GUNTLOW & ASSOCIATES, INC.
55 North Street
Williamstown,
Massachusetts 01267
413-458-2198
413-458-2712 FAX

14 October, 2020

Shelburne Open Space Committee, Larry Flaccus, co-chair
Town of Shelburne
51 Bridge Street
Shelburne, MA 01370
lkf2@rcn.com

Franklin Regional Council of Governments, Peggy Sloan, Director of Planning & Development
12 Olive Street
Greenfield, MA 01301
psloan@frcog.org

Part 1 Report: Engineering Evaluation of Alternatives

Dear Mr. Flaccus & Ms. Sloan,

As requested, Guntlow & Associates, Inc. has performed Part 1 scope of our proposal for services relating to the proposed Mahican Mohawk Trail and offer the following report as a summary of our findings and recommendations. These engineering services related to the initial site evaluation and conceptual design of two sections of the proposed Mahican Mohawk Trail. The two portions of the trail are roughly 150 feet and 100 feet in length, located approximately 400 feet east of the end of Deerfield Avenue, across very steep slopes and above the 100 year flood plain associated to the Deerfield River. These slopes appear to be unstable and not good candidates for conventional trail construction.

**Geotechnical Review of the site / subsurface conditions within the areas of study:**

Gifford Engineering, of Niskayuna, NY, made a site visit with Guntlow & Associates, Inc. and Jim Perry of the Shelburne Open Space Committee on July 24, 2020, to walk the site and subsequently perform hand auger test holes for evaluation of the onsite soils. Their geotechnical report is attached.

A summary of their findings and recommendations is the following:

1. The installation of a 'French Drain' type system might allow for the dewatering and stabilization of the trail area and allow for a conventional trail system to be built.
2. The trail could be raised above the wet areas using landscape timbers and decking if installed appropriately to not block surface drainage.
3. Soil borings indicated fairly shallow soils to refusal on rock.
4. Recommended the second phase (2A) of soil investigations be test pit excavation and not borings so evaluation of difficulty of excavation can be obtained to inform potential construction options.

**Engineering Review and Evaluation of Alternatives:**

Guntlow & Associates, Inc. used the findings of Gifford Engineering and our own observations made at site visits to develop potential trail cross section options for consideration and evaluation.

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When observing the site, it isn't clear what portions of the trail in this area would actually be classified as 'bordering vegetated wetlands'. We feel the very next step in the design process should be a delineation of wetlands in these sections of the trail. The presence of wetlands, or lack thereof, will affect what type of trail cross section is proposed.

Generally, we have considered three types of trail cross sections that might be appropriate for these steep, somewhat wet areas:

1. Typical ground trail with up-gradient underdrainage and possibly some stepping stones
2. Conventional wood plank trail spanning between cross timbers
3. Elevated trail bridge sections supported by posts or cross timbers

The typical ground trail cross section would be the best long term solution from a maintenance, upfront cost, and long term stability point of view. However, implementation and dewatering in the wetter areas may be difficult or not allowed if those sections of wet areas are bordering vegetated wetlands. This trail cross section would consist of dewatering measures outlined by the Geotechnical Engineer utilizing French drains immediately above the trail and periodically crossing the trail to daylight below the trail. This would allow for dewatering of the trail section for the most part and allow for a typical ground surface to be the trail landscape. This section could be supplemented with occasional stepping stones where wetter areas are.
The dewatered ground trail cross section would likely hold up to annual freeze/thaw better than any structural trail and thus result in less annual maintenance. The anticipated cost of the dewatered ground trail cross section is $44/lf installed.

The conventional wood plank trail cross section is widely used on state and national forests trails to get hikers through wet areas of the trail. Generally these are used on flatter cross slopes, but we think that some leveling and anchoring of the cross timbers may provide a simple method of getting a trail across some of these difficult areas. This type of trail cross section will have minimal impact on wetlands and is reasonably affordable. The challenge with plank trails is keeping them from getting too slippery. This is done in part by keeping them level. The plank trail section also has a somewhat shallow impact on the ground and below ground. This is beneficial in shallow/stony soils. This section is also fairly affordable to maintain and repair due to its simple nature. The anticipated cost of the wood plank trail cross section is $30/lf installed.

The elevated trail bridge cross section is the most expensive cross section and generally allows for the trail system to be above any wet and/or steep terrain. It may have less impact on the ground surface, but that really depends on the type of footing/pier system that would be possible at the site. Since the trail is an above grade structure, the foundation/pier system is more extensive and more important to the structure stability over time. This also makes it more expensive as there is more work/material associated to every aspect of the trail section per linear foot of trail. Given the sites shallow depth of soils and likely refusal on large rock below grade, the typical post/pier/foundation system could vary from helical piers drilled into the earth to pressure treated timber posts sitting on top of ledge/boulders. On this site, where stability of the slope is a concern, there is no guarantee that even the most expensive foundations will remain unchanged over time. This section is more expensive to maintain and repair due to its more elaborate

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construction and more materials per linear foot. The anticipated cost of the elevated trail bridge cross section is $100/lf installed.

**Summary:**

The approximate length of proposed trail through the hillside, questionable stability, areas is 200' to 250' in length (2 separate segments combined). Within this length, we envision that the trail can be constructed of a combination of the trail cross sections discussed above. We would recommend that the 'ground' and 'wood plank' trail sections be maximized and the 'elevated bridge' trail sections be minimized both based on cost, construction and maintenance considerations. Any trail sections through these areas should be as narrow as can comfortably accommodate the trail use. The cost estimates provided are very conceptual and consultation with a local contractor is recommended to get more accurate estimates. Work along the uphill/slope side of the trail should be avoided or minimized where possible. Stability of that slope will always be a concern and portions will likely continue to migrate a little with every annual freeze / thaw season.

We recommend the next steps include detailed wetlands delineation and survey of these areas so that they can be mapped as to what type of trail cross section might be most appropriate and to what length while crossing these areas. Once that is done, further subsurface evaluation can be done strategically and by excavation, not borings, to finalize trail design designation along this difficult section of the proposed trail.

See attached Geotechnical Report and Typical Trail Cross Sections.

Please let us know if you have any questions or comments.
Sincerely,
Guntlow & Associates, Inc.

Charles J. LaBatt

Charles J. LaBatt, PE Senior Engineer

w/enclosures

GIFFORD ENGINEERING
*Geotechnical & Geoenvironmental Services*

August 17, 2020

Guntlow & Associates Inc
Attn: Mr. Charlie LaBatt
55 North St
Williamstown, MA 01267

Re: Geotechnical Engineering Evaluation of Two Wet Areas at Mahican Trail Expansion along the Deerfield River, Shelbourne Falls, MA, File No. 2008

Gentlemen:

At your request, this report is issued to present findings of a subsurface investigation at the referenced site. The report also presents and discusses geotechnical engineering evaluation of feasible means to traverse the two wet areas. The trail is to be extended along the Deerfield River, above the 100-year flood plain, near the base of a very steep slope that inclines upward to Bridge Street. On July 24, 2020, we walked the site with Mr. Jim Perry of the Shelbourne Open Space Committee. He showed us the two wet areas and proposed using a raised wooden walkway comprised of short steps to provide a dry surface for walking.

We entered the proposed trail from a parking lot off Deerfield Ave near the west end of the proposed expansion. The trail will head eastward along the northern shoreline of the Deerfield River. The proposed trail will run somewhat parallel to Bridge St and the river. Bridge St is situated high above the proposed trail, to the north. MASSGIS shows that the slope is about 100 feet tall in the area of the proposed trail. The slope is tree and brush covered with a few houses fronting on Bridge St. The slope is unstable as judged by its inclination, bent trees, debris scattered on the ground near the base, and remnants of failed geocells that had been placed in a wet area on the slope presumably for added stability. The two wet areas are probably due to runoff from Bridge St and/or groundwater seeping from the hillside towards the river. Stability evaluation of this slope is beyond our scope of services.

There are two industrial type buildings near the west end of the proposed trail. There are many boulders in the area east of these buildings. Mr. Perry reported that these boulders were placed there by man, perhaps to prevent erosion of the shoreline and steepening of the slope. The first wet area is situated east of the boulders and extends about 150 feet across undulating terrain. The second wet area is situated further east and is about 100 feet long over similar terrain. The planned trail is reported to be only about 3 feet wide or less over these wet areas. Original plans were to build a bridge like structure spanning the low-lying wet areas. Mr. Perry suggested that they use wooden stepped timbers and decking to raise the trail above the wet areas.

The ground surface in these wet areas is strewn with debris such as bottles, metals, wood, bricks, plastic, fallen trees, etc. There are numerous boulders and a very uneven walking surface.

The subsurface investigation included seven hand auger borings. These are advanced manually by twisting the handle of the bucket auger to gather soil samples. The auger is unable to move or advance beyond roots or cobbles that are larger than a couple inches. Soils that were obtained were identified and logged at the site by the engineer. Samples were placed in plastic bags and taken to the lab for testing. Boring logs were prepared and are attached with a location diagram.

The ground surface at the borings is underlain with a layer of wet topsoil varying between 1 and 4 inches in depth. Subjacent to this is a layer of wet sand with varying amounts of silt and gravel with cobbles and boulders. The deepest auger boring was advanced to a depth of 4 feet where it refused further penetration apparently on cobbles and boulders. The other borings encountered refusals at shallower depths.

Subsurface drainage could be installed to lower the water table, intercept runoff, and pipe it under the trail. An acceptable drain could be constructed with a 4-inch diameter perforated pipe surrounded with a minimum of 6 inches of washed stone all wrapped in a geotextile such as Mirafi 140N. The drainage lines could be about 8 to 10 feet long and about 2 feet deep and run perpendicular to the trail. The drain can outlet about 2 to 4 feet below the trail. It should have 8 to 12 inches of native material over the washed stone to provide similar footing. The drains could be "Y" or "T" shaped uphill of the trail to intercept water from both sides of the outlet pipe. The washed stone at these legs of the drain system should be French drains, i.e. the stone that surrounds the pipe should continue upward to the ground surface. A berm should be shaped parallel to the trail on the uphill side of the trail to block the water and force it to infiltrate to the underlying piping. This French drain will need to be maintained as the stone surface will become covered with leaves and other debris that will inhibit infiltration. The drains can be spaced as needed.

The drain lines could be dug by hand however the cobbles and boulders could make this a daunting task. A mini excavator could reduce the manual workload and more readily remove cobbles and small boulders. Once the drainage is installed and operational for some time, the trail should dry up and the ground surface become more stable.

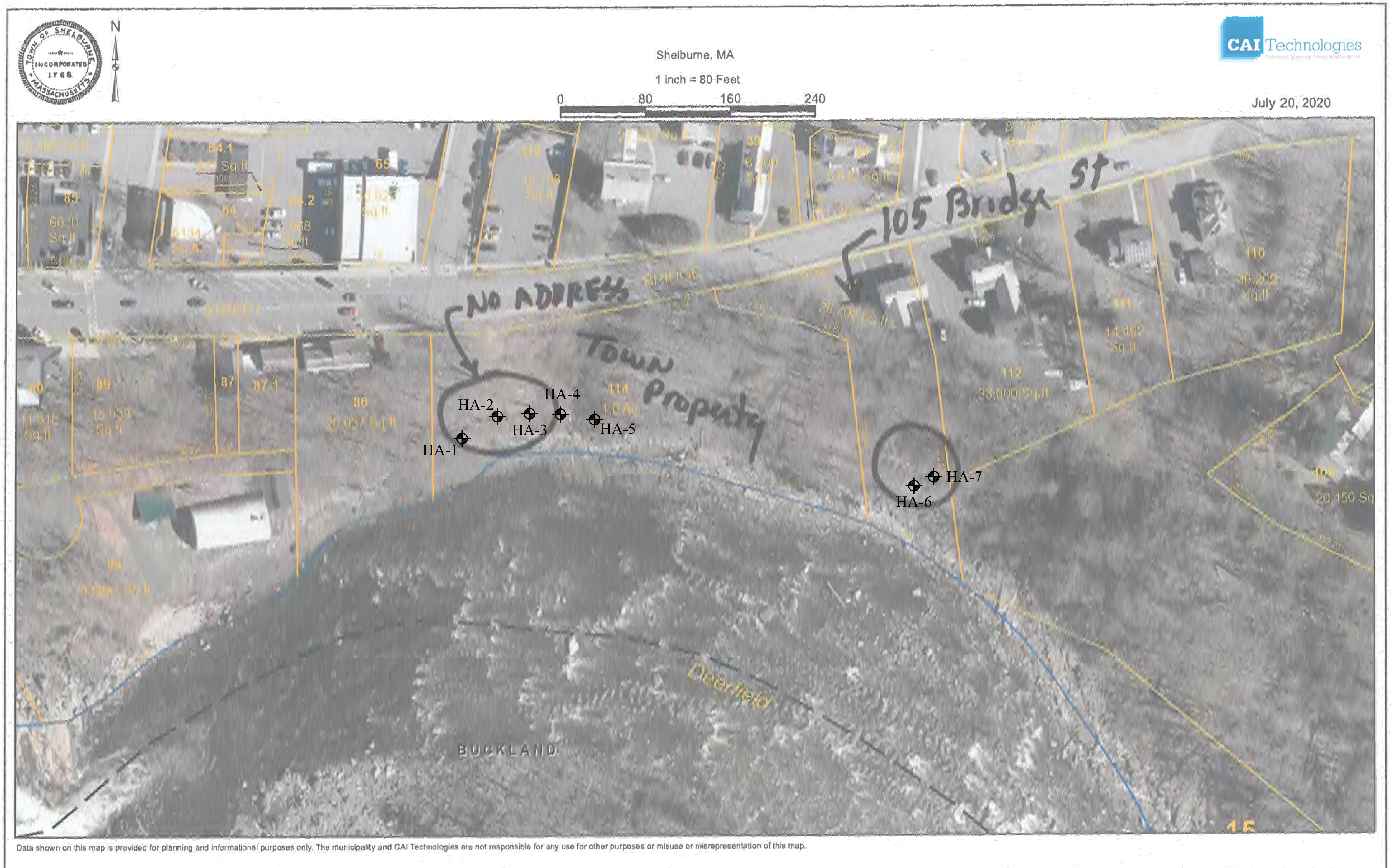
Alternatively, the trail could be raised above the wet soils by using landscaping timbers and decking so the surface runoff and groundwater can flow beneath the raised wood walkway. The landscape timbers should not be placed parallel to the trail as they could block underground seepage and runoff. The timbers could become dislodged during winter freeze thaw cycling. Maintenance will be needed to clean the wood surface and relevel timbers. A hybrid system combining drainage with wooden walkways is also feasible.

It is recommended that the second phase of this investigation be changed from advancing borings to excavating test pits. These could be dug with a mini excavator. Access will be difficult and may need to be built as the machine is working its way in along the path. The geotechnical engineer will log the pits by measuring down the sides of the excavations. The pits will be an indicator of the degree of difficulty of installing the drainage system.

If I can be of further assistance in this matter, please contact me.

Truly yours,
Gifford Engineering LLC

Gregory P Gifford PhD PE
President






| Date | Revisions |
|---|---|
| | |

GENERAL NOTES:
1. PLAN PROVIDED BY CLIENT.
2. BORINGS LAID OUT BY GEOTECHNICAL ENGINEER BY MEASURING OFF EXISTING IMPROVEMENTS.

LEGEND

⊕ BORING LOCATION

# MAHICAN MOHAWK TRAIL
SHELBURNE, MA


GIFFORD ENGINEERING
Geotechnical and Geoenvironmental Services
865 Pearse Road
Schenectady, NY 12309
(518) 382-2545


# LOCATION DIAGRAM

| | |
|---|---|
| CAD by: JCB | Date: 07/31/2020 |
| Approved By: GPG | File No.: 2008 |
| Scale: 1" = 100' | Sheet: 1 of 1 |

July 31, 2020

HAND AUGER BORING LOGS
Mahican Mohawk Trail, File No.: 2008
Shelbourne Falls, MA
Borings were hand augered and logged by Mr. Jared Bazan (GE) on July 24, 2020.

HA – 1
0"-2" Dark brown, wet, Silty topsoil.
2"-10" Brown, moist, Sand and Gravel, some Silt, SM, probable native. Refusal at Cobble or Boulder at 10 inches.
End of boring at 10 inches. No measurable water encountered.

HA – 2
0"-4" Dark brown, wet, loamy topsoil with roots.
4"-8" Brown, moist, Sand and Gravel, some Silt, SM, fill with 1qt plastic bottle encountered at about 5 inches. Refusal at Cobble or Boulder at 10 inches.
End of boring at 10 inches. No measurable water encountered.

HA – 3
0"-3" Dark brown, wet, loamy topsoil.
3"-24" Grey, wet, Sand, trace Silt and Gravel, SP-SM, native. Water seeping into hole at about 12 inches deep, filling hole with wet fine Sand. Unable to recover samples beyond 24 inches.
End of boring at 24 inches. Water encountered at 12 inches.

HA – 4
0"-0" Unable to auger beyond surface due to Cobbles and Boulders.
Boring abandoned. No water encountered.

HA – 5
0"-2" Dark brown, wet, loamy topsoil with roots.
2"-13" Grey, wet, Sand, trace Silt and Gravel, SP-SM, native. Refusal at 13 inches on Cobble or Boulder.
End of boring at 13 inches. No measurable water encountered.

HA – 6
0"-1" Dark brown, wet, loamy topsoil with roots (to about 8 inches).
1"-24" Brown/grey/white/black, wet, Sand, some Silt, trace Gravel (round, up to about 3" dia.), SM, fill with ash, glass and brick fragments.
24"-48" Grey, wet, Sand, trace Silt and Gravel, SP-SM, native. Refusal at Cobble or Boulder at 48 inches.
End of boring at 48 inches. Water encountered at ground surface.

HA – 7
0"-3" Dark brown, moist, loamy topsoil with roots.
3"-19" Brown, moist to wet, Sand, some Silt, little Gravel, SM, probably native.
End of boring at 19 inches. No measurable water encountered.

CONSTRUCTION TECHNOLOGY
INSPECTION & TESTING DIVISION, P.D.& T.S., INC.
4 William Street, Ballston Lake, New York 12019
Phone: (518) 399-1848 Email: constructiontech@live.com

| | | | |
|---|---|---|---|
| CLIENT: | **GIFFORD ENGINEERING** | REPORT DATE: | 07/27/20 |
| | 875 PEARSE ROAD | SAMPLE NUMBER: | 19445 |
| | NISKAYUNA, NEW YORK 12309 | OUR FILE NO: | 544.000 |
| | | | *Robert Behan* |
| ATT'N: | DR. GREGORY GIFFORD, P.E. | REVIEWED BY: | ROBERT BEHAN, NICET |
| PROJECT: | **MAHICAN TRAIL, SHELBOURNE FALLS, MASSACHUSETTS** | | |

## ASTM C136 / C117 / D422: SIZE DISTRIBUTION OF SOIL & AGGREGATES: SIEVE ANALYSIS

| | |
|---|---|
| MATERIAL SOURCE: | **CLIENT ID: HA-3 @ 18"** |
| MATERIAL DESCRIPTION: | SAND, fine; trace Silt/Clay; trace fine Gravel |
| MATERIAL PROJECT USE: | PER CLIENT |
| EVALUATION SPECIFICATION: | PER CLIENT |

| COARSE SIEVE SERIES: US STANDARD | | | | MEDIUM SIEVE SERIES: US STANDARD | | | | FINE SIEVE SERIES: US STANDARD | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SIEVE SIZE | PERCENT RETAINED | PERCENT PASSING | SPECIFICATION ALLOWANCE | SIEVE SIZE | PERCENT RETAINED | PERCENT PASSING | SPECIFICATION ALLOWANCE | SIEVE SIZE | PERCENT RETAINED | PERCENT PASSING | SPECIFICATION ALLOWANCE |
| 4" | | | | 1/4" | 0.5 | 99.5 | | #50 | 32.4 | 67.6 | |
| 3" | | | | #4 | 1.3 | 98.7 | | #60 | | | |
| 2 1/2" | | | | 1/8" | | | | #80 | | | |
| 2" | | | | #8 | 2.5 | 97.5 | | #100 | 80.8 | 19.2 | |
| 1 1/2" | | | | #10 | | | | #140 | | | |
| 1" | | | | #16 | 3.5 | 96.5 | | #200 | 91.3 | 8.7 | |
| 3/4" | | | | #20 | | | | SILT | | | |
| 1/2" | | | | #30 | 6.3 | 93.7 | | CLAY | | | |
| 3/8" | | 100.0 | | #40 | 10.3 | 89.7 | | COLLOID | | | |

## GENERAL NOTES

### DRILLING & SAMPLING SYMBOLS*

| | |
|---|---|
| **SS** | Split Spoon – 1 3/8” I.D., 2” O.D. |
| **ST** | Shelby Tube – 3” O.D. |
| **OS** | Osterberg Sampler – 3” Shelby Tube |
| **DB** | Diamond Core – NQ, BX, HQ |
| **WR** | Weight of Rod |
| **WH** | Weight of Hammer |
| **RD** | Rotary Drill Bit |
| **DC** | Driven Casing, Washed |
| **WB** | Washed Boring |
| **HSA** | Hollow Stem Auger |
| **OH** | Open Hole |
| **MT** | Macro Core MC5 Soil Sampling System |

### WATER LEVEL SYMBOLS**

| | |
|---|---|
| **WL** | Water Level |
| **WCI** | Wet Cave In |
| **DCI** | Dry Cave In |
| **WS** | While Sampling |
| **WD** | While Drilling |
| **BCR** | Before Casing Removal |
| **ACR** | After Casing Removal |
| **AB** | After Boring |

*Standard “N” Penetration**:** Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon, except where noted.

** Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In pervious soils, the indicated elevations are considered reliable ground water levels. In impervious soils, the accurate determination of ground water elevations is not possible in even several days observation, and additional evidence on ground water elevations must be sought.

## CLASSIFICATION

### COHESIONLESS SOILS

| | |
|---|---|
| “Trace” | 1% - 10% |
| “Little” | 10% - 20% |
| “Some | 20% - 35% |
| “And” | 35% - 50% |
| | |
| Very Loose | 0 – 3 Blows |
| Loose | 4 – 9 Blows |
| Medium Dense | 10 – 29 Blows |
| Dense | 30 – 50 Blows |
| Very Dense | > 50 Blows |

### COHESIVE SOILS*

| | **N** (Blows/ft) | **$Q_c$** (TSF) |
|---|---|---|
| Very Soft | 0 – 1 | 0.00 – 0.25 |
| Soft | 2 – 4 | 0.25 – 0.49 |
| Medium | 5 – 8 | 0.50 – 0.99 |
| Stiff | 9 – 15 | 1.00 – 1.99 |
| Very Stiff | 16 – 30 | 2.00 – 3.99 |
| Hard | > 30 | ≥ 4.00 |

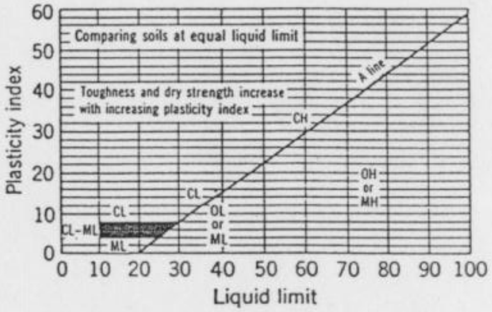
* If Clay content is sufficient so that clay dominates soil properties, then Clay becomes the principal noun with the other major soil constituent as modifier: i.e., Silty Clay. Other minor soil constituents may be added according to classification breakdown for cohesionless soils: i.e., Silty Clay, little Sand, trace Gravel. Additional explanation available upon request. See attached Unified Soil Classification sheet.

Updated Oct 2019

## Table 3.5 Unified Soil Classification

| Field Identification Procedures (Excluding particles larger than 3 in. and basing fractions on estimated weights) | | | | Group Symbols[a] | Typical Names | Information Required for Describing Soils | Laboratory Classification Criteria |
|---|---|---|---|---|---|---|---|
| Coarse-grained soils More than half of material is *larger* than No. 200 sieve size[b] (The No. 200 sieve size is about the smallest particle visible to naked eye) | Gravels More than half of coarse fraction is larger than No. 4 sieve size (For visual classification, the ¼ in. size may be used as equivalent to the No. 4 sieve size) | Clean gravels (little or no fines) | Wide range in grain size and substantial amounts of all intermediate particle sizes | *GW* | Well graded gravels, gravel-sand mixtures, little or no fines | Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles ½-in. maximum size; rounded and subangular sand grains coarse to fine, about 15% nonplastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*) | Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols. $C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | *GP* | Poorly graded gravels, gravel-sand mixtures, little or no fines | | Not meeting all gradation requirements for *GW* |
| | | Gravels with fines (appreciable amount of fines) | Nonplastic fines (for identification procedures see *ML* below) | *GM* | Silty gravels, poorly graded gravel-sand-silt mixtures | | Atterberg limits below "A" line, or *PI* less than 4. Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols |
| | | | Plastic fines (for identification procedures, see *CL* below) | *GC* | Clayey gravels, poorly graded gravel-sand-clay mixtures | | Atterberg limits above "A" line, with *PI* greater than 7 |
| | Sands More than half of coarse fraction is smaller than No. 4 sieve size | Clean sands (little or no fines) | Wide range in grain sizes and substantial amounts of all intermediate particle sizes | *SW* | Well graded sands, gravelly sands, little or no fines | | $C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3 |
| | | | Predominantly one size or a range of sizes with some intermediate sizes missing | *SP* | Poorly graded sands, gravelly sands, little or no fines | | Not meeting all gradation requirements for *SW* |
| | | Sands with fines (appreciable amount of fines) | Nonplastic fines (for identification procedures, see *ML* below) | *SM* | Silty sands, poorly graded sand-silt mixtures | | Atterberg limits below "A" line or *PI* less than 5. Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols |
| | | | Plastic fines (for identification procedures, see *CL* below) | *SC* | Clayey sands, poorly graded sand-clay mixtures | | Atterberg limits below "A" line with *PI* greater than 7 |

| Identification Procedures on Fraction Smaller than No. 40 Sieve Size | | Dry Strength (crushing characteristics) | Dilatancy (reaction to shaking) | Toughness (consistency near plastic limit) | Group Symbols | Typical Names | Information Required for Describing Soils |
|---|---|---|---|---|---|---|---|
| Fine-grained soils More than half of material is *smaller* than No. 200 sieve size | Silts and clays liquid limit less than 50 | None to slight | Quick to slow | None | *ML* | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity | Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions. Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*) |
| | | Medium to high | None to very slow | Medium | *CL* | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays | |
| | | Slight to medium | Slow | Slight | *OL* | Organic silts and organic silt-clays of low plasticity | |
| | Silts and clays liquid limit greater than 50 | Slight to medium | Slow to none | Slight to medium | *MH* | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts | |
| | | High to very high | None | High | *CH* | Inorganic clays of high plasticity, fat clays | |
| | | Medium to high | None to very slow | Slight to medium | *OH* | Organic clays of medium to high plasticity | |
| Highly Organic Soils | | Readily identified by colour, odour, spongy feel and frequently by fibrous texture | | | *Pt* | Peat and other highly organic soils | |



Plasticity chart for laboratory classification of fine grained soils

From Wagner, 1957.

[a] *Boundary classifications*. Soils possessing characteristics of two groups are designated by combinations of group symbols. For example *GW–GC*, well graded gravel-sand mixture with clay binder.

[b] All sieve sizes on this chart are U.S. standard.

### *Field Identification Procedure for Fine Grained Soils or Fractions*

These procedures are to be performed on the minus No. 40 sieve size particles, approximately 1/64 in. For field classification purposes, screening is not intended, simply remove by hand the coarse particles that interfere with the tests.

*Dilatancy* (Reaction to shaking):

After removing particles larger than No. 40 sieve size, prepare a pat of moist soil with a volume of about one-half cubic inch. Add enough water if necessary to make the soil soft but not sticky.

Place the pat in the open palm of one hand and shake horizontally, striking vigorously against the other hand several times. A positive reaction consists of the appearance of water on the surface of the pat which changes to a livery consistency and becomes glossy. When the sample is squeezed between the fingers, the water and gloss disappear from the surface, the pat stiffens and finally it cracks or crumbles. The rapidity of appearance of water during shaking and of its disappearance during squeezing assist in identifying the character of the fines in a soil.

Very fine clean sands give the quickest and most distinct reaction whereas a plastic clay has no reaction. Inorganic silts, such as a typical rock flour, show a moderately quick reaction.

*Dry Strength* (Crushing characteristics):

After removing particles larger than No. 40 sieve size, mould a pat of soil to the consistency of putty, adding water if necessary. Allow the pat to dry completely by oven, sun or air drying, and then test its strength by breaking and crumbling between the fingers. This strength is a measure of the character and quantity of the colloidal fraction contained in the soil. The dry strength increases with increasing plasticity.

High dry strength is characteristic for clays of the CH group. A typical inorganic silt possesses only very slight dry strength. Silty fine sands and silts have about the same slight dry strength, but can be distinguished by the feel when powdering the dried specimen. Fine sand feels gritty whereas a typical silt has the smooth feel of flour.

*Toughness* (Consistency near plastic limit):

After removing particles larger than the No. 40 sieve size, a specimen of soil about one-half inch cube in size, is moulded to the consistency of putty. If too dry, water must be added and if sticky, the specimen should be spread out in a thin layer and allowed to lose some moisture by evaporation. Then the specimen is rolled out by hand on a smooth surface or between the palms into a thread about one-eight inch in diameter. The thread is then folded and re-rolled repeatedly. During this manipulation the moisture content is gradually reduced and the specimen stiffens, finally loses its plasticity, and crumbles when the plastic limit is reached.

After the thread crumbles, the pieces should be lumped together and a slight kneading action continued until the lump crumbles.

The tougher the thread near the plastic limit and the stiffer the lump when it finally crumbles, the more potent is the colloidal clay fraction in the soil. Weakness of the thread at the plastic limit and quick loss of coherence of the lump below the plastic limit indicate either inorganic clay of low plasticity, or materials such as kaolin-type clays and organic clays which occur below the A-line.

Highly organic clays have a very weak and spongy feel at the plastic limit.

# Important Information about This

# Geotechnical-Engineering Report

**Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.**

**While you cannot eliminate all such risks, you can manage them. The following information is provided to help.**

**The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.**

## Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

## Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

## You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

## This Report May Not Be Reliable

*Do not rely on this report* if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

## Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

## This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

## This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

## Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

## Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

## Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

## Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

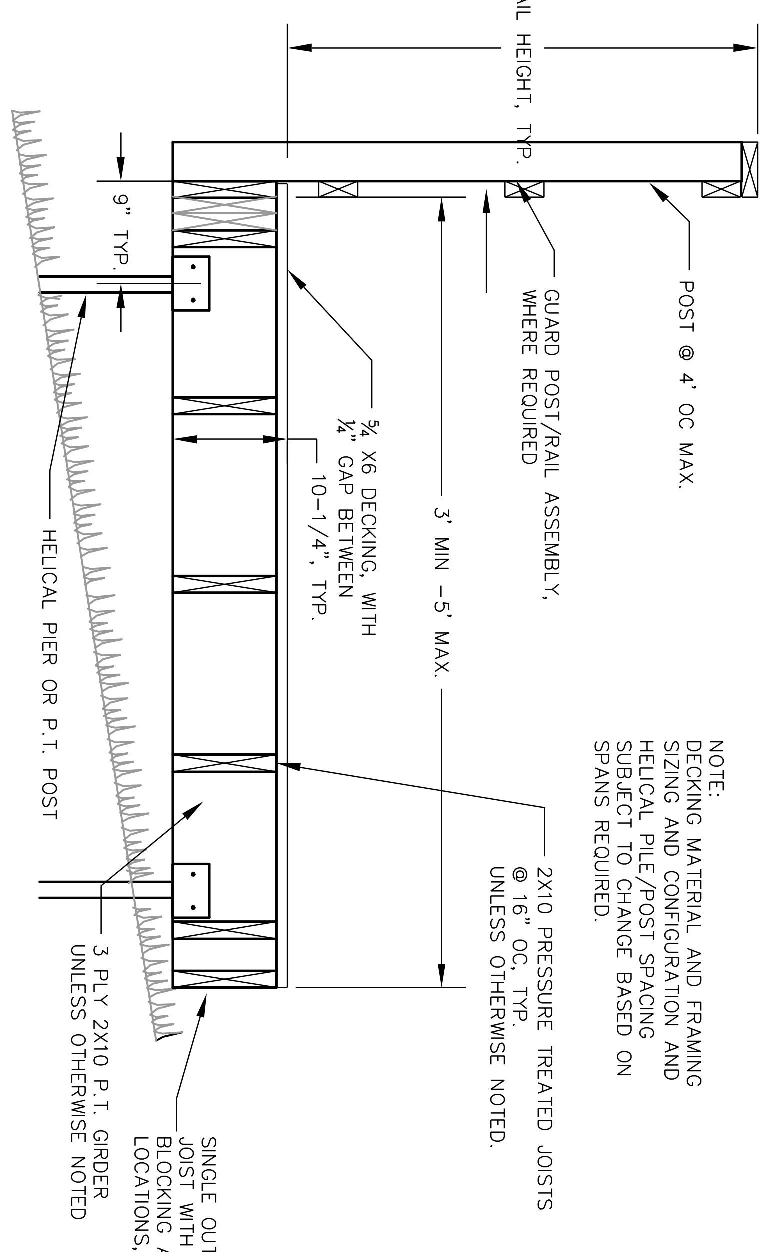
While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

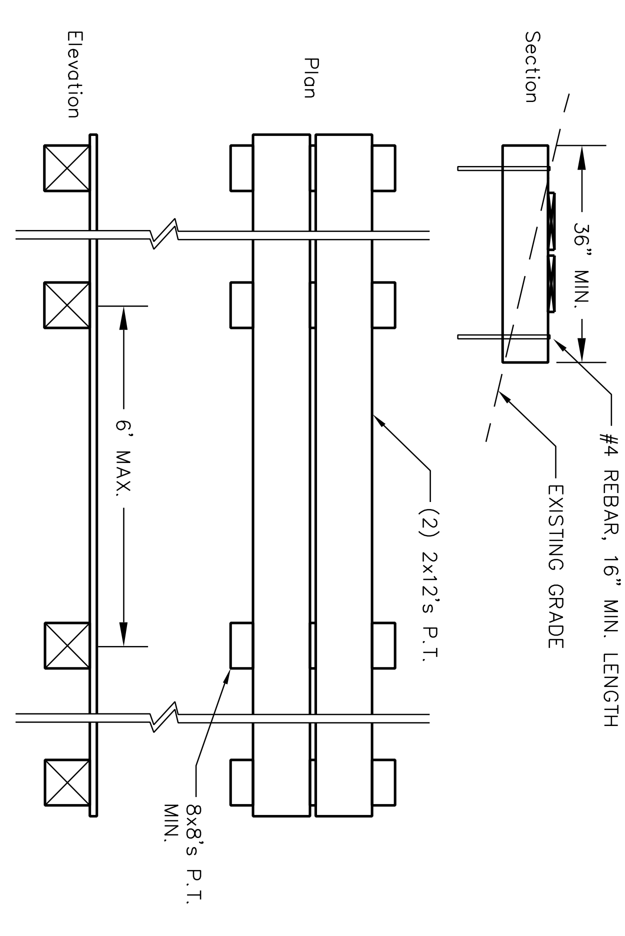
## 1 / C1 Typical Elevated Bridge Trail Section

Not to Scale



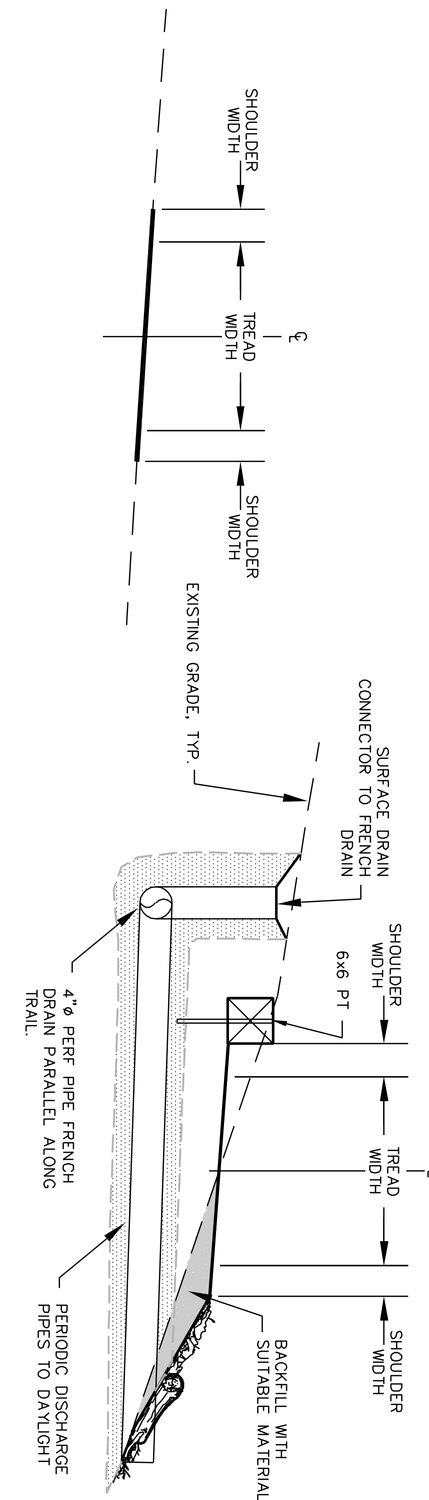

## 2 / C1 Typical Boardwalk Trail

Not to Scale




## 3 / C1 Typical Trail Detail-Flat Section & Balanced Section

Not to Scale




GUNTLOW & ASSOCIATES
ENGINEERING · SURVEYING · ARCHITECTURE

55 NORTH STREET
WILLIAMSTOWN, MA. 01267
413-458-2198
413-458-2712 FAX

# Mahican Mohawk Trail Typical Sections

PREPARED FOR

Town of Shelburne

Shelburne, MA

| | |
|---|---|
| DATE: | 10.14.20 |
| DRAWN BY: | CJL |
| CHECKED BY: | |
| SCALE: | NTS |
| SHEET | 1 OF 1 |