site-Civil Engineer in consideration of all City of Nashua, State of New Hampshire and Federal regulations. The final design site plans should be provided to MMI for our review to determine the actual extent of the various subdrainage systems particularly after project final design grades and addition(s) footprint locations have been selected. Additionally, it will be further necessary for the Engineer to determine actual subdrainage requirements in the field during construction based on his/her observations.

5.7 Pavement Considerations

Prior to placement of any required new raise-in-grade compacted structural fill within proposed pavement areas, all existing loam fill, woody debris, former foundation remnants, underground utilities, and all other deleterious materials (i.e. roots, stumps, woodchips, organic matter, etc.) and any excessively loose or soft surficial in-place fill materials should be removed. All resultant subgrade surfaces to potentially remain below pavement areas should then be assessed by proofrolling under the observation of the Engineer prior to placement of any new raise-in-grade materials and pavement support materials.

Evaluation of the necessity for this proofrolling, and interpretation of the results to ascertain suitability of these subgrade materials for support of new raise-in-grade materials and proposed pavement support materials should be made by the Engineer during construction. Proofrolling should be performed with at least 4 passes of a steel drum compactor weighing at least 10 tons, without the use of vibratory compaction.

After proofrolling operations have been completed to the satisfaction of the Engineer, the upper 12 inches of all subgrade soils to remain in place should be compacted to at least 95% of ASTM D 1557.

The subgrade soil for support of pavement sections should consist of suitable proofrolled fill materials, glacial till deposits or compacted structural fill (CSF) placed over suitable subgrade surfaces. Depending upon final grading plan cuts and fills, and as determined by the Engineer during construction, it may also be necessary to place a geotextile stabilization layer over subgrade surfaces prior to placement of pavement support materials. Although traffic loadings are not currently developed, based on typical school campus vehicular traffic, MMI has considered the following ranges of pavement sections:

	STANDARD DUTY PAVEMENT SECTION	HEAVY DUTY PAVEMENT SECTION
BITUMINOUS CONCRETE:		
Top Course Thickness	1.5 inches	2.0 inches
Binder Course Thickness	2.0 inches	2.5 inches
SUPPORT MATERIALS:		
Base Course Thickness (NHDOT 304.4)	6 inches	8 inches
Subbase Course Thickness (NHDOT 304.3)	10 inches	12 inches

The base course and subbase should be compacted to at least 95% of the optimum dry density per ASTM D 1557. Underlying raise in grade CSF, where required, should be compacted to at least 95% of the optimum dry density per ASTM D 1557.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Spread Footings

All spread footing foundations should be supported directly on i) suitable in-place glacial till deposits, ii) on compacted choke layer fill material placed over bedrock surfaces, iii) on new compacted structural fill (CSF) placed directly over suitable in-place glacial till deposits, iv) or on new CSF placed directly over a compacted choke layer fill material which has been placed over bedrock surfaces, in accordance with the recommendations outlined herein.

All existing unsuitable soils should be completely removed from below all footings, and the footing bearing zones and be replaced with new compacted structural fill. The footing bearing zone is defined herein as the area encompassed within a zone beginning 1 foot horizontally beyond the bottom edge of the footing and extending outward and downward at a 1H:1V slope until suitable natural outwash deposits are encountered. All replacement structural fill required below footings should meet the requirements given in Section 6.5.1.

The contractor should be required to maintain a dry (dewatered, if necessary) stable-working soil subgrade bottom during footing construction. Subgrades should slope to sumps as necessary. Footing subgrades should be constructed essentially level prior to placement of reinforcing steel and concrete. It is recommended that all footings be excavated and concrete placed the same day in order to avoid ponding of any surface water runoff in the excavations. Disturbed, frozen or loosened soils should be removed prior to placement of concrete. The footing subgrades should be free of water for the final observation and during placement of concrete. Ground surface grades in the vicinity of the excavations should be graded to promote positive drainage away from the open excavations.

6.2 Floor Slab-on Grade

Floor slabs should be supported on a minimum 9-inch-thick base course of NHDOT 304.33 (Crushed Aggregate for Shoulders) placed and compacted to a minimum of 95 percent of maximum dry density per ASTM D 1557. Excavated on site materials should not be reused as floor slab base course material. The floor slab base course should be placed directly on new compacted structural fill, choke layer material or suitable natural in-place glacial outwash deposits in accordance with the recommendations outlined herein.

The recommended vapor barrier should be placed below the slab to protect against capillary moisture impact to the concrete and limit the transmission of moisture into the floor slab. All vapor barrier joints should be glued or taped in accordance with the manufacturer's recommendations. Additionally, the vapor barrier should be similarly affixed to the sides of the footing, column or basement wall concrete in order to provide for a water/moisture tight barrier.

Prior to placement of new compacted structural fill, the in-situ subgrade soils should be assessed for proofrolling. This will allow the Engineer to evaluate for the presence of any soft or weaving unsuitable existing subgrade materials. Any such soft or weaving unsuitable existing subgrade materials should be locally over-excavated and replaced with new compacted structural fill.

As with footings, all existing forest mat, subsoil and any other unsuitable materials should be completely removed from below all floor slabs and be replaced with compacted structural fill where necessary. Raise-in-grade structural fill required for below the floor slabs should consist of suitable non-plastic granular material generally meeting the requirements given in Section 6.5.1.

6.3 Subgrade Stabilization

Due to the sensitive nature of the natural glacial till deposits; excessive snowmelt, precipitation, runoff, perched water, subgrade disturbance or other construction-phase conditions may result in areas of subgrade instability (i.e. weaving, pumping, etc.). No geotextile or crushed gravel replacement materials should be placed over unstable subgrade surfaces. Should an area of unstable subgrade be encountered, the area should either:

a. Be locally over-excavated as necessary and replaced with a layer woven geotextile stabilization fabric and crushed gravel; or

b. Be locally over-excavated as necessary and a minimum 4-inch-thick lean concrete mud mat placed; or

c. Be allowed to dry and be re-proofrolled.

The need for excavation and replacement of unstable subgrade soils should be assessed by the Engineer.

6.4 Materials Reuse

It is anticipated that only limited portions, if any, of the excavated existing on-site (non-organic containing) glacial till may potentially be suitable for reuse as new structural fill, provided that they meet the gradation requirements of Section 6.5.1 and/or are approved by the Engineer. The Contractor should consider additional efforts that will be required to screen out boulders and cobbles, and to reduce the moisture content of excessively wet excavated soils prior to placement and compaction.

Forest mat and subsoil not able to be used in proposed landscape areas should be removed from the site. All potentially re-usable materials should be segregated and reused only following approval by the Engineer. All boulders, excessively silty material, organic and foreign debris should be removed from all material prior to approval for reuse.

6.5 Materials Placement & Compaction

6.5.1 Compacted Structural Fill

Compacted Structural Fill to be used for raise-in-grade fill, below footings and floor slabs (except for the floor slab base course material), should have a liquid limit and plastic limit not exceeding 40 and 15, respectively, and meeting the following gradation requirements:

STRUCTURAL FILL	
SIEVE SIZE	PERCENT FINER BY WEIGHT
4 inch	100
No. 4	50-85
No. 10	25-75
No. 40	10-50
No. 100	8-35
No. 200	4-10 (total)

6.5.2 Crushed Aggregate for Shoulders (NHDOT 304.33)

Crushed Aggregate to be used the recommended 9-inch-thick slab base course, for chimney drains behind retaining walls, should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and consist of crushed aggregate conforming to New Hampshire Department of Transportation (NHDOT) Item 304.33 (Crushed Aggregate for Shoulders), and meeting the following gradation requirements:

CRUSHED AGGREGATE (NHDOT Item 304.33)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
1 ½ inch	100
1 inch	90-100
No. 4	30-65
No. 200	0-10 (total)

6.5.3 Crushed Stone (3/4")

Crushed stone to be used for utility construction, subdrainage systems or for use as a stabilization material over wet and sensitive subgrades should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and should consist of hard durable sand and gravel conforming to the NHDOT #67 Stone as follows:

¾" CRUSHED STONE (NHDOT #67 Stone)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
1 inch	100
3/4 inch	90 – 100
3/8 inch	20 – 55
No. 4	0 – 10
No. 8	0 – 5

6.5.4 Crushed Stone Fine

Crushed stone (fine) to be used as Choke Layer Material and sidewalk subbase material should be free of ice and snow, roots, stumps, rubbish and other deleterious materials and consist of crushed aggregate conforming to New Hampshire Department of Transportation (NHDOT) Item 304. (Crushed Stone (Fine)), and meeting the following gradation requirements:

CRUSHED AGGREGATE (NHDOT Item 304.4)	
SIEVE SIZE	PERCENT FINER BY WEIGHT
2 inch	100
1 ½ inch	85-100
¾ inch	45-75
No. 4	10-45
No. 200	0-5 (total)

6.5.5 Material Placement

All compacted structural fill, crushed gravel, and stone material should be placed in loose lifts not exceeding 12 inches in thickness, unless recommended elsewhere herein, and should be compacted to a minimum of 95% of maximum dry density per ASTM D 1557, Method C, with the moisture content no less than 3 percent below or 1 percent above the optimum moisture content as determined by ASTM D 1557.

Backfill within a zone defined by a 45 degree (1H: 1V) from vertical extending upward and outward from the bottom edge of frost walls should be placed in maximum 6-inch loose lifts and compacted using manually operated equipment to avoid damaging the frost walls.

6.5.6 Geotextile

Geotextile for use in subdrain construction or subgrade stabilization should consist nonwoven geotextile fabric such as Mirafi 140N or similar.

6.5.7 Vapor Barrier

Vapor Barrier material to be placed below the floor slab should consist of 15 mil Griffolyn Type-65G, Stego Wrap or a similar product, approved by the Engineer meeting the following requirements:

VAPOR BARRIER (ASTM E 1745: Class A)		
PROPERTY	TEST METHOD	MIN. AVG. ROLL VALUE
Water Vapor Permeance	ASTM E 96	0.037 grains/hr/ft²/in
Tensile Strength	ASTM D 882	240 lbs
PPT Resistance	ASTM D 2582	51 lbs
Puncture Strength	ASTM D 4833	185 lbs
Drop Dart	ASTM D 1709	3,500 g
Weight	ASTM D 3776	76 lbs/1,000 ft²

6.6 Proofrolling

Prior to placement of new raise in grade materials over existing subgrade surfaces to be potentially left in-place should be assessed by proofrolling. This will allow the Engineer to evaluate for the presence of any soft or weaving unsuitable existing subgrade materials. Any such soft or weaving unsuitable existing subgrade materials assessed by proofrolling should be locally over-excavated and replaced with new compacted structural fill.

Evaluation of the necessity for this proofrolling, and interpretation of the results to ascertain suitability of these subgrade materials for support of new compacted structural fill should be made by the Engineer during construction. Proofrolling should be performed with at least 4 passes of a steel drum compactor weighing at least 10 tons, without the use of vibratory compaction.

After proofrolling operations have been completed to the satisfaction of the Engineer, the upper 12 inches of all subgrade soils, including exposed glacial, outwash deposits, to remain in place should be compacted to at least 95% of ASTM D 1557.

6.7 Freezing Conditions

During freezing conditions, additional care must be exercised during construction to prevent disturbance of the soil subgrades and to achieve the required degree of fill compaction. The subgrades and each lift of backfill should be compacted before the water in the subgrade or backfill can freeze.

Frozen material should not be placed as backfill, nor should backfill or foundations be placed on frozen soil. If, during construction, the top layer of soil becomes frozen, the frozen soil should be removed before backfill or foundations are placed on it. When the air temperature is below 32° F, the contractor should not be allowed to place fill or expose final subgrades unless special procedures, approved by a qualified Engineer, are used to prevent freezing. If foundations are built and left exposed during the winter season, precautions should be implemented to prevent damage due to frost heave.

6.8 Removal of Unsuitable Materials

All fill, topsoil, forest mat, subsoil, building remnants, abandoned utilities and any other deleterious materials within the proposed foundation bearing zones should be completely removed and disposed of in a legal manner off-site. However, to the extent practicable, all excess soil should remain on-site otherwise additional costs will be incurred for off-site disposal. All potentially reusable materials should be segregated and assessed by the engineer.

All resulting excavations should be backfilled with new structural fill and be compacted to a minimum of 95% of maximum dry density per ASTM D 1557. All suitable existing glacial material which becomes loose or disturbed as a result of earthwork operations should be re-compacted to a minimum 95% of maximum dry density per ASTM D 1557.

6.9 Deep Excavations

Deep excavations may be necessary for construction of the proposed attendant underground utilities. As an alternative to temporary slopes, vertical excavations can be temporarily shored. The Contractor or the Contractor's specialty subcontractor should be responsible for the design and adequacy of any temporary shoring in accordance with all applicable regulatory requirements. The Owner and Contractor should make themselves aware of and become familiar with applicable local, state and federal safety regulations, including the current Occupational Safety and Health Administration (OSHA) Excavation and Trench Safety Standards. Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods and sequencing of construction operations.

The Contractor should be aware that slope height, slope inclination, and excavation depths, including utility trench excavations, should in no case exceed those specified in local, state or federal safety regulations, e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, and all successor regulations. Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors may be liable for substantial penalties. MMI is providing this information solely as a service to the City of Nashua. Under no circumstances should the information provided herein be interpreted to mean that MMI is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

7.0 ROCK REMOVAL

As indicated previously, HSA refusal conditions were encountered in each test boring at varying depths. Given this condition rock excavation will be required for this project. It should also be noted that abrupt changes in top of rock elevations will occur over relatively short horizontal distances and should be expected on this site. Actual rock excavation depths can only be accurately determined during construction once all overburden materials have been removed. It is desirable to limit the depth of bedrock overblast, since all overblast material must be removed from below proposed building footprints, footing bearing zones and pavement areas.

7.1 Rock Removal Techniques

Controlled drilling and blasting must be carefully performed so as not to damage nearby structures. Other methods of rock excavation such as mechanical chiseling or chemical fracturing should also be considered, based on required quantities and economic considerations.

Any blasting operations should conform to State of New Hampshire and City of Nashua regulations. Additionally, all blasting should also adhere to the provisions of 29 CFR Ch. XVII Section 1910.109 for explosives and blasting agents.

Nearby properties consist of commercial and residential structures and underground utilities, all of which are potentially susceptible to blasting induced vibration damage. In order to prevent any blasting damage, all blasting should be accomplished in a safe, least disturbing manner to prevent any damage to the abutting structures, slopes and utilities. Heavy blasting mats should be utilized on top of a minimum 3-foot layer of soil to prevent fly-rock and reduce destructive airblast overpressures. MMI recommends that maximum airblast overpressure not exceed 128 decibels.

Upon completion of rock excavation within proposed building footprint, all loose and over blasted materials should be completely removed from below all footing and floor slab areas prior to placement of any new fill materials.

7.2 Pre-Blast Survey

Existing structures and underground utilities are susceptible to damage due to seismic blasting responses. Accordingly, a pre-blast survey should be conducted at all structures that will be located within 500 feet of each proposed blast. Prior to blasting, the following pre-blast survey measures should be implemented:

a. Pre-blast survey requirements should be conducted in accordance with the requirements of local authorities.

b. Contact all owners likely to be impacted by the rock excavation operations and obtain legal access to these structures for survey.

c. Survey methods should entail the observation and documentation (video and still photography) of the interior and exterior features of each structure being reviewed. Documentation should also include any interior sensitive equipment and the manufacturers specified vibration tolerances if available. Landscaped features including retaining walls, decorative features (sculptures, stonewalls, pools, etc.) should be surveyed to document their present condition.

d. The condition of existing underground utilities should be verified through the local utility provider and documented.

e. Familiarize the property owners as to what will likely occur during the rock excavation activities on each individual property.

f. Obtain information from property owners regarding any existing structural defects.

g. Preparation of a written report including the aforementioned surveyed results for each structure analyzed and distribute to the City of Nashua Fire Marshall's office.

7.3 Blast Design Considerations

Preliminary blast design operations in conjunction with resulting seismic response monitoring should be based on the limitation of the maximum peak particle velocity versus frequency graph included in Appendix D. MMI recommends that an initial scaled distance of 100 be used for design of the first blast, with appropriate seismic monitoring, in order to document the seismic response. Providing that detrimental seismic responses are not obtained with the initial blast, the next detonation may be designed using a lesser scaled distance along with appropriate seismic monitoring. This procedure may be repeated, providing that detrimental seismic responses do not occur. Scaled distances of less than 50 should not be used at any time. Additionally, scaled distances of not less than 100 should be used for all blasts within 100 feet of the nearest structure or underground utility.

The following maximum recommended charge weight/delay versus distance relationships and frequency versus amplitude relationships should be followed and not exceeded at any time:

Estimated Maximum Charge Wt/Delay (lbs)	Distance (ft)
Less than 4	100
5 – 16	200
17 – 25	300
26 – 36	400
37 – 50 (maximum)	500

Frequency of Ground Vibration (Hz)	Maximum Amplitude of Ground Motion (inches)
Up to 10	0.0305
20	0.0153
30	0.0102
40	0.0076
50	0.0061
60	0.0051
70	0.0043
80	0.0038

Lesser charge weights per delay may be required depending upon the seismic response.

Response frequencies for nearby structures are estimated to be in the range of 5 to 20 Hz, respectively. Additionally, rock excavations creating blast vibration frequencies which approach the response frequency of these structures should be avoided so that the maximum allowable peak particle velocities indicated by the U.S. Bureau of Mines, and as given in Appendix D, are not exceeded in order to minimize the resonant effects. This US Bureau of Mines guidance should be considered as upper limit relationships only; lower response frequencies and velocities may be necessary.

Seismograph instrumentation should be set up at the nearest structure to each blast and at any structures identified during the pre-blast survey that are considered to be particularly susceptible to vibration damage. Peak particle velocity versus frequency, resultant waveform and airblast overpressures should be recorded. Monitoring results from each blast should be given to the blasting contractor as soon as possible so that he can modify his blasting program to conform to the recommendations given herein.

These guidelines are provided to assist the Blasting Contractor in the development of his blasting program. However, it is the ultimate responsibility of the Blasting Contractor to perform all blast related activities without damage to any structures and underground utilities.

7.4 Blasting Near Fresh Concrete

The Contractor shall not conduct blasting operations within 20 feet (6 meters) of newly placed concrete (less than 14 days since placement) without the written approval of the Engineer. For blasting greater than 6 meters (20 feet) away from new concrete the following PPV ground vibration limits apply:

GROUND VIBRATION LIMITS FOR NEW CONCRETE	
AGE OF CONCRETE	**MAXIMUM PPV, in/s (mm/s)**
Less than 3 days	No blasting
After 3 days	1.0 in/s (25 mm/s)
After 5 days	1.8 in/s (46 mm/s)
After 7 days	2.0 in/s (50 mm/s)

8.0 CONSTRUCTION MONITORING

It is recommended that MMI be retained to provide construction observation services, including observation and monitoring of all operations involving soil excavation, removal of unsuitable materials and overburden soils, assessment of existing in-situ soils as potentially may be considered to remain in place or be reused, and for inspection of subgrade surfaces/material to potentially remain below the proposed structures.

The purpose of these observations and testing is to verify that construction is being performed in accordance with the intent of the recommendations given in this report and to observe any changes in subsurface conditions which may warrant modification to the foundation systems recommended herein.

If MMI is not retained to provide full-time observation of earthwork during the construction-phase of this project, we cannot be held responsible if unforeseen conditions are not identified and addressed, or if conditions identified in this report are not addressed as we intended.

9.0 REVIEW OF FINAL PLANS

It is also recommended that once final site, grading and foundation plans have been developed, that the plans be reviewed by MMI in order to assess whether any of the recommendations outlined herein will require revision, or if additional explorations, subdrainage, or other recommendations are required based on proposed final grades and structural layouts. The recommendations provided herein shall not be considered valid unless MMI is provided the opportunity to review the final site, grading, and foundation plans.

TABLES

MILONE & MACBROOM

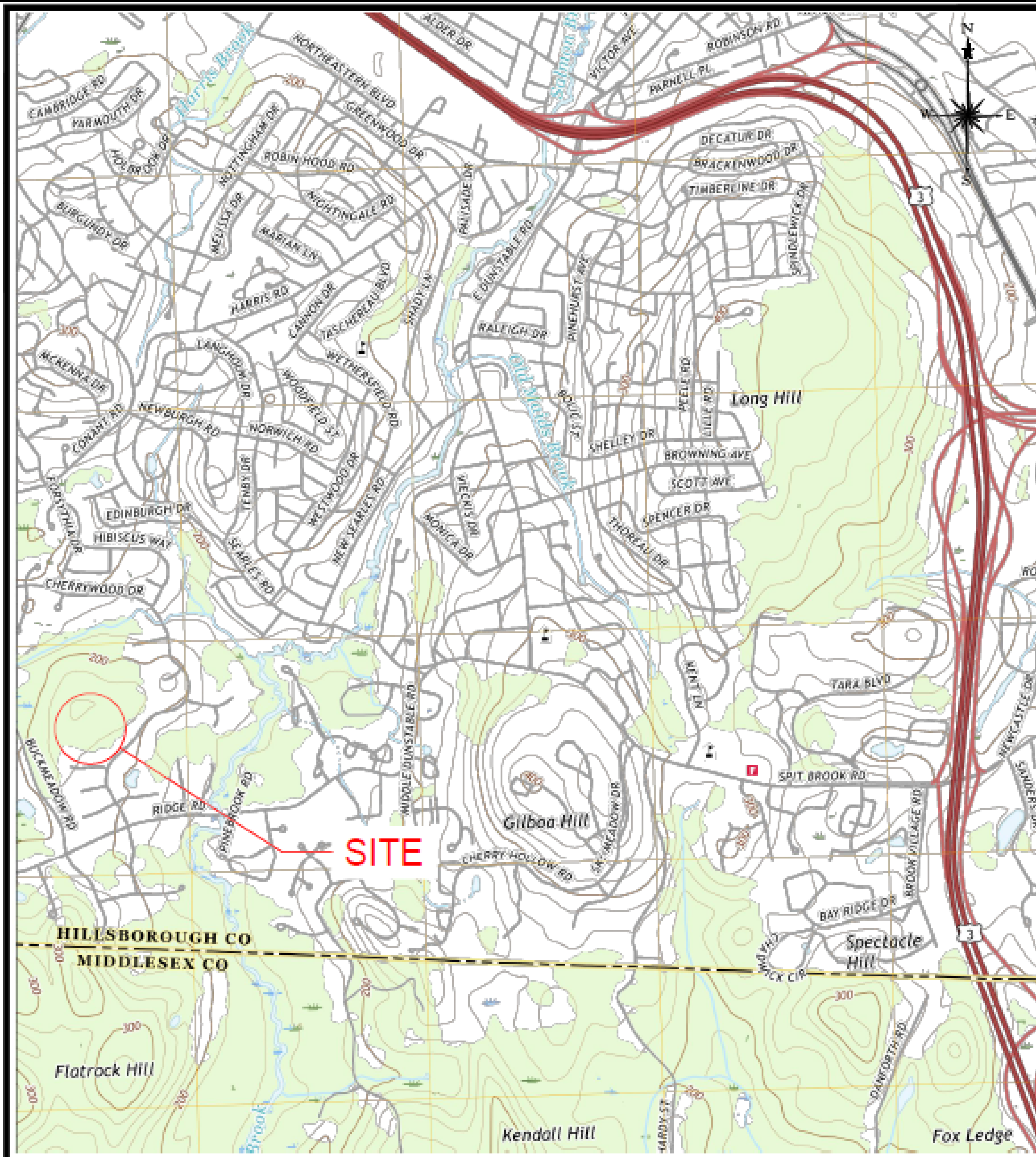
TABLE 1
SUMMARY OF SUBSURFACE EXPLORATIONS
PROPOSED NEW SCHOOL SITE
CHERRYWOOD DRIVE, NASHUA, NEW HAMPSHIRE
PROJECT NO. 6119-03-02

EXPLORATION DESIGNATION	BOTTOM OF FOREST MAT/ SUBSOIL	TOP OF GLACIAL TILL DEPOSITS	TOP OF WEATHERED BEDROCK DEPOSITS	BOTTOM OF EXPLORATION	OBSERVED GROUNDWATER LEVELS DURING DRILLING OPERATIONS
	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)	DEPTH (FT)
MMI-101	2.0 ±	2.0 ±	NE	5.5 ± R	NE
MMI-102	2.0 ±	2.0 ±	NE	6.9 ± R	NE
MMI-103	1.5 ±	1.5 ±	8.5 ±	10.2 ± R	NE
MMI-104	0.8 ±	0.8 ±	NE	7.4 ± R	NE
MMI-105	2.0 ±	2.0 ±	9.0 ±	14.5 ± R	NE
MMI-106	3.0 ±	3.0 ±	9.0 ±	10.8 ± R	NE
MMI-107	0.2 ±	0.2 ±	NE	4.5 ± R	NE
MMI-108	2.0 ±	2.0 ±	NE	8.7 ± R	NE
MMI-109	1.0 ±	1.0 ±	9.0 ±	11.4 ± R	NE
MMI-110	1.0 ±	1.0 ±	NE	16.5 ± R	NE
MMI-111	1.5 ±	1.5 ±	NE	5.5 ± R	NE
MMI-112	1.5 ±	1.5 ±	NE	27.5 ± R	NE
MMI-113	2.0 ±	2.0 ±	NE	28.0 ± R	NE
MMI-1	4.0 ±	NE	NE	4.0 ± R	NE
MMI-2	3.0 ±	3.0 ±	NE	5.3 ± R	3.5 ±
MMI-3	3.5 ±	3.5 ±	NE	4.9 ± R	NE
MMI-4	3.5 ±	3.5 ±	NE	10.8 ± R	NE

Notes:
1) MMI-100 series Test Borings were performed between September 21 & 23, 2019 by New England Boring Contractors of Derry, New Hampshire.
2) MMI-1 series Test Borings were performed on April 26, 2019 by New England Boring Contractors of Derry, New Hampshire.
3) Groundwater levels were measured during exploration advancement and therefore are not indicative of stabilized groundwater conditions.
4) "NE" indicates not encountered.
5) "R" indicates auger refusal

B:\6119-03 City of Nashua Elm Street School\New School\6119-03-02\6119-03-02 Table 1.xlsx

FIGURES

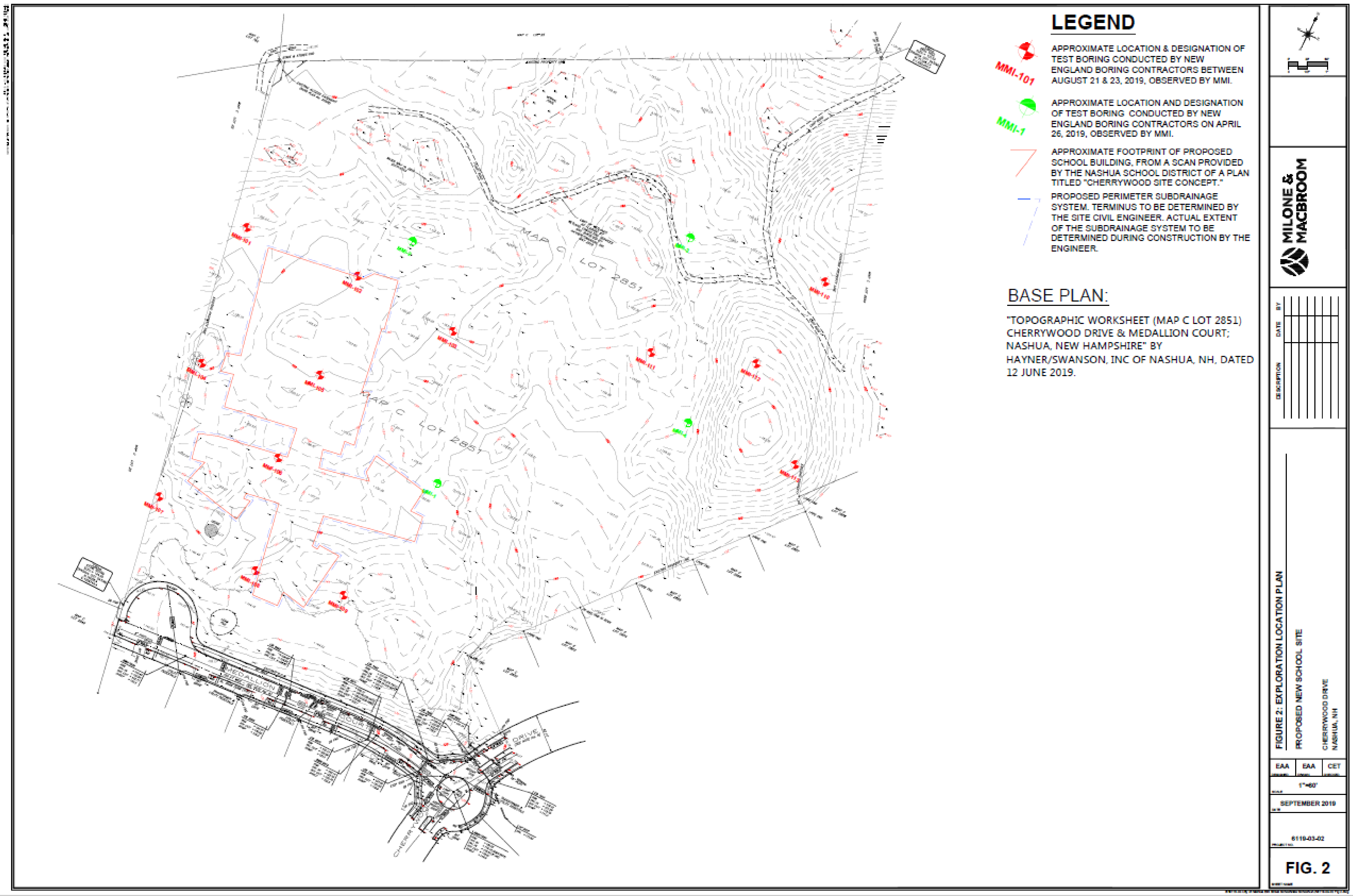


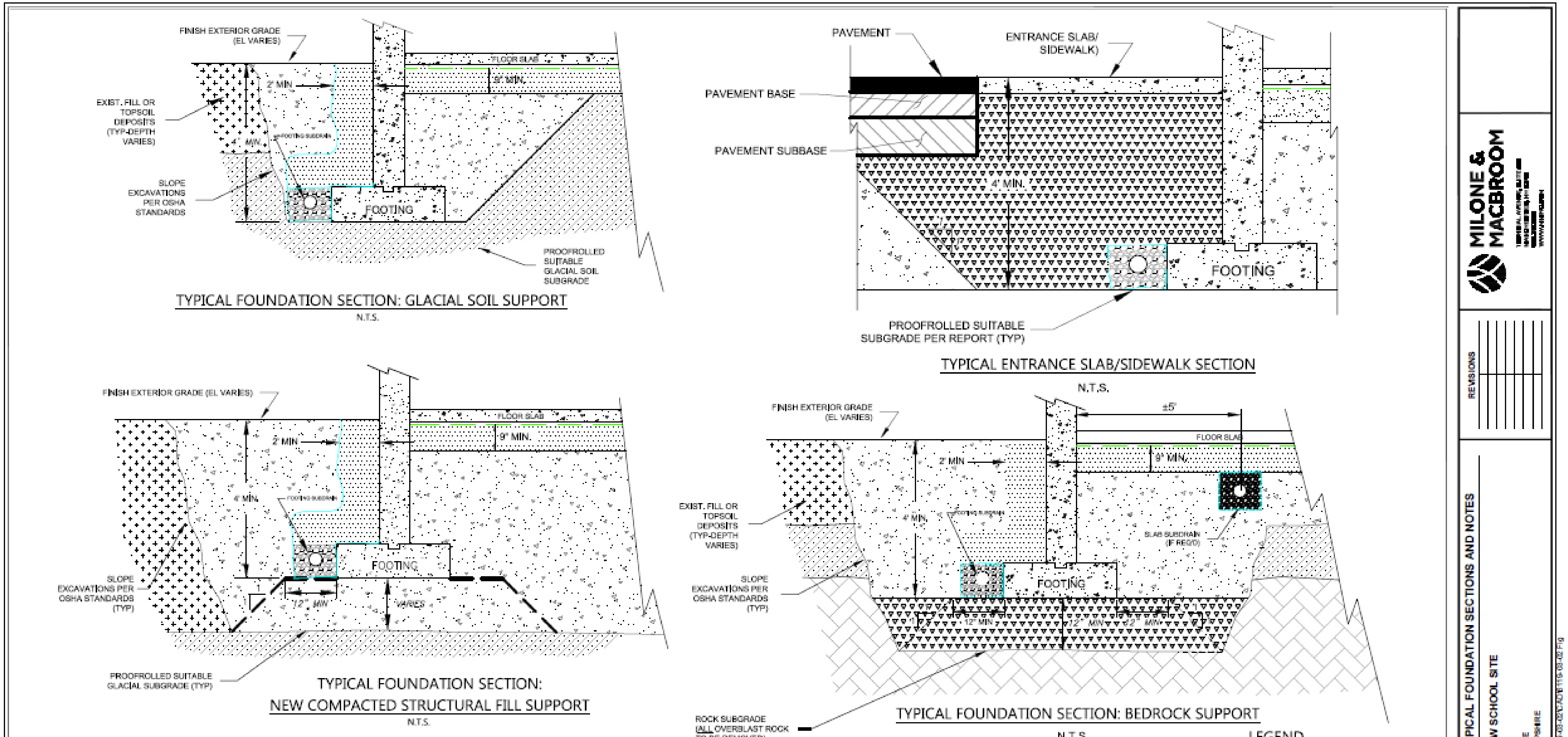
SOURCE: 2018 USGS NASHUA SOUTH (NH), 7.5 MINUTE SERIES.

MILONE & MACBROOM

FIGURE 1 - SITE LOCUS	DATE	SEPTEMBER 2019	
PROPOSED NEW SCHOOL SITE	SCALE	1" = ±2000'	
	PROJ. NO.	6119-03-02	
CHERRYWOOD DRIVE NASHUA, NEW HAMPSHIRE	DESIGNED EAA	DRAWN EAA	CHECKED CET
PROJECT PHASE: GEOTECHNICAL REV: —	DRAWING NAME: **FIG. 1**		

B:\6119-03 City of Nashua Elm Street School\New School\CAD\6119-03-02 Fig 1.dwg


LEGEND
MMI-101
APPROXIMATE LOCATION & DESIGNATION OF TEST BORING CONDUCTED BY NEW ENGLAND BORING CONTRACTORS BETWEEN AUGUST 21 & 23, 2019, OBSERVED BY MMI.
MMI-1
APPROXIMATE LOCATION AND DESIGNATION OF TEST BORING CONDUCTED BY NEW ENGLAND BORING CONTRACTORS ON APRIL 26, 2019, OBSERVED BY MMI.
APPROXIMATE FOOTPRINT OF PROPOSED SCHOOL BUILDING, FROM A SCAN PROVIDED BY THE NASHUA SCHOOL DISTRICT OF A PLAN TITLED "CHERRYWOOD SITE CONCEPT."
PROPOSED PERIMETER SUBDRAINAGE SYSTEM. TERMINUS TO BE DETERMINED BY THE SITE CIVIL ENGINEER. ACTUAL EXTENT OF THE SUBDRAINAGE SYSTEM TO BE DETERMINED DURING CONSTRUCTION BY THE ENGINEER.
BASE PLAN:
"TOPOGRAPHIC WORKSHEET (MAP C LOT 2851) CHERRYWOOD DRIVE & MEDALLION COURT; NASHUA, NEW HAMPSHIRE" BY HAYNER/SWANSON, INC OF NASHUA, NH, DATED 12 JUNE 2019.
MAP C LOT 2851
MEDALLION
DRIVE
MILONE & MACBROOM
FIGURE 2: EXPLORATION LOCATION PLAN
PROPOSED NEW SCHOOL SITE
CHERRYWOOD DRIVE
NASHUA, NH
EAA
EAA
CET
1"=60'
SEPTEMBER 2019
6119-03-02
FIG. 2



NOTES:

1. THE ABOVE CROSS-SECTION IS BASED ON RESULTS OF MMI'S SUBSURFACE EXPLORATION PROGRAM AND SITE RECONNAISSANCE.
2. FOOTING AND FLOOR SLAB SUBGRADE PREPARATION SHOULD BE PERFORMED IN ACCORDANCE WITH MMI'S GEOTECHNICAL REPORT DATED SEPTEMBER 13, 2019.
3. FOOTINGS SHOULD BE FOUNDED EITHER ON a) IN-SITU GLACIAL TILL DEPOSITS, b) COMPACTED STRUCTURAL FILL PLACED OVER SUITABLE GLACIAL TILL SUBGRADE SURFACES, c) CHOKE LAYER FILL PLACED OVER BEDROCK SURFACES, OR d) COMPACTED STRUCTURAL FILL PLACED OVER CHOKE LAYER FILL.
4. FLOOR SLABS SHOULD BE PLACED ON A MINIMUM 9 INCH CRUSHED AGGREGATE BASE COURSE PLACED DIRECTLY ON PROOFROLLED AND COMPACTED SUITABLE NATURAL GLACIAL TILL; OR ON NEW COMPACTED STRUCTURAL FILL PLACED DIRECTLY OVER THE ABOVE; OR CHOKE LAYER FILL PLACED OVER BEDROCK SURFACES.
5. ALL NEW FILL MATERIALS TO BE PLACED BELOW FOOTINGS AND FLOOR SLABS SHOULD BE COMPACTED TO A MINIMUM OF 95% OF MAXIMUM DENSITY PER ASTM D 1557.
6. ALL EXISTING FILL, TOPSOIL,, FOUNDATIONS, BOULDERS OR OTHER DELETERIOUS MATERIALS SHOULD BE COMPLETELY REMOVED FROM BELOW ALL FOOTINGS, AND FROM WITHIN ALL BEARING ZONES.

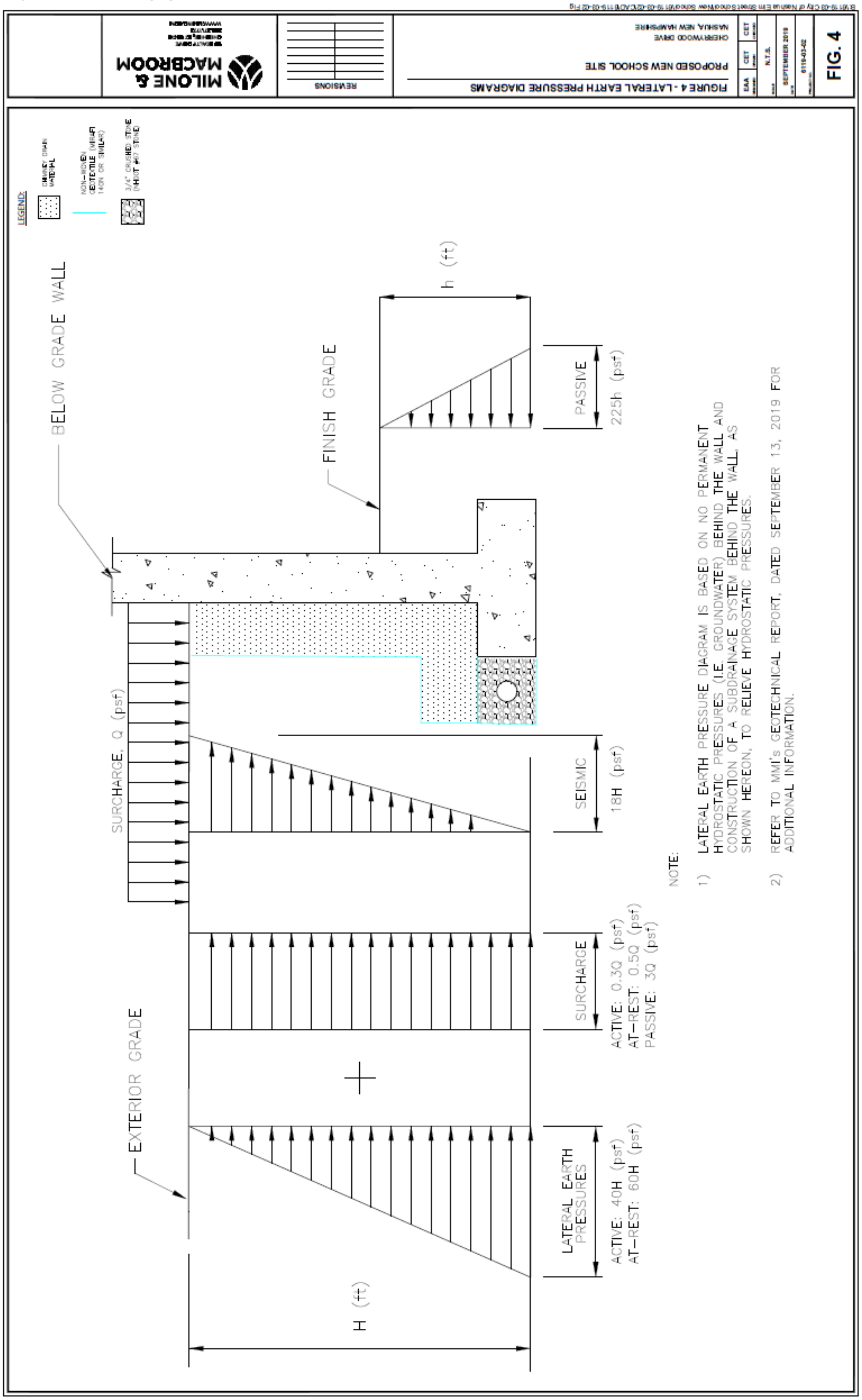


FIGURE 4 - LATERAL EARTH PRESSURE DIAGRAMS
PROPOSED NEW SCHOOL SITE
CHERRYWOOD DRIVE
NASHUA, NEW HAMPSHIRE
MILONE & MACBROOM
REVISIONS
SEPTEMBER 2019
N.T.S.
6119-03-02
FIG. 4
LEGEND:
CHIMNEY DRAIN MATERIAL
NON-WOVEN GEOTEXTILE (MIRAFI 140N OR SIMILAR)
3/4" CRUSHED STONE (NHDOT #67 STONE)
BELOW GRADE WALL
FINISH GRADE
h (ft)
PASSIVE
225h (psf)
SURCHARGE, Q (psf)
SEISMIC
18H (psf)
EXTERIOR GRADE
SURCHARGE
ACTIVE: 0.3Q (psf)
AT-REST: 0.5Q (psf)
PASSIVE: 3Q (psf)
LATERAL EARTH PRESSURES
ACTIVE: 40H (psf)
AT-REST: 60H (psf)
H (ft)
NOTE:
1) LATERAL EARTH PRESSURE DIAGRAM IS BASED ON NO PERMANENT HYDROSTATIC PRESSURES (I.E. GROUNDWATER) BEHIND THE WALL AND CONSTRUCTION OF A SUBDRAINAGE SYSTEM BEHIND THE WALL, AS SHOWN HEREON, TO RELIEVE HYDROSTATIC PRESSURES.
2) REFER TO MMI's GEOTECHNICAL REPORT, DATED SEPTEMBER 13, 2019 FOR ADDITIONAL INFORMATION.

APPENDIX A

Limitations

MILONE & MACBROOM

APPENDIX A

LIMITATIONS ON WORK PRODUCT

Site Observations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from limited subsurface observations. The nature and extent of subsurface variations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. 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 limited observations (no engineering subsurface samples were obtained; actual soil and bedrock transitions are probably more erratic.

3. Water level readings have been made under conditions stated. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of groundwater may occur due to variations in rainfall, temperature and other factors occurring since the time observations were made.

4. In the event that any changes in the proposed general project development are planned (e.g. floor slab on grade elevations, column and wall loads, building footprint size and location, etc.), 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 Milone & MacBroom, Inc. (MMI). It is recommended that this firm be provided the opportunity to review the final design plans and specifications in order to verify that earthwork and foundation recommendations have been properly interpreted and implemented.

Construction

5. It is also recommended that this firm be provided the opportunity to perform the recommended construction phase monitoring services to verify that the intent of our recommendations is being properly implemented in the field during construction. The recommendations given in this report shall not be considered valid unless we are given the opportunity to perform in this capacity.

Topographic Data

6. Site topographic data has been obtained from the provided Hayner/Swanson, Inc. "Topographic Worksheet" of the site provided in an electronic format on 9/1/2019.

Use of Report

7. This Geotechnical Engineering Report has been prepared for the exclusive use of the City of Nashua relative to the proposed new school planned to be located off Cherrywood Drive in Nashua, New Hampshire and is intended to be in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied is made.

8. This Geotechnical Engineering Report has been prepared for this project by Milone & MacBroom, Inc. This report is for design purposes only and is not sufficient to prepare an accurate bid. Contractors wishing a copy of the report may secure it only with the authorization of the owner and then with the understanding that its scope is limited to design considerations only.

APPENDIX B

MMI Exploration Logs

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-1	SHEET:	1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors		
PROJ. NO:	6119-03	FOREMAN:	B. Cross		
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale		
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:			

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	20	1	6" Forest Mat	FOREST MAT 0.5	
1			3	Loose red brown fine SAND, some Silt.	SUBSOIL	
			2		1.5	
2			3	Loose brown fine SAND, little Silt.	SUBSOIL	
3						
4				Auger refusal at ±4'	4	
	S2	0	100/4"	Very dense, No Recovery.		
5						
				Offset 5' north,		
6				Auger refusal at ±4'		
				Bottom of Exploration at ± 4'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-2	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0		
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)	5		
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	3.5		
HAMMER FALL (IN)	--	--	30	--	☐ NO GROUNDWATER ENCOUNTERED			

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	12	1	2" of very loose red-brown fine SAND, some Silt, organics.	SUB-SOIL	
			1	4" of tan fine Sand, some Silt, trace Gravel.		
			1			
2						
3					3	
				Auger Action indicates cobble/gravel from 3'-5.3'±.	G.W.T. 3.5	
4					GLACIAL TILL	
5	S2	3	100/3"	Very dense red-brown fine SAND, little Silt, rock fragments.	5.3	
				Auger Refusal at 5.3±		
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-3	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	16	1	4" Forest Mat	FOREST MAT 0.3	
			1	Loose red-brown fine SAND, some Silt.	SUBSOIL	
1			1	Very loose brown fine SAND, little Silt.		
			3			
2						
3					3.5	
4					GLACIAL TILL	
	S2		24	Very dense grey brown rock fragments.		
			100/5"	Auger refusal at ±4.5'	4.9	
5				Offset ±8' west, Auger refusal at ±2.5'		
				Bottom of Exploration at ± 4.9'		
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-4 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.
TYPE	HSA	--	S	--
SIZE ID (IN)	4 1/4	--	1 3/8	--
HAMMER WT (LB)	--	--	140	--
HAMMER FALL (IN)	--	--	30	--

GROUNDWATER OBSERVATIONS

ELAPSED TIME (HR)			
CASING AT (FT)			
DEPTH (FT)			

☐ NO GROUNDWATER ENCOUNTERED

☐ FIELD TESTING
☐ LABORATORY TESTING
☐ MONITORING WELL INSTALLED
☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	10	1	Very loose red-brown fine SAND, little Silt, organics.	SUB-SOIL	
			2			
			6			
2						
3					3.5	
4				Auger Action indicates cobble/gravel from 3.5'-5'±.	WEATHERED GLACIAL TILL	
5						
			18	Very dense red-brown fine SAND, little Silt, rock fragments.		
6	S2	16	29		6	
			32	Auger Action indicates cobble/gravel from 6'-8.5'±.	GLACIAL TILL	
			37			
7						
8						
9						
10						
	S3	10	78	Top 5": Very dense fine sand, little Silt, rock fragments.		
11			100/4"	Bottom 5": Dark gray rock fragments.	10.8	
				Auger Refusal at 10.8'±		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: -03 City of Nashua Elm Street School\New School\[Boring Logs.xl

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-101	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 21, 2019	GROUND SURFACE ELEVATION:	± 164

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	7	WOH	2" Forest Mat	0.17	
1			1/12"	Very loose red-brown fine SAND, trace Silt, no structure, no odor, moist.		
2			1		2	
3						
4	S2	12	12	Very dense tan fine SAND, some (+) Silt, layered, no odor, dry.	TILL	
5			11			
			40	Auger refusal at 5.5'; offset 5' south, auger refusal at 5'	5.5	
6				Bottom of Exploration at ± 5.5'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 - 15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-02	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-102 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 21, 2019	GROUND SURFACE ELEVATION:	± 162

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA		S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--		140	--	DEPTH (FT)			
HAMMER FALL (IN)	--		30	--	[X] NO GROUNDWATER ENCOUNTERED			

- [ ] FIELD TESTING
- [ ] LABORATORY TESTING
- [ ] MONITORING WELL INSTALLED
- [ ] PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	7	WOH	2" Forest Mat	0.17	
			1/12"	Very loose brown to tan fine SAND, trace (+) Silt, no structure, no odor, moist.		
1						
			1		2	
2						
3						
4	S2	6	13	Very dense red-brown coarse to fine SAND, trace Silt, no structure, no odor, moist.	TILL	
			24			
5			100/0"	Auger refusal at 5'; Offset ±5' east.		
6						
				Auger refusal at 6.9'	6.9	
7				Bottom of Exploration at ± 6.9'		
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.

FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-02

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-103 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 22, 2019	GROUND SURFACE ELEVATION:	± 161

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	7	1	3" Forest Mat, undrelain by 2" tan fine SAND subsoil.	0.42	
			2	Very loose brown coarse to fine SAND, trace Silt, no structure, no		
1			1	odor, moist.	1.5	
			6			
2						
3						
4	S2	11	16	Dense brown medium to fine SAND, little Gravel, trace (+) Silt,	TILL	
			14	no structure, angular gravel, no odor, dry.		
5			19			
			30			
6						
7						
8				Auger action indicates probable weathered bedrock at ±8.5'	8.5	
					WEATHERED BEDROCK	
9						
10				Auger refusal at 10.2'	10.2	
				Bottom of Exploration at ± 10.2'		
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-02E	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-104 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 21, 2019	GROUND SURFACE ELEVATION:	± 162

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	9	1	4" Forest Mat	0.33	
1			4	Medium dense red-brown medium to fine SAND, trace Silt,		
			7	no structure, no odor, moist.	0.75	
2			9			
3						
4						
	S2	13	30	Very Dense brown fine SAND some Gravel, trace Silt, no	TILL	
5			45	structure, no odor, dry.		
			50/1			
6						
7				Auger refusal at 7.4'; Offset 5' north, Auger refusal at 7'.	7.4	
8				Bottom of Exploration at ± 7.4'		
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: shua Elm Street School\New School\6119-03-02\J6113-03-01-02E	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-105	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 23, 2019	GROUND SURFACE ELEVATION:	± 160

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA		S	--	ELAPSED TIME (HR)			☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)			☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)			☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED			☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	5	WOH	3" Forest Mat	0.25	
1			1/12"	Very loose red-brown fine SAND, little Silt, no structure, no odor, moist.		
2			1		2	
3						
4	S2	13	61	Dense grey-brown coarse to fine SAND, little Gravel, trace Silt, well blended in-situ, no odor, dry.	TILL	
5			27			
			18			
			20			
6						
7						
8						
9	S3	14	54	Very dense light grey coarse to fine SAND, some Gravel, trace (-) Silt, rock matrix visible, no odor, dry.	9 WEATHERED BEDROCK	
10			68			
			75			
11						
12						
13						
14	S4	4	100/5"	Very dense light grey coarse to fine SAND, some Gravel, trace (-) Silt, rock matrix visible, no odor, dry.	WEATHERED BEDROCK 14.5	
15				Auger refusal at 14.5' Bottom of Exploration at ± 14.5'		
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.

FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-02(

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 - 15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-106	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 23, 2019	GROUND SURFACE ELEVATION:	± 154

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA		S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--		140	--	DEPTH (FT)			
HAMMER FALL (IN)	--		30	--	[X] NO GROUNDWATER ENCOUNTERED			

- [ ] FIELD TESTING
- [ ] LABORATORY TESTING
- [ ] MONITORING WELL INSTALLED
- [ ] PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	12	WOH	4" Forest Mat		
			1	4" Red-brown fine SAND, no structure, no odor, moist.		
1			1	Very loose tan fine SAND, trace Silt, no structure, no odor, dry.		
2			1			
				Auger action indicates strata change at ±3'	3	
3						
4	S2	14	23	Dense brown-grey coarse to fine SAND, little Gravel, trace Silt,	TILL	
5			20	well blended in-situ, no odor, dry.		
			28			
6			28			
7						
8						
9					9	
	S4	4	100/5	Very dense grey coarse to fine SAND, little (+) Gravel, trace Silt,	WEATHERED BEDROCK	
10				rock matrix visible, no odor, dry.		
				Auger refusal at 10.8'	10.8	
11				Bottom of Exploration at ± 10.8'		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.

FILE: ishua Elm Street School\New School\6119-03-02\[6113-03-01-028

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-107 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 21, 2019	GROUND SURFACE ELEVATION:	± 147

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.
TYPE	HSA		S	--
SIZE ID (IN)	2 1/4		1 3/8	--
HAMMER WT (LB)	--		140	--
HAMMER FALL (IN)	--		30	--

GROUNDWATER OBSERVATIONS: ELAPSED TIME (HR); CASING AT (FT); DEPTH (FT)
[X] NO GROUNDWATER ENCOUNTERED

[ ] FIELD TESTING
[ ] LABORATORY TESTING
[ ] MONITORING WELL INSTALLED
[ ] PID SCREENING
[ ]

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	3	50/3"	2" Forest Mat	0.17	
				Very dense grey GRAVEL and medium to fine SAND.		
1						
2					TILL	
3						
4				Auger refusal at 4.5'; Offset 5' east, Auger refusal at 4.5'	4.5	
				Bottom of Exploration at ± 4.5'		
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.

FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-02

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-108	SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 23, 2019	GROUND SURFACE ELEVATION:	± 147

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS			
TYPE	HSA		S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--		140	--	DEPTH (FT)			
HAMMER FALL (IN)	--		30	--	[X] NO GROUNDWATER ENCOUNTERED			

- [ ] FIELD TESTING
- [ ] LABORATORY TESTING
- [ ] MONITORING WELL INSTALLED
- [ ] PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	12	4	6" Topsoil/Loam Fill	0.50	
			6	Loose brown fine SAND, trace Silt, no structure, no odor, dry.		
1			3			
			3		2	
2						
3						
4	S2	16	14	Dense grey-brown coarse to fine SAND, trace Gravel, trace (+)	TILL	
			17	Silt, no structure, no odor, dry.		
5			20			
			30			
6						
7						
8				Auger refusal at 8.7'; Offset 5' north, Auger refusal at 7.7'	8.7	
				Bottom of Exploration at ± 8.7'		
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.

FILE: ashua Elm Street School\New School\6119-03-02\[6113-03-01-02

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 - 2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 - 15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-109 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 23, 2019	GROUND SURFACE ELEVATION:	± 146

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS					
TYPE	HSA		S	--	ELAPSED TIME (HR)					☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)					☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)					☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED					☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	11	1 1	Very loose Loam Fill	1	
1			2 3	Cuttings indicate brown medium to fine SAND, little Silt, no structure, no odor, moist.		
2						
3						
4	S2	14	9 19 21 23	Dense grey-brown coarse to fine SAND, some Gravel, little Silt no structure, no odor, dry.	TILL	
5						
6						
7						
8					9	
9	S3	10	53 46 78	Very dense grey-brown coarse to fine SAND, little Gravel, trace Silt, rock matrix visible, no odor, dry.	WEATHERED BEDROCK	
10						
11				Auger refusal at 11.4'	11.4	
				Bottom of Exploration at ± 11.4'		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: shua Elm Street School\New School\6119-03-02\J6113-03-01-02	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-110 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 22, 2019	GROUND SURFACE ELEVATION:	± 164

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	9	3	3" Forest Mat	0.25	
			6	Medium dense brown to grey-brown medium to fine SAND,		
1			17	little Gravel, trace Silt, no structure, no odor, moist.	1	
			16			
2						
3						
4						
5	S2	18	11	Dense olive-grey coarse to fine SAND, little Silt, trace Gravel,	TILL	
			15	well bonded in-situ, no odor, moist.		
6			16			
			21			
7						
8						
9						
10	S3	20	15	Dense olive-grey coarse to fine SAND, some Silt, trace (+)	TILL	
			16	Gravel, well bonded in-situ, no odor, moist.		
11			21			
			43			
12						
13						
14						
15	S4	12	33	Very dense olive-grey coarse to fine SAND, some Silt, trace	TILL	
			68	Gravel, well bonded in-situ, no odor, moist.		
16			100/3"	Auger refusal at 16.5'	16.5	
				Bottom of Exploration at ± 16.5'		
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-02	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-111 SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	August 22, 2019	GROUND SURFACE ELEVATION:	± 157

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	2	1	2" Forest Mat	0.17	
1			1	Auger cuttings indicate brown coarse to fine SAND, trace		
			2	Gravel, trace Silt.	1.5	
			6			
2						
3						
4	S2	10	10	Very dense brown to grey coarse to fine SAND, little Gravel,	TILL	
5			20	trace Silt, no structure, no odor, moist.	5	
			95	Auger refusal at 5.5'; Offset 5' east, Auger refusal at 4'	5.5	
6				Bottom of Exploration at ± 5.5'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
3) Surficial boulders in vicinity.	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-028	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-112 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	September 22, 2019	GROUND SURFACE ELEVATION:	

EQUIPMENT:	AUGER	CASING	****************		GROUNDWATER OBSERVATIONS			
TYPE	HSA		S	--	ELAPSED TIME (HR)			
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)			
HAMMER WT (LB)	--		140	--	DEPTH (FT)			
HAMMER FALL (IN)	--		30	--	[X] NO GROUNDWATER ENCOUNTERED			

- [ ] FIELD TESTING
- [ ] LABORATORY TESTING
- [ ] MONITORING WELL INSTALLED
- [ ] PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	4	6	4" Forest Mat	0.33	
			5	Auger cuttings indicate grey-brown coarse to fine SAND, little		
1			6	Silt.	1.5	
			15			
2						
3						
4						
5	S3	3	43	Very dense grey coarse to fine SAND, some Silt, little Gravel	TILL	
			48	well bonded in-situ, no odor, moist.		
6			33			
			38			
7						
8						
9						
10	S3	20	17	Dense olive-grey coarse to fine SAND, some Silt, little (-) Gravel,	TILL	
			20	well bonded in-situ, no odor, moist.		
11			23			
			32			
12						
13						
14						
15	S4	24	17	Very dense olive-grey coarse to fine SAND, some Silt, little	TILL	
			23	Gravel, well bonded in-situ, no odor, moist.		
16			32			
			37			
17						
18						
19						
20	S5	12	17	Very dense olive-grey coarse to fine SAND, some Silt, little	TILL	
			21	Gravel, well bonded in-situ, no odor, moist.		
21			33			
			25			
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
3) Large surficial bourlders in vicinity of boring.	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: shua Elm Street School\New School\6119-03-02\J6113-03-01-02	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-112	SHEET: 2 of 2
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	September 22, 2019	GROUND SURFACE ELEVATION:	± 175

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S5	12	33 25	Very dense olive-grey coarse to fine SAND, some Silt, little Gravel, well bonded in-situ, no odor, moist.	TILL	
22						
23						
24						
25	S6	18	40 58 73	Very dense olive-grey coarse to fine SAND, some Silt, little Gravel, well bonded in-situ, no odor, moist.	TILL	
26						
27				Auger refusal at 27.5'	27.5	
				Bottom of Exploration at ± 27.5		
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:
1) TYPE OF RIG:
2) HAMMER/HOIST TYPE: Auto.
3) Large surficial bourlders in vicinity of boring.

FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-028

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane; Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-113 SHEET: 1 of 2
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	September 22, 2019	GROUND SURFACE ELEVATION:	± 173

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ LABORATORY TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ MONITORING WELL INSTALLED
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ PID SCREENING
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐

☐ FIELD TESTING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	8	WOH	6" Forest Mat	0.50	
1			1	Loose brown coarse to fine SAND, little Gravel, trace Silt, no structure, no odor, moist.		
			2			
2			4		2	
3						
4	S2	14	15	Very dense olive-grey coarse to fine SAND, some Silt, trace (+) Gravel, well bonded in-situ, no odor, moist.	TILL	
5			29			
			27			
			58			
6						
7						
8						
9	S3	22	17	Dense olive-grey coarse to fine SAND, some Silt, trace (+) Gravel, well bonded in-situ, no odor, moist.	TILL	
10			17			
			21			
			24			
11						
12						
13						
14	S4	24	13	Dense olive-grey coarse to fine SAND, some Silt, trace (+) Gravel, well bonded in-situ, no odor, moist.	TILL	
15			18			
			16			
			19			
16						
17						
18						
19	S5	24	17	Very dense olive-grey coarse to fine SAND, some Silt, trace (+) Gravel, extremely well bonded in-situ, no odor, moist.	TILL	
20			25			
			56			
			33			
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-02E	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.: MMI-113	SHEET: 2 of 2
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03-02	FOREMAN:	W. Hoeckele
CLIENT:	Joint Special School Building Committee	INSPECTOR:	E. Adler
DATE:	September 22, 2019	GROUND SURFACE ELEVATION:	± 173

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA		S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	2 1/4		1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--		140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--		30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
22						
23						
24	S6	24	27 40	Very dense olive-brown coarse to fine SAND, some (+) Silt, little (-) Gravel, extremely well bonded in-situ, no odor, moist.	TILL	
25			48 42			
26						
27				Auger refusal at 28'	28	
28				Bottom of Exploration at ± 28'		
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG:	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Auto.	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
3) Large surficial bourlders in vicinity of boring.	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-02E	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-1 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	± 153

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	20	1	6" Forest Mat	FOREST MAT 0.5	
1			3	Loose red brown fine SAND, some Silt.	SUBSOIL	
			2		1.5	
2			3	Loose brown fine SAND, little Silt.	SUBSOIL	
3						
4				Auger refusal at ±4'	4	
	S2	0	100/4"	Very dense, No Recovery.		
5						
				Offset 5' north,		
				Auger refusal at ±4'		
6				Bottom of Exploration at ± 4'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:	COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted	N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
2) HAMMER/HOIST TYPE: Automatic	4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
	10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
	30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
FILE: ıshua Elm Street School\New School\6119-03-02\6113-03-01-02E	50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

MILONE & MACBROOM
2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-2 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	± 166

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	0			FIELD TESTING
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)	5			LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	3.5			MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	NO GROUNDWATER ENCOUNTERED				PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	12	1	2" of very loose red-brown fine SAND, some Silt, organics.	SUB-SOIL	
			1	4" of tan fine Sand, some Silt, trace Gravel.		
			1			
2						
3					3	
				Auger Action indicates cobble/gravel from 3'-5.3'±.	G.W.T. 3.5	
4					GLACIAL TILL	
5	S2	3	100/3"	Very dense red-brown fine SAND, little Silt, rock fragments.	5.3	
				Auger Refusal at 5.3±		
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-02E

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

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2 Cote Lane, Suite 1
Bedford, New Hampshire 03110
603-668-1654

PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-3 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	C. Teale
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	± 158

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS	
TYPE	HSA	--	S	--	ELAPSED TIME (HR)	☐ FIELD TESTING
SIZE ID (IN)	3 1/4	--	1 3/8	--	CASING AT (FT)	☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)	☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED	☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
	S1	16	1	4" Forest Mat	FOREST MAT 0.3	
			1	Loose red-brown fine SAND, some Silt.	SUBSOIL	
1			1	Very loose brown fine SAND, little Silt.		
			3			
2						
3					3.5	
4					GLACIAL TILL	
	S2		24	Very dense grey brown rock fragments.		
5			100/5"	Auger refusal at ±4.5'	4.9	
				Offset ±8' west, Auger refusal at ±2.5'		
6				Bottom of Exploration at ± 4.9'		
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: ishua Elm Street School\New School\6119-03-02\6113-03-01-028

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

TEST BORING LOG

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Bedford, New Hampshire 03110
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PROJECT:	PROPOSED NEW SCHOOL SITE	BORING NO.:	MMI-4 — SHEET: 1 of 1
LOCATION:	Cherrywood Drive, Nashua, NH	CONTRACTOR:	New England Boring Contractors
PROJ. NO:	6119-03	FOREMAN:	B. Cross
CLIENT:	Joint Special School Building Committee	INSPECTOR:	J. Carrier
DATE:	April 26, 2019	GROUND SURFACE ELEVATION:	± 156

EQUIPMENT:	AUGER	CASING	SAMPLER	COREBRL.	GROUNDWATER OBSERVATIONS				
TYPE	HSA	--	S	--	ELAPSED TIME (HR)				☐ FIELD TESTING
SIZE ID (IN)	4 1/4	--	1 3/8	--	CASING AT (FT)				☐ LABORATORY TESTING
HAMMER WT (LB)	--	--	140	--	DEPTH (FT)				☐ MONITORING WELL INSTALLED
HAMMER FALL (IN)	--	--	30	--	☒ NO GROUNDWATER ENCOUNTERED				☐ PID SCREENING

Depth (FT)	SAMPLE NUMBER	RECOVERY (IN)	BLOWS PER 6"	SOIL AND ROCK CLASSIFICATION-DESCRIPTION BURMISTER SYSTEM (SOIL) U.S. CORPS OF ENGINEERS SYSTEM (ROCK)	STRATUM CHANGE DESCRIPTION	PID (PPM)
			0	6" Forest Mat	FOREST MAT 0.5	
1	S1	10	1	Very loose red-brown fine SAND, little Silt, organics.	SUB-SOIL	
			2			
			6			
2						
3					3.5	
4				Auger Action indicates cobble/gravel from 3.5'-5'±.	WEATHERED GLACIAL TILL	
5						
	S2	16	18	Very dense red-brown fine SAND, little Silt, rock fragments.		
6			29		6	
			32	Auger Action indicates cobble/gravel from 6'-8.5'±.	GLACIAL TILL	
			37			
7						
8						
9						
10	S3	10	78	Top 5": Very dense fine sand, little Silt, rock fragments.		
			100/4"	Bottom 5": Dark gray rock fragments.	10.8	
11				Auger Refusal at 10.8'±		
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						

Notes:
1) TYPE OF RIG: Mobile Drill B-53; Track Mounted
2) HAMMER/HOIST TYPE: Automatic

FILE: ishua Elm Street School\New School\6119-03-02\J6113-03-01-02I

COHESIONLESS SOILS	COHESIVE SOILS	SAMPLE TYPE	PROPORTIONS
N = 0 - 4 = VERY LOOSE	N = 0 -2 = VERY SOFT	C = ROCK CORE	trace = 0% - 10%
4-10 = LOOSE	2 - 4 = SOFT	S = SPLIT SPOON	little = 10% - 20%
10-30 = MEDIUM	4 - 8 = MEDIUM	UP = UNDISTURBED PISTON	some = 20% - 35%
30-50 = DENSE	8 -15 = STIFF	UT = UNDISTURBED THINWALL	and = 35% - 50%
50 + = VERY DENSE	30 + = HARD		

MILONE & MACBROOM

BURMISTER SOIL CLASSIFICATION SYSTEM

A. CLASSIFICATION OF SOIL COMPONENTS

PRINCIPAL COMPONENT	DESCRIPTIVE PARTICLE SIZE	SMALLEST DIAMETER OF ROLLED THREAD (IN.)	SIEVE SIZE	OVERALL PLASTICITY AND PLASTICITY INDEX
GRAVEL	Coarse Fine	---- ----	3/4" to 3" No. 4 to 3/4"	---- ----
SAND	Coarse Medium Fine	---- ---- ----	No. 10 to No. 4 No. 40 to No. 10 No. 200 to No. 40	---- ---- ----
SILT	----	----	Passing No. 200	Non-Plastic 0
Clayey Silt	----	1/4	Passing No. 200	Slight 1 to 5
SILT and CLAY	----	1/8	Passing No. 200	Low 5 to 10
CLAY and SILT	----	1/16	Passing No. 200	Medium 10 to 20
Silty Clay	----	1/32	Passing No. 200	High 20 to 40
CLAY	----	1/64	Passing No. 200	Very High 40 and greater
PEAT	Partially decomposed fibrous organic matter without living fibers			

B. INDENTIFICATION OF DESCRIPTION TERMS

DESCRIPTION OF SOIL COMPONENTS	PERCENTAGE OF SAMPLE BY WEIGHT
PRINCIPAL COMPONENT	
GRAVEL, SAND, SILT CLAY, etc.	50 or more
MINOR COMPONENTS	
and fine to coarse SAND, and GRAVEL etc.	35 to 50
some some Gravel, some Silt, etc.	20 to 35
little little Gravel, little Silt, etc.	10 to 20
trace trace Gravel, trace Silt, etc.	1 to 10

C. DEFINITION OF TERMS IDENTIFYING THE GRADATION OF THE GRANULAR COMPONENT

GRADATION DESIGNATIONS FOR IDENTIFICATION	DEFINING PROPORTIONS
fine to coarse	all fractions greater than 10 percent
medium to coarse	less than 10 percent fine
fine to medium	less than 10 percent coarse
medium	less than 10 percent coarse and fine
fine	less than 10 percent coarse and medium

D. DENSITY OR CONSISTENCY

GRANULAR SOILS

Standard Penetration Resistance (N value) blows/foot	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
50+	Very dense

PLASTIC SOILS

Standard Penetration Resistance (N value) Blows/foot	Consistency
0 - 2	Very soft
2 - 4	Soft
4 - 8	Medium
8 - 15	Stiff
15 - 30	Very stiff
30+	Hard

E. GLOSSARY OF MISCELLANEOUS TERMS

PLUS (+) NEARER THE UPPER LIMIT OF THE PROPORTION OR OVERALL PLASTICITY
MINUS (-) NEARER THE LOWER LIMIT OF THE PROPORTION OR OVERALL PLASTICITY
NO SIGN - MIDDLE RANGE OF THE PROPORTION OR OVERALL PLASTICITY
COBBLES - ROUNDED PIECES OR ROCK BETWEEN 3 TO 6 INCHES
BOULDERS - ROUNDED PIECES OF ROCK LARGER THAN 6 INCHES
ROCK FRAGMENTS - ANGULAR PIECES OF ROCK WHICH HAVE SEPARATED FROM PARENT ROCK AND ARE PRESENT IN A SOIL MATRIX
QUARTZ - A HARD SILICA MINERAL OFTEN FOUND IN SOME GLACIAL LAYERS
IRONITE - CEMENTED DEPOSITS OF IRON OXIDE WITHIN A SOIL LAYER
CEMENTED SAND - VARIOUS SIZED AND GRAINS CEMENTED BY CALCIUM CARBONATE OR OTHER MINERALS WITHIN THE SOIL DEPOSIT
VARVED DEPOSITS - ALTERNATING LIGHT AND DARK LAYERS OF COHESIVE CLAYS AND SILTS DEPOSITED AS GLACIAL LAKE SEDIMENTATION
FISSURED CLAYS - COHESIVE SOILS AND EXHIBITING A JOINT STRUCTURE. GENERALLY SLIGHTLY TO HIGHLY OVER CONSOLIDATED

ORGANIC MATTER (EXCLUDING PEAT):
TOPSOIL - SURFICIAL SOILS THAT SUPPORT PLANT LIFE AND WHICH CONTAIN CONSIDERABLE AMOUNTS OF ORGANIC MATTER
DECOMPOSED VEGETATION - PARTIALLY DECOMPOSED ORGANIC MATTER WHICH RETAINS ITS ORIGIANAL CHARACTER;
LIGNITE - IMMATURE COALS WITH LOW FIXED CARBON CONTENT GENERALLY EXHIBITING DISTINCT TEXTURE OF WOOD;
HUMUS - COMPLETELY DECOMPOSED ORGANICMATTER
FILL - MAN MADE DEPOSIT CONTAINING SOIL, ROCK OR FOREIGN MATTER
PROBABLE FILL - SOILS WHICH CONTAIN NO VISUALLY DETECTABLE FOREIGN MATTER BUT WHICH ARE SUSPECT WITH RESPECT TO ORIGIN
LENSES - LAYER LESS THAN 1/2 INCH   LAYERS - 1/2 TO 12 INCH THICK LAYER
POCKET - DISCONTINUOUS LAYERS LESS THAN 12 INCHES
STRATUM - CONTINUOUS LAYERS GREATER THAN 12 INCHES
COLOR SHADING - LIGHT OR DARD TO INIDCATE SUBSTANTIAL DIFFERENCE IN COLOR
MOISTURE CONDITIONS - WET, MOIST, OR DRY PER VISUAL OBSERVATION

APPENDIX C

Laboratory Gradation Analyses

MILONE & MACBROOM

LABORATORY GRADATION REPORT

PROJECT:	Proposed New School Site	**CLIENT:**	Joint Special School Building Committee
LOCATION:	Cherrywood Drive, Nashua, NH	**CONTRACTOR:**	n/a
PROJECT NO.:	6119-03-02	**SOURCE:**	Onsite MMI-101; S2

SAMPLE NO.:	MMI-101; S2	**TEST METHOD:**	ASTM D422/D1140	**DATE RETRIEVED:**	8/21/2019
TEST DATE:	9/12/2019	**TESTED BY:**	EAA	**CHECKED BY:**	CET

SAMPLE DESCRIPTION: Tan fine Sand, some Silt.
PROPOSED SAMPLE USE: Onsite

	SIEVE SIZE	SIEVE OPENINGS		WEIGHT RETAINED (grams)	CUMULATIVE WEIGHT RETAINED (grams)	PERCENT FINER OF TOTAL
		inches	millimeters			
GRAVEL	6"	6.000	152.4	0.0	0.0	100.0
	3"	3.000	76.20	0.0	0.0	100.0
	2"	2.000	50.80	0.0	0.0	100.0
	1-1/2"	1.500	38.10	0.0	0.0	100.0
	1"	1.000	25.40	0.0	0.0	100.0
	3/4"	0.750	19.00	0.0	0.0	100.0
	1/2"	0.500	12.70	0.0	0.0	100.0
	3/8"	0.375	9.50	0.0	0.0	100.0
SAND	#4	0.187	4.75	0.2	0.2	99.9
	#8	0.093	2.36	0.3	0.5	99.8
	#10	0.079	2.00	1.0	1.5	99.4
	#16	0.046	1.18	0.9	2.4	99.1
	#40	0.017	0.43	2.7	5.1	98.0
	#50	0.012	0.30	5.5	10.6	95.8
	#100	0.006	0.15	74.9	80.0	68.6
	#200	0.003	0.07	113.2	193.2	24.1
Silt or Clay	Pan	0.000	0.00	13.4	206.6	18.8
			Total weight of sample		254.5	

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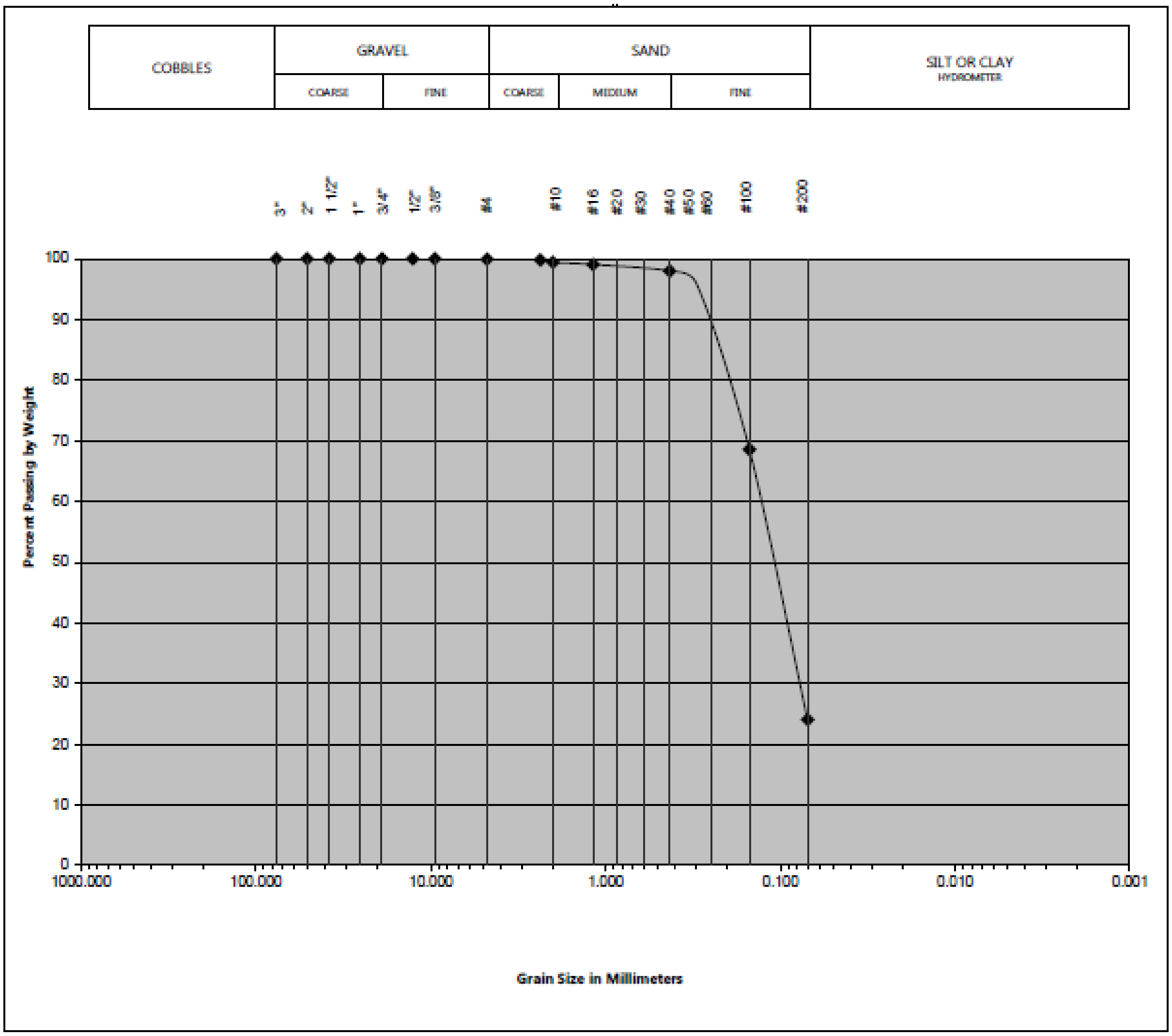
LABORATORY GRADATION REPORT

PROJECT:	Proposed New School Site	**CLIENT:**	Joint Special School Building Committee
LOCATION:	Cherrywood Drive, Nashua, NH	**CONTRACTOR:**	n/a
PROJECT NO.:	6119-03-02	**SOURCE:**	Onsite MMI-101; S2

SAMPLE NO.:	MMI-101; S2	**TEST METHOD:**	ASTM D 422 / D 1140	**DATE RETRIEVED:**	8/21/2019
DATE TESTED:	9/12/2019	**TESTED BY:**	EAA	**CHECKED BY:**	CET

SAMPLE DESCRIPTION: Tan fine Sand, some Silt.
PROPOSED SAMPLE USE: Onsite



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LABORATORY GRADATION REPORT

PROJECT:	Proposed New School Site	**CLIENT:**	Joint Special School Building Committee
LOCATION:	Cherrywood Drive, Nashua, NH	**CONTRACTOR:**	n/a
PROJECT NO.:	6119-03-02	**SOURCE:**	Onsite MMI-109; S2

SAMPLE NO.:	MMI-109; S2	**TEST METHOD:**	ASTM D422/D1140	**DATE RETRIEVED:**	8/23/2019
TEST DATE:	9/12/2019	**TESTED BY:**	EAA	**CHECKED BY:**	CET

SAMPLE DESCRIPTION: Grey-brown coarse to fine SAND, some Gravel, little Silt.
PROPOSED SAMPLE USE: Onsite

	SIEVE SIZE	SIEVE OPENINGS		WEIGHT RETAINED (grams)	CUMULATIVE WEIGHT RETAINED (grams)	PERCENT FINER OF TOTAL
		inches	millimeters			
GRAVEL	6"	6.000	152.4	0.0	0.0	100.0
	3"	3.000	76.20	0.0	0.0	100.0
	2"	2.000	50.80	0.0	0.0	100.0
	1-1/2"	1.500	38.10	0.0	0.0	100.0
	1"	1.000	25.40	0.0	0.0	100.0
	3/4"	0.750	19.00	29.8	29.8	89.2
	1/2"	0.500	12.70	32.9	62.7	77.2
	3/8"	0.375	9.50	15.0	77.7	71.7
SAND	#4	0.187	4.75	23.7	101.4	63.1
	#8	0.093	2.36	6.4	107.8	60.8
	#10	0.079	2.00	12.4	120.2	56.3
	#16	0.046	1.18	6.9	127.1	53.7
	#40	0.017	0.43	11.9	139.0	49.4
	#50	0.012	0.30	6.2	145.2	47.2
	#100	0.006	0.15	42.8	181.8	33.8
	#200	0.003	0.07	48.8	230.6	16.1
Silt or Clay	Pan	0.000	0.00	9.9	240.5	12.5
			Total weight of sample		274.8	

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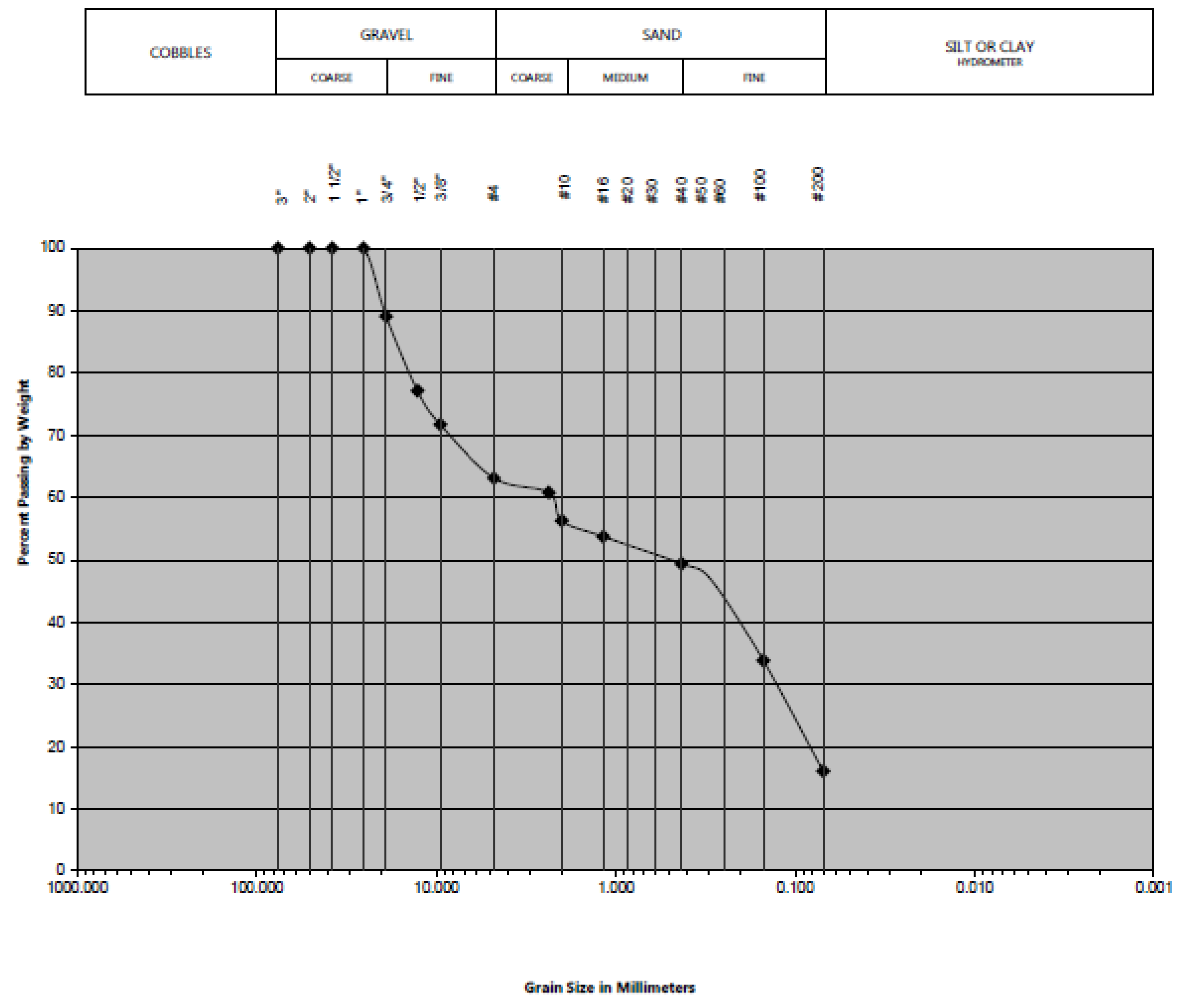
MILONE & MACBROOM

LABORATORY GRADATION REPORT

PROJECT:	Proposed New School Site	**CLIENT:**	Joint Special School Building Committee
LOCATION:	Cherrywood Drive, Nashua, NH	**CONTRACTOR:**	n/a
PROJECT NO.:	6119-03-02	**SOURCE:**	Onsite MMI-109; S2

SAMPLE NO.:	MMI-109; S2	**TEST METHOD:**	ASTM D 422 / D 1140	**DATE RETRIEVED:**	8/23/2019
DATE TESTED:	9/12/2019	**TESTED BY:**	EAA	**CHECKED BY:**	CET

SAMPLE DESCRIPTION: Grey-brown coarse to fine SAND, some Gravel, little Silt.
PROPOSED SAMPLE USE: Onsite



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MILONE & MACBROOM

LABORATORY GRADATION REPORT

PROJECT: Proposed New School Site
LOCATION: Cherrywood Drive, Nashua, NH
PROJECT NO.: 6119-03-02

CLIENT: Joint Special School Building Committee
CONTRACTOR: n/a
SOURCE: Onsite MMI-112; S3

SAMPLE NO.: MMI-112; S3 **TEST METHOD:** ASTM D422/D1140 **DATE RETRIEVED:** 8/22/2019
TEST DATE: 9/12/2019 **TESTED BY:** EAA **CHECKED BY:** CET

SAMPLE DESCRIPTION: Grey coarse to fine Sand, some silt, trace gravel.
PROPOSED SAMPLE USE: Onsite

	SIEVE SIZE	SIEVE OPENINGS		WEIGHT RETAINED (grams)	CUMULATIVE WEIGHT RETAINED (grams)	PERCENT FINER OF TOTAL
		inches	millimeters			
GRAVEL	6"	6.000	152.4	0.0	0.0	100.0
	3"	3.000	76.20	0.0	0.0	100.0
	2"	2.000	50.80	0.0	0.0	100.0
	1-1/2"	1.500	38.10	0.0	0.0	100.0
	1"	1.000	25.40	0.0	0.0	100.0
	3/4"	0.750	19.00	0.0	0.0	100.0
	1/2"	0.500	12.70	0.0	0.0	100.0
	3/8"	0.375	9.50	6.7	6.7	96.3
SAND	#4	0.187	4.75	12.8	19.5	89.1
	#8	0.093	2.36	9.6	29.1	83.8
	#10	0.079	2.00	4.5	33.6	81.3
	#16	0.046	1.18	16.4	50.0	72.2
	#40	0.017	0.43	37.2	87.2	51.4
	#50	0.012	0.30	10.7	97.9	45.5
	#100	0.006	0.15	20.1	107.3	40.3
	#200	0.003	0.07	12.4	119.7	33.4
Silt or Clay	Pan	0.000	0.00	2.5	122.2	32.0
			Total weight of sample		179.6	

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SAMPLE NO.:	MMI-112; S3	**TEST METHOD:**	ASTM D 422 / D 1140	**DATE RETRIEVED:**	8/22/2019
DATE TESTED:	9/12/2019	**TESTED BY:**	EAA	**CHECKED BY:**	CET

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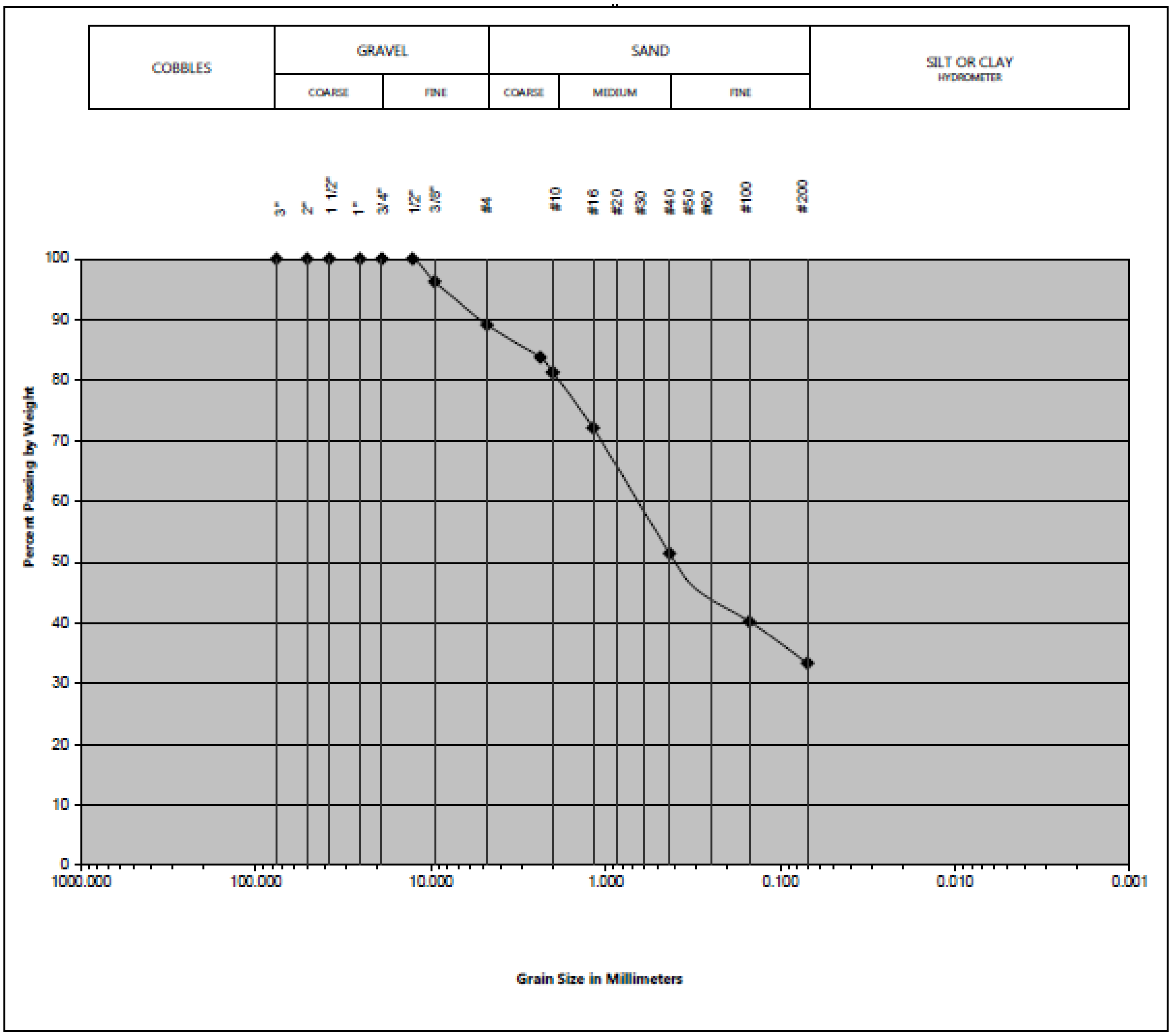
PROPOSED SAMPLE USE: Onsite



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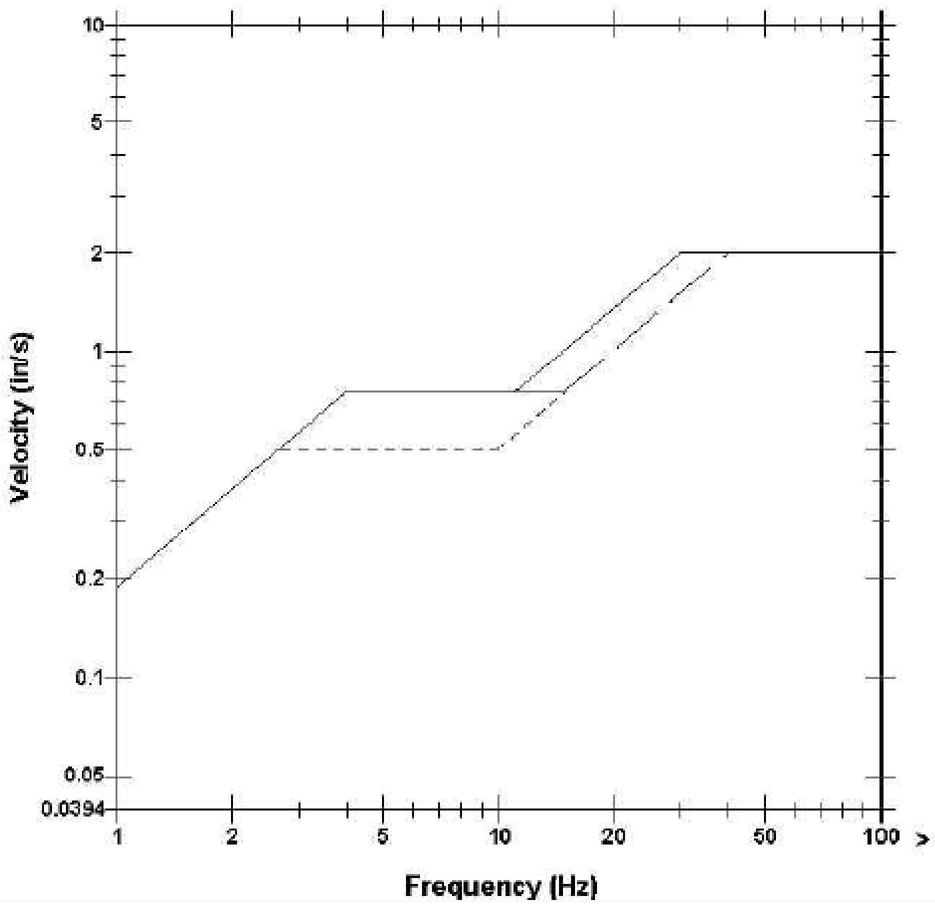
APPENDIX D

Blast Design Consideration Graphs

USBM RI 8507 APPENDIX B
ALTERNATIVE BLASTING LEVEL CRITERIA



SUGGESTED MAXIMUN LEVELS OF VELOCITY VERSUS FRE□UENCY RELATIONSHIPS

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GRAPH 1

PROPOSED NEW SCHOOL SITE

CHERRYWOOD DRIVE
NASHUA, NEW HAMPSHIRE

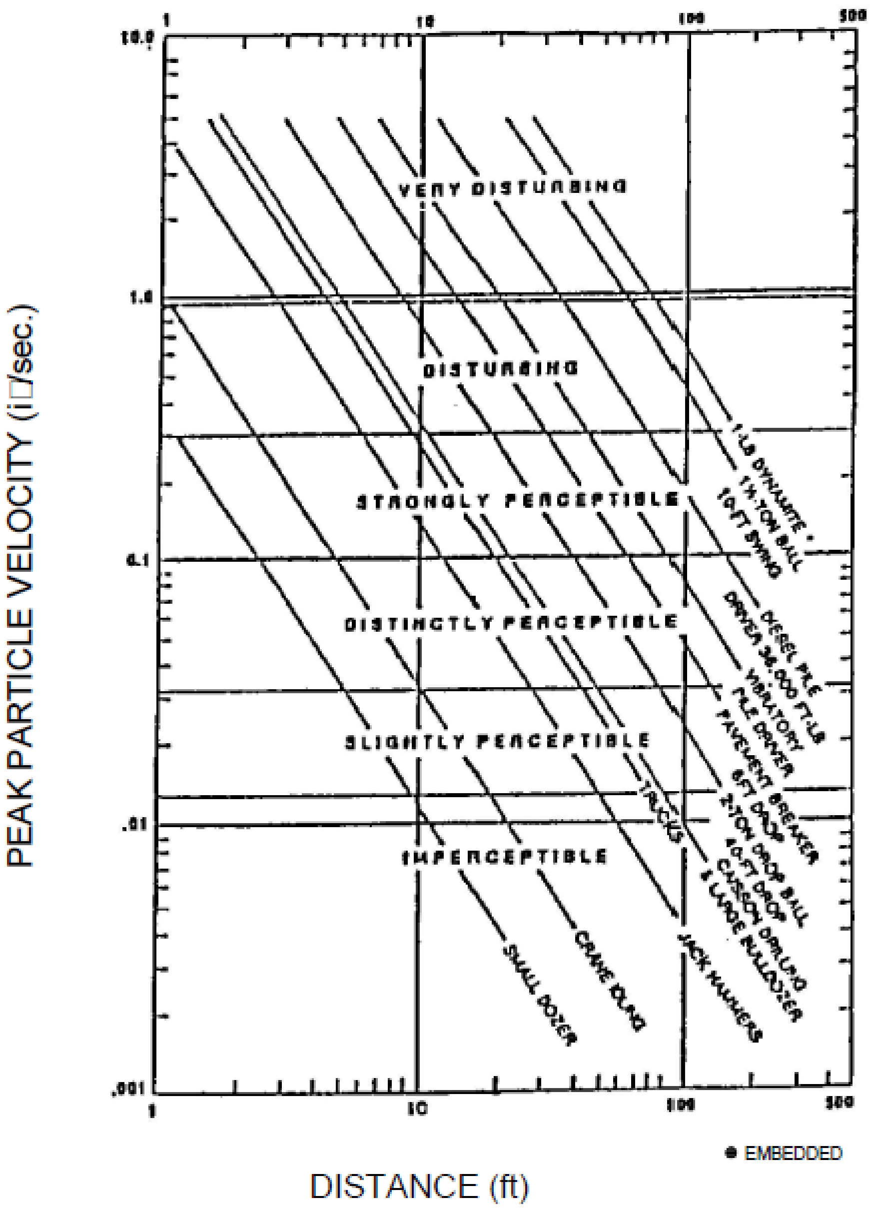
PROJECT PHASE: FOCUSED DESIGN GEOTECH REV: —

DATE	SEPTEMBER 2019
SCALE	N.T.S.
PROJ. NO.	6119-03-02

DESIGNED	DRAWN	CHECKED
EAA	EAA	CET

DRAWING NAME: **GR. 1**

B:\6119-03 City of Nashua Elm Street School\New School\6119-03-02\CAD\6119-03-02 VIBE GRAPHS.dwg



TYPICAL CONSTRUCTION RELATED VIBRATIONS

MILONE & MACBROOM

GRAPH 2

PROPOSED NEW SCHOOL SITE

CHERRYWOOD DRIVE
NASHUA, NEW HAMPSHIRE

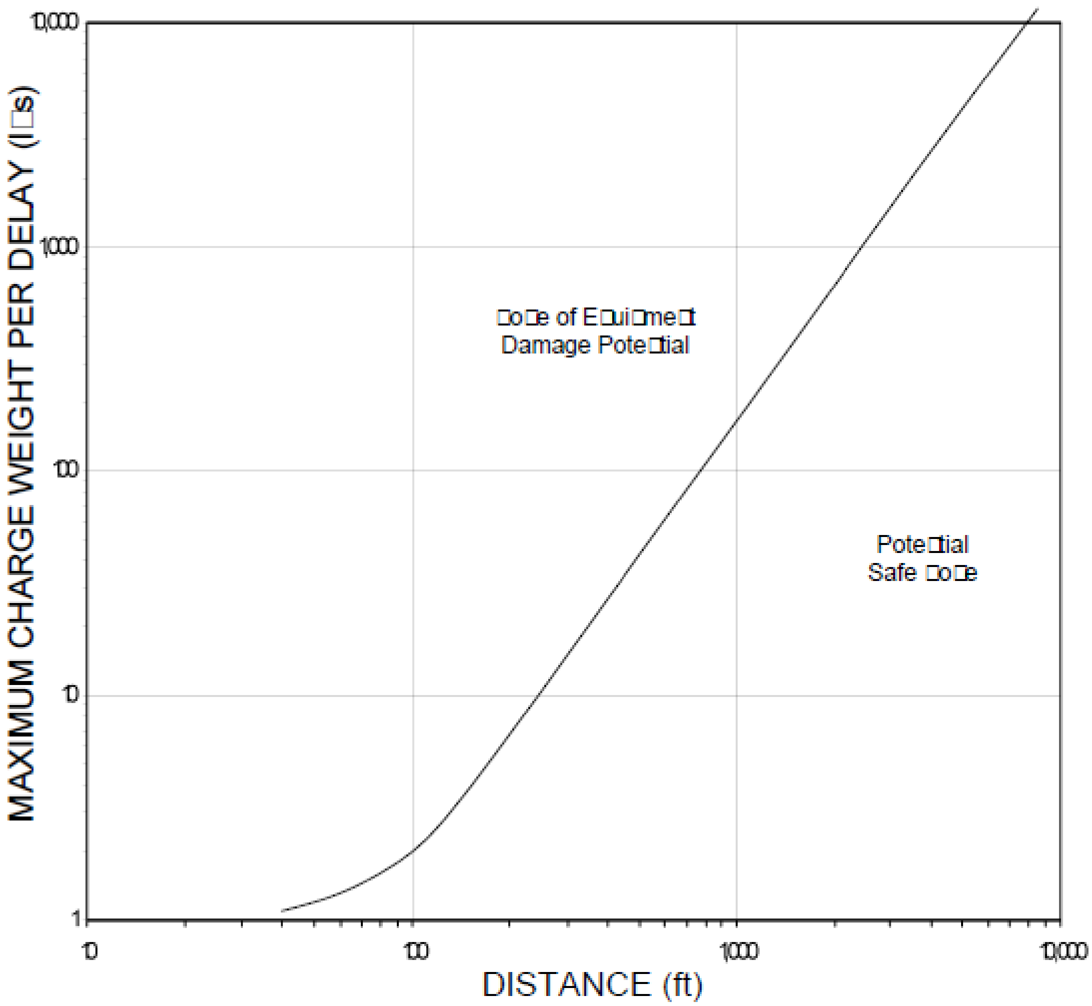
PROJECT PHASE: FOCUSED DESIGN GEOTECH   REV: —

DATE	SEPTEMBER 2019
SCALE	N.T.S.
PROJ. NO.	6119-03-02

DESIGNED	DRAWN	CHECKED
EAA	EAA	CET

DRAWING NAME: **GR. 2**

B:\6119-03 City of Nashua Elm Street School\New School\6119-03-02\CAD\6119-03-02 VIBE GRAPHS.dwg



E□UIPMENT DAMAGE POTENTIAL FOR BLASTING OPERATIONS

MILONE & MACBROOM	GRAPH 3	DATE	SEPTEMBER 2019	
	PROPOSED NEW SCHOOL SITE	SCALE	N.T.S.	
		PROJ. NO.	6119-03-02	
	CHERRYWOOD DRIVE NASHUA, NEW HAMPSHIRE	DESIGNED EAA	DRAWN EAA	CHECKED CET
	PROJECT PHASE: FOCUSED DESIGN GEOTECH REV: —	DRAWING NAME:	GR. 3	

B:\6119-03 City of Nashua Elm Street School\New School\6119-03-02\CAD\6119-03-02 VIBE GRAPHS.dwg

RECOMMENDATIONS
SECTION 2: FACILITY ANALYSIS

This section contains recommendations for each of the following schools.

/ Elm Street Middle School
/ Fairgrounds Middle School
/ Pennichuck Middle School

SITE RECOMMENDATIONS

Based upon the observations made from the site visit at the Elm Street Middle School, Harriman would recommend the following improvements:

- Repair the damaged walkways surrounding the building.
- Provide additional site lighting to parking areas, where applicable.
- Provide separate bus loop and parent drop-off areas, if possible.
- Provide additional signage for parking and driving circulation.
- Prohibit parking from the existing paved walk near the cafeteria, or add additional paint markings to signify that it is permitted.
- Provide detectable warning plates to all ADA accessible routes.

ARCHITECTURAL RECOMMENDATIONS

Building Shell Recommendations

1936 Exterior Walls

Apply furring to metal stud exterior walls, fill voids with spray foam insulation to seal envelope perimeter, and add a layer of gypsum dry wall. This will also allow space for additional concealed electrical and IT wiring. Conduct test for asbestos of plaster coatings.

Brick Repointing

Areas of brick deterioration need to be repointed. Ongoing maintenance is recommended to maintain the brick walls and keep moisture from penetrating the building's shell.

Pre-Cast Concrete Exposed Framing and Sills

Repair spalled and cracked concrete sections, including sills and rusted lintels.

Windows

Remove all double hung awnings and fixed windows. Replace with new aluminum thermally broken double hung, awning, fixed with thermal pane glazing. Depending on ceiling heights, upper portion may require fixed glass or insulated panel. Operable sash size should be reduced to lessen weight of lifting sash, or different operation types should be explored. Windows should be insulated glazing, low-E, and argon-filled for best performance. Also replace window shades with clutch shades similar to Broad Street and Sunset Heights schools. Finish should be a similar color as existing.

Existing Roofs and Testing

For budget purposes, roofs over 15-years-old should be re-roofed. Conduct roof cuts and samples on all roofs to verify insulation thickness, type of adhesive, flashing at curbs, and roof edges and materials used. Verify if original roof is still below new re-roof and verify deck type. Test samples for asbestos.

Recommendations for Finishes

Asbestos Containing Building Materials (ACBM)

Note regarding ACBM: Asbestos-containing building materials, per the AHERA re-inspection report dated August 26, 2014, reported pipe insulation was observed in the stage area of the auditorium; however, upon further observation, it appears to be fiberglass. Further testing should be taken to verify.

The following was also noted in the report:

- Asbestos pipe insulation reportedly was located throughout the school above ceilings and in crawl spaces; however, upon further observation, it appears to be fiberglass. Further testing should be taken to verify.
- The internal boiler materials in the boiler room next to the Gymnasium are assumed to be containing ACBM. It was noted that both boiler rooms were labeled with "Caution: Asbestos Hazard." Further testing should be taken to verify.
- Floor tile beneath the new floor on ground floor corridors and Common Area G100 assumed ACBM, approximately 2,500 square feet.
- Floor tile mastic throughout assumed ACBM, approximately 100,000 square feet.
- A hazardous material survey was done by Desmarais Environmental in August 2019 indicating numerous areas of hazardous materials. Removal of such materials shall be

considered and done by properly trained personnel and by proper procedures

Vinyl Composition Tile (VTC)
Due to the AHERA report, as noted above and for budget purposes, replace all VCT flooring.

Harriman has provided a proposal to provide ADA accessibility and a secured entrance. These areas will need entrance mats, new carpeting, and VCT flooring.

All rooms to receive new vinyl base, including rubber treads and risers at all stairs. Stairs will need to be replaced to not only meet code but to accommodate for replacement of the floor system.

Additional Finishes Recommendations

- Gymnasiums: consider adding acoustical panels to ceiling and walls.
- All entrances to receive entry mats.
- Stairs to receive rubber treads and risers, including landings. Paint all handrails, stringers, and all exposed metal.
- Stair in 1936 original section does not meet code dimensional criteria and needs to be rebuilt.
- Gang toilet room to receive new ceramic flooring and new ceramic walls at wet walls, half height.
- Provide all new VCT flooring with vinyl base, including in corridors.

Millwork Recommendations

Install all new millwork with new plumbing fixtures. Many areas must incorporate ADA accessible counter tops and sinks in science and family and consumer science.

Visual Display Boards/Projectors/Screens Recommendations

- Visual Display Boards: Remove all existing chalk and tack boards and replace with a minimum 12' marker board with 4' tack board on each side (approximately 22 spaces). For budget purposes replace 50% of existing marker boards and tack boards in the remaining spaces (approximately 10 spaces).
- Technology: Integration by means of projector/pull down screen/white board verses interactive board will highly depend on what available technology is at the time of the design process. Costs have come down significantly and technology has advanced for short-throw HD projectors onto whiteboard. For budget purposes, all new integrated technology in the school, including upgrading all data wiring, is recommended.

Doors and Hardware Millwork Recommendations

- All exterior and interior doors to be replaced with new doors, frames, sidelights, transom, and hardware. Provide fire rating assemblies as required.
- Replace all interior doors, frames, and hardware. All doors to be wood with clear finish in hollow metal frames. Per the recent Physical Security Enhancement Master Plan, doors are to have less glass so as to deter perpetrators from easily unlocking the door. Hardware locksets to be classroom security functions. Hollow metal frames in good condition can remain.

Stair Recommendations

- 1936 Stairs: Provide 1-hour fire rated enclosure at Stair 4 next to Common Area G100, ground to first floor. We suggest stairs be reconstructed to accommodate appropriate egress loads and to accommodate for the recommended floor replacement.
- 1961 Stairs: Perform two-story boys and girls locker room re-design. Shower use was reported to be minimal and exploring a one-story area, level with the Gymnasium B floor would be preferred. This would eliminate two stairs.

ICC/ANSI A117.1 Recommendations

- It is Harriman's opinion that an accessible path of travel will be required to access the main entrance to a floor leading to the existing elevator. The accessible path of travel may consist of ramps, elevators, and lifts.

- Harriman highly recommends the proposed main entrance off Chestnut Street with a new secured vestibule and new Administration area, as shown on proposed site plan and proposed floor plans.

Title II Recommendations

To comply with Title II of the ADA, Harriman recommends the following:

- Provide accessible parking spaces in compliance with ADA Std. 208 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1010282 and ADA Std. 502 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1006250
- Provide and designate wheelchair accessible seating areas at the bleachers, with companion seating also provided, in compliance with ADA Std. 221 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#sec221 and ADA Std. 802 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#sec802
- Provide an accessible unisex public toilet room in compliance with ADA Std. 213 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-101041 9 and ADA Std. Chapter 6 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#c6.
- Provide an accessible route to the concession stand, in compliance with ADA Std. 206.2.8 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1010125 and ADA Std. Chapter 4 http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#c4.
- Provide an accessible route to the press box per ADA Std. 206.2.7 (scroll to 206.2.7) Note: technically infeasible. http://www.ada.gov/regs2010/2010ADAStandards/2010ADAstandards.htm#pgfId-1010125.

NOTE: Provide all programs and services on the lower level. Any service or program provided on the upper level must be provided on the lower level.

STRUCTURAL RECOMMENDATIONS

The following recommendations should be considered as part of present maintenance of the existing structure, as well as for future renovations.

The following recommendations should be considered as part of present maintenance of the existing structure, as well as for future renovations.

- Repair spalled and cracked sections of the concrete foundation to avoid further damage that can be caused by water infiltration and freeze-thaw cycles.
- Repoint exterior brick at locations where roof runoff and water exposure has compromised the integrity of the brick mortar joints.
- Repair precast sills that are separating from each other to prevent further damage to sills and windows.
- Repair spalled precast beams and deck associated with the cafeteria structure. The spalling of the precast concrete impacts the structural integrity of the beams and roof.
- Repair rusted lintels. Further deterioration will lead to damaged brick.
- Monitor condition of gypsum roof plank at the 1936 original building, and patch repair areas where holes or lost material has been observed.
- Monitor accumulation of snow at the lower roofs and canopy areas adjacent to high roofs and promptly remove snow following significant snow events and whenever snow accumulations exceed 2'.
- If new mechanical equipment, other rooftop elements, or any components are supported on or hung from the existing floor or roof framing system, evaluate the addition of localized structural reinforcements to support the additional loads.
- Roof framing members are capable of supporting anticipated dead and snow loads in the existing condition, but installation of additional roof insulation will require consideration of a greater magnitude of snow accumulation per IBC 2015 code requirements. This increased load will result in some framing members exceeding their design

capacity, requiring reinforcement of the existing members or installation of supplement framing.

/ Structural improvements resulting in significantly increased loads on existing columns and foundations would require that a geotechnical investigation is conducted to ensure adequate bearing capacity of the existing soils is present, or foundations reinforcements will be necessary.

/ In order to address currently enforced building code requirements and ongoing maintenance, it is recommended that complete replacement of the entire floor system is considered. Construction of the new floor systems should consider placement of a new 3 ½" thick concrete slab on 1 1 /2" – 22gauge non-composite metal form deck reinforced with 6x6-W2.1xW2.1 welded wire fabric.

/ The existing lateral force resisting system was not accessible and has not been evaluated as part of this study. While current code recommendations for wind and seismic effects are more stringent than at the time this building was designed and constructed, the IEBC 2015 does not require structural upgrades to an existing building unless an addition, alteration (such as an increase in roof insulation) or change of use prompts or causes an increase in loads. Should significant structural renovations be made which affect the lateral force resisting system (including the floor system replacement listed in Item 11 above, seismic upgrades will be required. Further detailed and specific analysis would be necessary to evaluate the impact and design necessary reinforcements.

/ Monitor roof drains regularly to ensure that they remain functional. Promptly remove any significant standing water present at any roof areas. Existing parapets allow for significant water ponding on the roof which can overload the framing.

/ The roof trusses in the 1961 gymnasium area were designed with knee braces to resist wind and seismic forces, but were not considered as a direct load path for gravity loads. The current gravity loads limit the total capacity of the gym truss through the knee bracing. We recommend to limit roof accumulated snow on this roof to 15".

MECHANICAL RECOMMENDATIONS

At present this school has two separate heating systems: steam and hot water. Convention has it that hot water is the better type of system. Most of the air handlers are in need of replacement. The piping and controls are outdated and should be replaced. There is very little in the present HVAC system that is worth saving. It would be our recommendation to plan for an entire HVAC replacement if the long term plan for this facility is to retain it.

The present heating boilers have a total input capacity of approximately 20,000,000 BTUH. A school should normally have a heating load of about 30 BTUH/SF. At about 250,000 SF, this school would require a heating system of somewhere around 7,500,000 BTUH or about a third of what is presently installed. If it is decided to move forward with a total renovation of this school, along with a total HVAC upgrade, the entire system should be accurately resized and redesigned. Two or possibly three (if one boiler is to be the back-up) modern, gas-fired, condensing boilers could handle this school at a great savings in fuel and maintenance costs.

Another option that could be considered would be to totally VRV the entire school with a few air handlers designated to provide ventilation. The long-term fuel savings would be considerable.

PLUMBING RECOMMENDATIONS

/ Upgrade the Gymnasium restrooms to current low flow fixtures.

/ Make accommodation for ADA access to the Gymnasium restrooms.

/ Remove the fixtures and showers from the locker room areas.

/ Provide a gas fired water heater for summer use of the Gymnasium hot water system.

/ Consider replacing all toilets with water saving 1.28 gallons per flush.

/ Consider replacing lavatory aerators with low flow models.

- Cap the open water pipe above the water meter below the Gymnasium and insulate the piping.
- Replace ADA stations to comply with ADA requirements at science room sinks.
- Replace science room eyewash stations to comply with ADA requirements.
- The gas piping system should be surveyed to confirm that all fittings and joints comply with code for safety reasons; another school in Nashua the area has been found to have inappropriate couplings.

FIRE SPRINKLER RECOMMENDATIONS

- Provide sprinklers under the roof of the loading dock.

ELECTRICAL RECOMMENDATIONS

- Some older model panels exist and are nearing the end of their service life. Replace older panels.
- Panels that are in corridors are accessible to students need to be outfitted with lockable hardware to prevent unauthorized access.
- Corridors, office, support and classrooms have many different fixture types. While considering major renovations in the future, replace all fixtures with LED lighting to improve energy efficiency and lamp life. Utility rebates would be available.
- Site lighting is mainly high pressure sodium fixtures with minimal to no lighting in several walkways. Additional lighting is needed in the parking and drive areas. Outfit all new LED lighting with a lighting control system. While considering major renovations in the future, redesign entire exterior site lighting.
- Present emergency lighting by emergency battery units. Existing standby power generator to be replaced with new generator with automatic transfer switch for emergency lighting (Life Safety), and automatic transfer switch building support systems and non-required emergency loads. Review with Owner for circuits to connect to the new generator.
- Outlets in classrooms and teaching spaces have minimal receptacles, with some less than four outlets. The use of technology proliferates with middle schools. Typically between 10 - 12 duplex receptacles are required in classrooms, with more in Science, Art, Music, unified Arts, etc.
- Provide a new fire alarm system, ongoing repairs and issues have been reported.
- Replacing existing and add new cameras. To be reviewed with Director Plant Operations (Safety/Security).
- A new intercom/paging system should be installed. The existing system has no additional capacity for expansion.
- The phone system in the process of converting to City wide system.

SITE RECOMMENDATIONS

Based upon the observations made from the site visit at the Fairgrounds Middle School, Harriman would recommend the following site improvements:

- Add "Do Not Enter" signage at the exit of the bus loop;
- Add signage at the fire lane entry/exit off of Cleveland Street in order to indicate the intended uses;
- Add "Stop" and/or "Do Not Enter" signage to the connection point from the northeastern and northwestern parking lots prior to entering into the bus loop;
- Other additional circulation/pedestrian signage, as applicable;
- Repair existing paved walkways, where applicable;
- Repair and regrade existing fire lane behind the building to drain appropriately away from the building;
- Repair eroded areas surrounding the fire lane entry/exit from Cleveland Street to reduce the amount of sediment build-up;
- Add detectable warning plates for ADA accessibility, where applicable;
- Relocate the existing recycling container onto the concrete pad to protect the underlying pavement from additional damage;
- Repair pavement within the existing bus loop area, where applicable;
- Repair pavement within the front of the school and gym egress area to properly drain away from the building; and
- Prohibit parking from the existing paved areas in front of the school.

ARCHITECTURAL RECOMMENDATIONS

Building Shell Recommendations

Exterior Walls and Façade

- Localized areas of joints in poor shape were noted and should be repaired.
- Regular inspection of sealants should be performed and resealed if the inspections warrant it. Any missing sealant at joints should be filled to prevent infiltration of weather.
- It is recommended to repair any damage and properly repaint EIFS. Continue a maintenance plan with inspections and periodic repainting as required.
- We recommend minor roof items be repaired. Any open soffits should be closed up to prevent pests from entering and creating nests.
- A ramp located near the library addition was noted as having rails embedded into spalling concrete. These should be repaired to prevent unintentional failure of the rail supporting persons leaning against it.
- Damaged windows should be replaced.
- Replacement of any missing or damaged screens should be done to prevent pests from entering the building when windows are open.
- Resealing of windows should be done and continued maintenance should persist to ensure long life of wall components.
- It is recommended that the doors and frames be replaced with new galvanized or aluminum doors and frames.

Roofs

- Roofs over 15-years-old should be considered for re-roofing. Conduct roof cuts to verify insulation thickness over the existing roof systems. Also, verify if existing built-up tar and gravel is roofed over and test for hazardous materials before determining roof replacement.

Interior Finish Recommendations

Vinyl Composition Tile (VCT)

- During any major renovations, it would be recommended that flooring of this age be considered for replacement.

Carpet

- Carpet should be considered for replacement, especially in areas of high use.

Acoustical Ceiling Tile (ACT)

- Any damaged or stained tiles should be replaced to match existing tiles.

Partitions and Painting

- During any significant renovation it is recommended that the building or spaces be painted.
- Replacement of ceramic tile wainscoting by patching or wholesale is recommended.

Additional Building Finish Recommendations

Gymnasiums

- The wood gym floor has evident areas of wear. It appears the floor is original to the building and should be considered for replacement.
- Consideration for replacement of both sets should be considered to meet ADA requirements, proper operation, and to be able to accommodate a roll-down curtain should one be installed.
- The space could benefit from the addition of sound panels around the walls to absorb some of the sounds in the space.
- The existing divider partition is outdated and should be replaced with a roll down curtain which is easier to operate and better equipped to create a more flexible space.
- Replacement of the windows with a frosted translucent wall panel system could not only improve the aesthetics and environment of the space, but could also increase energy efficiency of the opening.

Lockers

- It is recommended to replace lockers throughout the spaces. Handicap-accessible lockers should be appropriately located throughout the field of lockers to accommodate those with accessibility concerns.

Millwork and Casework

- Limited handicapped accessible stations were found and should be considered in future work.
- Plastic laminate tops on lockers should be replaced if and when lockers are replaced.
- The art rooms would benefit from updated casework.
- Replacement is recommended to accommodate accessibility.
- Each room should provide handicap accessibility.

Visual Display Boards/Projectors/Screens

- Consideration should be given to bringing all teaching spaces/walls up to the District's current teaching standards.

Doors and Hardware

- Replacement of door panels should be considered. Standardization of finish appearance and material should be implemented during replacement. Any doors that do not meet ADA size requirements and handling should be updated during the replacement process.

STRUCTURAL RECOMMENDATIONS

The following recommendations should be considered as part of present maintenance of the existing structure, as well as for future renovations.

- Repair spalled and cracked sections of the concrete foundation to avoid further damage that can be caused by water infiltration and freeze-thaw cycles.
- Repair rusted lintels. Further deterioration will lead to damaged brick.
- Repair cracked sections of masonry to avoid further damage.
- Repair spalling of entry slabs with epoxy grout.
- Repoint exterior brick where mortar is compromised at the brick mortar joints.
- If new mechanical equipment, other rooftop elements, or any components are supported on or hung from the existing floor or roof framing system, evaluate the addition of localized structural reinforcements to support the additional loads.
- Roof framing members that were analyzed are capable of supporting anticipated dead and snow loads in the existing condition, but installation of additional roof insulation will require consideration of a greater magnitude of snow accumulation per IBC 2015 code requirements. This increased load will result in some framing members exceeding their design capacity, requiring reinforcement of the existing members or installation of supplement framing.
- Structural improvements resulting in significantly increased loads on existing columns and foundations would require that a geotechnical investigation is conducted to ensure adequate bearing capacity of the existing soils is present, or foundations reinforcements will be necessary.

- The existing lateral force resisting system was not accessible and has not been evaluated as part of this study. While current code recommendations for wind and seismic effects are more stringent than at the time this building was designed and constructed, the IEBC 2015 does not require structural upgrades to an existing building unless an addition, alteration (such as an increase in roof insulation) or change of use prompts or causes an increase in loads. Should significant structural renovations be made which affect the lateral force resisting system, seismic upgrades would likely be required. Further detailed and specific analysis would be necessary to evaluate the impact and design necessary reinforcements.
- Monitor roof drains regularly to ensure that they remain functional. Promptly remove any significant standing water present at any roof areas.

MECHANICAL FUTURE RECOMMENDATIONS

Existing Systems

The boilers have enough capacity to handle any planned expansion and retain full redundancy in the system. The burners shall be replaced with PowerFlame with a Honeywell 7800 Series controller to maintain consistency throughout the school district. Any rooms above the boiler room that overheat should be thermally isolated to prevent heat transfer through the floor.

Further investigation if needed to determine why some areas of the building do not have adequate heat. The following items should be reviewed:

- Water flow at the main hot water pumps.
- Measure water flow at a sampling of terminal units including areas where heating is an issue.
- Measure supply water temperatures leaving the boiler room and entering a sampling of terminal units including areas where heating is an issue.

Based on these results and any proposed addition, the main pumps may need to be replaced to match the building heating loads.

Expansion

Any classroom expansion shall have year round climate control. A modular air handler with hot water heating, DX cooling, and a flat plate heat recovery shall provide ventilation to the spaces. Air shall be delivered into the space using displacement diffusers. The DX coil shall be connected to a roof mounted condensing unit with staged capacity. Air handler size shall be kept under 10,000 CFM.

The primary source of heat shall be perimeter fin tube selected for 20 percent over design capacity. If the expansion is located in the southeast corner of the facility, there are existing pipes that can extend to serve an addition.

DDC shall be used to control any new components in the expanded area.

PLUMBING RECOMMENDATIONS

- Replace the existing gas fired water heater and storage tank with a high efficiency gas-fired water heater.
- Replace all toilets with water saving models (1.28 gallons per flush).
- Replace urinals with 0.5 GPF or less water conserving models.
- Replace all lavatories and faucets with ADA compliant models.
- Provide one ADA compliant urinal in each boy's restroom.
- Provide ADA access in each restroom.
- Provide ADA access in the Art and Science rooms.
- Consider providing emergency eyewash stations in the Art and Science rooms.
- Replace gas ranges with electric in the Life Skills rooms or install emergency gas shut-down equipment.

FIRE SPRINKLER RECOMMENDATIONS

- Rework the existing sprinkler systems within the building where spaces are being renovated or layouts are changed. Provide new sprinkler branches and mains as required.
- Install semi-recessed, white, quick response sprinklers within the proposed building additions and in existing spaces being renovated.

ELECTRICAL RECOMMENDATIONS

- The electrical service entrance will require upgrading to accommodate the proposed additional load. The existing location of the MDP is good, however, due to the prolonged outage associated with replacing the MDP in place, an alternate location might need to be considered and factored into a construction schedule/phasing plan.
- Any panelboard requiring work as part of the renovations and additions that is of the 1960s vintage will require replacement of both the panelboard and feeder.
    - All Federal Pacific panelboards and their associated feeders should be replaced due to their age and condition.
    - Areas of the building where there are few “SPARE” circuit breakers should have panelboards added or replace the existing panelboards with larger tubs to accommodate additional circuits.
- It’s not required but, upgrading all existing fluorescent lighting to LED will aid in energy savings. There are often energy incentives/rebates available through utility companies to assist with the initial financial burden when upgrading from fluorescent to energy efficient LED lighting fixtures.
- Code officials might require that the entire building be provided with automatic lighting controls to comply with current state energy codes.
- Provide pole-mounted site lighting to light parking and drop-off areas.
- Upgrade and fill in areas requiring additional emergency egress lighting, including exterior egress doors to a “public way.” This includes adding exit signs as needed throughout so two signs can always be seen, giving two ways out of the building.
    - May be desirable to replace all egress battery units so all units are of the same type.
    - If LED lighting is provided throughout, a central inverter might be the best solution. With the low power consumption of LED the inverter remains quite small and reduces the points of maintenance.
- Add power outlets in classrooms to accommodate current and, as best as possible, future needs.
- The fire alarm system will require replacement.
- A minimum of rewiring the existing Public Address System will be required. Due to the expense of proprietary work, it might be beneficial to replace the system entirely.
    - This item requires review with the owner as Bogen Systems exist in many other buildings and might be a standard for use in all buildings.
- CCTV system should be expanded or replaced to cover all areas outlined in the report above.
- Access Control:
    - All exterior doors should be monitored for position to ensure the building is secure throughout the school day.
    - Card readers and electronic locks should be provided at the main entry inner and outer vestibule doors to allow access as controlled by the main office.
- Update the data infrastructure as described above.
- Routing pathways for wiring and cabling is difficult in this building:
    - The existing roof structure protrudes down to the face of the ceiling.
    - Pathways must be run exposed where run against the structure (majority of runs).
    - Where wiring/cabling is run with the structure, wiring/cabling can be run concealed above the ceiling (limited locations).

SITE RECOMMENDATIONS

Based upon the observations made from the site visit at the Pennichuck Middle School, Harriman would recommend the following improvements to the site:

- Provide additional paint markings and signage at the entrance in order to guide vehicles appropriately;
- Provide additional circulation signage to guide vehicles/ pedestrians throughout the school campus and parking areas;
- Repair existing paved walkways, where applicable;
- Repair existing pavement within all parking areas and access drives, and damaged areas surrounding existing utilities infrastructure, where applicable;
- Repair existing modular buildings, specifically the siding at the ground level (damaged in several areas);
- Provide handicap signage at all ADA parking spaces;
- Repair any areas with soil erosion to limit the migration of sediments (observed near the pedestrian walkway connection to the school parking lot);
- Repair the trench drain within the pedestrian bridge connector walkway and prepare a maintenance plan (currently filled with sediment/soil);
- Prohibit parking from the concrete walkway in front of the southern entrance of the school;
- Provide detectable warning plates to all ADA accessible routes; and
- Relocate the existing recycling container onto the concrete pad to protect the surrounding pavement areas.

ARCHITECTURAL RECOMMENDATIONS

Building Shell Recommendations

Exterior Walls and Façade

- The majority of brick and CMU veneer located at ground level under pitched roofs were noted as heavily soiled. A proper thorough cleaning could alleviate any visual impurities and aesthetics.
- Regular inspections of sealants should be done and upkept, should the inspections warrant it. Any missing sealant at joints should be filled to prevent infiltration of weather.
- The condition of the fascia and soffits are mostly in fair condition, with localized areas of damage that should be repaired.
- Some damage was noted at the rear entry soffit. Repair utilizing the appropriate drywall should be made. Occasional painting of the soffit should be done to prevent peeling of the surface long term.
- It is recommended that further investigation of the rust at the metal stairs located near the Gym be done to see if structural integrity is still in place. If no structural repairs are needed, the stairs, stringers and railings should be cleaned, prepped, and painted to preserve the metal.

Windows

- It is recommended that any joints missing sealant be resealed.
- It was noted that the tops of the angles were grouted where the brick begins. This generally is not desired to allow any water in the brick to weep out below the brick, above the angle. It is recommended that the mortar between the top of the angle and the brick be cleaned out to support this.

Doors and Frames

- It is recommended that the doors and frames be replaced with new galvanized doors and frames.
- It was noted that some doors had a step as you exited through them. This does not meet code and a walk off pad at the floor level should be created, with appropriate grading sloping down to meet ADA.

Roofs

- Roofs over 15 years old should be considered for re-roofing. Conduct roof cuts to verify insulation thickness over existing roof systems. Also, verify if existing built-up tar and gravel is roofed over and test for hazardous materials before determining roof replacement.

Modular Buildings

- If continued use is required, the age of the roofing on modular buildings should be assessed and replaced if there is evidence of damage, aging, or if it is more than 15 years old. Any vinyl siding, trim, and skirting should be checked for damage and replaced if found. A full cleaning of the vinyl should also be done. Regular inspections should be performed on any ramps or stairs to the buildings and confirmation of code requirements will need to be done.

- / If modular structures remain for the long term, a covered and secure vestibule may be desired to keep students and staff safe.
- / The recommendation for long term capacity needs would be to remove the modular buildings and build proper additions to the existing school to accommodate additional classrooms/students.

Interior Finish Recommendations

Asbestos Containing Building Materials (ACBM)

- / It is recommended that a renovation impact study be done prior to construction on any building that may contain hazards.

Vinyl Composition Tile (VCT)

- / During any major renovations, it would be recommended that flooring be considered for replacement.

Acoustical Ceiling Tile (ACT)

- / Replacement of ceiling tiles should be considered.

Partitions and Painting

- / During any significant renovation it is recommended that the building or spaces be painted.
- / Folding partitions in some classrooms are in poor condition and should either be replaced or removed and filled in if they are not utilized.

Additional Building Finish Recommendations

Gymnasium

- / Replacement of the wood gym floor should be considered.
- / The bleachers not only need refinishing, but are not accessible to meet today's codes. Replacement should be considered.
- / The space could benefit from the addition of sound panels around the walls to absorb some of the noise in the space.

Toilet Rooms

- / It is recommended that the partitions be replaced. Additional consideration should be given to review the lack of handicap-compliant stalls in the gang toilets if renovations take place.
- / The flooring in the gang toilets is noted to be epoxy flooring. These floors are showing signs of age and wear and should refinishing or replacement should be considered.

Library

- / Replacement or removal of the skylight should be considered.
- / Light switches for the Library were in a location above bookshelves that were difficult to find and reach and should be properly located for ADA accessibility.

Lockers

- / Handicap-accessible lockers should be appropriately located throughout the field of lockers to accommodate those with accessibility concerns.

Millwork and Casework

- / Limited handicap-accessible stations were found and should be considered in future work.

Visual Display Boards/Projectors/Screens

- / Consideration should be given to bring all teaching spaces/walls up to the District's current teaching standards.

Doors and Hardware

- / Classrooms with tall glass sidelights adjacent to the door were of concern for safety and security by some teachers. Replacement of door frames should be considered.

STRUCTURAL RECOMMENDATIONS

The following recommendations should be considered as part of present maintenance of the existing structure, as well as for future renovations.

- / Repoint exterior brick where mortar is compromised at the brick mortar joints.
- / Repair rusted lintels. Further deterioration will lead to damaged brick.
- / If new mechanical equipment, other rooftop elements, or any components are supported on or hung from the exist-

ing roof framing system, evaluate the addition of localized structural reinforcements to support the additional loads.

- Where analyzed, roof framing members are capable of supporting anticipated dead and snow loads in the existing condition, but installation of additional roof insulation will require consideration of a greater magnitude of snow accumulation per IEBC 2015 code requirements. This increased load will result in some framing members exceeding their design capacity, requiring reinforcement of the existing members or installation of supplement framing.
- Structural improvements resulting in significantly increased loads on existing columns and foundations would require that a geotechnical investigation is conducted to ensure adequate bearing capacity of the existing soils is present, or foundations reinforcements will be necessary.
- The existing lateral force resisting system was not accessible and has not been evaluated as part of this study. While current code recommendations for wind and seismic effects are more stringent than at the time this building was designed and constructed, the IEBC 2015 does not require structural upgrades to an existing building unless an addition, alteration (such as an increase in roof insulation) or change of use prompts or causes an increase in loads. Should significant structural renovations be made which affect the lateral force resisting system, seismic upgrades would likely be required. Further detailed and specific analysis would be necessary to evaluate the impact and design necessary reinforcements.
- Monitor roof drains regularly to ensure that they remain functional. Promptly remove any significant standing water present at any roof areas.
- Replace caulking in expansion joints in the gymnasium walls with an elastomeric product.
- Add steel angle bracing to match the existing configuration through the gymnasium wall at the locker rooms and connect it to the exterior bearing wall.

MECHANICAL RECOMMENDATIONS

Existing Systems

The existing air systems that are original need to be replaced. To keep with other HVAC upgrades in the school district, any new classrooms systems shall provide full climate control with cooling. New air handling units shall be located inside if possible and shall consist of a flat plate heat recovery module. Similar to the 2004 HVAC upgrades, new equipment may be able to be located in the existing attic space. The preference is to have air delivered to the classrooms with displacement diffusers. Other packaged rooftop cooling units shall be replaced in kind.

The existing pneumatic control system will need to be replaced with a DDC system.

Expansion

The boilers do not have enough capacity to handle any planned expansion and retain full redundancy in the system and should be replaced. Each new boiler should have a total output of approximately 3,800 MBTU. The burners shall be PowerFlame with a Honeywell 7800 Series controller to maintain consistency throughout the school district. The main hot water pumps shall be replaced with new to match the new heating load.

Any classroom expansion shall have year round climate control with similar displacement systems described above. The primary source of heat for new rooms shall be perimeter fin tube selected for 20 percent over design capacity.

DDC shall be used to control any new components in the expanded area.

ELECTRICAL RECOMMENDATIONS

- The electrical service entrance will require upgrading to accommodate the proposed additional load and modifications to the distribution system. The existing location of the MDP may not give adequate space for a new board. Also, due to the prolonged outage associated with replacing the MDP in place, an alternate location might need to be considered and factored into a construction schedule/phasing plan.

- Add panelboard circuit breaker space by either replacing existing tubs with panelboards that accommodate larger quantities of circuit breakers and / or add new panelboards to accommodate additional circuits.
- Clean and test dry-type transformers.
- Not required but, upgrading all existing fluorescent lighting to LED will aid in energy savings. There are often energy incentives / rebates available through Utility Companies to assist with the initial financial burden when upgrading from fluorescent to energy efficient LED lighting fixtures.
- Code officials might require that the entire building be provided with automatic lighting controls to comply with current state energy codes.
- Provide pole mounted site lighting to light parking and drop off areas.
- Upgrade and fill in areas requiring additional emergency egress lighting, including outside exterior egress doors to a “public way”.
  - May be desirable to replace all egress battery units so all units area of the same type.
  - If LED lighting is provided throughout, a central inverter might be the best solution. With the low power consumption of LED the inverter remains quite small and reduces the points of maintenance.
- The fire alarm system will require replacement.
  - Completely replace the existing Public Address System.
- CCTV system should be expanded or replaced to cover all areas outlined in the report above.
- Access Control:
  - All exterior doors should be monitored for position to ensure the building is secure throughout the school day.
  - Card readers and electronic locks should be provided at the main entry inner and outer vestibule doors to allow access as controlled by the main office.
- Intercom / Public Address System will require replacement.
  - Completely replace the existing Intercom and Public Address System.
- Update the data infrastructure as described above.

Items Requiring Upgrades / Replacement to Accommodate the Proposed Additions and Renovations

- The electrical service entrance will require upgrading to accommodate the proposed additional load and modifications to the distribution system. The existing location of the MDP may not give adequate space for a new board. Also, due to the prolonged outage associated with replacing the MDP in place, an alternate location might need to be considered and factored into a construction schedule / phasing plan.
- Upgrade and fill in areas requiring additional emergency egress lighting, including outside exterior egress doors to a “public way”.
  - May be desirable to replace all egress battery units so all units area of the same type.
- The fire alarm system will require replacement.
  - Completely replace the existing Public Address System.
- Intercom/Public Address System will require replacement.
  - Completely replace the existing Intercom and Public Address System.

FIRE SPRINKLER RECOMMENDATIONS

- Extend the existing wet and dry sprinkler systems to protect the south and west additions to the building.
- Extend the existing wet sprinkler system to protect the proposed boiler room addition.
- Provide new wet and dry sprinkler risers for the North addition to the building.
- Rework the existing sprinkler systems within the building where spaces are being renovates or layouts are changed. Provide new sprinkler branches and mains as required.
- Install semi-recessed, white, quick response sprinklers within the proposed building additions and in existing spaces being renovated.

PLUMBING RECOMMENDATIONS

- / Replace the existing gas fired water heater and storage tank with a gas fired water heater.
- / Consider replacing all toilets with water saving 1.28 gallons per flush.
- / Provide one ADA compliant urinal in each boy's restroom.
- / Provide ADA access in the boy's restrooms.
- / Provide ADA access in the Art, Science, and Life Skills rooms.
- / Consider providing emergency eyewash stations in the Art and Science rooms.
- / Consider replacing the two reduced-pressure backflow preventers serving the building at the water service entrance with lead-free models.
- / Remove the irrigation meter and backflow preventer if not required.
- / Relocate the fire department connection away from the gas service.