PREPARED FOR: Vanasse Hangen Brustlin, Inc.

GEOTECHNICAL DESIGN BASIS REPORT

PROPOSED REMOVAL OF GREAT DAM,
EXETER RIVER
EXETER, NEW HAMPSHIRE

PREPARED BY:

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1.0 BACKGROUND/SITE LOCATION

This report presents the results of geotechnical investigations and evaluations undertaken by Pare Corporation (PARE) for the proposed removal of the Great Dam (NH00304) along the Exeter River located in Exeter, New Hampshire. The dam is bordered by Water Street to the West, High Street to the South, Pleasant Street to the east, and String Bridge to the north. The project site is shown on Figure 1, Locus Plan. This report has been prepared in general accordance with our proposal and is subject to the geotechnical limitations presented in Appendix C.

1.1 Purpose and Scope

The purpose of this study is to identify the existing subsurface conditions and assess the potential impact the removal of the impoundment will have on the retaining walls and foundations for structures located in the immediate area around the dam. The assessment is limited to effects on the structures’ stability related to changes in effective stresses, settlement, and anticipated scour depths (to be calculated by others). The scope of work includes the following:

- Reviewing available subsurface information;
- Drilling four (4) borings within the current impoundment area;
- Drilling two (2) landside borings on either side of the dam (one on each side);
- Sampling and performing Standard Penetration Testing (SPT);
- Converting the two (2) landside borings to observation wells upon completion of drilling;
- Logging of drilling information and classifying soil samples;
- Performing up to six (6) laboratory tests on soil samples; and
- Preparing a geotechnical report summarizing the exploration findings, data evaluations, implications of subsurface conditions, geotechnical design recommendations, and construction recommendations.

The scope of this evaluation did not include an evaluation of the site for the presence of contamination or other environmental concerns, as those tasks are outside of PARE’s scope of services.

1.2 Background

PARE understands that the proposed project includes the removal of the Great Dam and its ancillary structures. Great Dam is a run-of-the-river, concrete gravity dam. The dam consists of an approximately 80-foot wide ogee spillway, a Denil-type fish ladder, a low-level outlet, and a penstock (which extends under Founder’s Park). Approximately 120-feet downstream of the dam there is a lower dam that extends the width of the river. The dam is a Class A (low) Hazard structure.

On July 25, 2000, the State of New Hampshire – Department of Environmental Services (NHDES) issued a Letter of Deficiency to the Town of Exeter regarding the Great Dam. The letter outlined that the dam abutments were overgrown, there was no operations and maintenance plan, and that the dam could not pass the 50-year storm. The NHDES stated that the dam deficiencies must be corrected. Subsequent letters of deficiency were received on June 1, 2004 and March 9, 2009.

The Town of Exeter requested assistance from Vanasse Hangen Brustlin, Inc. (VHB) to complete the removal of the dam. As part of the removal preparation, VHB contracted PARE to complete an assessment to highlight the potential impacts that the removal of the impoundment will have on the surrounding retaining walls and foundation walls.

As part of this report, PARE will consider the effects the dam removal and subsequent lowering of the river water elevation (to between elevation 17 and 15 feet) will have on the retaining walls located along Founder's Park (between the High Street [Great Bridge] and the lower dam) and the foundation walls for the structures (adjacent to the river) located at 9 through 39 Water Street.

1.3 Surface Conditions

Currently, areas between the Great Dam and High Street (Great Bridge) are impounded with 2 to 7 feet of water.

Founder's Park is located on the right side of the dam and is relatively flat, with a gentle downward slope from the High Street Bridge (Great Bridge) to the Exeter Public Library (located just downstream of the lower dam). The park is supported by a retaining wall along the river and adjacent to the dam. The retaining wall ranges in height from 9 feet near High Street to 4 feet at the upper dam. Between the upper and lower dams, the retaining wall transitions to an approximately 1:1 slope protected by armor stones.

Mixed residential and commercial buildings line the left side of the Exeter River on both the upstream and downstream sides of the dam. Stacked stone masonry foundation walls support the buildings from Great Bridge to 11 Water Street. A concrete wall supports a vacant lot 35-feet upstream of the dam and supports a 3-story building 40-feet downstream of the dam. A stacked stone masonry wall supports the remaining buildings up to and beyond the lower dam. Walls upstream of the dam range in height from 2 to 5 feet, while the walls downstream of the dam are approximately 10 to 16 feet tall.

1.4 Mapped Surficial and Bedrock Geology

The surficial geology map[1] of this area indicates that the site is underlain by Marine Silt and Clay deposits. This deposit is described as "fine silt and soft clay containing minor fine sand laminae". These deposits are stated to occupy primarily in lowlands and stream valleys although isolated Glacial Till deposits are also mapped to be present in this area. The bedrock geology map[2] of this area indicates the site to be underlain by gray to green Phyllite, Calcareous Quartzite, Mica Schist and Calcareous Silicates of the Eliot Formation within the Merrimack Group. The site is mapped to be just to the east of the exposure of Kittery Formation that consists of Metasandstone and Phyllite, and it is possible that the rocks of this formation could encroach onto the site.

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[1] Quaternary Geologic Map of the Boston 4 x 6 degree Quadrangle, United States and Canada (1991)

[2] Bedrock Geology Map of New Hampshire (1997)

1.5 Proposed Grading

There are no proposed grading changes along the river walls associated with the removal of the Great Dam. As a result of the dam removal, the impoundment level upstream of the dam will lower from approximately elevation 22.53 feet (normal pool elevation) to between elevation 17 and 15 feet.

We understand that the river channel grade will be revised although details of these changes have not been finalized.

2.0 SUBSURFACE EXPLORATIONS

A subsurface exploration program was undertaken to determine soil and rock conditions at the site to provide geotechnical information on the in-situ soil and rock as a basis to perform the required assessments of the potential impacts to surrounding structures due to the removal of the impoundment. Logs of the soil borings are included in Appendix A and their locations are shown on Figure 3: Subsurface Exploration Plan.

The subsurface investigation program was performed by New England Boring Contractors of Derry, New Hampshire (formerly New Hampshire Boring) and observed by PARE personnel on October, 1 and October 2, 2014. The soil borings were advanced using a truck-mounted drill rig (landside borings) and a barge based drill rig (impoundment borings). PARE field personnel observed the drilling conditions and visually identified the SPT soil and rock core samples during the advancement of the explorations, as well as, conducted push probe explorations to determine the depth of soft sediment and hard bottom within the river channel.

2.1 Sampling Methodology

The sampling methodology for the soil borings consisted of obtaining disturbed samples of the deposits continuously until bedrock was reached. The samples were obtained by advancing a 2-inch diameter, thick-walled split-spoon sampler during the performance of the Standard Penetration Test in general accordance with ASTM D-1586. The SPT was used to obtain an indication of the characteristics, relative density, and consistency of the underlying soils. The test consisted of driving a 1 3/8-inch inside diameter standard split spoon sampler 24 inches with an automatic 140-pound hammer dropping from a height of 30 inches. The SPT value used in analysis is the number of blows (N) required to drive the sampler from 6 to 18 inches of penetration.

When rock was encountered, the driller used a 2-inch inside diameter rock core bit to drill and collect up to 5 feet of rock core at a time. Drilling progressed at a constant pressure until the core bit advanced 5 feet. The rock cores were measured for Total Core Recovery and Rock Quality Designation (RQD).

During the explorations, subsurface soils were visually classified utilizing the Burmister Classification System. This systems describes soil composition based upon the percentage of soil particle size present by weight in the sample with the major soil particle size listed first followed by other soil components described as “trace” indicating 0-10% by weight, “little” indicating 10-20% by weight, “some” indicating 20-35% by weight or “and” indicating 35-50% by weight.

Push probes were completed by a PARE engineer by pushing a ¾-inch diameter steel rod, by hand, into the sediment. “Soft” and “Hard” sediment boundaries were determined in the field by the engineer performing the push probes.

2.2 Field Measurement and Methodology

The soil boring and push probe locations were recorded in the field using a handheld GPS with sub-foot accuracy. Actual depths of each of the borings and soil and rock strata are noted in Table 3-1: Subsurface Exploration Summary. Depths of each push probe are noted in Table 3-2:

Push Probe Exploration Summary.

2.3 Locations

The subsurface exploration program included a total of six (6) soil borings and twenty-nine (29) push probes. Four borings (B14-1, B14-2, B14-3, and B14-4) were performed within the impoundment area. These borings were advanced to SPT/roller bit refusal on bedrock and then 5 foot rock cores were taken. The range in termination depth (including the rock cores) for these borings was 12.60 feet to 15.75 feet.

Two borings (B14-5 and B14-6) were performed in grassed areas on the left (B14-5) and right (B14-6) abutments of the dam. These borings were advanced to SPT/roller bit refusal on bedrock and then 5 foot rock cores were taken. The range in termination depth (including the rock cores) for these borings was 16.75 feet (left side) to 14.50 feet (right side). These borings were converted to observation wells.

Twenty-nine push probes were conducted throughout the impoundment area to determine the depth to soft sediment and the depth to hard bottom. These probes were generally conducted during the drilling of the water borings, with 5 to 6 probes performed around each of the borings B14-1 through B14-4 (probes 1 through 23). Push probes 24 through 29 were performed near the location of the existing penstock intake.

Exact locations of the borings and push probes are shown on Figure 3: Subsurface Exploration Plan.

3.0 SUBSURFACE CONDITIONS

The impoundment borings generally encountered WATER at the surface with GRAVEL forming the river bed, underlain by WEATHERED ROCK and QUARTZITE BEDROCK.

The left embankment landside boring generally encountered grassed TOPSOIL surfaces, underlain by FILL, followed by WEATHERED ROCK and QUARTZITE BEDROCK.

The right embankment landside boring generally encountered grassed TOPSOIL surfaces, underlain by SANDY SILT, GRAVEL, WEATHERED ROCK and QUARTZITE BEDROCK.

TABLE 3-1:- SUBSURFACE EXPLORATION SUMMARY

Boring / Test Pit ID	General Location	Approx. Ground / Water Surface Elevation (Feet)[1]	Approximate Depth to Top of Stratum (Feet)							
			(Stratum 1) WATER / TOPSOIL	(Stratum 2a) Sandy SILT	(Stratum 2b) FILL	(Stratum 3) GRAVEL	(Stratum 4) WEATHERED ROCK	(Stratum 5) QUARTZITE BEDROCK	Depth of Exploration	Groundwater (Elevation)
B14-1	Water	21.53	0.00	NE	NE	4.50	9.33	10.75	15.75	21.53
B14-2	Water	21.53	0.00	NE	NE	6.00	8.50	10.50	15.50	21.53
B14-3	Water	21.53	0.00	NE	NE	5.50	6.25	7.50	12.60	21.53
B14-4	Water	21.53	0.00	NE	NE	4.00	NE	8.00	13.00	21.53
B14-5 OW-1	Left Embankment	27.00	0.00	NE	0.16	NE	11.50	12.00	16.75	21.50
B14-6 OW-2	Right Embankment	27.53	0.00	0.33	NE	6.00	9.33	11.00	14.50	21.33

1. Vertical datum references top of spillway as 22.53 (NGVD29)

NM = Not measured

NE=Not Encountered

3.1 Soil Strata

The various soil strata encountered in the borings are described as follows. It should be noted that the depths to, and thickness of the various soil and rock strata will vary between and away from the exploration locations. Similarly, the nature of the various deposits will also vary between and away from the exploration locations.

Stratum 1 – Topsoil

TOPSOIL was encountered at the site in the landside borings (B14-5 and B14-6) and is generally described as moist, brown, fine to medium SAND with “and” fine GRAVEL, “trace” silt, and “trace” roots with organic matter. The thickness of the TOPSOIL ranged from 2 inches to 4 inches.

Stratum 2a –FILL

The FILL deposits were encountered underlying the TOPSOIL at the site within the landside boring on the left embankment and is generally described as moist to wet, brown/gray/reddish-brown, coarse SAND, with “and” to “some” fine to coarse Gravel, and “trace” silt. This deposit also contained brick, ash, and cinders throughout the various samples. An odor was noted in samples taken in this layer. Standard Penetration Tests performed in Stratum 2a indicate a corrected density ranging from very loose to very dense.

FILL (Stratum 2a) was encountered within boring B14-5 below the TOPSOIL. The thickness of the FILL was 11.25 feet.

Stratum 2b – SANDY SILT

The SANDY SILT deposit was encountered underlying the TOPSOIL at the site within the landside boring on the right embankment and is described as moist, light brown, SILT, with “and” to “some” fine to medium SAND, and “trace” fine gravel. Standard Penetration Tests performed in Stratum 2 generally indicate a corrected density of medium dense to very dense.

SANDY SILT (Stratum 2b) was encountered within boring B14-6 below the TOPSOIL. The thickness of the SANDY SILT was 5.66 feet.

Stratum 3 – GRAVEL

The GRAVEL deposits were encountered at the river bottom within the Exeter River (impoundment borings) and underlying the SANDY SILT and are generally described as gray/light brown, fine to coarse GRAVEL, with “and” to “some” fine to coarse SAND, and “trace” silt. Standard Penetration Tests performed in Stratum 3 generally indicate a corrected density of medium dense to very dense.

GRAVEL (Stratum 3) was encountered at the river bottom surface in all the water borings and underlying the SANDY SILT in boring B14-6. GRAVEL was not encountered in boring B14-5. The thickness of GRAVEL ranged from 9 inches (B14-3) to 4.83 feet (B14-1).

Stratum 4 – WEATHERED ROCK

The WEATHERED ROCK deposits were encountered underlying the GRAVEL and FILL and are generally described similarly to the GRAVEL stratum; however, the WEATHERED ROCK material was significantly more angular, more dense, and similar to the parent rock. Standard Penetration Tests performed in Stratum 4 generally indicate a corrected density of very dense.

WEATHERED ROCK (Stratum 4) was encountered within all borings except B14-4. The thickness of the WEATHERED ROCK ranged from 6 inches (B14-5) to 2 feet (B14-2).

Stratum 4 – QUARTZITE BEDROCK

The QUARTZITE BEDROCK was encountered underlying the GRAVEL and WEATHERED ROCK deposits and is generally described light gray, moderately weathered to fresh, hard to very hard, moderately fractured to sound, fine grained, QUARTZITE. Rock Quality Designation (RQD) measurement performed on cores recovered from this Stratum generally indicates RQD values of 60% or higher (although a RQD value of 0% and 50% were recorded in borings B14-2 and B14-6).

QUARTZITE BEDROCK (Stratum 5) was encountered within all borings. The elevation of the bedrock appears to slope both upward from near elevation 11 at Great Bridge to approximately 15 feet near the dam.

3.2 Push Probes

The depths to "soft" and "hard" bottom within the channel of the Exeter River are tabulated as follows. It should be noted that the depths to, and thickness of the soil will vary between and away from the probe locations. Table 3-2 summarizes the depths encountered during the probe exploration and is intended to give an approximate bathymetric layout of the river bottom.

TABLE 3-2: PUSH PROBE EXPLORATION SUMMARY

ID	Water Surface Elevation (ft)	Depth/Elevation to Soft Sediment (ft)	Depth/Elevation to Hard Bottom (ft)
PP14-1	21.5	NE	5.2 / 16.3
PP14-2	21.5	NE	5.0 / 16.5
PP14-3	21.5	NE	5.2 / 16.3
PP14-4	21.5	NE	6.2 / 15.3
PP14-5	21.5	5.5 / 16.0	5.7 / 15.8
PP14-6	21.5	4.5 / 17.0	5.9 / 15.6
PP14-7	21.5	4.5 / 17.0	6.0 / 15.5
PP14-8	21.5	2.5 / 19.0	3.5 / 18.0
PP14-9	21.5	NE	6.0 / 15.5
PP14-10	21.5	NE	6.0 / 15.5
PP14-11	21.5	NE	6.2 / 15.3
PP14-12	21.5	NE	6.0 / 15.5
PP14-13	21.5	NE	5.5 / 16.0
PP14-14	21.5	6.2 / 15.3	6.5 / 15.0
PP14-15	21.5	5.9 / 15.6	6.0 / 15.5
PP14-16	21.5	3.7 / 17.8	4.2 / 17.3
PP14-17	21.5	3.0 / 18.5	5.2 / 16.3
PP14-18	21.5	4.5 / 17.0	5.5 / 16.0
PP14-19	21.5	NE	4.0 / 17.5
PP14-20	21.5	4.0 / 17.5	4.2 / 17.3
PP14-21	21.5	NE	2.5 / 19.0
PP14-22	21.5	NE	2.0 / 19.5
PP14-23	21.5	NE	3.0 / 18.5
PP14-24	21.5	5.0 / 16.5	5.1 / 16.4
PP14-25	21.5	4.5 / 17.0	5.2 / 16.3
PP14-26	21.5	4.0 / 17.5	4.1 / 17.4
PP14-27	21.5	4.5 / 17.0	5.0 / 16.5
PP14-28	21.5	5.2 / 16.3	6.0 / 15.5
PP14-29	21.5	6.2 / 15.3	6.5 / 15.0

NE = Not Encountered

The push probes were performed by PARE personnel during the advancement of the borings performed in the pond. All push probes reference a water surface elevation of at the time the explorations were performed (approximately El. 21.53 NGVD29). The water surface elevation was determined to be approximately 1 foot below the spillway crest with a known elevation of El. 22.53 NDVD29 as identified in VHB's Existing Conditions Plan dated January 26, 2012.

3.3 Groundwater

Based on visual observations of soil samples and field readings, groundwater was encountered between 5.5 and 6.2 feet below the surface in the landside borings. These groundwater elevations were similar to the water elevation of the Exeter River at the time of drilling.

During the drilling process, water was introduced to each borehole; therefore, the groundwater table may have not equilibrated before the final water reading was taken and the observation wells installed (groundwater readings were not taken at the impoundment borings). Due to the introduction of water, the moisture descriptions within the boring logs may not reflect the actual in-situ moisture conditions.

It should be noted that groundwater levels may fluctuate over time due to variations in rainfall and other factors different from those prevailing at the time the explorations were performed.

3.4 Observation Wells

Observation wells were installed within borings B14-5 (on the west bank) and B14-6 (on the east bank). Well readings were taken on the day of installation (10/2/2014) and three weeks later (10/22/14). The results from the well readings are summarized in Table 3-3 below.

TABLE 3-3: OBSERVATION WELL READINGS

Well	Well Elevation (ft)	Date of Reading	Depth to Groundwater (ft)	Groundwater Elevation (ft)	River Elevation at Time of Reading (ft)
B14-5 (OW-1)	27.00	10/2/14	5.5	21.5	21.53
		10/22/14	4.9	22.1	22.53
B14-6 (OW-2)	27.53	10/2/14	6.2	21.3	21.53
		10/22/14	5.5	22.0	22.53

Based on the well readings it appears that the ground water elevation behind the walls varies with the water level in the Exeter River.

4.0 LABORATORY TESTING

The laboratory testing program consisted of mechanical grain size determinations using both dry and wash (if necessary) sieve methodologies. The laboratory testing data forms for the grain size analyses are included in Appendix B.

4.1 Procedures

Grain Size Analysis

Six grain size analyses were completed by PARE on materials recovered during the subsurface investigation with descriptions and results presented as follows:

TEST No. 1 - Fine to coarse GRAVEL and fine to coarse Sand, trace silt

- Sample S-1B extracted from a depth of 4.5 to 6.5 feet at impoundment boring B14-1.
- Dry sieve method only.

TEST No. 2 - Fine GRAVEL, some coarse to medium Sand, trace silt

- Sample S-1B extracted from a depth of 6 to 8 feet at impoundment boring B14-2.
- Dry sieve method only.

TEST No. 3 – Fine GRAVEL and coarse to medium Sand, trace silt

- Sample S-1 extracted from a depth of 5.5 to 6.25 feet at impoundment boring B14-3.
- Dry sieve method only.

TEST No. 4 – Fine GRAVEL and coarse to medium Sand, trace silt

- Sample S-1 extracted from a depth of 4 to 6 feet at impoundment boring B14-4.
- Dry sieve method only.

TEST No. 5 – Fine to coarse SAND and fine Gravel, little silt

- Sample S-2 extracted from a depth of 2 to 4 feet at landside boring B14-5 (West bank).
- Dry sieve method only.

TEST No. 6 – SILT, some fine to coarse Sand, trace fine gravel

- Sample S-2 extracted from a depth of 2 to 4 feet at landside boring B14-6 (East bank).

- Combination dry and wash sieve methods.

4.2 Results

Grain Size Analysis

Table 4-1: Results of Grain Size Analyses

Test No.	Boring / Sample No.	Depth (ft.)	Representative Soil Strata	Moisture Content %	% Gravel	% Sand	% Fines
1	B14-1 / S-1B	4.5-6.5	Stratum 3 - GRAVEL	12.4	54.9	39.9	5.2
2	B14-2 / S-1B	6-8	Stratum 3 - GRAVEL	7.9	61.2	35.2	3.6
3	B14-3 / S-1	5.5-6.25	Stratum 3 - GRAVEL	12.8	47.6	48.1	4.3
4	B14-4 / S-1	4-6	Stratum 3 - GRAVEL	16.1	53.1	43.6	3.3
5	B14-5 / S-2	2-4	Stratum 2b - FILL	2.9	40.2	47.7	12.1
6	B14-6 / S-2	2-4	Stratum 2a – SANDY SILT	16.8	10.2	33.4	56.4

5.0 IMPLICATIONS OF SUBSURFACE CONDITIONS

Based on the subsurface investigation program and observations made during the fieldwork, the following are the geotechnical issues identified that could potentially impact the development of the site as proposed:

- The FILL and SANDY SILT strata along the banks of the river were found to be in various states of compaction. These layers will be susceptible to settlement if the groundwater level is lowered.

- A "very loose" layer of FILL was encountered approximately 8 to 10 feet below the ground surface along the west bank. This layer will be susceptible to large settlements if the groundwater level is lowered beyond the top of this layer.

    - Currently, assumed river elevations of 17 and 15 feet will make it so groundwater elevations repeatedly rise and fall through this layer of fill. This will increase the rate of settlement as rising and falling water levels will promote the movement of soil particles to a more natural (condensed) state.

- Due to the variability in the densities of the in-situ SANDY SILT and FILL there is a risk of excessive total and differential settlements developing at walls and adjacent structures if the water level is lowered beyond densified layers.

- The settlement of surface soils both in front and behind retaining walls will change the location and magnitude of passive and active forces on the walls and should therefore be monitored. Excessive soil settlements adjacent to walls could have a negative impact on overall wall stability.

- Weathered rock was encountered at various states of weathering. Upper portions of the layer were found with higher sand contents and advanced weathering and will behave similarly to a very dense sand and gravel. Lower portions of the layer were found with lower sand contents and only slight weathering and will behave similarly to bedrock.

- Shallow bedrock will limit the depth to which the Exeter River can be easily lowered. The bedrock was found to be in a generally competent state in the borings. Specialized methods of rock removal may be required during construction.

- Shallow bedrock and weathered rock will limit the depth to which support of excavation and water controls can be embedded. Rock anchors and/or rock removal may be required during dam removal and wall stabilization activities.

- Based on observation well readings it appears that the river and the ground water along the river are hydraulically connected.

- Reuse of the onsite soils is <u>not</u> anticipated for "Granular Fill" or "Sand Gravel Fill". Larger stones removed during dredging or dam removal operations may be suitable for reuse as a stone buttress against selected walls.

- Due to the primarily silt and fine sand makeup present along the eastern bank of the river, any crushed stone used on-site under foundations, slab, or around utilities of new walls and structures should be wrapped with geotextile filter fabric to prevent the migration of the fine sand and silt particles into the voids within the crushed stone.

- Normal pool, and thus anticipated groundwater, is at elevation 22.53 feet. At this elevation, a lowering of the water level by 5.5 to 7.5 feet is anticipated. This will expose the loose layer of fill encountered during the subsurface exploration and long term settlements may be an issue.

- To avoid the potential to increase water and soil loads on the various retaining and foundation walls the impoundment should be lowered in a controlled and staged means such that the groundwater elevation lowers with the impoundment and the water is at the anticipated final elevation (or lower) before dam removal begins (see Section 7.2).

- Observation wells should be used to track the groundwater elevations in relation to the impoundment elevation.

- There may be environmental limitations to the amount and rate the water can be lowered, which are outside the scope of this report. Lowering of the water should be completed in accordance with all Local, State, and Federal laws.

- Temporary support systems may be required at some locations to retain the surrounding soil and maintain a near-vertical excavation face where it will be necessary to protect the adjacent building walls, pavement, or underground utilities. Design of cantilever and braced support systems is beyond the scope of this report, and should be performed by the Contractor.

- The site preparation, excavation and backfill, compaction, dewatering, underpinning, and wall installation should be observed by a geotechnical field engineer(s) under the direction of a registered professional engineer experienced in geotechnical engineering.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Foundation and Retaining Wall Evaluation/Analysis

The removal of the Exeter River Great Dam will result in changing water levels that have the potential to impact the surrounding infrastructure. Seven unique wall structures have been identified between the Great Bridge (along High Street) and the lower portion of the Great Dam. These structures serve a variety of purposes including retaining soils on public lands and supporting residential and commercial structures. The displacement of any of these walls during and after the dam removal process will therefore have lasting impacts on the surrounding community and efforts should be focused on protecting these structures prior to the implementation of the dam removal.

Currently behind the upper dam, the Exeter River elevation is at or around the normal pool elevation (EL. 22.53). Depending on the results of a scour analysis, it is expected that the river elevation will reduce to between Elevations 17 and 15 (representing a 5.5 to 7.5-feet reduction in water level). Based on observation well readings, it can be expected that the groundwater levels behind the surrounding walls will respond and lower to similar elevations.

With the drawdown of the river and resulting groundwater changes, the effective stress in the retained soils will increase. This will in turn change the static conditions both in front of (river side) and behind (retained soils side) the walls along the banks of the river. This increase in effective stress could also result in soil compression, which may result in settlements of relatively loose soil layers, particularly within the SANDY SILT (Stratum 2a) and FILL (Stratum 2b) layers.

Each of the following wall sections were analyzed based on assumed geometries. The effects on and recommendations to improve the stability are discussed; however, comments on intrinsic stability and conformance with current building requirements are beyond the scope of this report. The locations of the wall sections are shown in Figure 3.

NOTE: For all wall sections, a rapid drawdown in water level will result in a short term significant increase in the water pressures and active pressures behind the wall. When combined, these forces will increase both the lateral pressure and overturning moment on the wall. Due to the unknown geometries and construction of many of the wall elements, a rapid drawdown is NOT recommended as the ability of the wall sections to support the additional loads cannot be determined without additional studies that are beyond the scope of this report. Drawdown recommendations are discussed in Section 7.2.

The following evaluations are based on analyses that assume long term conditions after dam removal. An important assumption is that the groundwater table has been given sufficient time to equilibrate to the 'new' river level.

6.1.1 Wall Section 1

Wall Section 1 is a retaining wall structure located along the east bank of the Exeter River, to the immediate north of the Great Bridge. The wall retains soils that make up Founder's Park. The wall was newly constructed as part of the project titled, "Great Bridge Over Exeter River", dated August 2003. The wall is a dry set, square stone masonry gravity wall and extends approximately 150 feet along the river. Construction plans made available to PARE indicate that the wall is founded on a concrete base with a tremie seal slab set on weathered rock and bedrock. A stone fill buttress is located on the front of the wall and extends to the approximate normal pool elevation. Borings conducted as part of the August 2003 work indicated that the soil retained by the wall is sandy silt underlain by fill.

In the case of Wall Section 1, the proposed water surface elevation will be lowered to below the recorded wall foundation elevation. Modeling of groundwater level reduction with conditions as shown on the construction plan resulted in minimal effects to the wall stability. Wall stability for this section of wall is, however, dependent on the stone fill buttress located on the front (river) side of the wall. During lowering of the river, efforts should be made to keep the buttress intact. Upon completion of a scour analysis, the stone buttress may require additional stone to withstand expected flows. The soil in front of the stone buttress may also require additional stabilization if it is found to be susceptible to scour.

Assuming the wall is founded weathered rock and bedrock, settlement of the wall is not anticipated. During the subsurface explorations (both those performed for the reconstruction of the Great Bridge and that recently performed by PARE), soils with varying densities were encountered behind the wall section. PARE estimates that up to 2 inches of settlement could develop at the ground surface behind the wall. This may affect the alignment of fences, gates, pathways, and trees located behind the wall.

6.1.2 Wall Section 2

Wall Section 2 is a retaining wall structure located along the east bank of the Exeter River, to the immediate north/northwest of Wall Section 1. The wall retains soils that make up Founder's Park and leads to the former penstock intake at the Great Dam. The wall was likely constructed as part of the dam construction around 1831. The wall appears to be a dry set, granite stone masonry gravity retaining wall which extends approximately 55 feet along the river. Measurements during previous draw-down of river level indicate that the wall is at least 9.5-feet high, however, the foundation construction and geometry is unknown. Based on observations, the wall appears to be relatively stable with no obvious bows or leans. Soft sediment and vegetative growth have collected along the front of the wall. Borings conducted as part of the October 2014 subsurface investigation indicated that the soil retained by the wall is sandy silt underlain by gravel and weathered rock. It is assumed the wall is founded on the weathered rock layer.

In the case of Wall Section 2, the proposed water surface elevation will be lowered to below the assumed wall foundation elevation. Modeling of groundwater level reduction with the assumed wall geometry and construction resulted in minimal effects to the wall stability. It is unknown whether the soft sediment located along the wall was an as-built condition or has collected throughout the years. During lowering of the river, this wall should be surveyed for signs of movement. Upon completion of a scour analysis, a stone buttress may be required to provide protection for the foundation of the wall. As the wall appears to have remained intact since its construction (and has likely seen various river levels throughout the years) the stability of the wall in its current state appears satisfactory.

As the wall is located in close proximity to the dam, this wall should be monitored daily for signs of movement during removal of the dam. If movement is detected, the addition of a stone buttress or soil nailing may be required.

Assuming the wall is founded on weathered rock, settlement of the wall is not anticipated. During the subsurface exploration boring B14-6 indicated soils with varying densities were encountered behind the wall section. PARE estimates that up to 1 inch of settlement could develop at the ground surface behind the wall. This may affect the alignment of fences, gates, pathways, and trees located behind the wall.

6.1.3 Wall Section 3

Wall Section 3 is a retaining wall structure located along the west bank of the Exeter River, to the immediate north of the Great Dam. The wall retains soils that support 27 Water Street, a mixed residential and commercial structure. From records made available by VHB, the wall appears to have been constructed after November 2009. The wall is assumed to be a cantilevered, reinforced concrete wall and extends approximately 35 feet along the river to the north of the dam. The wall is founded on a concrete base set on weathered rock and bedrock. The toe of the wall is exposed to the river. Borings conducted as part of the October 2014 subsurface investigation indicated that the soil retained by the wall is likely fill material.

Currently the water elevation in the river adjacent to the wall is near the anticipated river elevation after the dam removal. No flow was observed from the wall’s weep holes; therefore, current groundwater elevations behind the wall are assumed to be near the anticipated river elevation after the dam removal. Stability and settlement of the wall and its retained soils should not be affected by the changing of the river elevation.

Pending a scour analysis, additional stabilization of the weathered rock and/or bedrock surface of the wall function may need to be considered. The addition of a stone buttress at and above the toe of the wall or the stabilization of the weathered rock/bedrock through grout injection are both viable methods to secure the bearing surface of the wall.

As the wall is located in close proximity the dam, this wall should be monitored daily for signs of movement and damage during removal of the dam. If signs of movement or damage are detected the addition of a stone buttress, additional support, and repair of damage may be required.

6.1.4 Wall Section 4

Wall Section 4 is a retaining/foundation wall structure located along the west bank of the Exeter River, to the south of the Great Dam. The wall supports the foundation of 11 Water Street, a mixed residential and commercial structure. The construction of the wall is unknown. The wall appears to be a dry set, stone masonry, gravity retaining wall which extends approximately 35 feet along the river. The wall is known to be at least 4.5-feet high; however, the foundation construction and geometry is unknown. Soft sediment and vegetative growth underlain by a gravel layer has collected along the front of the wall. Observations made at the site indicated that the foundation for the structure at 11 Water Street appears to have been poured directly against the back face of the stone wall. It is assumed that the concrete foundation of 11 Water Street meets building requirements.

As the structure's foundation is located adjacent to the wall, it is not likely that the wall stability will be affected by the lowering of the river elevation. The natural ground surface within the river channel also appears high and stable enough to provide the required support of the wall structure. Pending the scour analysis, armor stone may be required to protect the river channel from scour after the removal of the dam. It is not recommended that any dredging activities are performed adjacent to this wall section without further investigation of the wall geometry and stability.

During the subsurface exploration, soils with varying densities were encountered near this wall section (particularly a "very loose" layer of fill). PARE estimates that up to 3 inches[1] of settlement could develop over time during drained conditions at the wall and structure (note that repeated rising and falling of the water table within this loose layer of fill may accelerate settlement). This may result in differential settlements that have the potential to reduce the structural integrity of 11 Water Street. As the wall and structure are located in close proximity, the dam and settlement resulting from a lowered water table is a concern. During drawdown and removal of the dam, the structure should be monitored daily for signs of movement and damage. If signs of movement, settlement, or damage are detected, underpinning of the foundation and repair of damage may be required (see Section 7). Underpinning of the structure prior to work commencing should be considered to mitigate the risk of settlement-induced damage.

6.1.5 Wall Section 5

Wall Section 5 is a retaining/foundation wall structure located along the west bank of the Exeter River, to the immediate north of the Great Bridge. The wall also acts as a portion of the foundation for 9 Water Street, a mixed residential and commercial structure. The construction of the wall is unknown. The wall appears to be a dry set, stone masonry, gravity retaining wall which extends approximately 90 feet along the river. Information supplied by VHB indicates that the wall is at least 4-feet high: however, the foundation and geometry is unknown. A gravel buttress has been observed along the front of the wall.

The wall currently appears to be in a state of disrepair, with large portions of missing stones and large diameter (2 to 5 inches) vegetation growing from within the joints of the stones. The structure at 9 Water Street is also showing signs of movement along the alignment of this wall with a sinking roof line and a slight lean of the structure over the wall. PARE anticipates that lowering the water table will, in combination with the shifting loads of the structure at 9 Water Street, reduce the stability of the wall and the structural integrity of the building at 9 Water Street. Stabilization of this wall should be performed to any drawdown of the river. It is not recommended to conduct any dredging activities adjacent to this wall section without further investigation of the wall geometry or a scour analysis.

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[1] Based upon comparisons of initial and final void ratios assumed from NAVFAC, SPT values, and soil descriptions

During the subsurface exploration, soils with varying densities were encountered near this wall section. PARE estimates that up to 3 inches[1] of settlement could develop over time during drained conditions at the wall and structure (note that repeated rising and falling of the water table within this loose layer of fill may quicken the rate of settlement). This may result in differential settlements that have the potential to reduce the structural integrity at 9 Water Street. As settlement resulting from a lowered water table is likely, underpinning of the foundation, the construction of a new wall, or the installation of a buttress prior to the lowering of the water table is recommended. During drawdown and removal of the dam, the structure should be monitored daily for signs of movement and damage. If signs of movement or damage are detected additional support and repair of damage may be required. Underpinning of the structure prior to work commencing should be considered to mitigate the risk of settlement-induced damage.

6.1.6 Wall Section 6

Wall Section 6 is a retaining wall structure located along the west bank of the Exeter River, to the immediate south of the Great Dam. The wall retains soils that support a vacant lot adjacent to 11 Water Street. The wall appears to have been constructed during the installation of the fish run structure associated with the dam. The wall is assumed to be a cantilevered, reinforced concrete wall and extends approximately 35 feet along the river to the south of the dam. From information supported by VHB and our site observations, the wall is at least 11.9-feet high; however, the foundation construction and geometry are unknown. Soft sediment and vegetative growth have collected along the front of the wall. Borings conducted as part of the October 2014 subsurface investigation indicated that the soil retained by the wall is likely fill material and founded on bedrock.

In the case of Wall Section 6, the proposed water elevation will be lowered to several feet above the assumed wall foundation elevation. Modeling of the water level reduction together with assumed wall geometry and construction resulted in minimal effects to the wall stability. It is unknown whether the soft sediment located along the wall was an as-built condition or has collected throughout the years. During lowering of the river, the wall should be surveyed for signs of movement. Upon completion of a scour analysis a stone buttress may be required to provide protection for the foundation of the wall.

As the wall is located in close proximity the dam, during removal of the dam this wall should be monitored daily for signs of movement. If signs of movement are detected, the addition of a stone buttress or soil nailing may be required.

Assuming the wall is founded on bedrock, settlement of the wall is not anticipated. During the subsurface exploration boring B14-5 indicated soils with varying densities were encountered behind the wall section. PARE estimates that up to 3 inches of settlement could develop at the ground surface behind the wall.

6.1.7 Wall Section 7

Wall Section 7 is a retaining/foundation wall structure located along the west bank of the Exeter River, downstream of the Great Dam. The wall retains soils and supports a portion of the

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[1] Based upon comparisons of initial and final void ratios assumed from UFC (NAVFAC), SPT values, and soil descriptions

building located at 43 Water Street, a mixed residential and commercial structure. The wall appears to be a mortared, granite stone masonry gravity wall which extends approximately 70 feet along the river. From information supplied by VHB, it appears that the wall is at least 16.5-feet high; however, the geometry is unknown. The wall is founded on weathered rock and bedrock. Borings conducted as part of the October 2014 subsurface investigation indicated that the soil retained by the wall is likely fill material.

Currently the water elevation in the river adjacent to the wall is near the anticipated river elevation after the dam removal. Based upon the wall location, groundwater elevations behind the wall are assumed to also currently be near the anticipated river elevation after the dam removal. Stability and settlement of the wall and its retained soils should not be affected by the changing of the river elevation.

Pending a scour analysis, additional stabilization of the weathered rock and/or bedrock surface may need to be considered. The additions of a stone buttress above the base of the wall or the stabilization of the weathered rock/bedrock through grout injection are both viable methods to secure the bearing surface of the wall.

As the wall and building are located in close proximity the dam, during removal of the dam this wall and building should be monitored daily for signs of movement and damage. If signs of movement or damage are detected the addition of a stone buttress, additional support, and repair of damage may be required.

6.1.8 Additional Wall Improvement Summary

The following Tables 6-1 and 6-2 summarize the recommended methodologies to address wall stability and settlement concerns at each of the wall sections. The concern of wall stability refers to the movement of the wall due to sliding or overturning. Structural settlement refers to settlement of the wall due to the subsidence of underlying soils. It is assumed that wall sections 1, 2, 3, 6, and 7 are founded on weathered rock or bedrock and are therefore not susceptible to structural settlement. Soil settlement refers to settlement of the surface soils both behind and in front of the wall. Note that the settlement of soils may ultimately affect the wall stability and should be closely monitored during construction. Further discussions on the methodologies are discussed in Section 7.3.

Table 6-1: Additional Wall Support Recommendations for Wall Sections 1, 2, 3, 6, and 7

Improvement Method	Wall Stability	Structural Settlement	Soil Settlement
Buttressing	X	Not a Concern for Wall Sections 1, 2, 3, 6, and 7	-
Underpinning	-		-
Soil Stabilization	X		X
New Wall Construction	X		-

Note: "X" indicates that this method is suitable to address the concern

Table 6-2: Additional Wall Support Recommendations for Wall Sections 4 and 5

Improvement Method	Wall Stability	Structural Settlement	Soil Settlement
Buttressing	X	-	-
Underpinning	X	X	-
Soil Stabilization	-	X	X
New Wall Construction	X	X	-

Note: “X” indicates that this method is suitable to address the concern

6.2 Unit Weights of On-Site Soils

In order to calculate recommended earth pressure coefficients in Table 6-4, the dry, moist and saturated unit weights of the on-site soils will need to be calculated. Table 6-3 provides assumed unit weights for the on-site soils at the specified depths. Values were correlated from corrected SPT values and Figure 7 of UFC-Soil Mechanics.

TABLE 6-3: RECOMMENDED UNIT WEIGHTS OF ON-SITE SOILS

Stratum	Soil Classification	Dry Unit Weight (pcf)	Moist Unit Weight (pcf)	Saturated Unit Weight (pcf)	Friction Angle (ϕ)
2a	SANDY SILT	105	117	128	31
2b	FILL	120	129	138	31
3	GRAVEL	135	141	146	35
4	WEATHERED ROCK	135	141	146	38

6.3 Lateral Earth Pressures and Retaining Wall Design

For the design of retaining walls with level backfill, recommended lateral earth pressure coefficients are indicated in Table 6-4. A unit weight of 125 pounds per cubic foot (pcf) and an internal friction angle (ϕ) of 35° for imported free draining “Granular Fill” are recommended. The lateral earth pressure coefficient should be increased where the ground surface slopes up behind the wall. The retaining walls should be designed to withstand surcharge loading which may be present over the life of the structure. These would include traffic loads, as well as loads from storage, fill or construction equipment which may be placed adjacent to the wall. The influence zone behind the wall can be defined by a one horizontal to one vertical line extending upward from the outside edge of the wall footing.

The magnitude of lateral earth pressure against retaining walls is dependent upon the type of backfill, method of fill placement, drainage provisions, and the amount of yielding the wall is permitted to undergo after the placement of the backfill. PARE recommends that the retaining walls be backfilled with a free draining “Granular Fill”, as defined herein.

The lateral earth pressure distribution against retaining walls should be computed using the appropriate value of K, the coefficient of lateral earth pressure. Recommended values of K for on-site soils and imported fill are presented in the table below. Friction factors are also presented for use in checking resistance to unbalanced forces on walls.

TABLE 6-4: RECOMMENDED EARTH PRESSURE AND FRICTION COEFFICIENTS

Stratum	At-Rest Coefficient (K_o)	Active Coefficient (K_a)	Passive Coefficient (K_p)
2a – SANDY SILT	0.48	0.29	3.12
2b – FILL	0.48	.029	3.12
3 – GRAVEL	0.43	0.25	3.69
4 – WEATHERED ROCK	0.38	0.22	4.20
Imported Granular Fill Fills	0.43	0.27	3.69
FRICTION COEFFICIENTS			
Concrete Poured on Imported Sand Gravel fill/On-site Soils			tan δ = 0.45 / 0.34
Precast Concrete on Imported Sand Gravel Fill/On-site Soils			tan δ = 0.30 / 0.23

Traffic loads and other anticipated loadings that could occur behind the walls should be considered. In addition, the effect of adjacent footings on lateral walls should be accounted for during design.

6.4 Settlement

For the design of new walls, underpinning or other support structures, settlement of the existing structures should be limited to 1-inch total settlement of the existing foundations and 0.5-inch differential settlement. Where existing differential movement or damage is evident in a structure, no additional movement should be allowed. Based on the subsurface information collected, the soil profile on landside portions of the site consists of SANDY SILT (Stratum 2a) and sandy and gravelly FILL (Strata 2b) of varying density. These layers were determined to be susceptible to settlement with the lowering of the water level.

A very loose layer of FILL encountered 8 to 10 feet below the ground surface along the west bank is anticipated to undergo large settlements once the groundwater table is lowered below this layer. Likewise, the SILT material encountered on the east bank is prone to settlement during lowering of the water table.

6.5 Liquefaction Evaluations

Liquefaction is the tendency for a soil type, particularly fine sands, to lose a significant amount of strength and behave more similar to a liquid in the event of an earthquake, or sufficient vibrations. Liquefaction analyses generally relate Standard Penetration Test (SPT) N values, corrected for overburden, and measured groundwater levels to the liquefaction potential of the materials in question. In general, in order for liquefaction to occur three conditions have to be met simultaneously. These are: 1.) loose sandy soils susceptible to liquefaction, 2.) saturated soil conditions, and 3.) vibration.

The liquefaction analyses completed during preparation of this report takes into account the soil and groundwater conditions encountered during the subsurface exploration program. It should be noted that fluctuations in groundwater levels can have a significant effect in the liquefaction potential of soils. If the groundwater is observed to change during the construction process or future explorations, PARE should be contacted as it may be necessary to re-analyze the soil for liquefaction potential.

Based upon the observed relative densities, groundwater elevation and material composition, it appears that the in-situ SILTY SAND (Stratum 2a) between the depths of 6 and 12 feet and the loose FILL (Stratum 2b) between the depths of 8 and 10 feet are susceptible to liquefaction. It is important to note that the susceptibility of these soils to liquefaction is an existing condition and is not a concern related to the change conditions brought about by the dam removal. Liquefaction concerns can be addressed through soil stabilization techniques discussed in Section 7.3.3.

6.6 Drainage

Groundwater encountered during the subsurface investigation and subsequent observation well readings indicate that the groundwater depths are dependent on the river elevation. As the dam removal will result in a decreased groundwater elevation (as a result of the lower river elevation) larger portions of the walls located around the dam will be exposed. During rain events this may result in increased earth pressures behind the walls due to saturated soil conditions. As stated in Section 6.1, allowing the buildup of water pressures behind the walls will result in increased lateral and moment forces on the wall that may affect overall stability.

Walls constructed from impermeable materials (i.e. concrete or mortared stone) should be modified shortly after drawdown to include weep holes at required elevations. Crushed stone wrapped in geotextile filter fabric should also be added behind the weep holes to aid in water collection. Landscaped areas should be graded such that surface water is carried away from the walls. If this is not possible then the ground should be graded such that the water is sent to collection systems that can safely disperse the water away from the back of the walls.

As the water surface in the river may rise and fall dramatically during events or periods of large precipitation, weep holes should be fitted with covers that prevent the backflow of water into the weep hole.

6.7 Construction Materials

Fill materials should be friable soil, free from trash, ice, snow, tree stumps, roots, and other organic matter and deleterious materials. PARE recommends the following soil gradations in Table 6-5 for imported fills, crushed stone, and coarse sands:

TABLE 6-5: SOIL GRADATIONS

(Percent Passing the Designated Sieve Sizes)

Sieve Size	Sand Gravel Fill	Granular Fill	1-1/2 inch Crushed Stone	3/4 inch Crushed Stone	Coarse Sand
3-inch*	100	60-100	-	-	-
1-1/2-inch	-	-	85-100	100	100
¾-inch	70-100	-	10-40	90-100	95-100
½-inch	50-85	50-85	0-8	10-50	20-55
$^3/_8$-inch	-	45-80	-	-	0-15
No. 4	40-75	40-75	-	0-5	-
No. 10	30-60	-	-	-	-
No. 40	10-35	0-45	-	-	-
No. 100	5-20**	-	-	-	-
No. 200	0-8	0-10	<1	<1	-

* The maximum recommended stone size is three inches where placed as base course below slabs and pavement; elsewhere, maximum stone size shall be 2/3 of the loose lift thickness.

** The amount passing the No. 100 sieve should be between 40 and 70 percent of that amount passing the number 40 sieve.

- "Sand Gravel Fill" should be used as backfill against retaining walls or as a direct bearing surface under slabs or foundations (if prepared in the dry).

- "Granular Fill" should be used below structures and for material utilized in regrading areas, trench backfill, and backfill against below-grade walls.

- “1-½ and ¾ inch Crushed Stone” should be used as bearing material (if prepared in the wet) and behind weep holes. When in contact with soils the stone should be wrapped with a geotextile filter fabric.

7.0 CONSTRUCTION CONSIDERATIONS/RECOMMENDATIONS

This section presents construction considerations and recommendations, which include impoundment drawdown, additional wall stability improvements, excavation, backfilling, utility installation, dewatering, lateral earth support, protection of adjacent structures, and construction monitoring.

7.1 Additional Wall Geometry Evaluation

A full intrinsic evaluation of wall condition and geometry to determine the overall stability of the wall structures were beyond PARE's scope of work, and this evaluation is recommended before drawdown of the water is performed should be completed. This will also help determine if the wall sections are in compliance with the current building code requirements. For this assessment, access to adjacent buildings and historical documents will be required. While valuable to ascertaining the general issues that may be present during construction, this report cannot give certainty to the stability of the wall sections analyzed and thus general recommendations are offered. Additional studies should be considered to highlight wall sections that are at a greater risk of stability failure during the construction process. In the event a wall section is observed to move or become damaged during construction, a full assessment of the wall section will be necessary to determine the proper course of action.

7.2 Impoundment Drawdown

In order to reduce the risk of over stressing the walls during the dam removal, the impoundment should be drawn down in small increments. The wall stability analyses found that all wall sections (except Sections 3 and 7) may be at risk of movement or damage if the impoundment is rapidly drawn down. For the purposes of this report, a rapid drawdown shall be considered any lowering of the river elevation that occurs such that the groundwater does not or has not had time to equalize with the river elevation.

The drawdown of the impoundment should be completed in a controlled manner such that the groundwater is never more than 1 foot higher than the river elevation. The observation wells installed as part of the subsurface exploration at borings B14-5 and B14-6 can be used to track the groundwater elevations.

In the event that the groundwater does not respond to the lowering of the river, the drawing down of the impoundment should be stopped until the groundwater equalizes with the river elevation. If equalization does not occur then PARE should be contacted so that additional wall stability analyses can be completed. At this time, pre-dam removal stability improvements may need to be implemented at several of the wall sections.

7.3 Wall Stability Improvements

If it is found that the water table is not equalizing with the river elevation during drawdown or movement or damage is observed at any wall section additional wall stability improvements may be required. Stability improvements discussed in this section will include buttressing, underpinning, and new wall construction. The implementation of any of these improvements will require a full analysis of the affected wall geometry and structural condition for the improvement to be effective.

7.3.1 Buttressing

This method of supplemental support includes the addition of a section of high density material (e.g., rip rap or grouted rip rap) that slopes from the river bottom to a predetermined height on the affected wall. Prior to placement of the buttress, the river bottom will need to be improved in accordance with Section 7.4 of this report (and all other pertinent sections). The buttress will need to be founded on a stabilized ground surface and include a layered profile to prevent the choking of the buttress with sediment. Sizing of rip rap and the requirement for grouted rip rap will be dependent on a scour analysis. Dewatering (see Section 7.6) and support of excavation (see Section 7.7) may be required to accomplish this task.

Buttressing would be a viable option to increase wall stability on all wall section covered in this report. Buttressing will not however, address the settlement concerns of Wall Sections 4 and 5, or the settlement of the soils behind any of the walls.

7.3.2 Underpinning

Underpinning involves exposing and temporarily supporting the foundation of the affected element before a permanent support (e.g. micro piles or concrete block) can be installed. Underpinning can also be used to support a structure until ground improvements are in place or repairs are made to the structure. Due to the shallow bedrock and dense weathered rock encountered at the site the addition of micro piles or concrete blocks to underpin unstable walls or walls/footings prone to settlement may be a viable option. Underpinning will require dewatering, support of excavation, and temporary support of the affected structure, and is therefore design and construction intensive; however, these methods will increase long term stability and reduce the settlement of structures.

Underpinning would be a viable option to increase wall stability on wall sections not founded on weathered rock or bedrock (Wall Sections 4 and 5). Underpinning will address the settlement concerns of these wall sections (and their associated structures); however, soils behind the wall will still be prone to settlement.

7.3.3 Soil Stabilization

Soil stabilization includes the uses of pins, anchors, or grout injection to strengthen weaker soils or anchor unstable wall sections to stable soil sections. Pins and anchors are routinely used on taller wall sections where additional overturning capacity is required, while grout injection can be used to strengthen layers of weak soils. These methods require specialized equipment with high mobilization cost; however, the work is relatively quick and effective. These methods only require dewatering to allow the machinery access to the affected area.

Pinning and anchoring will address wall stability on concrete or mortared wall sections of taller walls (Wall Sections 1, 2, 3, 6, and 7); however, these methods will not address concerns related to settlement of the walls or settlement of the soils behind any of the walls. Grout injection will address concerns relating to both settlement of the wall sections (and associated structures) and the settlement of soils behind the walls; however, injection can only moderately address stability. Grout injection will also change how the soils respond to changes in the water table and can created perched groundwater, thus increasing instability. The methods require comprehensive designs to be effective.

7.3.4 New Wall Construction

If other methods of supplemental support are found to be ineffective or impractical, new wall construction is an alternative to address stability. Although expensive and construction intensive, new wall construction can address stability concerns of any wall section at the site. This method will require dewatering, support of excavation, and likely support of adjacent structures. Old walls should be removed prior to in installation of the new wall. Depending on the extent of the work the new wall construction may be able to address the settlement related to adjacent structures; however, soil settlement behind walls will remain an issue.

7.4 Excavation

SITE PREPARATION (For Additional Wall Support)

After rough grades have been established, but before placement of compacted “Granular Fill”, exposed surfaces should be visually inspected and probed. Frozen, wet, or loose soils and other undesirable materials should be removed. The exposed subgrade should be further tested by proof rolling with a minimum 10,000-pound static weight sheep’s foot roller to identify loose or soft pockets that may be present.

The area of the proposed structures will need to be grubbed of all vegetation and topsoil. Construction debris from demolished structures and roadways should be removed and properly disposed. Should the material contain solid wastes, such material should be segregated and disposed of in a manner consistent with local and state regulations. Care should be taken so as not to combine or mix organic material with the material to be reused as fill in other portions of the site.

In areas of observed demolition, all debris should be removed from the site and disposed of in accordance with applicable regulations. Any buried debris should be chased to its full extent and replaced with compacted “Granular Fill”.

All existing drainage pipes, structures, existing utilities on the site, including electric, telecom, drainage, and sewer pipes, and structures encountered during the progression of the work should be removed to the full extent and the resulting excavations backfilled with compacted "Granular Fill". Alternately the pipes and structures can be filled with concrete. Care should be taken during the procedure to ensure complete filling of the pipes and/or structures.

Should the subgrade become disturbed during excavation and/or construction, all disturbed material should be over-excavated to firm or native soil and replaced with a minimum of one foot of compacted "Granular Fill”.

7.5 Backfilling (Permanent Fill)

GRANULAR FILL

PARE recommends that footings, foundation walls, and areas requiring fill below the floor slab be backfilled to within 12 inches of the footings and slabs with compacted “Granular Fill”. Compacted “Granular Fill” should be free draining friable soil free from trash, ice, snow, tree stumps, roots, other organic matter, and deleterious materials.

In general, compaction should be accomplished by placing fill in 8 to 12 inch loose lifts and mechanically compacting each lift to the specified dry density. Thinner lifts may be required in certain instances depending on the type of mechanical compaction equipment utilized.

SAND GRAVEL FILL

Sand Gravel Fill should be placed for the final 12 inches below pile caps, slabs, and as pavement base layers. This material should be placed in 8 to 12 inch thick layers and compacted to the minimum requirements.

7.6 Dewatering

During construction, temporary dewatering will likely be required to control ponded water resulting from rain and surface runoff. There are many methods that can be implemented by the contractor for dewatering purposes (such as horizontal drains, sumps, well points, etc.). If encountered, groundwater should, at a minimum, be drawdown to 6 inches below the base of the crushed stone layer so work can be completed in the dry and to provide a stable working platform. Sometimes, depending on the working conditions, it is typical practice to draw groundwater down to 2.5 feet below working grade to facilitate work.

Based on observations taken during the subsurface investigation, groundwater was determined to be dependent on the elevation of the river. It should be noted that groundwater levels will also fluctuate over time due to variations in rainfall and/or other factors different from those prevailing at the time the explorations were performed. Therefore, dewatering due to groundwater is not expected to be a construction issue if completed after the drawdown of the impoundment. If excavations are required prior to the drawdown of the impoundment dewatering controls may need to be implemented. In either case, all excavations or footing placement should be conducted in the dry and the Contractor should provide for proper drainage of surface water away from any excavations as ponding of water during and after rainfall events.

7.7 Lateral Support

Should excavations be required during the removal of the dam, excavation support is solely the Contractor’s responsibility. Several excavations are expected when providing additional support for at risk wall sections. Temporary support systems may be required at some locations to retain the surrounding soil and maintain a near-vertical excavation face where it will be necessary to protect the adjacent building walls, foundations, or underground utilities. Design of cantilever and braced support systems is beyond the scope of this report, and should be performed by the Contractor.

In areas where an open cut is possible without a temporary support system, the final side slopes should conform to Local, State, and Federal safety requirements.

7.8 Protection of Adjacent Structures

PARE recommends that prior to the start of construction, a video and/or photo pre-construction survey should be performed at any buildings, walls, or other structures, which are located near the work area which may be affected. This should also include adjacent utilities that may be affected by the dam removal or construction of supporting structures. This survey would record "before-construction-conditions" of existing structures and utilities that are expected to remain through construction. These surveys are invaluable in resolving potential project claim disputes.

PARE recommends that crack gauges be installed to monitor movement of existing cracks and on any cracks that develop in new concrete, foundation walls, or existing structure foundations. PARE also recommends the installation of control points on any buildings, walls, or other structures that may be affected by construction. The control points should be measured on a daily basis starting with the drawdown of the impoundment and ending with the completion of work. Following the work reading of the control points should be completed after major rain events where the river elevation fluctuates greater than 1 foot or as requested by the owner.

Vibration monitors should be set up throughout the construction period to continuously monitor vibrations at 11 and 9 Water Street. As these structures are of particular historic significance vibration threshold levels of 0.12 in/sec (for a continuous source event) and 0.30 in/sec (for a single source event) are recommended[1]. If these thresholds are found to be exceeded during construction then additional monitoring or a change in construction methodology may be necessary. A mobile vibration monitor should also be used during construction at Wall Sections 2, 3, 6, and 7. Placement of this monitor should be at the wall section that will be most affected by the day's work. For wall Sections 2 and 7 vibration threshold levels of 0.2 in/sec and 0.5 in/sec are recommended (for continuous and single source events, respectively) and for Wall Sections 3 and 6 threshold levels of 0.5 in/sec and 1.2 in/sec are recommended.

7.9 Construction Monitoring

The impoundment drawdown, site preparation, wall support installations, and excavation and backfill (for additional wall support) should be monitored and observed by our geotechnical field engineer(s) under the direction of one of our registered professional engineers experienced in geotechnical engineering. While onsite, our engineer(s) would provide assistance in general interpretation of the geotechnical requirements during construction and vibration monitoring services. This would provide an accurate record of construction, alert the designer to changed conditions, and make useful data available for upcoming construction.

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[1] Vibration levels reference the Swiss Association of Standardization Vibration Damage Criteria.

REFERENCES

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5. AASHTO, "*AASHTO Guide for Design of Pavement Structures*", 1993.

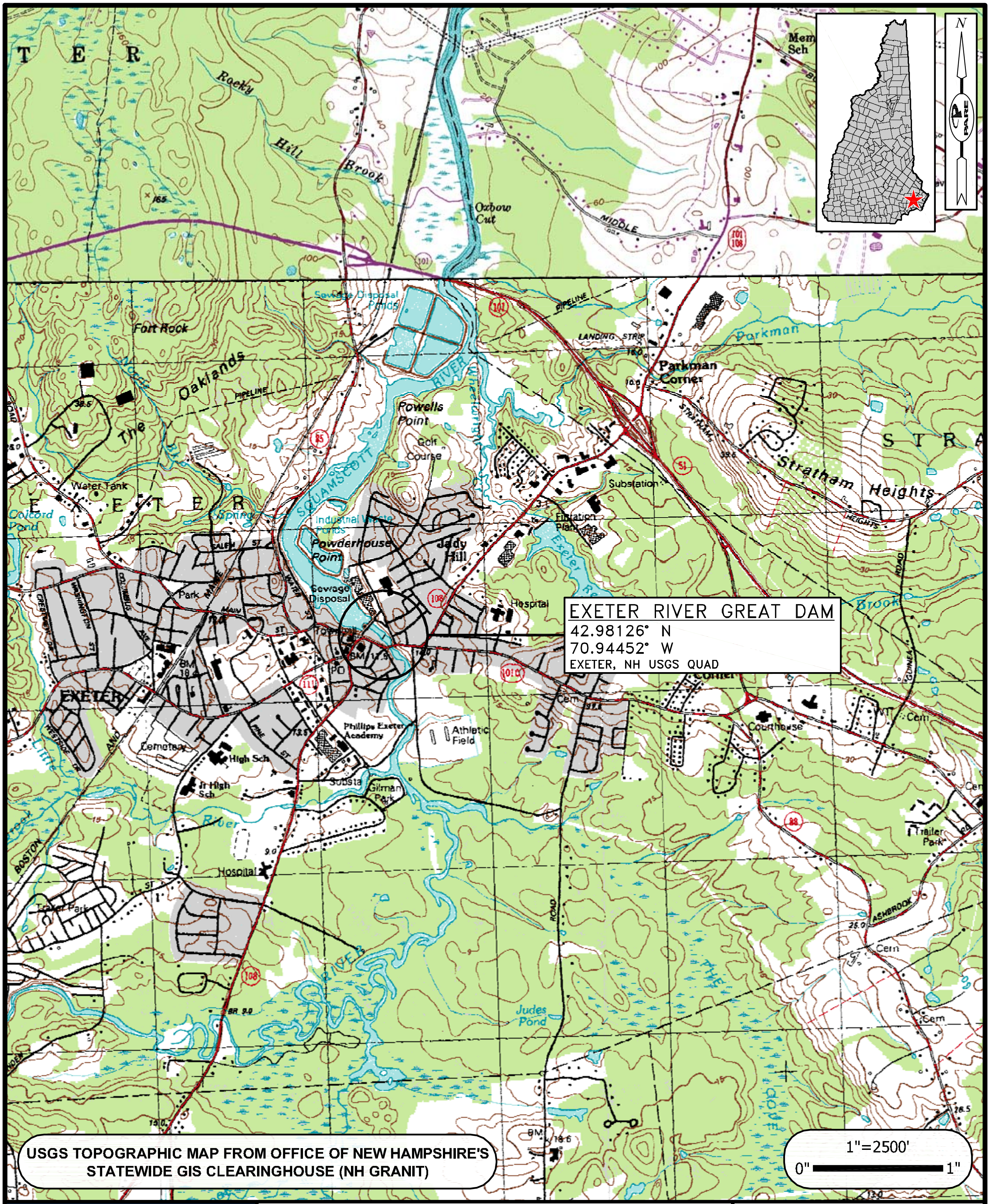
6. IBC 2012. International Code Council. *"International Building Code 2012"*, 2012.

7. "Transportation and Construction Induced Vibration Guidance Manual". Prepared by: Jones & Stokes, Sacramento, CA. prepared for: California Department of Transportation. June 2004.

8. "Exeter River Great Dam Removal Feasibility and Impact Study", prepared by VHB/Venasse Hangen Brustlin, Inc., Bedford, New Hampshire. October 2013.

9. "Plans of Proposed Bridge Replacement and Safety Work: Great Bridge Over Exeter River." Prepared by: SEA Consultants Inc., Concord, New Hampshire. August 2013.

FIGURES



EXETER RIVER GREAT DAM
42.98126° N
70.94452° W
EXETER, NH USGS QUAD

USGS TOPOGRAPHIC MAP FROM OFFICE OF NEW HAMPSHIRE'S STATEWIDE GIS CLEARINGHOUSE (NH GRANIT)

1"=2500'
0" 1"

PARE
CORPORATION

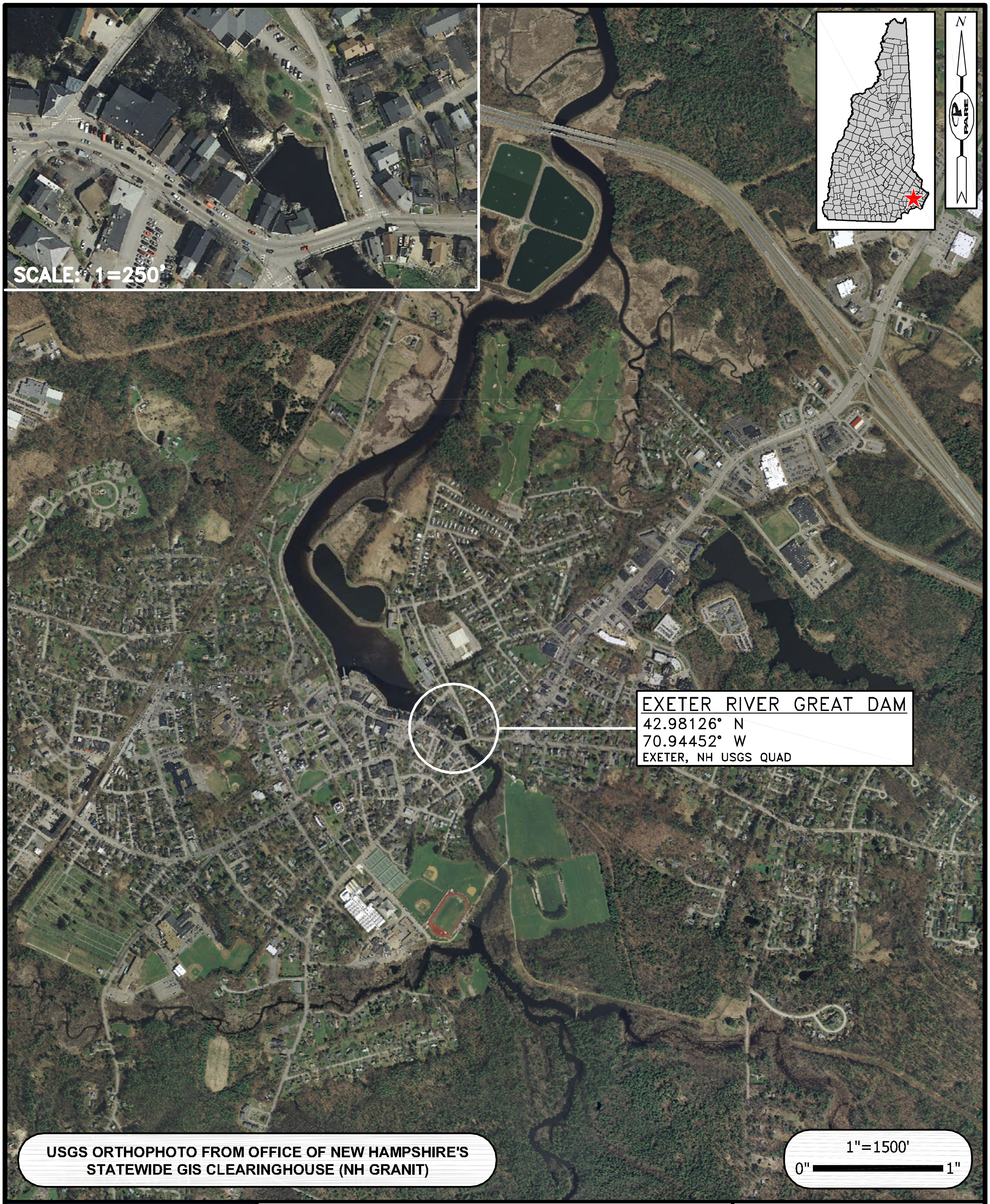
EXETER RIVER GREAT DAM

NH00304 / 082.01
EXETER, NEW HAMPSHIRE

TOWN OF EXETER

LOCUS PLAN

OCTOBER 2014 FIGURE 1



PARE
CORPORATION

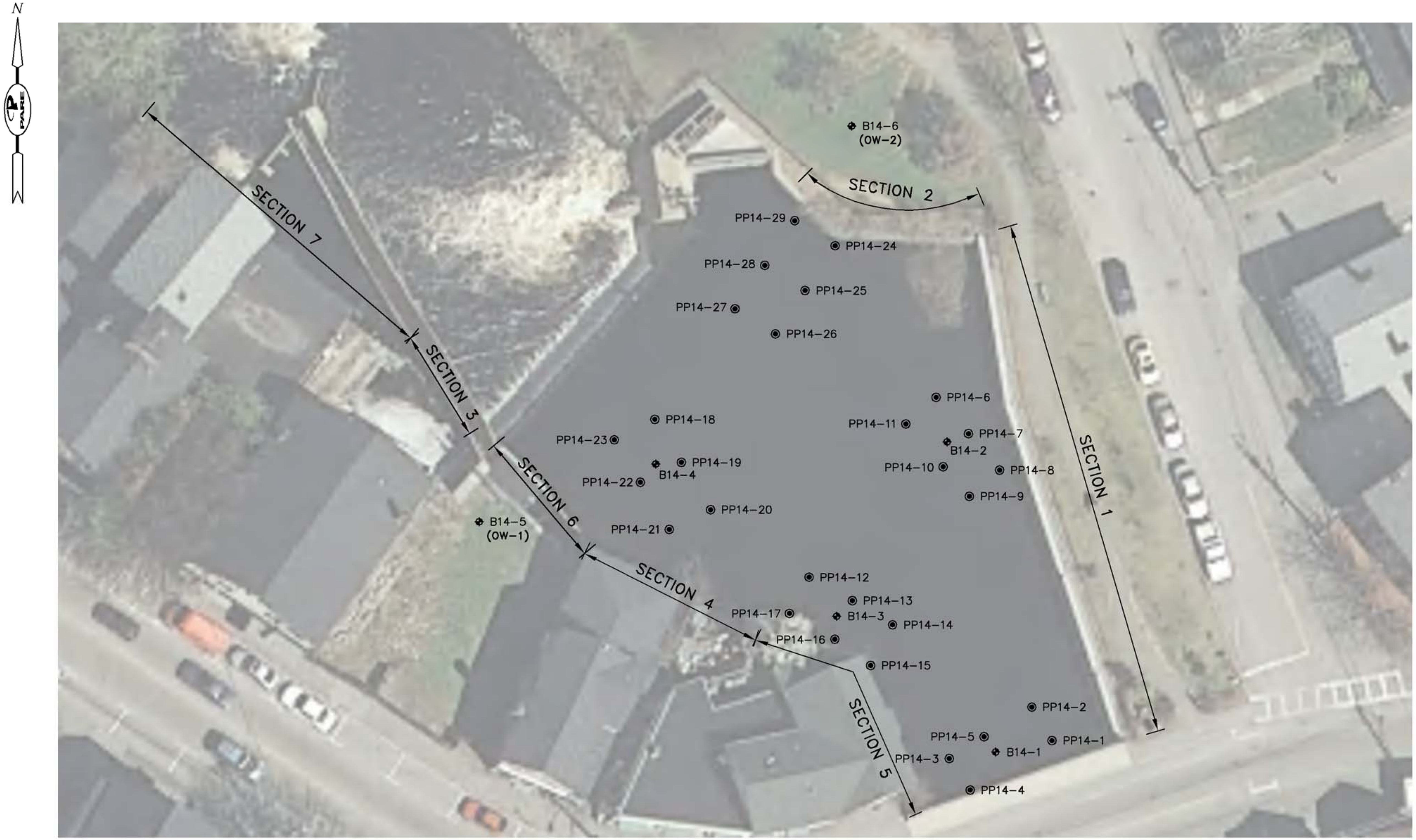
EXETER RIVER GREAT DAM

NH00304 / 082.01
EXETER, NEW HAMPSHIRE

TOWN OF EXETER

AERIAL PLAN

OCTOBER 2014
FIGURE 2



LEGEND

⌖ B14-1	BORINGS COMPLETED BY NEW HAMPSHIRE BORING OF BROCKTON, MA. ON OCTOBER 1, 2014 AND OCTOBER 2, 2014. BORINGS WERE OBSERVED BY PARE CORPORATION PERSONNEL.
◉ PP14-1	PUSH PROBES PERFORMED BY PARE PERSONNEL DURING THE ADVANCEMENT OF THE BORINGS PERFORMED IN THE POND. ALL PUSH PROBES REFERENCE A WATER SURFACE ELEVATION AT THE TIME OF THE EXPLORATIONS AT APPROXIMATELY EL. 21.53 NGVD29. WATER SURFACE ELEVATION WAS DETERMINED TO BE APPROXIMATELY 1 FOOT BELOW THE SPILLWAY CREST WITH A KNOWN ELEVATION OF 22.53 NGVD29 AS IDENTIFIED IN VHB'S EXISTING CONDITIONS PLAN DATED JANUARY 26, 2012.
|←→|	INDICATED WALL SECTION AS EVALUATED IN SECTION 6 OF THE REPORT.

Graphic Scale *1"=30'*

30' 15' 0 30' 60'

PARE CORPORATION
ENGINEERS • SCIENTISTS • PLANNERS
10 LINCOLN ROAD, SUITE 103
FOXBORO, MA 02035
508-543-1755

SCALE ADJUSTMENT GUIDE

0" 1"

BAR IS ONE INCH ON ORIGINAL DRAWING.

EXETER RIVER GREAT DAM

NH00304 / 082.01
EXETER, NEW HAMPSHIRE

TOWN OF EXETER

REVISIONS:

PROJECT NO.:	14227.00
DATE:	OCTOBER 2014
SCALE:	AS NOTED
DESIGNED BY:	DC
CHECKED BY:	SM
DRAWN BY:	LMC
APPROVED BY:	JMB

SUBSURFACE EXPLORATION PLAN

FIGURE NO.: 3

Z:\JOBS\14 Jobs\14227.00 Dam Removal, Exeter, NH\DWG\FIG 3 BORING LOCATION.dwg

APPENDIX A
Boring Logs

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-1**
SHEET 1 OF 1

PROJECT VHB Exeter Dam Removal
Exeter, NH
PROJECT NO. 14227.00
CHKD. BY SJM

BORING CO. New Hampshire Boring
FOREMAN Sam
INSPECTOR M. Dunn

BORING LOCATION SEE EXPLORATION LOCATION PLAN
WATER SURFACE ELEVATION 21.53 DATUM NGVD29
DATE START 10/1/2014 DATE END 10/1/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:

OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/1/14	12:00	0'	0'	N/A

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	TONS/FT² OR KG/CM²	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
									WATER
									4'6"
5		S-1	24/4	4'6"-6'6"	WOR 1		1A: Wet, loose, gray, fine to coarse GRAVEL, little coarse sand.*	2.	
					9 10				
									GRAVEL
		S-2	15/6	8'6"-9'4"	26 70		2A: Wet, very dense, gray, fine to coarse GRAVEL, little, gray-light brown, medium to coarse sand, trace silt.**	3.	9'4"
					100/3"				POSSIBLE
10									WEATHERED BEDROCK
		C-1	60/54	10'9"-15'9"					10'9"
					5 Min		Light gray, slightly weathered to fresh, very hard, slightly fractured to sound, medium grained to coarse grained QUARTZITE	4.	
					7 Min				QUARTZITE
					4 Min				BEDROCK
15					4 Min		Recovery: 90%		
					6 Min		RQD: 83%		15'9"
							END OF EXPLORATION @ 15'9".		
20									
25							*1B: Wet, loose, gray, fine to coarse GRAVEL, little light brown, medium to coarse sand, trace silt.		
							*1C: Coarse gravel in tip.		
							**2B: Coarse gravel in tip.		
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:

1. Barge mounted rig with safety hammer. Rotary wash drilling with 4" casing.
2. S-1A top 1" of recovery, S-1B bottom 3" of recovery, S-1C coarse gravel in tip.
3. Spoon refusal at 9'4". Drive and drill down to roller bit refusal at 10'9". Core 10'9" to 15'9".
4. Dip angle 40-50 degrees at breaks

BURMISTER CLASSIFICATION

TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-1**

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-2**
SHEET 1 OF 1

PROJECT: VHB Exeter Dam Removal
Exeter, NH
PROJECT NO.: 14227.00
CHKD. BY: SJM

BORING CO.: New Hampshire Boring
FOREMAN: Sam
INSPECTOR: M. Dunn
BORING LOCATION: SEE EXPLORATION LOCATION PLAN
WATER SURFACE ELEVATION: 21.53
DATUM: NGVD29
DATE START: 10/1/2014
DATE END: 10/1/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:

OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/1/14	2:00	0'	0'	N/A

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	$TONS/FT^2$ OR KG/CM^2	SAMPLE DESCRIPTION Burmister	CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
										WATER
5										
										6'
		S-1	24/12	6-8	11 24		1A: Wet, very dense, dark gray, coarse GRAVEL, some medium to coarse sand.*		2.	GRAVEL
					28 40					
		S-2	19/12	8'6"-10'1"	35 100		Wet, very dense, gray, coarse SAND and fine coarse GRAVEL, little fine to medium sand, trace silt.		3.	8'6"
10					100 100/1"					WEATHERED ROCK
		C-1	60/38	10'6"-15'6"						10'6"
					3 Min		Light gray, moderately weathered to slightly weathered, soft to hard, fine grained, QUARTZITE			
					3 Min					QUARTZITE
					3 Min		Recovery: 63%			BEDROCK
15					3 Min		RQD: 0%			
					4 Min					15'6"
							END OF EXPLORATION @ 15'6".			
20										
25							*1B: Wet, very dense, gray, fine to coarse GRAVEL, some light brown, medium to coarse sand, trace silt.			
							*1C: Wet, very dense, orange-brown, fine GRAVEL, some light brown, coarse sand, trace silt.			
30										

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:

1. Barge mounted rig with safety hammer. Rotary wash drilling with 4" casing.
2. S-1A top 2" of recovery, S-1B middle 7" of recovery, S-1C bottom 3" of recovery
3. Spoon refusal at 10'1". Drive and drill to roller bit refusal @ 10'6". Core from 10'6" to 15'6".

BURMISTER CLASSIFICATION	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%
PERCENT BY WEIGHT	

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-2**

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-3**

SHEET 1 OF 1

PROJECT: VHB Exeter Dam Removal
Exeter, NH

PROJECT NO.: 14227.00
CHKD. BY: SJM

BORING CO.: New Hampshire Boring
FOREMAN: Sam
INSPECTOR: M. Dunn

BORING LOCATION: SEE EXPLORATION LOCATION PLAN
WATER SURFACE ELEVATION: 21.53 DATUM: NGVD29
DATE START: 10/2/2014 DATE END: 10/2/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:

OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/2/14	8:00	0'	0'	N/A

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	TONS/FT² OR KG/CM²	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
								1.	
									WATER
5									
		S-1	9/4	5'6"-6'3"	8 100/3"		Wet, very dense, dark gray, fine to coarse GRAVEL and coarse SAND, trace silt.		5'6"
								2.	GRAVEL 6'3"
		C-1	60/60	7'6"-12'6"					POSSIBLE WEATHERED BEDROCK 7'6"
					7 Min		Light gray, fresh, hard to very hard, moderately fractured to sound, fine grained QUARTZITE	3.	
10					7 Min				QUARTZITE
					3 Min		Recovery: 100%		BEDROCK
					4 Min		RQD: 60%		
					5 Min				12'6"
							END OF EXPLORATION @ 12'6".		
15									
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:

1. Barge mounted rig with safety hammer. Rotary wash drilling with 4" casing.
2. Spoon refusal at 6'3". Drive and drill to roller bit refusal @ 7'6". Core from 7'6"-12'6".
3. Dip angle 40-50 degrees at breaks

BURMISTER CLASSIFICATION	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%
PERCENT BY WEIGHT	

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-3**

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-4**
SHEET 1 OF 1

PROJECT: VHB Exeter Dam Removal
Exeter, NH
PROJECT NO. 14227.00
CHKD. BY SJM

BORING CO. New Hampshire Boring
FOREMAN Sam
INSPECTOR M. Dunn
BORING LOCATION SEE EXPLORATION LOCATION PLAN
WATER SURFACE ELEVATION 21.53 DATUM NGVD29
DATE START 10/2/2014 DATE END 10/2/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:

OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/2/14	10:00	0'	0'	N/A

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	TONS/FT^2 OR KG/CM^2	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
								1.	
									WATER
									4'
5		S-1	24/8	4-6	5 9		Wet, medium dense, gray, fine to coarse GRAVEL, little medium to coarse sand, trace silt.		
					5 5				GRAVEL
		S-2	24/8	6-8	9 8		Wet, medium dense, fine to coarse GRAVEL, trace fine to coarse sand, trace silt.		
					8 100/6				8'
		C-1	60/60	8-13	4 Min		Light gray, slightly weathered to fresh, hard to very hard, moderately fractured to sound, fine grained QUARTZITE	3.	
10					5 Min				QUARTZITE
					5 Min				BEDROCK
					5 Min		Recovery: 100%		
					7 Min		RQD: 85%		13'
							END OF EXPLORATION @ 13'.		
15									
20									
25									
30									

GRANULAR SOILS BLOWS/FT	GRANULAR SOILS DENSITY	COHESIVE SOILS BLOWS/FT	COHESIVE SOILS DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:

1. Barge mounted rig with safety hammer. Rotary wash drilling with 4" casing.
2. Drill and drive to roller bit refusal @ 8'. Core from 8' to 13'.
3. Dip angle 40-50 degrees in bedrock

BURMISTER CLASSIFICATION

TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-4**

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-5**
OW-1
SHEET 1 OF 1

PROJECT: VHB Exeter Dam Removal
Exeter, NH
PROJECT NO.: 14227.00
CHKD. BY: SJM

BORING CO.: New Hampshire Boring
FOREMAN: Sam
INSPECTOR: M. Georgian
BORING LOCATION: SEE EXPLORATION LOCATION PLAN
GROUND SURFACE ELEVATION: 27.00
DATUM: NGVD29
DATE START: 10/2/2014
DATE END: 10/2/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:
OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/2/14	2:00	5.5'	0'	3.5 hrs.

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	TONS/FT^2 OR KG/CM^2	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
		S-1	24/10	0-2	6 12		Moist, medium dense, brown, fine GRAVEL and fine to medium SAND, trace silt, trace roots.		2" TOPSOIL
					17 11				
		S-2	24/11	2-4	14 28		Moist, dense, brown, fine GRAVEL, some sand, trace silt.	2.	
					15 24				FILL
5		S-3	24/4	4-6	14 15		Wet, medium dense, gray-reddish brown, coarse SAND, some fine to coarse gravel, traces of brick.		
					15 7				
		S-4	24/6	6-8	14 14		Wet, medium dense, brown with traces of dark brown, medium to coarse SAND, some fine gravel, little brick,*	3.	
					9 5			4.	
		S-5	24/6	8-10	1 1		Wet, loose, gray, coarse sand, trace silt, trace brick.		
10					1 1				FILL 10'7"
		S-6	23/18	10-11'11"	11 18		Wet, very dense, gray, fine to coarse angular GRAVEL, trace silt.	5.	TIMBER 11'5"
					41 100/5"			6.	POSSIBLE WEATHERED ROCK
		C-1	57/54	12-16'9"	4 Min		Light gray, fresh, extremely hard, moderately fractured to sound, fine grained QUARTZITE	7.	12'
					4 Min				QUARTZITE
15					5 Min		Recovery: 95%		BEDROCK
					6 Min/9"		RQD: 62%		
								8.	16'9"
							END OF EXPLORATION @ 16'9".		
20									
							*(odor in sample).		
25									
30									

GRANULAR SOILS BLOWS/FT	GRANULAR SOILS DENSITY	COHESIVE SOILS BLOWS/FT	COHESIVE SOILS DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:

1. ATV mounted drill rig with safety hammer. Rotary wash drilling with 4" casing.
2. Pulverized gray stones encountered.
3. Spoon jammed by a stone.
4. Ash & cinders encountered. DPW indicated a house burned down on this lot.
5. Top 4" of recovery: coarse sand similar to S-5. 4" to 12" of recovery

BURMISTER CLASSIFICATION

TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-5**
OW-1

timber with odor.

6. Spoon refusal @ 11'11". Advance roller bit to 12'. Core from 12' to 16'9".
7. Dip angle 50-60 degrees at 6 breaks, 90 degrees at 3 breaks
8. OW-1 installed: 10' slotted screen from 18'-8'. Solid from 8'-0'. Sand from 18'-5'9". Bentonite from 5'9"-4'9".

PARE CORPORATION

10 LINCOLN ROAD, SUITE 103, FOXBORO, MASSACHUSETTS
ENGINEERS *** PLANNERS *** CONSULTANTS

BORING NO. **B14-6**
OW-2
SHEET 1 OF 1

PROJECT VHB Exeter Dam Removal
Exeter, NH
PROJECT NO. 14227.00
CHKD. BY SJM

BORING CO. New Hampshire Boring
FOREMAN Sam
INSPECTOR M. Dunn
BORING LOCATION SEE EXPLORATION LOCATION PLAN
GROUND SURFACE ELEVATION 27.53 DATUM NGVD29
DATE START 10/2/2014 DATE END 10/2/2014

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 LB. HAMMER FALLING 30 IN.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING 300 LB. HAMMER FALLING 24 IN.

CASING SIZE:
OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER AT	CASING AT	STABILIZATION TIME
10/2/14	2:40	6.2'	0'	15 Min

DEPTH (ft)	CASING (bl/ft)	SAMPLE NO.	PEN. (in.)/ REC.	DEPTH (FT)	BLOWS/6"	TONS/FT^2 OR KG/CM^2	SAMPLE DESCRIPTION Burmister CLASSIFICATION	REMARKS	STRATUM DESCRIPTION
		S-1	24/18	0-2	1 6		Moist, medium dense, brown, fine to medium SAND.	1.	4" TOPSOIL
					7 8				
		S-2	24/12	2-4	8 6		Moist, medium dense, light brown, fine SAND and SILT.		
					7 7				SILTY SAND
5		S-3	24/6	4-6	19 47		Moist, very dense, light brown, fine to medium SAND, some silt, trace fine gravel.	2.	
					12 7			3.	6'
		S-4	24/12	6-8	43 30		Wet, medium dense, gray-light brown, fine to coarse GRAVEL, trace coarse sand, trace silt.		
					15 22				GRAVEL
		S-5	4/3	9-9'4"	100/4"		Wet, very dense, gray, fine to coarse GRAVEL, trace fine sand, trace silt.	4.	9'4"
10									POSSIBLE WEATHERED ROCK
		C-1	42/37	11-14'5"			Light gray, fresh, extremely hard, moderately fractured to sound, fine grained QUARTZITE		11'
					7 Min			5.	
					5 Min		Recovery: 88% RQD: 50%		QUARTZITE
					10 Min				BEDROCK
15					8 Min/6"			6.	14'6"
							END OF EXPLORATION @ 14'6".		
20									
25									
30									

GRANULAR SOILS		COHESIVE SOILS	
BLOWS/FT	DENSITY	BLOWS/FT	DENSITY
0 - 4	V. LOOSE	<2	V.SOFT
4 - 10	LOOSE	2 - 4	SOFT
10 - 30	M.DENSE	4 - 8	FIRM
30 - 50	DENSE	8 - 15	STIFF
>50	V.DENSE	15 - 30	V.STIFF
		>30	HARD

REMARKS:
1. ATV mounted drill rig with safety hammer. Rotary wash with 4" casing.
2. Fractured coarse gravel from 3"-4" from bottom of recovery.
3. Obstruction at approximately 5'.
4. Spoon refusal @ 9'4". Drill from 9'4"-11', driller indicated that the rock was more sound starting at 11'. Core from 11' to 14'6".
5. Dip angle 50 degrees.

BURMISTER CLASSIFICATION

TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

PERCENT BY WEIGHT

NOTES:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

BORING NO. **B14-6**
OW-2

6. OW-2 installed, 10' slotted screen from 14.5' to 4.5'. 4.5' solid from 4.5 to 0': sand from 14.5' to 3.5'. Bentonite 3.5' to 2.5'.

APPENDIX B
Laboratory Testing Data

PARE CORPORATION

SIEVE ANALYSIS

SOIL SAMPLE

Location: Exeter Dam Removal
Boring No.: B14-1
Depth: 4.5-6.5'
Sample No.: S-1B

Specific Gravity, Gs: 2.65

WATER CONTENT

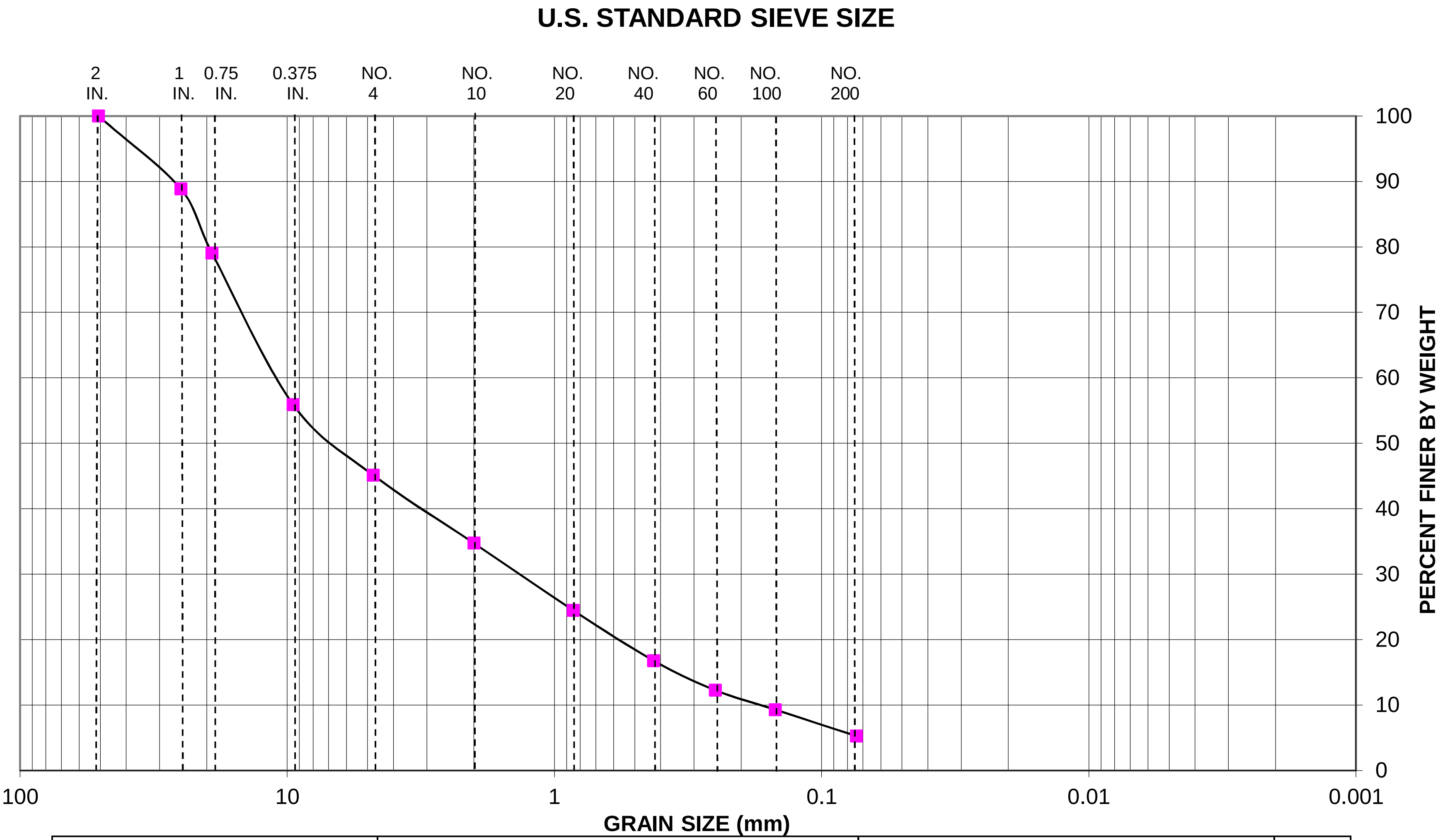
Container No. 2
Wt. Container (g) 191.02
Wt. Container, Wet Soil (g) 449.08
Wt. Container, Dry Soil (g) 420.54
Wt. Water (g) 28.54
Wt. Dry Soil (g) 229.52
Water Content (%) 12.4%
Wt. Con, Washed Dry Soil (g) 420.54
Wt. Washed Dry Soil (g) 229.52

File No. 14227.00
Test No. 1
Date 10/16/2014
Tested By: DRC
Checked By
Dry Sieve X
Wash Sieve
Combined

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	544.1	569.6	25.5	11.1	88.9
0.75"	19.1	553.3	575.7	47.9	20.9	79.1
0.375"	9.5	536.75	589.7	100.8	44.1	55.9
4	4.76	498.2	522.9	125.5	54.9	45.1
10	2	481.1	504.9	149.2	65.3	34.7
20	0.85	433.2	456.6	172.7	75.5	24.5
40	0.425	377.2	394.9	190.3	83.2	16.8
60	0.250	348.7	359.0	200.6	87.7	12.3
100	0.149	361.4	368.2	207.4	90.7	9.3
200	0.074	331.7	341.0	216.7	94.8	5.2
Pan	▨	370.72	382.7	228.7	100.0	0.0
Split Sample Wt (Washed)				0.0		
Total Sample Weight				228.7		

Loss Check: 0.375%



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
1	Exeter River Great Dam, Exeter, MA, Impoundment Boring B14-1, S-1B, 4.5'-6.5'	Loose, wet, gray, fine to coarse GRAVEL and fine to coarse Sand, trace silt TESTED BY:___DRC_____DATE:____10/16/2014_CHECK BY:_________DATE:__________.

PARE
CORPORATION

SIEVE ANALYSIS

SOIL SAMPLE

Location: Exeter Dam Removal
Boring No.: B14-2
Depth: 6-8'
Sample No.: S-1B

Specific Gravity, Gs: 2.65

WATER CONTENT

Container No. Big Bowl
Wt. Container (g) 320.1
Wt. Container, Wet Soil (g) 636.1
Wt. Container, Dry Soil (g) 612.92
Wt. Water (g) 23.18
Wt. Dry Soil (g) 292.82
Water Content (%) 7.9%
Wt. Con, Washed Dry Soil (g) 612.9
Wt. Washed Dry Soil (g) 292.8

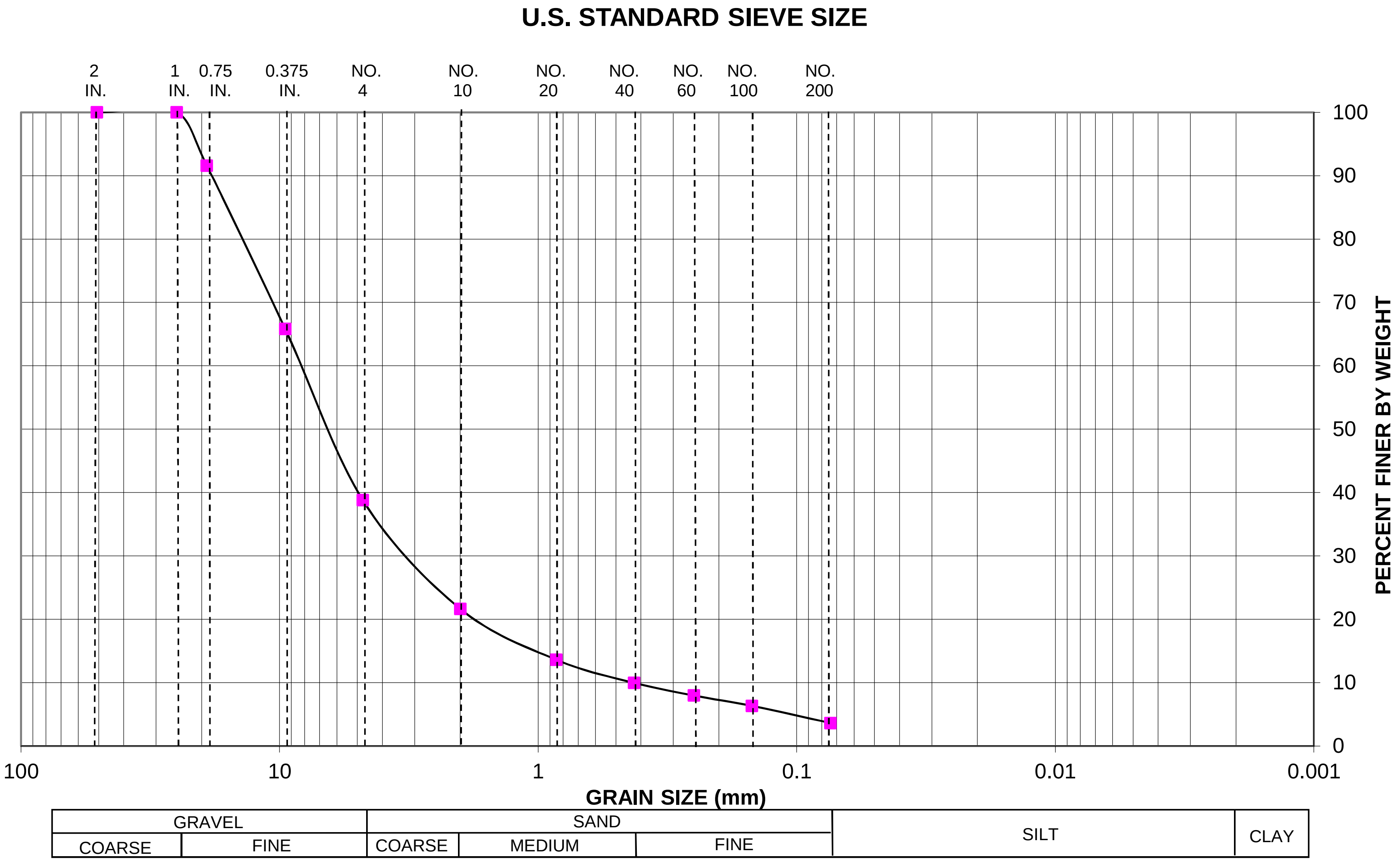
File No. 14227.00
Test No. 2
Date 10/16/2014
Tested By: DRC
Checked By
Dry Sieve X
Wash Sieve
Combined

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	545.9	545.9	0.0	0.0	100.0
0.75"	19.1	553.3	577.7	24.4	8.4	91.6
0.375"	9.5	536.7	611.6	99.3	34.2	65.8
4	4.76	498.2	576.7	177.8	61.2	38.8
10	2	481.32	531.1	227.6	78.4	21.6
20	0.85	433.2	456.5	250.9	86.4	13.6
40	0.425	377.3	387.9	261.5	90.0	10.0
60	0.250	348.6	354.4	267.3	92.0	8.0
100	0.149	361.1	365.9	272.1	93.7	6.3
200	0.074	331.7	339.6	279.9	96.4	3.6
Pan	▨	370.72	381.2	290.4	100.0	0.0

Split Sample Wt (Washed)			0.0
Total Sample Weight			290.4

Loss Check: 0.820%



TEST NO.	MATERIAL SOURCE	REMARKS
2	Exeter River Great Dam, Exeter, MA, Impoundment Boring B14-2, S-1B, 6'-8'	Very dense, wet, dark gray, fine GRAVEL, some coarse to medium Sand, trace silt TESTED BY:___DRC______DATE:____10/16/2014_CHECK BY:__________DATE:___________.

SIEVE ANALYSIS

SOIL SAMPLE

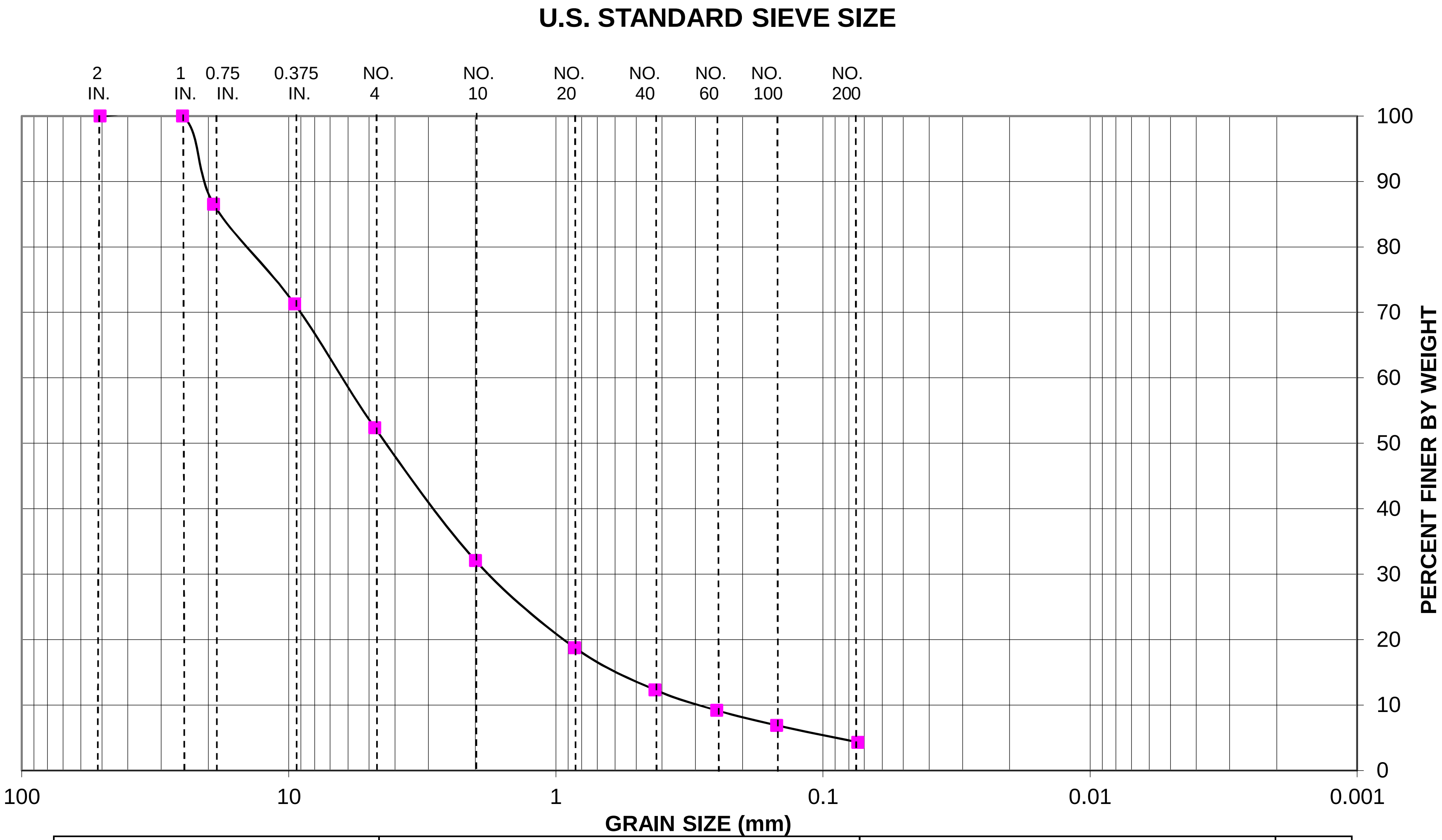
WATER CONTENT

Location:	Exeter Dam Removal	Container No.	Small Bowl	File No.	14227.00
Boring No.:	B14-3	Wt. Container (g)	266.6	Test No.	3
Depth:	5.5-6.25'	Wt. Container, Wet Soil (g)	541.9	Date	10/16/2014
Sample No.:	S-1	Wt. Container, Dry Soil (g)	510.75	Tested By:	DRC
		Wt. Water (g)	31.15	Checked By	
Specific		Wt. Dry Soil (g)	244.15		
Gravity, Gs:	2.65	Water Content (%)	12.8%	Dry Sieve	X
		Wt. Con, Washed Dry Soil (g)	510.75	Wash Sieve	
		Wt. Washed Dry Soil (g)	244.15	Combined	

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	545.9	545.9	0.0	0.0	100.0
0.75"	19.1	553.3	585.9	32.6	13.5	86.5
0.375"	9.5	536.8	573.8	69.6	28.7	71.3
4	4.76	498.2	544.0	115.4	47.6	52.4
10	2	481.5	530.7	164.6	67.9	32.1
20	0.85	433.1	465.4	196.8	81.2	18.8
40	0.425	377.4	393.0	212.5	87.7	12.3
60	0.250	348.7	356.3	220.1	90.8	9.2
100	0.149	361.38	366.9	225.6	93.1	6.9
200	0.074	331.9	338.2	231.9	95.7	4.3
Pan		370.72	381.1	242.3	100.0	0.0
Split Sample Wt (Washed)				0.0		
Total Sample Weight				242.3		

Loss Check: 0.750%



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
3	Exeter River Great Dam, Exeter, MA, Impoundment Boring B14-3, S-1, 5.5'-6.25'	Very dense, wet, dark gray, fine GRAVEL and coarse to medium SAND, trace silt TESTED BY:___DRC______DATE:_____10/16/2014_CHECK BY:__________DATE:___________.

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SIEVE ANALYSIS

SOIL SAMPLE

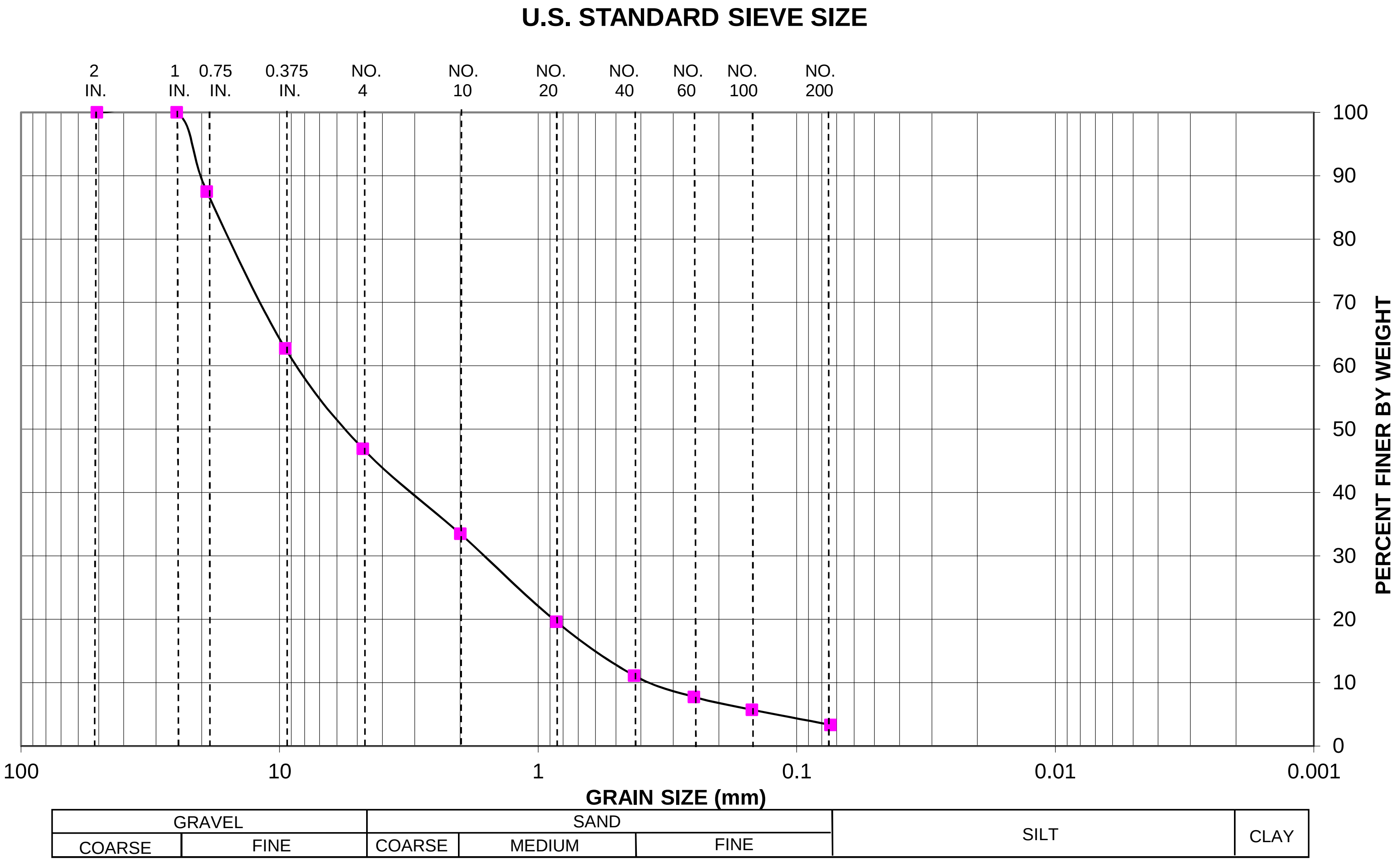
WATER CONTENT

Location:	Exeter Dam Removal	Container No.	2	File No.	14227.00
Boring No.:	B14-4	Wt. Container (g)	191	Test No.	4
Depth:	4-6'	Wt. Container, Wet Soil (g)	533.1	Date	10/17/2014
Sample No.:	S-1	Wt. Container, Dry Soil (g)	485.62	Tested By:	DRC
		Wt. Water (g)	47.48	Checked By	
Specific		Wt. Dry Soil (g)	294.62		
Gravity, Gs:	2.65	Water Content (%)	16.1%	Dry Sieve	X
		Wt. Con, Washed Dry Soil (g)	485.62	Wash Sieve	
		Wt. Washed Dry Soil (g)	294.62	Combined	

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	545.9	545.9	0.0	0.0	100.0
0.75"	19.1	553.4	590.3	36.9	12.5	87.5
0.375"	9.5	536.85	609.9	109.9	37.3	62.7
4	4.76	497.9	544.6	156.6	53.1	46.9
10	2	481.45	521.1	196.3	66.5	33.5
20	0.85	433.2	474.1	237.2	80.4	19.6
40	0.425	377.6	402.7	262.3	88.9	11.1
60	0.250	348.55	358.5	272.2	92.2	7.8
100	0.149	361.3	367.3	278.2	94.3	5.7
200	0.074	331.9	338.9	285.2	96.7	3.3
Pan		370.65	380.5	295.0	100.0	0.0
Split Sample Wt (Washed)				0.0		
Total Sample Weight				295.0		

Loss Check: -0.136%



TEST NO.	MATERIAL SOURCE	REMARKS
4	Exeter River Great Dam, Exeter, MA, Impoundment Boring B14-4, S-1, 4'-6'	Medium dense, wet, gray, fine GRAVEL and coarse to medium SAND, trace silt TESTED BY:___DRC______DATE:_____10/16/2014_CHECK BY:___________DATE:____________.

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PARE CORPORATION

SIEVE ANALYSIS

SOIL SAMPLE

WATER CONTENT

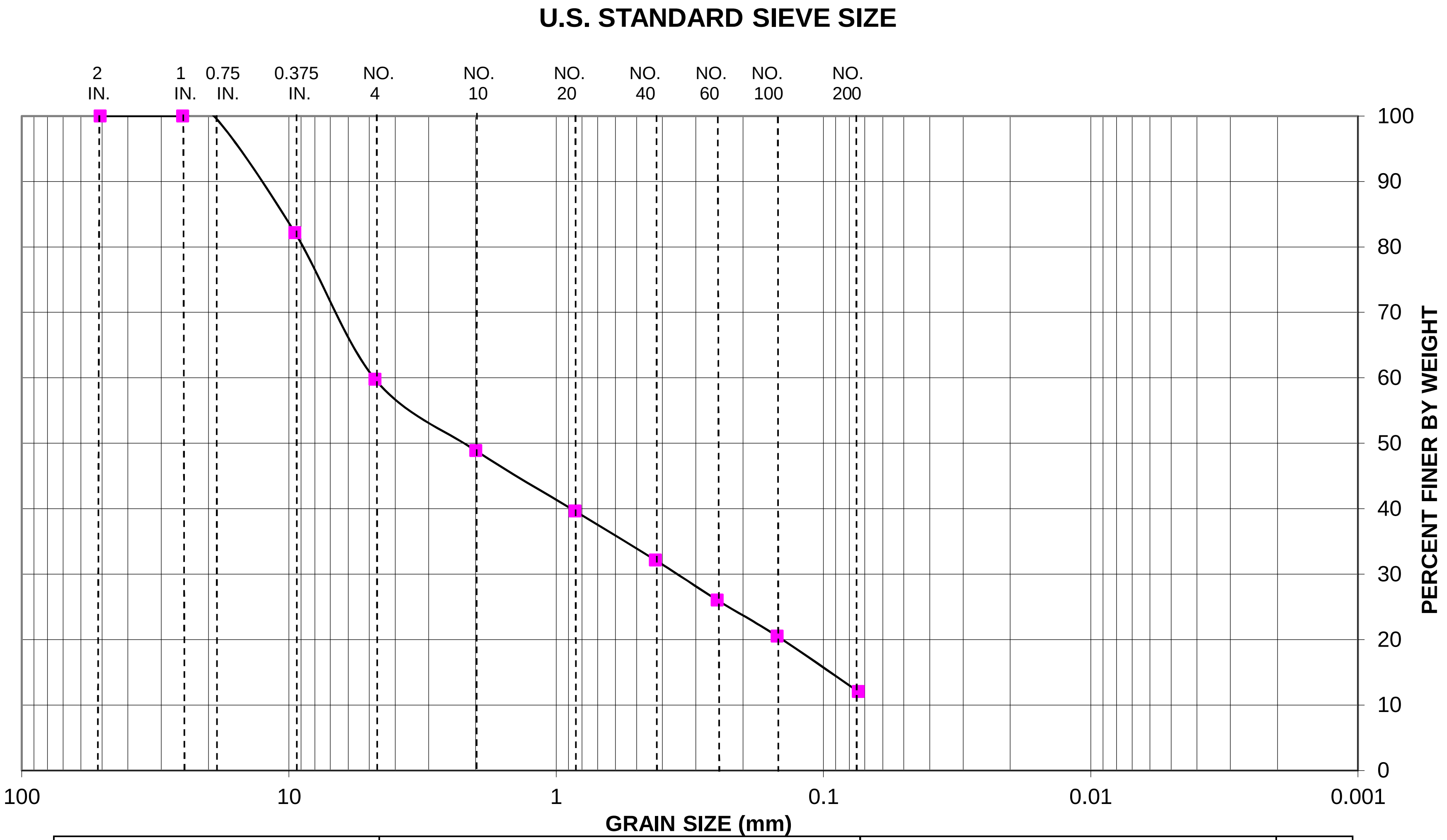
Location: Exeter Dam Removal
Container No. Small Bowl
File No. 14227.00
Boring No.: B14-5
Wt. Container (g) 266.6
Test No. 5
Depth: 2-4'
Wt. Container, Wet Soil (g) 493.22
Date 10/17/2014
Sample No.: S-2
Wt. Container, Dry Soil (g) 486.8
Tested By: DRC
Wt. Water (g) 6.42
Checked By
Specific Gravity, Gs: 2.65
Wt. Dry Soil (g) 220.2
Water Content (%) 2.9%
Dry Sieve X
Wt. Con, Washed Dry Soil (g) 486.8
Wash Sieve
Wt. Washed Dry Soil (g) 220.2
Combined

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	545.9	545.9	0.0	0.0	100.0
0.75"	19.1	553.4	553.3	-0.1	0.0	100.0
0.375"	9.5	536.85	576.1	39.2	17.8	82.2
4	4.76	497.9	547.3	88.5	40.2	59.8
10	2	481.45	505.5	112.6	51.1	48.9
20	0.85	433.2	453.6	132.9	60.4	39.6
40	0.425	377.6	394.1	149.4	67.9	32.1
60	0.250	348.55	362.0	162.8	73.9	26.1
100	0.149	361.3	373.5	175.0	79.5	20.5
200	0.074	331.9	350.6	193.6	87.9	12.1
Pan		370.65	397.2	220.2	100.0	0.0

Split Sample Wt (Washed)			0.0
Total Sample Weight			220.2

Loss Check: 0.005%



GRAVEL		SAND			SILT	CLAY
COARSE	FINE	COARSE	MEDIUM	FINE		

TEST NO.	MATERIAL SOURCE	REMARKS
5	Exeter River Great Dam, Exeter, MA, Landside (west bank) B14-5, S-2, 2'-4'	Dense, moist, brown, fine to coarse SAND and fine Gravel, little silt. TESTED BY:___DRC_____DATE:____10/17/2014_CHECK BY:__________DATE:___________.

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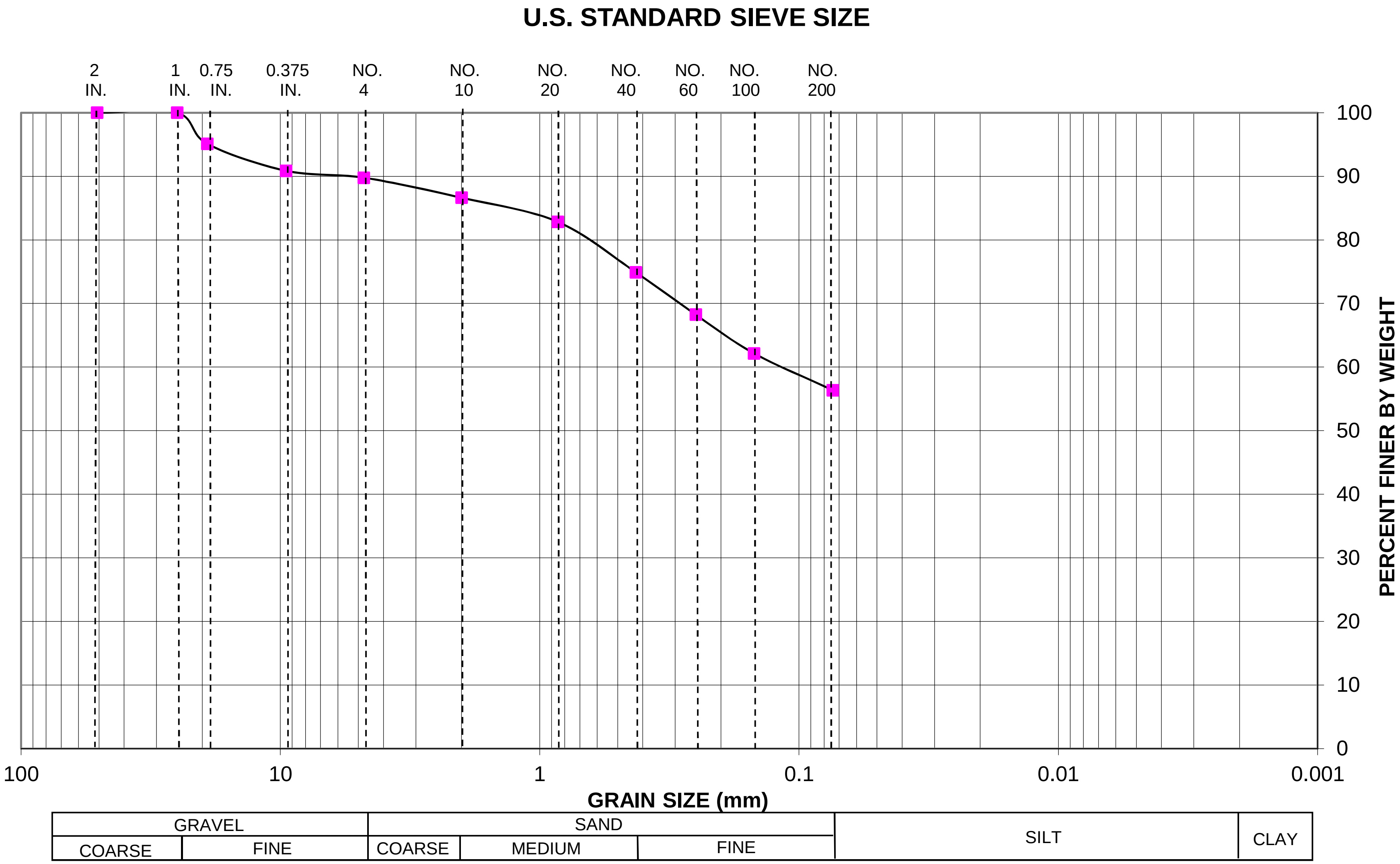
SIEVE ANALYSIS

SOIL SAMPLE		WATER CONTENT			
Location:	Exeter Dam Removal	Container No.	Big Bowl	File No.	14227.00
Boring No.:	B14-6	Wt. Container (g)	320.1	Test No.	6
Depth:	2-4'	Wt. Container, Wet Soil (g)	572.05	Date	10/17/2014
Sample No.:	S-2	Wt. Container, Dry Soil (g)	535.72	Tested By:	DRC
		Wt. Water (g)	36.33	Checked By	
Specific		Wt. Dry Soil (g)	215.62		
Gravity, Gs:	2.65	Water Content (%)	16.8%	Dry Sieve	
		Wt. Con, Washed Dry Soil (g)	420.12	Wash Sieve	
		Wt. Washed Dry Soil (g)	100.02	Combined	X

TOTAL SAMPLE

U.S. Standard Sieve No.	Sieve Opening (mm)	Sieve Wt. (g)	Sieve + Soil Wt. (g)	Accumulative Wt. of Soil Retained (g)	Accumulative Percent Retained	Total Sample Percent Finer By Wt.
2"	50.8	562.4	562.4	0.0	0.0	100.0
1"	25	545.9	545.9	0.0	0.0	100.0
0.75"	19.1	553.3	563.9	10.6	4.9	95.1
0.375"	9.5	536.75	545.9	19.8	9.1	90.9
4	4.76	498.2	500.6	22.1	10.2	89.8
10	2	481.1	487.9	29.0	13.4	86.6
20	0.85	433.2	441.4	37.2	17.2	82.8
40	0.425	377.2	394.4	54.4	25.1	74.9
60	0.250	348.7	363.1	68.8	31.8	68.2
100	0.149	361.4	374.6	82.0	37.8	62.2
200	0.074	331.7	344.3	94.5	43.6	56.4
Pan		370.72	377.2	101.0	46.6	53.4
Split Sample Wt (Washed)				115.6		
Total Sample Weight				216.6		

Loss Check: -0.455%



TEST NO.	MATERIAL SOURCE	REMARKS
6	Exeter River Great Dam, Exeter, MA, Landside (west bank) B14-6, S-2, 2'-4'	Medium dense, moist, light brown, SILT, some fine to coarse Sand, trace fine gravel. TESTED BY:___DRC_____DATE:____10/17/2014_CHECK BY:_________DATE:__________.

APPENDIX C
Geotechnical Limitations

GEOTECHNICAL LIMITATIONS

Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, Pare Corporation (PARE) should be asked to reevaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in the subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at the times and under the conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report. However, fluctuations in the level of groundwater may occur due to variations in rainfall, temperature, and other factors occurring since the time the measurements were made.

Review

4. In the event that any changes in the nature or removal of the Great Dam or associated structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified in writing by PARE. PARE should also be provided with the opportunity for a general review of the final design and specifications in order that the earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

Construction

5. PARE should be retained to provide soil engineering services during removal of the dam and during construction of the excavation and foundation of auxiliary support for walls affected by the phases of work in order to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those indicated prior to the start of construction.

Use of Report

6. This report has been prepared for the exclusive use of Vanasse Hangen Brustlin, Inc., for specific application to the proposed removal of the Great Dam within the Exeter River located in Exeter, New Hampshire in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

7. This engineering report has been prepared for this project by PARE. This report is for design purposes only and is not necessarily sufficient to prepare an accurate bid. Contractors wishing a copy of this report may secure it with the understanding that its scope is limited to design considerations only.