

US ROUTE 1 IMPROVEMENTS

POHICK CHURCH PRE-CONSTRUCTION SURVEY AND VIBRATION MONITORING PLAN

QEA PROJECT NO. 31304000



16 July 2014

POHICK CHURCH
PRE-CONSTRUCTION SURVEY AND
VIBRATION MONITORING PLAN

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Purpose

The “Pohick Church Pre-Construction Survey and Vibration Monitoring Plan” has been prepared for A. Morton Thomas & Associates to provide preconstruction survey and vibration monitoring recommendations for Pohick Church in advance of a road improvement project at the intersection of US Route 1 (Richmond Highway) and State Route 611 (Telegraph Road/Old Colchester Road) to be undertaken by Corman-Wagman adjacent to the church property. The project involves resurfacing the existing asphalt on US Route 1, reconfiguring the existing median of US Route 1 to modify the left turn lanes onto State Route 611, installing a new right turning lane from State Route 611 to US Route 1 across from the Pohick Church, installing a stormwater management pond on the side of U.S. Route 1 opposite from the Pohick Church, and potentially putting in noise walls on Telegraph Road across from the Pohick Church.

This Pre-Construction Survey and Vibration Monitoring Plan report is intended to:

1. Survey and evaluate the existing conditions and structural integrity of the Pohick Church sanctuary building and Vestry House, and the site wall adjacent to these buildings along Route 1.
2. Identify issues and establish baseline conditions for monitoring vibration impacts during construction.
3. Identify the types of construction activities and equipment that require monitoring, establish the vibration threshold not to be exceeded, and provide vibration monitoring recommendations for the Pohick Church structures, including the sanctuary, Vestry House and site walls.

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Project Team

The Pohick Church Pre-Construction Survey and Vibration Monitoring Plan has been prepared for A. Morton Thomas & Associates by:

Architect:

Quinn Evans Architects

Structural Engineer:

Robert Silman Associates

Geotechnical/Vibration Engineer:

Schnabel Engineering

Project Background

Based on information provided by A. Morton Thomas, proposed construction in the vicinity of the Pohick Church site consists of:

1. Milling and resurfacing of the pavement located along US Route 1 (Richmond Highway) immediately adjacent to the site. Milling and resurfacing of the pavement will be within about 70 feet of the sanctuary building.
2. Reconfiguring the existing median of US Route 1 (Richmond Highway) to modify the left turn lanes onto State Route 611 (Telegraph Road/Old Colchester Road). This activity will be within approximately 100 feet of the sanctuary building.
3. Constructing a new (i.e., full depth pavement) turning lane to the northwest of the intersection of State Route 611 (Telegraph Road/Old Colchester Road) and US Route 1 (Richmond Highway). Construction of the new turning lane will be within about 200 feet of the sanctuary building.
4. Construction of a stormwater management pond northwest of the intersection of US Route 1 (Richmond Highway) and State Route 611 (Telegraph Road/Old Colchester Road). This activity will be greater than 200 feet from the sanctuary building.
5. Community input is also being solicited as to whether or not to place noise control walls alongside the new turning lane. Note that these walls are separate from those that are in the work plan at Inlet Cove, approximately 1000 feet east of Pohick Church on US Route 1 (Richmond Highway).

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Methodology

The Pohick Church site consists of several buildings and site structures in a wooded setting at the southwest corner of US Route 1 (Richmond Highway) and State Route 611 (Telegraph Road/Old Colchester Road). The survey and recommendations in this report are focused on the sanctuary building, the Vestry House, and the site wall running along Route 1, between the road and the sanctuary building and Vestry House. The study does not address the cemetery gravestones on the property.

An initial walk-through of the site was conducted on December 11, 2013. Field surveys were conducted by Quinn Evans Architects and Robert Silman Associates.

In addition, Schnabel Engineering conducted a video survey of the existing conditions of the sanctuary and vestry buildings. A CD with the video survey is on file with the Federal Highway Administration – Eastern Federal Lands Highway Division (FHWA-EFLHD). Exterior survey of all structures was conducted from the ground. Interior survey of the sanctuary building included access to the balcony. Survey did not include the attic.

Additional information about the history of Pohick Church was obtained from interviews with church personnel, and from public relations materials available at the church. Following the initial walk-through, the team was also furnished with a copy of a report entitled “Condition Assessment and Recommendation,” dated March 31, 2001. Schnabel also reviewed available existing boring logs for the project area to inform their recommendations.

Description of Structures
Survey

Sanctuary Building:

The Pohick Church sanctuary building was originally constructed from 1769 to 1774. It was built with load-bearing brick walls, and Aquia Creek sandstone door surrounds and quoins.

The sanctuary building was used until the Civil War, during which time it was occupied by both Union and Confederate forces, and used as troop quarters and as a stable. During that period, almost all of the original interior woodwork and furnishings were destroyed, and the roof of the sanctuary

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was burned off. Following the Civil War, the church was left largely abandoned.

A major rebuilding effort was undertaken from 1900 to 1917. A new roof was installed and all the windows were replaced, and the interior was completely overhauled with new interior paneling, benches, pulpit, and other finishes.

Sometime after 1917 a balcony funded by the Mount Vernon Ladies' Association of the Union was constructed across the west end of the sanctuary's interior. The original ca. 1774 layout of the building did not include a balcony.

Various other repair and restoration projects were undertaken over the next approximately 100 years. For example, deteriorated stone and brick was repaired or replaced in 1958-1959, eroded sandstone was replaced in 1992, and windows were repaired in 1995.

The building is 66 feet by 45.5 feet in plan; the walls are 28 feet high. It is primarily a single-story structure, with the balcony noted above (which includes a pipe organ) at the west end of the building.

Vestry House:

The Vestry House was completed in 1931 using old brick intending to match the sanctuary building. It is a single-story building, 24 feet by 18 feet in plan.

Site Wall:

The period that the current site wall was constructed is unknown. It is double-wythe brick wall, approximately 3.5 feet in height, laid in a Flemish bond with a soldier course forming the wall coping.

Pre-Construction
Monitoring Issues

The following are critical issues that are recommended to be addressed for the successful management of vibrations caused by construction activity in the vicinity of the Pohick Church.

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Public Awareness:

Letters should be sent and personal contact should be made with church officials to discuss the planned construction activities that have the potential to generate perceptible ground vibrations. This contact must be made well in advance of the beginning of any construction activities. The Contractor should keep a clear record of all communications with all church officials contacted prior to the construction activities. The Contractor shall furnish the Engineer of Record with a list of those contacted prior to any construction activities, along with the pertinent information required by the Engineer of Record.

Permanent Displacement:

A line (location) and grade (elevation) survey should be performed by a surveyor licensed in the State of Virginia to establish control and gradelines to detect movements along the faces of the sanctuary, Vestry House, and site wall. Control points and gradelines should be referenced to a benchmark set at a location far enough away from the project site that it will not be affected by the work, but close enough to the Pohick Church structures to be readily accessible. The benchmark is to be a single semi-permanent setting that may be used through the duration of the project for monitoring the structures at the Church. Benchmarks, control points, and gradelines should be established and measurements taken prior to any work in the proximity of the Pohick Church site.

Existing Building Cracks:

Crack monitoring gauges should be installed and monitored during construction to record any permanent deformation caused by the construction activities. A minimum of four (4) crack monitoring gauges should be placed on the Pohick Church structures. Refer to the specific recommendations for locations to install the crack gauges in the monitoring recommendations below.

Existing Conditions
Survey

Quinn Evans Architects and Robert Silman Associates conducted an existing conditions field survey of the Pohick Church structures on December 11, 2013. Existing

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conditions were documented with photographs. Additionally, Schnabel Engineering prepared a pre-construction video survey of the sanctuary and vestry buildings. A CD with the video survey is on file with the Federal Highway Administration – Eastern Federal Lands Highway Division (FHWA-EFLHD).

Exterior survey of all structures was conducted from the ground. Interior survey of the sanctuary building included access to the balcony. Survey did not include the attic.

The sanctuary building, Vestry House, and wall along Route 1 are constructed of brick. The sanctuary building, Vestry House, and brick walls all appear to be founded on shallow foundations. The sanctuary building foundations likely consist of mortar and stone. Based on the limited field observations, the sanctuary building and Vestry House are in fair to good condition. The brick wall along Richmond Highway is generally in fair condition and exhibits selective deterioration of the mortar joints and isolated cracking through the mortar joints and brick units.

A pre-construction survey was completed of the sanctuary building (interior and exterior), the Vestry House (exterior), and brick wall along Route 1. A limited number of hairline cracks were observed in the plaster finishes, but the interiors are in generally good condition.

Photographic documentation of the exteriors and interiors are included in this report. For supplemental information on the pre-construction conditions, refer to the pre-construction video documentation noted above.

Vibration Monitoring
Plan

The sanctuary building is highly sensitive to damage from construction vibrations due to its historic nature, and the brick wall along Route 1 is highly vulnerable to damage from construction vibrations due to its condition. The Vestry House is less susceptible to damage based on its more recent construction.

Based on a review of available, nearby boring logs (Borings ECS-01 and B-32), the Pohick Church site is likely underlain by clayey sand, silt, and/or silty clay Terrace deposits to a depth of about 10 ft. The Terrace deposits are

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underlain by clayey sand of the Potomac Formation; some fill is likely present at the site. The extent and depth to which any of these materials is located below the PC site structures is unknown without specific subsurface investigations of the structures (e.g., test pits and test borings). Also, based on the nearby boring logs, groundwater is probably located more than 20 ft below the existing ground surface; however, some perched water may be present above this depth.

Threshold Peak Particle Velocity (PPV)

Based on site observations made by the project team, the historical nature/importance of the sanctuary building, the proposed nearby construction, and the subsurface soils likely present at the Pohick Church site, the threshold peak particle velocity (PPV) should be no more than 0.1 inches per second (ips) near the sanctuary building. Based on our analysis, we expect vibrations due to milling and resurfacing of the pavement located along Route 1 immediately adjacent to the Pohick Church site and construction of the new (i.e., full depth pavement) turning lane to the northwest of the intersection of State Road 611 (Telegraph Road/Old Colchester Road) and US Route 1 (Richmond Highway) to be significantly lower than 0.1 ips near the sanctuary building (see Appendix A). The analysis is based on the assumption that the contractor will be using common earth moving and paving equipment (e.g., heavy trucks, bulldozers, vibratory rollers, and pans/scrapers).

Pre-Construction Survey

Vibration and environmental condition monitoring and documentation are recommended at the Pohick Church in the vicinity of the sanctuary, Vestry House, and site walls prior to any construction operations.

Pre-Construction Baseline Vibration Survey:

It is recommended that a baseline vibration survey be completed by the Contractor approximately 4-6 months prior to construction activities. The objective of the baseline vibration survey is to establish baseline ground motions caused by vehicular traffic (buses, cars, trucks, and other non-construction sources) near the historic structures that are sensitive to vibration. These vibration levels will be compared to vibration levels during construction and the

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established threshold limits to prevent vibration-induced damage to the Pohick Church structures. The baseline vibration survey should be conducted for a minimum of 3 weeks, so that all typical traffic patterns may be covered (weekday morning and evening rush hours, weekend, holiday, etc.).

The results of the pre-construction baseline vibration survey can be included in the Corman-Wagman work plan for the project.

Pre-Construction Baseline Environmental Conditions Survey:

At the same time that the baseline vibration survey is conducted, it is recommended that there be concurrent monitoring and recording of site temperature, humidity, and precipitation so that weather conditions and their effects on crack size may be documented.

Environmental data collected must be gathered at and specific to the Pohick Church site. Regional weather information (such as National Weather Service reports, or local weather services or news stations) is not acceptable.

Pre-Construction Photographic and Video Documentation:

The contractor shall take digital images and video of the Pohick Church site and buildings and site wall, at the time of the baseline vibration and environmental conditions surveys. Images shall be taken at multiple locations, including (but not limited to) exterior and interior building walls, windows, and locations of existing cracks. Image and video files shall be named with the date they are taken, and included in the Corman-Wagman work plan for the project.

Construction Phase Monitoring

Vibration and environmental condition monitoring and documentation are recommended at the Pohick Church activity in the vicinity of the sanctuary, Vestry House, and site walls during construction operations.

Field Monitoring of Vibrations During Construction:

It is recommended that vibration monitoring during

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construction be incorporated into Corman-Wagman's work plan. The vibration measurements should be made using the seismograph specification included in this report as Appendix B. Vibration measurements shall be taken weekly during the construction activities and recorded in a construction activities log maintained by Corman-Wagman. The logs must be in the form specified in the Contractor's construction plan. During construction, the vibration logs shall be submitted to the Engineer throughout construction.

Vertical control markers should also be reviewed during construction to confirm that no permanent displacement (settlement) has occurred.

Field Monitoring of Environmental Conditions During Construction:

Monitoring of temperature, humidity, and precipitation shall continue concurrently with vibration monitoring throughout the duration of all construction operations, and shall be recorded along with vibration measurements in a construction activities log.

Photographic and Video Documentation During and at Completion of Construction:

The contractor shall take digital images and video of the Pohick Church site and buildings and site wall, at the time of the vibration and environmental conditions are recorded. Images shall be taken at locations of pre-construction documentation as well as of crack monitors. Image and videos files shall be named with the date they are taken, and included in a construction activities log.

Upon completion of construction operations, the contractor shall take video images and video of the same locations as the pre-construction images and video. Image and videos files shall be named with the date they are taken, and included in a construction closeout report.

Field Monitoring of Existing Cracks During Construction:

Permanent deformation of buildings should be monitored with crack monitoring gauges. Due to the sensitive nature of the historic Pohick Church structures, it is recommended

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that crack monitors be installed on existing cracks on the sanctuary building, the Vestry House and the site wall. These monitors should be reviewed before, during, and upon completion of the road widening project.

Gauges suitable for brick masonry should be used. These monitors should be placed by the contractor, and initial settings recorded, and then they should be checked during the progress of the roadwork and then after completion of the work. Surveys and gauge reading should be taken weekly during the construction activities and recorded in a construction activities log maintained by Corman-Wagman. The logs must be in the form specified in the Contractor's construction plan. During construction, the crack gauge readings logs shall be submitted to the Engineer throughout construction.

Robert Silman Associates recommends providing crack monitors on existing cracks on the sanctuary building, Vestry House, and site wall. On the sanctuary building, two crack monitors should be placed on existing cracks under first floor windows on the north side exterior of the building. On the Vestry House, one monitor should be placed on an existing crack over the north door. On the site wall, one crack monitor should be placed on an existing crack on the south of face wall, roughly north of the sanctuary building.

Refer to the illustrations in this report for specific crack monitor locations recommended by Quinn Evans Architect and Robert Silman Associates.

Stabilization Measures Prior to Construction:

Based on the condition of the existing buildings and site wall, and the projected construction activities, no pre-construction stabilization measures are recommended. The anticipated vibration levels for the road work are below the threshold peak particle velocity (PPV) established for the Pohick Church buildings, and the condition of the walls is generally good. For this reason, no specific vibration mitigation measures, such as repointing and structural reinforcement, are necessary.

If the scope or nature of the construction activities changes,

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the vibration mitigations requirements should be reevaluated to confirm whether or not any pre-construction stabilization measures are needed for any of the Pohick Church structures.

Protocols for Peak Particle Velocity (PPV) Control During Construction

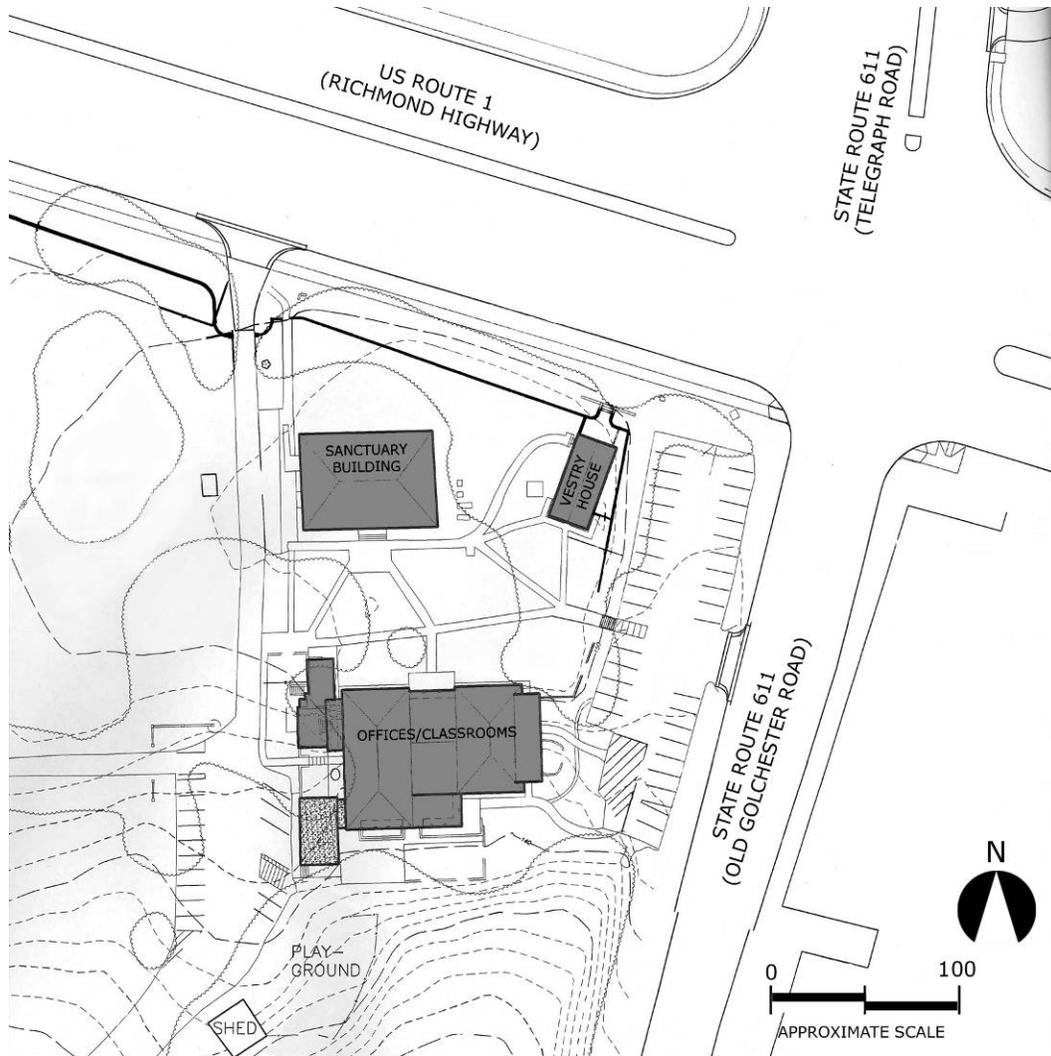
If the contractor exceeds 80 percent of the ground vibration PPV control limit for any single axis during construction activities, the Contractor must immediately submit a written report to the Engineer who has been designated by the Contractor to set up and interpret the vibration monitoring equipment, showing the vibration measurements data and include corrective actions for work going forward.

For any construction activity where 100 percent of the ground vibration control limit is reached for any single axis, the Contractor must stop related construction activities immediately and notify the Engineer. Additionally, the Contractor shall prepare a written report with corrective actions to be taken to prevent the specified PPV limit from being exceeded for the duration of construction.

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APPENDIX A: SUPPORTING PLANS AND IMAGES

The following plans and images indicate the general conditions of the Pohick Church site, and select specific conditions. For comprehensive survey of the conditions of the church site, refer to the Schnabel Pre-Construction Video, included with this report as a DVD in Appendix D.

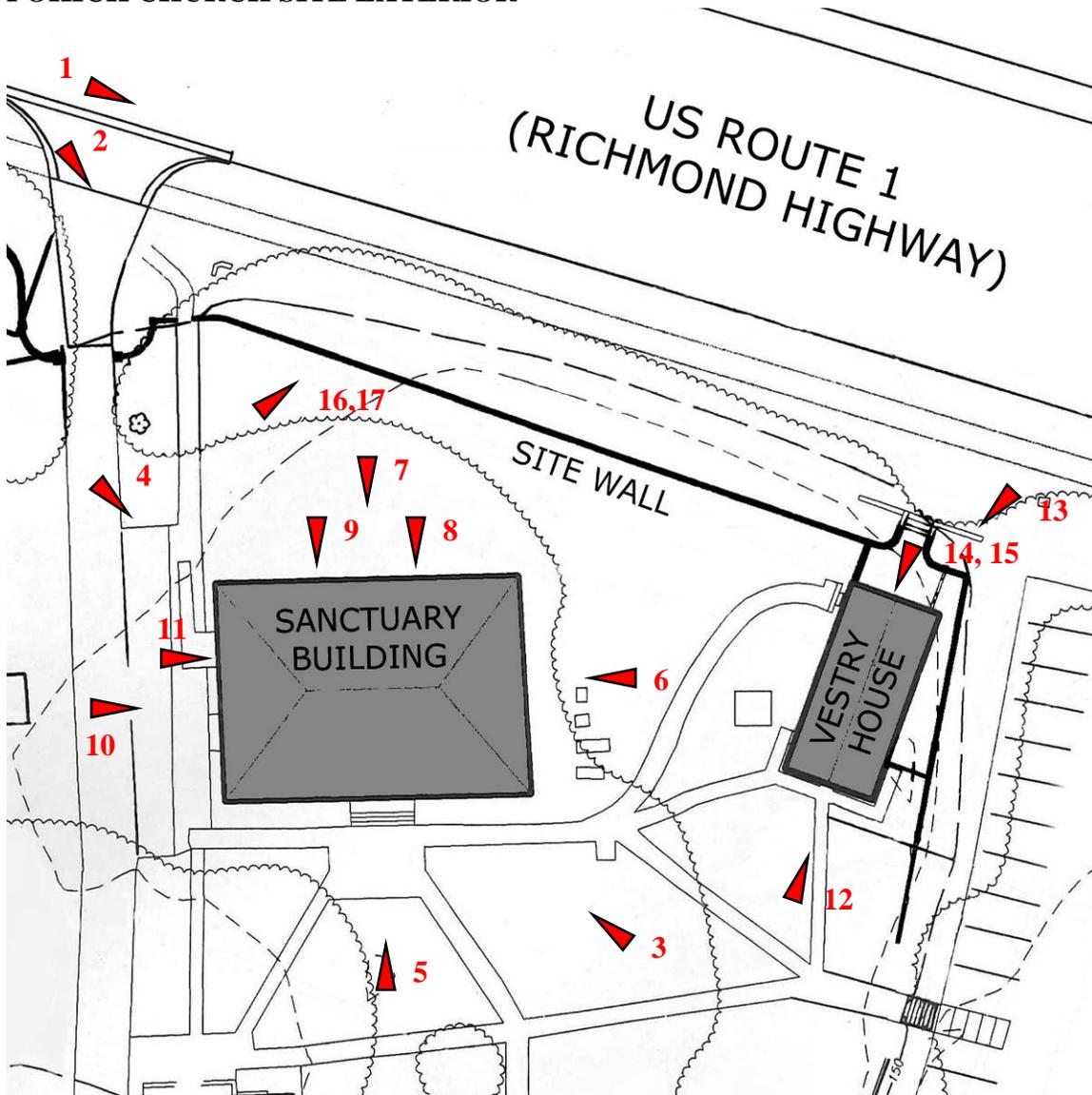


Site Plan of Pohick Church site

Adapted from drawing "Pohick Church Proposed Water Service"

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POHICK CHURCH SITE EXTERIOR



Site Plan Detail

Adapted from drawing "Pohick Church Proposed Water Service"



Photo location references for images on the following pages, used on plans.

Photo location references for images on the following pages, used on images.

Used on following pages to indicate approximate location of crack monitors referenced in report.

Legend

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Image 1: Looking east down US Route 1 (Richmond Highway)
Pohick Church site wall is along the right edge of the image



Image 2: View at entry to Pohick Church site
Site wall is in the foreground, sanctuary building is in the background

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Image 3: Sanctuary building, view from southeast



Image 4: Sanctuary building, view from northwest

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Image 5: Sanctuary building, view from southeast



Image 6: Sanctuary building, view from southeast

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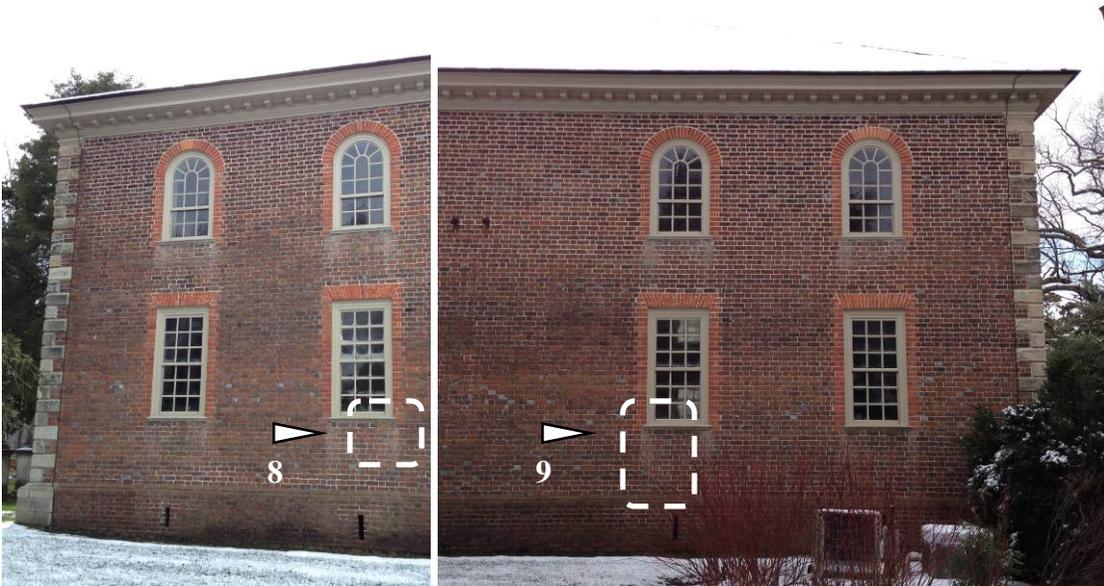


Image 7: Composite image of north façade of sanctuary building

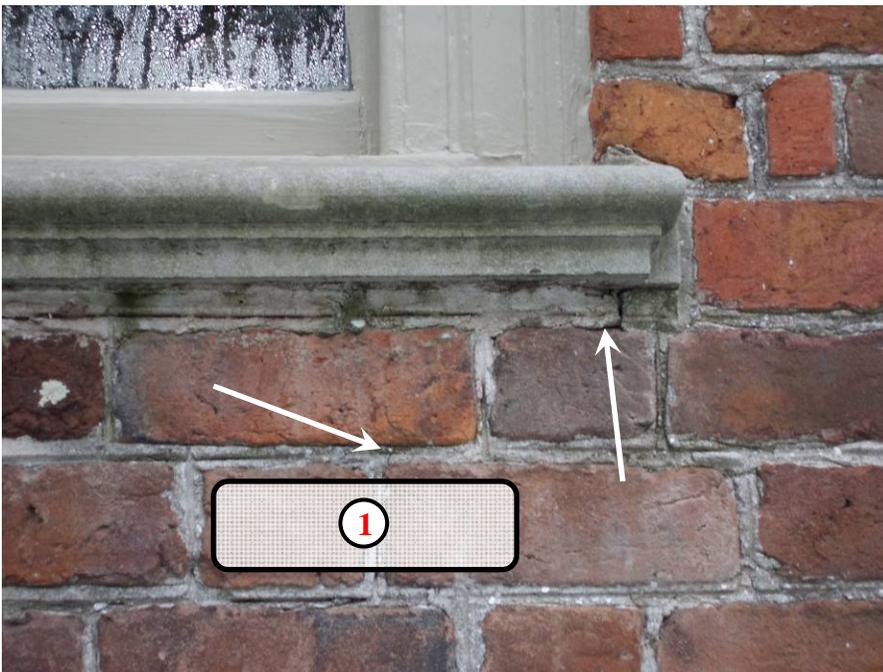


Image 8: Detail at north façade of sanctuary building

Arrows indicate existing crack under window. Approximate location of proposed crack monitor is indicated.

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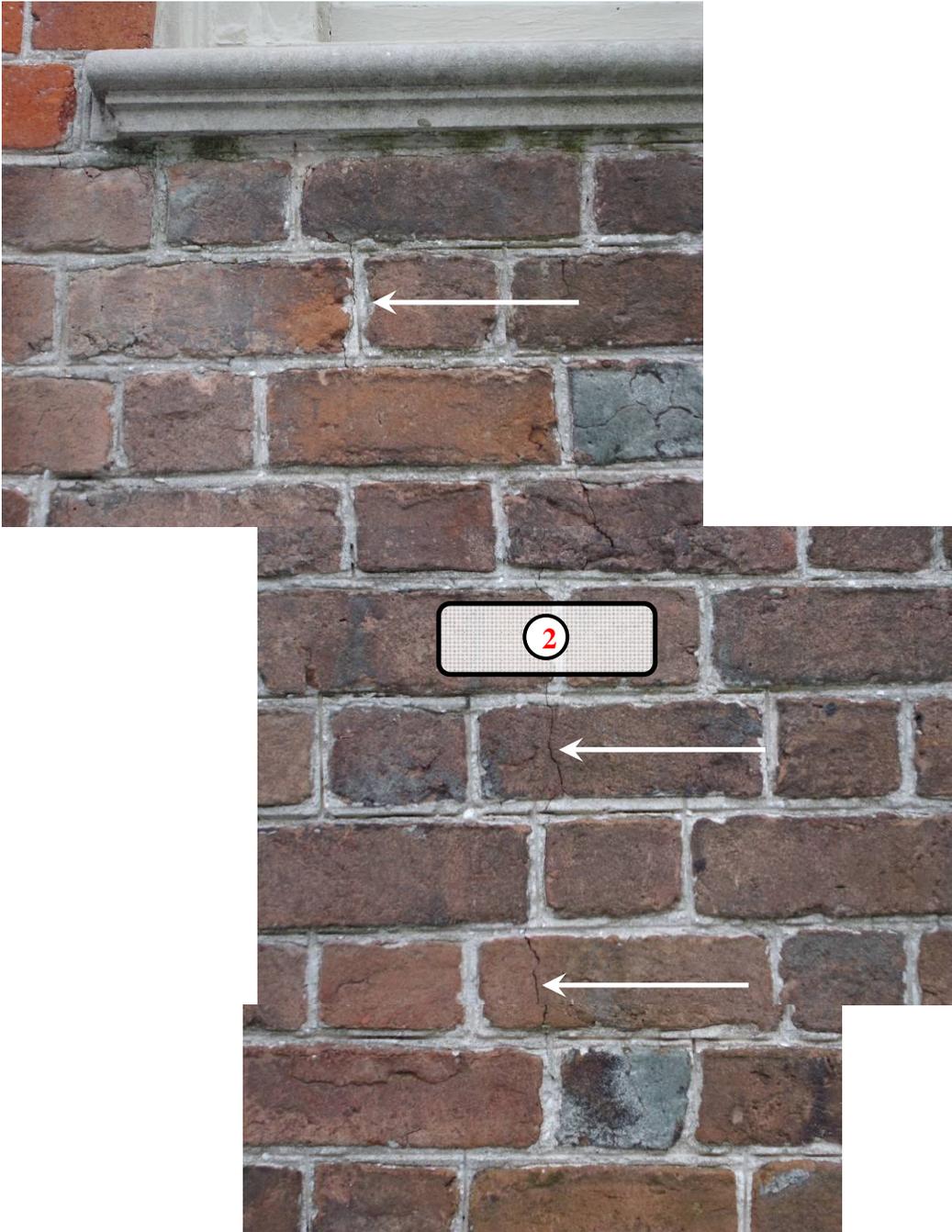


Image 9: Detail at north façade of sanctuary building
Arrows indicate existing crack under window. Approximate location of proposed crack monitor is indicated.

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Image 10: Sanctuary building, west facade
Refer to following images for detail of area indicated by dashed outline.



Image 11: Detail of sanctuary building, west elevation

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Image 12: Vestry House, south elevation



Image 13: Vestry House, north elevation

Refer to following images for detail of area indicated by dashed outline.

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Image 14: Vestry House, north elevation detail
Note existing crack below round vent.



Image 15: Vestry House, north elevation detail
Approximate location of proposed crack monitor is indicated.

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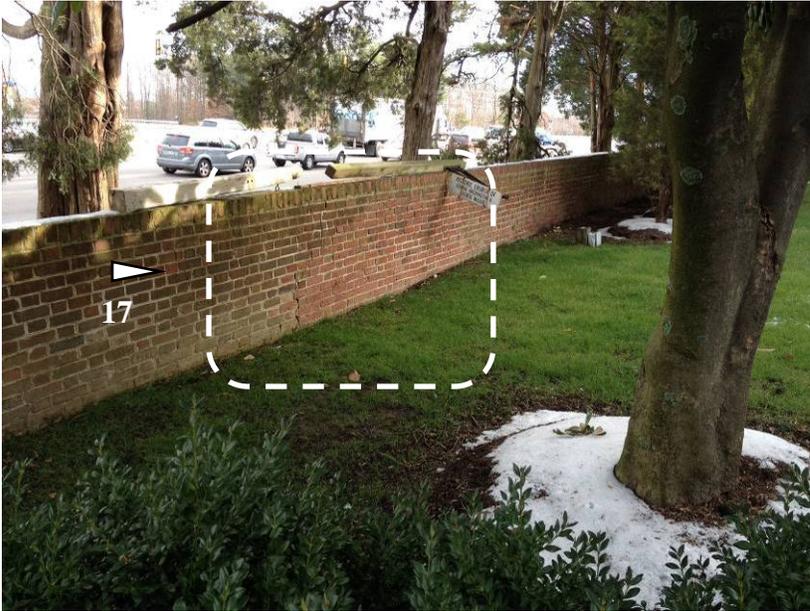


Image 16: Site wall

South face of wall. Route 1 is visible in the background. Refer to following image for detail of area indicated by dashed outline.

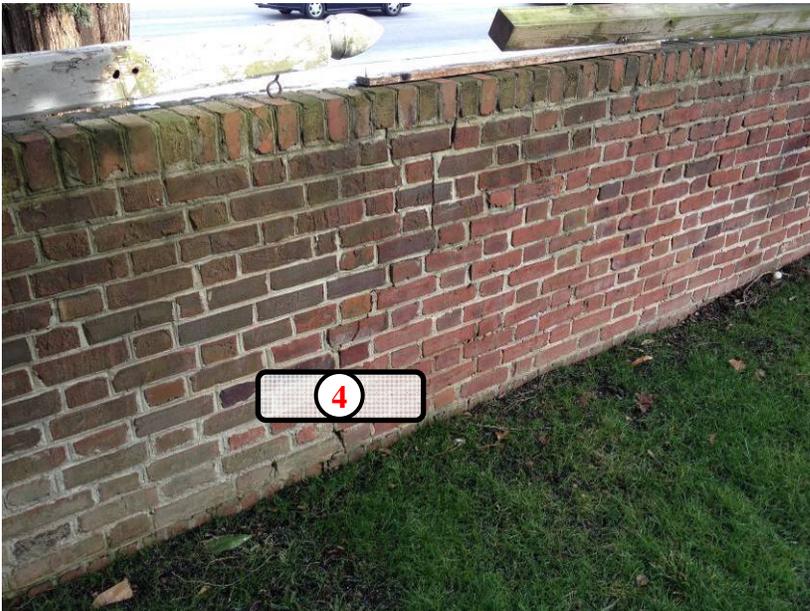
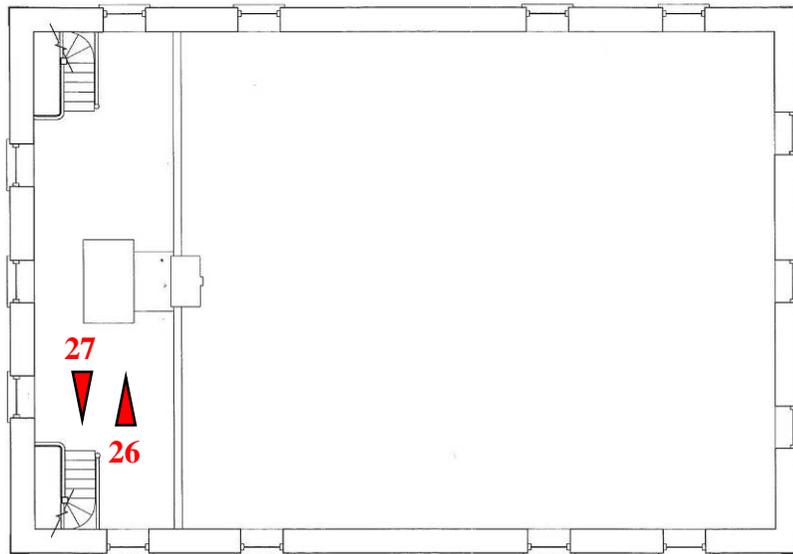


Image 17: Site wall

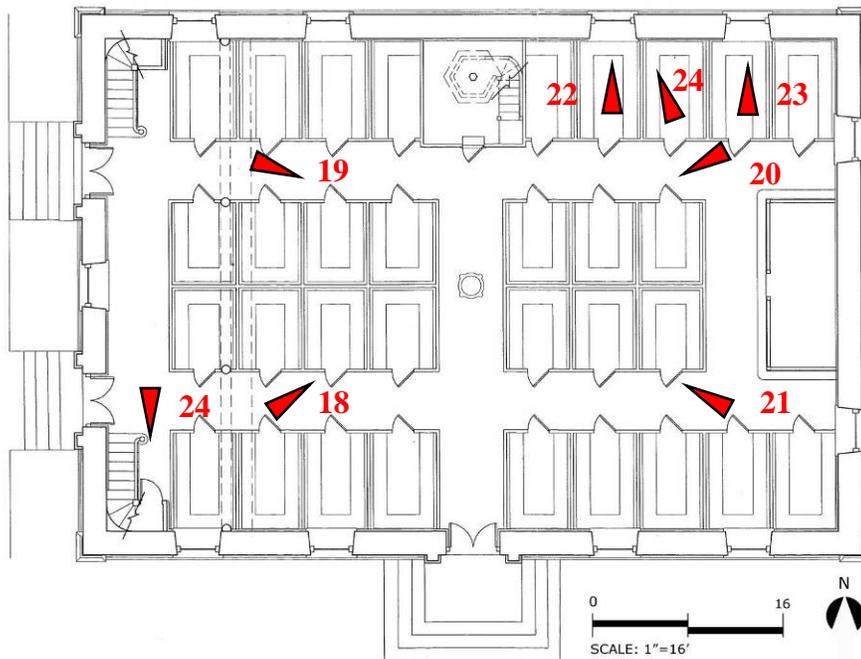
Approximate location of proposed crack monitor is indicated.

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SANCTUARY BUILDING INTERIOR



Balcony Plan



Ground Floor Plan

Floor Plans of Sanctuary Building

Adapted from report "Condition Assessment and Recommendation"

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Image 18: Sanctuary interior, looking northeast



Image 19: Sanctuary interior, looking southeast

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Image 20: Sanctuary interior, looking southwest



Image 21: Sanctuary interior, looking northwest

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Image 22: Interior detail, north wall, east side

Note existing crack between windows, indicated by arrows. Crack has been digitally emphasized in image. Refer to Survey Video for actual conditions.



Image 23: Interior detail, north wall, east side

Note existing crack between windows, indicated by arrows. Crack has been digitally emphasized in image. Refer to Survey Video for actual conditions.

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Image 24: Interior detail, north wall, east side
Note cracking in plaster at joint with wood wainscot, indicated by arrows.



Image 25: Interior detail, under balcony
Note existing damage to plaster above door, indicated by arrow.

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Image 26: Interior detail of balcony, looking north



Image 27: Interior detail of balcony, looking south

Seismograph Specification

The seismographs shall have the following minimum features:

1. Data acquisition systems or seismographs used to record peak particle velocity (PPV) shall have a minimum sampling rate of 1,024 samples per second for all recording channels.
2. Seismic Range: 0.01 to 4 inches per second with an accuracy of plus or minus five (5) percent of the measured peak particle velocity or better at frequencies between 10 and 100 Hertz, and with a resolution of 0.01 inch per second or less.
3. Frequency Response: (Plus or minus 3 Decibel Points) 2 to 200 Hertz.
4. One acoustic channel and three seismic channels.
5. Two Power Sources: Internal rechargeable battery and charger and 115-volts AC. Battery must be capable of supplying power to monitor vibrations continuously for up to 24 hours.
6. Capable of internal dynamic calibration.
7. Capability to transfer electronic data from memory to external memory devices. Provide computer software to perform analysis, produce reports of continuous monitoring, and to perform zero-line crossing frequency analyses of waveform data.
8. Self-triggering waveform capture mode that provides the following information: plot of waveforms, peak particle velocities, and frequencies of peaks.
9. Seismographs shall be installed per manufacturer's instructions.
10. Seismographs shall be calibrated annually.



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MEMORANDUM

TO:	Mr. Michael Wiercinski, PE, LS	DATE:	June 23, 2014
COMPANY:	A. Morton Thomas & Associates, Inc.	SUBJECT:	Pohick Church – Vibration Monitoring Consultation
ADDRESS:	12750 Twinbrook Parkway Rockville, MD 20852	PROJECT NAME/NO.:	US Route 1 Improvements / 13612045.01
FROM:	C. Richard Linamen & Matthew Grzelak, PE	CC:	Ben Like, PG & Matthew Wager, PE (Schnabel Engineering)

This memorandum provides guidance to the contractor for vibration monitoring at the Pohick Church (PC) site. Information presented herein should be included in the contractor’s Vibration Monitoring Plan (VMP), as per the RFP requirements. Services discussed/provided in this memorandum include:

- Site visits by the design team engineers and consultants to characterize the buildings by their construction type and vulnerability to damage from vibration.
- Threshold peak particle velocities (PPVs), including a thorough review of the subsurface soil and ground water conditions that would comprise the media through which the vibrations are transmitted.
- The required monitoring equipment, frequency of monitoring, and location of monitoring devices to be used on this project.

We visited the PC site on Wednesday, December 11, 2013. The site is located to the southwest of the intersection of Telegraph Road/Old Colchester Road (State Route 611) and Richmond Highway (US Route 1) at 9301 Richmond Highway in Lorton, VA. We observed the interior and exterior of the PC Sanctuary Building (SB), the exterior of the Vestry House (VH), the brick wall along Richmond Highway (to the north of the SB), and some of the monuments on the site (e.g., gravestones).

Based on the plans provided to us by your office, proposed construction in the vicinity of the PC site consists of milling and resurfacing of the pavement located along Richmond Highway immediately adjacent to the PC site and construction of a new (i.e., full depth pavement) turning lane to the northwest of the intersection of Telegraph Road/Old Colchester Road (State Route 611) and Richmond Highway (US Route 1). Milling and resurfacing of the pavement will be within about 70 ft of the SB; construction of the new turning lane will be within about 200 ft of the SB.

Based on literature obtained at the SB, we understand that construction of the SB was completed in 1774 and restoration work has been ongoing for some time. The SB is 66 ft by 45.5 ft in plan; the walls are 28 ft high. The SB contains a pipe organ on the balcony floor; the pipe organ was built in the late 1960s. Also based on literature obtained at the SB, we understand that construction of the VH was completed in 1931 using old brick to match the SB. The VH is 24 ft by 18 ft in plan. The SB, VH, and wall along Richmond Highway are constructed of brick. We believe that the SB, VH, and brick wall are founded on shallow foundations. The SB foundations likely consist of mortar and stone. Based on our observations, the SB and VH are in fair to good condition and the brick wall along Richmond Highway is generally in fair

SENT VIA: First Class Mail Overnight Service Email Other

A. Morton Thomas & Associates, Inc.
US Route 1 Improvements

condition. A pre-construction survey was completed of the SB (interior and exterior), the VH (exterior), and brick wall along Richmond Highway. Results of the pre-construction survey can be found under separate cover. Please consult the pre-construction survey for additional details concerning the above mentioned structures. We believe that the SB is highly sensitive to damage from construction vibrations due to its historic nature, the brick wall along Richmond Highway is highly vulnerable to damage from construction vibrations due to its condition, and the VH is less susceptible to damage based on its more recent construction.

Based on a review of available, nearby boring logs (Borings ECS-01 and B-32), the PC site is likely underlain by clayey sand, silt, and/or silty clay Terrace deposits to a depth of about 10 ft. The Terrace deposits are underlain by clayey sand of the Potomac Formation; some fill is likely present at the site. The extent and depth to which any of these materials is located below the PC site structures is unknown without specific subsurface investigations of the structures (e.g., test pits and test borings). Also, based on the nearby boring logs, groundwater is probably located more than 20 ft below the existing ground surface; however, some perched water may be present above this depths.

Based on our site observations, the historical nature/importance of the SB, the proposed nearby construction, and the subsurface soils likely present at the PC site, we believe that the threshold peak particle velocity should be no more than 0.1 inches per second (ips) near the SB. Based on our analysis, we expect vibrations due to milling and resurfacing of the pavement located along Richmond Highway immediately adjacent to the PC site and construction of the new (i.e., full depth pavement) turning lane to the northwest of the intersection of Telegraph Road/Old Colchester Road (State Route 611) and Richmond Highway (US Route 1) to be significantly lower than 0.1 ips near the SB (see Attachment 1). We based our analysis on the assumption that the contractor will be using common earth moving and paving equipment (e.g., heavy trucks, bulldozers, vibratory rollers, and pans/scrapers).

To monitor vibrations prior to and during construction, we recommend using seismographs that meet or exceed the specification attached to this memorandum (see Attachment 2). Vibration monitoring should be performed continuously during work hours while construction is being performed in the vicinity of the PC site. We recommend monitoring the SB when construction along Richmond Highway is within 300 ft of the SB, including construction of the new (i.e., full depth pavement) turning lane to the northwest of the intersection of Telegraph Road/Old Colchester Road (State Route 611) and Richmond Highway (US Route 1). The monitoring device should be placed between 3 ft and 5 ft to the north of the northeast corner of the SB (i.e., between the SB and Richmond Highway).

To determine existing vibration levels, we recommend performing vibration monitoring for one full week (7 continuous days) prior to the start of construction (i.e., "base monitoring period"). The "base monitoring period" should be scheduled during a normal 7-day week (i.e., no holidays or other extraordinary events). Correlating vibration monitoring results to events in the field will be difficult during the "base monitoring period" since unknown events will be recorded. It is also worth noting the close proximity of the PC site to Ft. Belvoir and the associated airfield. Results obtained during the "base monitoring period" should be reviewed and may be included in the VMP and used to adjust the threshold peak particle velocity, if required.

In addition to the vibration monitoring described above, and as recommended by Quinn Evans Architects (QEA) and Robert Silman Associates (RSA) in their memorandum dated March 29, 2014, crack monitors should be installed on a minimum of two interior and two exterior locations prior to construction. QEA and RSA have indicated that they will identify the recommended locations for the crack monitors as part of their pre-construction documentation report. A "base monitoring period" and other concurrent monitoring related to of the crack monitors should be determined by QEA and/or RSA (e.g., temperature and humidity), if required.

A. Morton Thomas & Associates, Inc.
US Route 1 Improvements

We have endeavored to complete the services identified herein in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this memorandum or any other instrument of service.

We appreciate the opportunity to be of service to you for this project. Please contact us if you have any questions regarding this memorandum.

SIGNED:

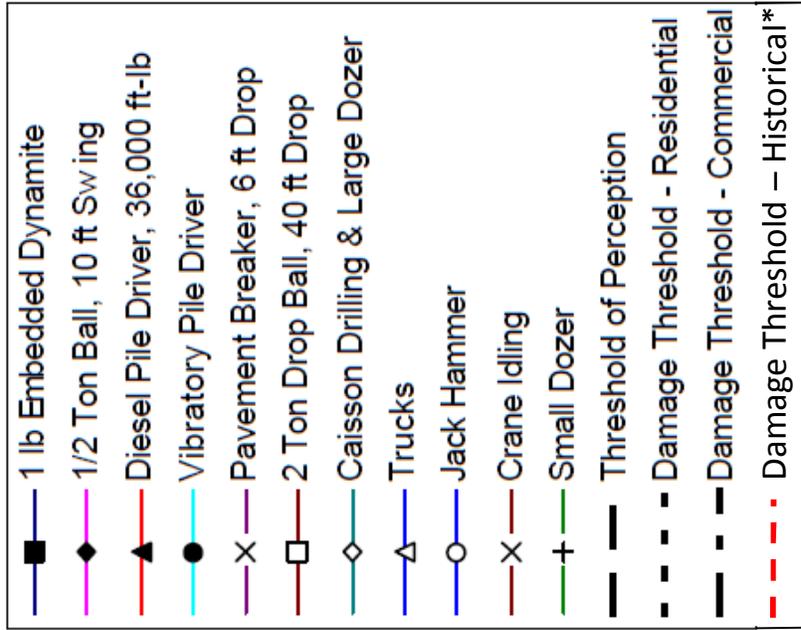


C. Richard Linamen, Executive Vice President

Attachments:

1. Typical Earth Vibrations Due to Construction (after Wiss, 1981)
2. Seismograph Specification

Typical Earth Vibrations due to Construction (after Wiss, 1981)



*Historical threshold based on typical industry standards

