12 December 2025

Katherine F. Watkins, P.E.
Deputy City Manager
City of Cambridge
795 Massachusetts Avenue
Cambridge, MA 02139

Project 200609.05 – Vibration Monitoring – Threshold Recommendation, Riverview Condominiums, 221 Mt. Auburn Street, Cambridge, MA

Dear Ms. Watkins:

At your request, we installed vibration monitors at six properties abutting Riverview Condominiums (Riverview) to document vibrations during the Riverview building demolition. The purpose of this letter is to outline our recommended vibration monitoring thresholds and the steps for evaluation of "triggering" events if the vibration threshold is exceeded.

1. BACKGROUND

The City of Cambridge (City) and Riverview are set to initiate the controlled demolition of the Riverview structure. The City and Riverview requested that Simpson Gumpertz & Heger Inc. (SGH) develop a vibration monitoring program to record the impact of construction activities on abutting properties during the building demolition. Prior to demolition, SGH conducted preliminary surveys of directly abutting properties to select monitoring locations. Based on these surveys, we selected six locations to install vibration monitors: 1, 7, and 11 Sparks Street, 38 Bradbury Street, 205 Mt. Auburn Street, and the Bradbury Building (see map in Figure 1 below). At each location, we installed a vibration monitor on the foundation wall or the basement-level slab-on-grade. We installed the vibration monitors approximately one month prior to the scheduled start of demolition to acquire typical ambient baseline vibration data at each monitoring location.

Figure 1

Aerial view of the Riverview Condominiums structure (outlined in red) and the abutting properties selected for vibration monitor installation (marked with yellow stars).

2. DATA COLLECTION

We installed Sigicom INFRA C22 wireless vibration monitors (VM) at each location to record vibrations during the demolition activities. VMs will collect data for 24 hrs a day. The measurable frequency range is between 1 Hz to 500 Hz, and the maximum vibration level is 10 in./sec. The VMs are powered by internal lithium-ion batteries. We will monitor battery level remotely and replace the batteries every several months as needed.

The VMs are configured to continuously monitor vibrations and record the Peak Particle Velocity (PPV) in three orthogonal directions in 5 min. intervals. The seismographs record a time history

when a preset trigger level is exceeded, capturing 4 sec of data, including a 1 sec pre-trigger time, and the data is automatically downloaded to a remote server. Automated email notifications are sent to a predefined distribution list consisting of project team members when a triggering event occurs. If no triggering event occurs during a calendar day, the system sends a summary report for each monitor showing the recorded vibrations for the day, including the peak particle velocity recorded in each orthogonal direction (vertical and two orthogonal horizontal directions). Table 1 summarizes the maximum peak particle velocity recorded for each location since installation. Monitoring data for each location is also included in Appendix A (attached).

Table 1 – Maximum Peak Particle Velocity Recorded

Location	Maximum Peak Particle Velocity (in./sec)		
	Vertical	Horizontal 1	Horizontal 2
Bradbury Building	0.03	0.01	0.01
205 Mt. Auburn Street	0.08	0.03	0.02
38 Bradbury Street	0.05	0.01	0.01
1 Sparks Street	0.05	0.01	0.02
7 Sparks Street	0.05	0.01	0.02
11 Sparks Street	0.01	0.01	0.01

3. DISCUSSION

Structural vibration monitoring is typically used to correlate construction activities with damage to neighboring structures. For the Riverview Demolition Project, we established six vibration monitoring locations around the site to document potential vibrations resulting from the project demolition activities. The following subsections describe the levels of damage that may be caused by vibrations to a structure, the trigger value we recommend to investigate vibrations, and the project team's course of action should the trigger value be exceeded.

Structural Vibrations Background

The probability of damage to above-ground structures from ground vibrations depends on many factors. These factors may include the type and condition of the structure (e.g., wood-framed structures, structures with existing damage), the soil conditions at the site (e.g., hard rock vs. clay), the frequency of the ground vibrations, and the distance from the vibration source to the structure under consideration. By comparing actual site measurements of vibration levels with established vibration damage threshold criteria, we can assess if vibrations may have contributed to damage of a structure.

We use the following terms, consistent with standard vibration monitoring criteria: "threshold damage," "minor damage," and "major damage." In general, the following definitions apply to these terms.[1,2]

- Threshold damage: loosening of paint, small plaster cracks at joints between elements, and lengthening of old cracks.
- Minor damage: loosening and falling of plaster, cracks in masonry around openings near partitions, hairline to 3 mm (0 to 1/8 in.) cracks, and falling of loose mortar.
- Major damage: cracks of several millimeters (>3 mm), rupture of opening vaults (arched roof chambers), fall of masonry (e.g., chimneys), and load-support ability affected.

Note that exceeding the vibration damage threshold levels does not confirm that damage has occurred or that vibration is the cause of observed damage, but only that vibration is a measurably probable cause of new damage.

Recommended Trigger Value

Not all vibrations will cause damage to existing structures; therefore, we have established a trigger value consistent with industry standards. Massachusetts CMR 527 (Massachusetts Comprehensive Fire Safety Code) 1.05 Section 65.9.1 adopts the threshold set by the US Bureau of Mines (USBM) Report of Investigation 8507/1980[1] by reference to National Fire Protection Association Code Number 495- Explosive Materials Code (NFPA 495). The USBM Report is based on studies of threshold damage in residential structures subject to repeated blasting (e.g., mining operations). The criteria are based on a 5% probability of threshold damage in residential structures.[2]

Using the criteria from USBM Report 8507, Section 11.2 of NFPA 495 limits ground vibration to a peak particle velocity of 0.5 in./sec at any building or structure for vibrations in the frequency range consistent with typical construction vibrations. We note that CMR 527/NFPA 495 is specific to blasting, and there is no equivalent Massachusetts code regulation for construction vibrations.

Based on the USBM Report of Investigation 8507 and CMR 527, we recommend using a trigger value of 0.5 in./sec. This value is consistent with a 5% chance of threshold damage occurring at

[1] Siskind et al., Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting, Report of Investigations 8507, United States Bureau of Mines, Pittsburgh, PA, 1980.
[2] Kelley et al., "Vibration Damage Claims: Ingredients for a Successful Investigation," Journal of the Boston Society of Civil Engineers. 16(1), 2001.

frequencies anticipated for construction vibrations. The maximum readings during our baseline period (preceding demolition) are approximately an order of magnitude below this threshold.

Protocol for Triggering Event

If a triggering event, vibrations greater than 0.5 in./sec, occurs during construction activities, we recommend the following protocol:

- Meet with the project team to discuss activities on site that may have triggered the vibrations.
- Analyze or review the vibration exceedance event and associated monitoring data.
- Visit the site to investigate any potential damage, if warranted.

We note that some "triggering events" may be due to residents disturbing the vibration monitoring units located in their homes. We will review the data from all monitors, in addition to the triggering unit, in relation to the day's construction activities to determine if this is likely the case. After we conclude our investigation into the triggering event, we will work with the project team to determine if additional protocols are required to limit the recurrence of similar triggering events.

4. CONCLUSIONS AND RECOMMENDATIONS

We expect vibration monitoring to continue throughout the full duration of the demolition process (approximately sixteen weeks based on the current schedule). Once demolition activities begin, we will prepare weekly reports that include records of the weekly vibration records. If construction activities cause vibrations greater than the set 0.5 in./sec trigger value, we will follow the protocol outlined in this letter to analyze the causes and potential impacts of the exceedance.

Sincerely yours,

John M. Porter, P.E.
Senior Principal
MA License No. 45684

Linda M. Seymour, Ph.D.
Project Consultant

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APPENDIX A

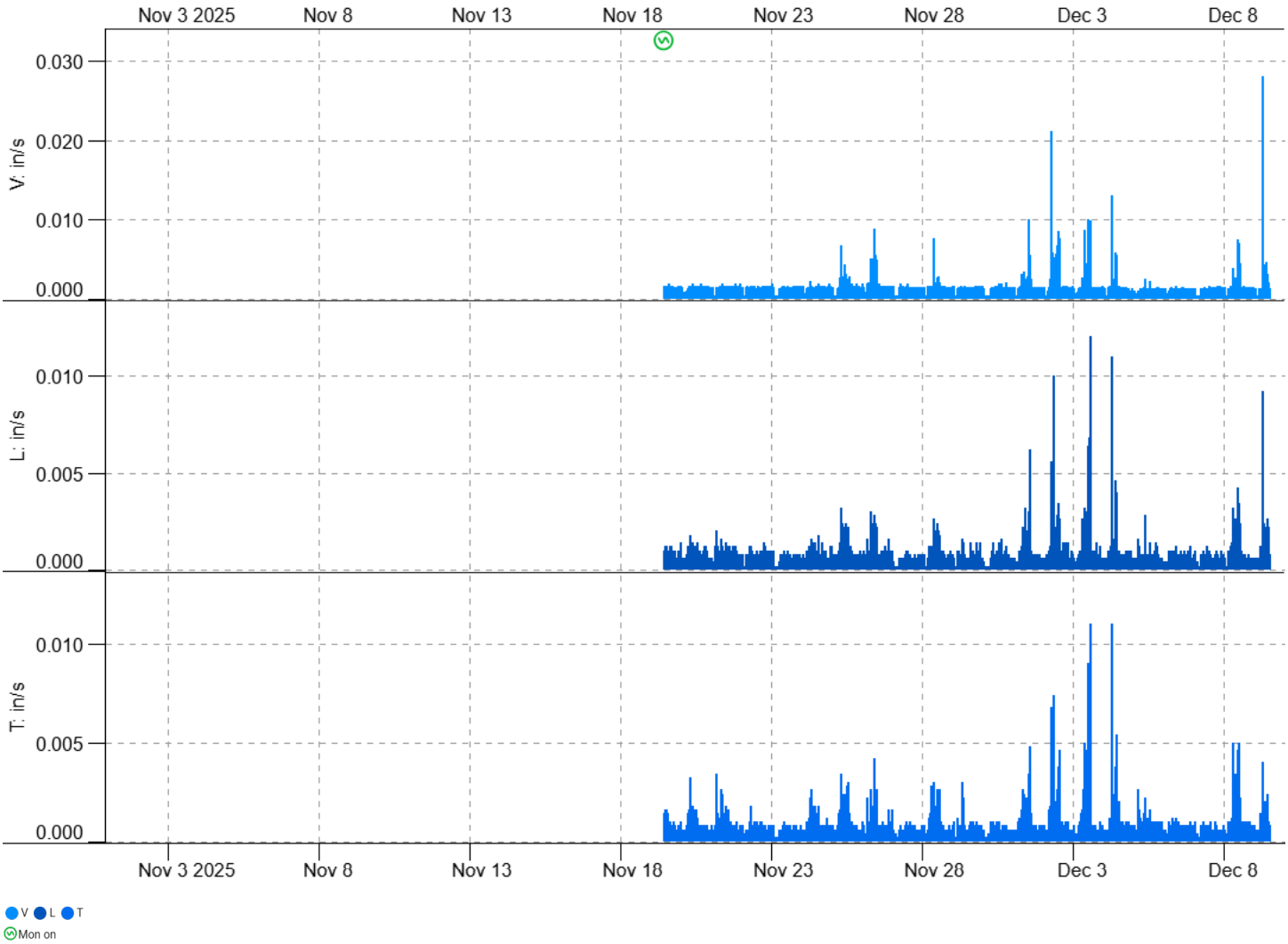
Vibration Monitoring Data

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv1, Bradbury Building [22 Bradbury St.], C22, Serial number: 110294, Calibrated: 2025-07-30,



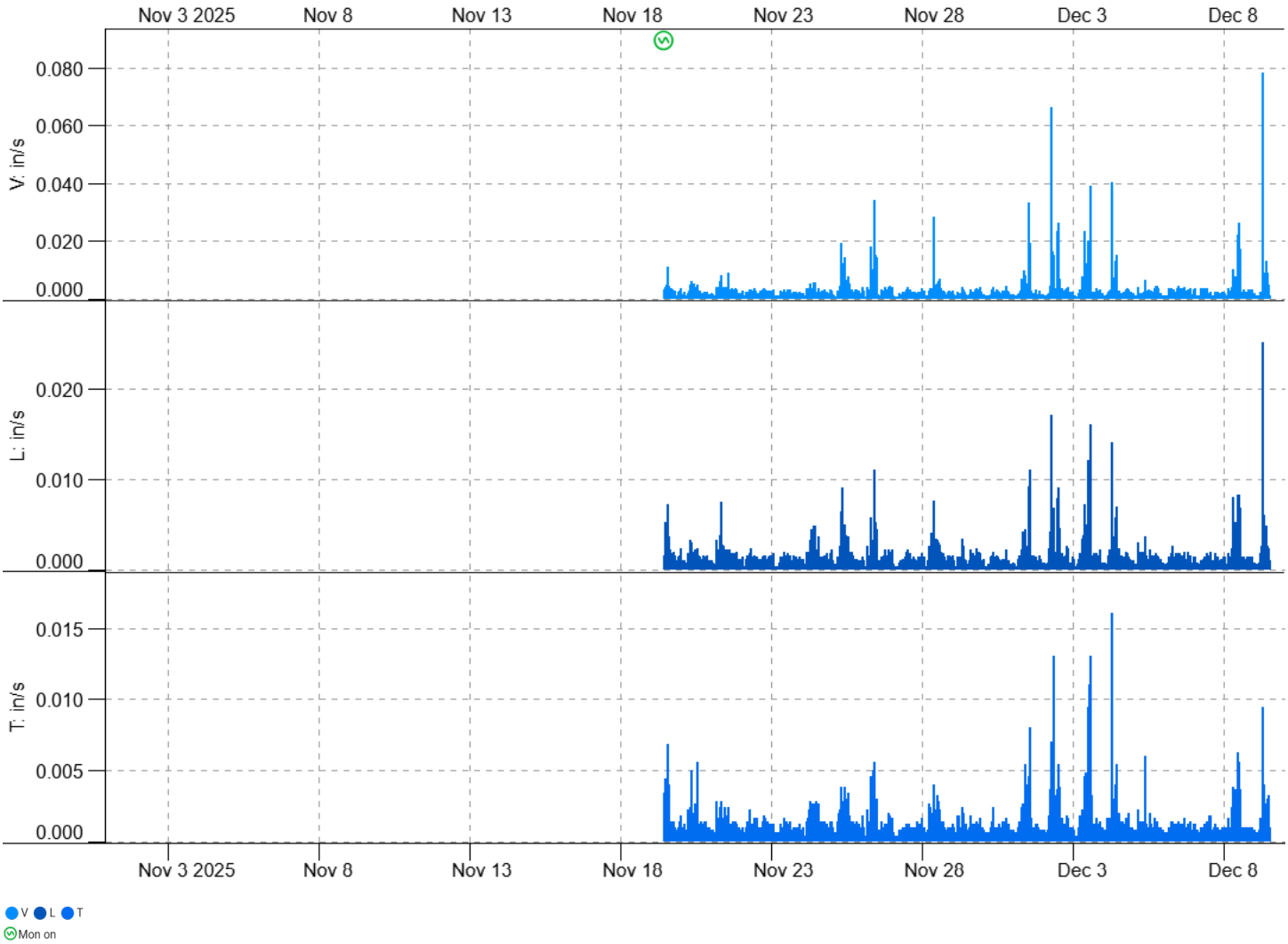
X-span	2025-11-01 00:00 - 2025-12-10 00:00		
Y-span	V: 0 - 0.03 in/s, L: 0 - 0.01 in/s, T: 0 - 0.01 in/s		
	V	**L**	**T**
Max	0.03 in/s	0.01 in/s	0.01 in/s
Date	2025-12-09	2025-12-03	2025-12-03
Time	07:30:00	14:30:00	14:30:00
Hz	6.1	5	5

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv2, 205 Mt. Auburn St., Cambridge, MA, C22, Serial number: 102013, Calibrated: 2025-07-23,



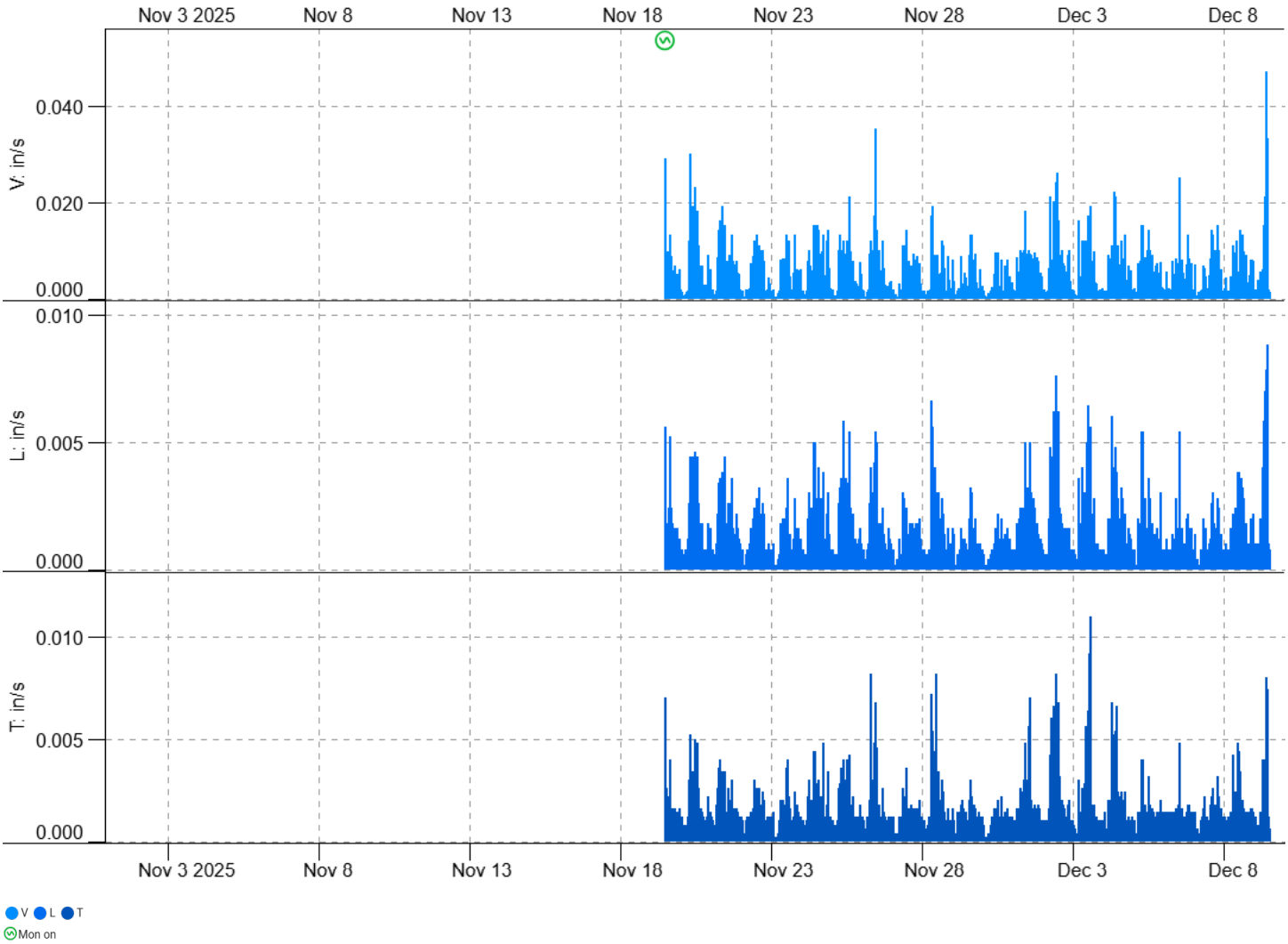
X-span	2025-11-01 00:00 - 2025-12-10 00:00		
Y-span	V: 0 - 0.08 in/s, L: 0 - 0.03 in/s, T: 0 - 0.02 in/s		
	V	**L**	**T**
Max	0.08 in/s	0.03 in/s	0.02 in/s
Date	2025-12-09	2025-12-09	2025-12-04
Time	07:30:00	07:30:00	07:30:00
Hz	6.4	5.05	5.05

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv3, 38 Bradbury St., Cambridge, MA, C22, Serial number: 103199, Calibrated: 2025-06-09,



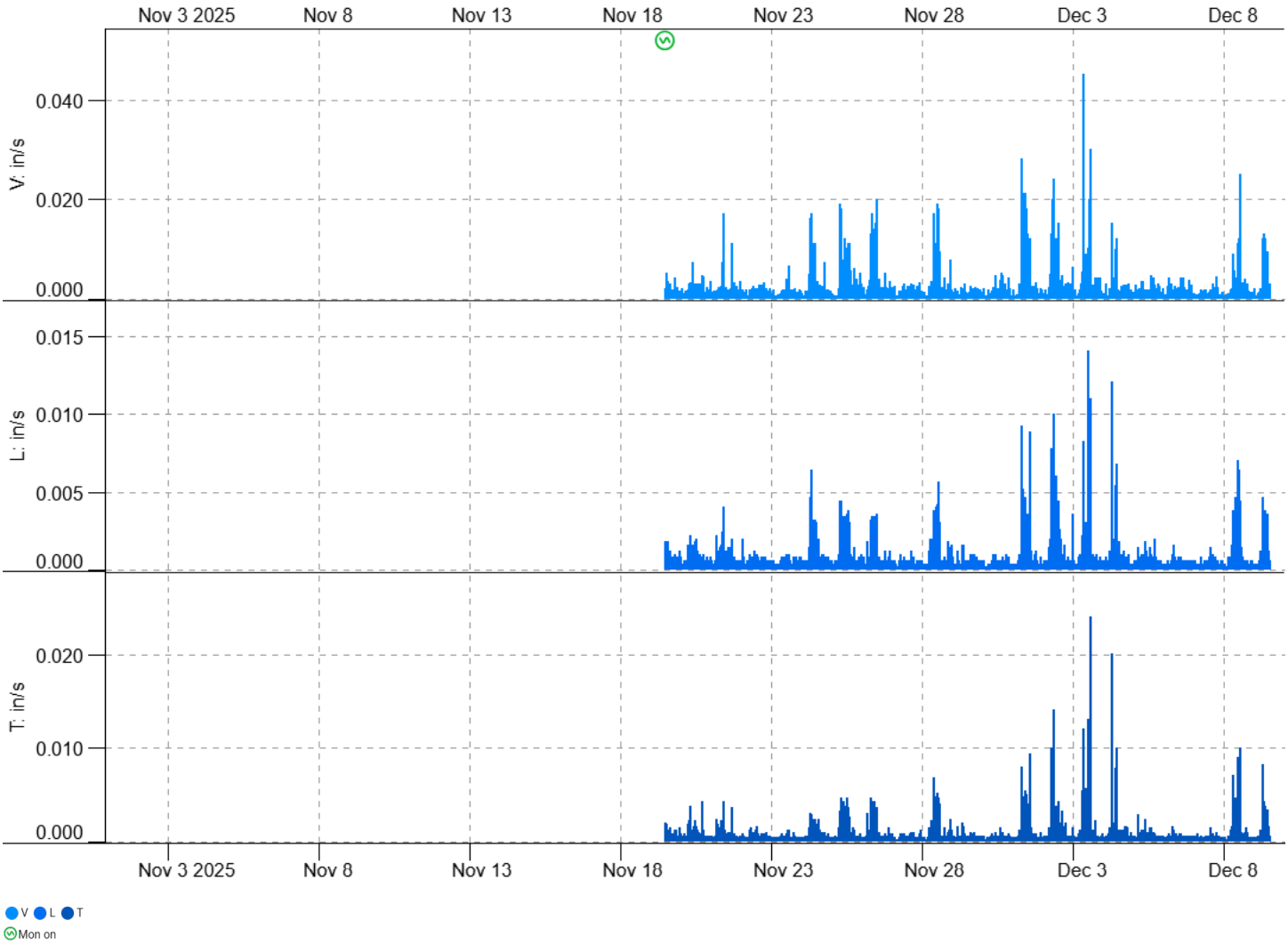
X-span	2025-11-01 00:00 - 2025-12-10 00:00		
Y-span	V: 0 - 0.05 in/s, L: 0 - 0.01 in/s, T: 0 - 0.01 in/s		
	V	**L**	**T**
Max	0.05 in/s	0.01 in/s	0.01 in/s
Date	2025-12-09	2025-12-09	2025-12-03
Time	10:30:00	11:30:00	14:30:00
Hz	13.5	10.4	4.95

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv4, 1 Sparks St., Cambridge, MA, C22, Serial number: 102403, Calibrated: 2025-07-02,



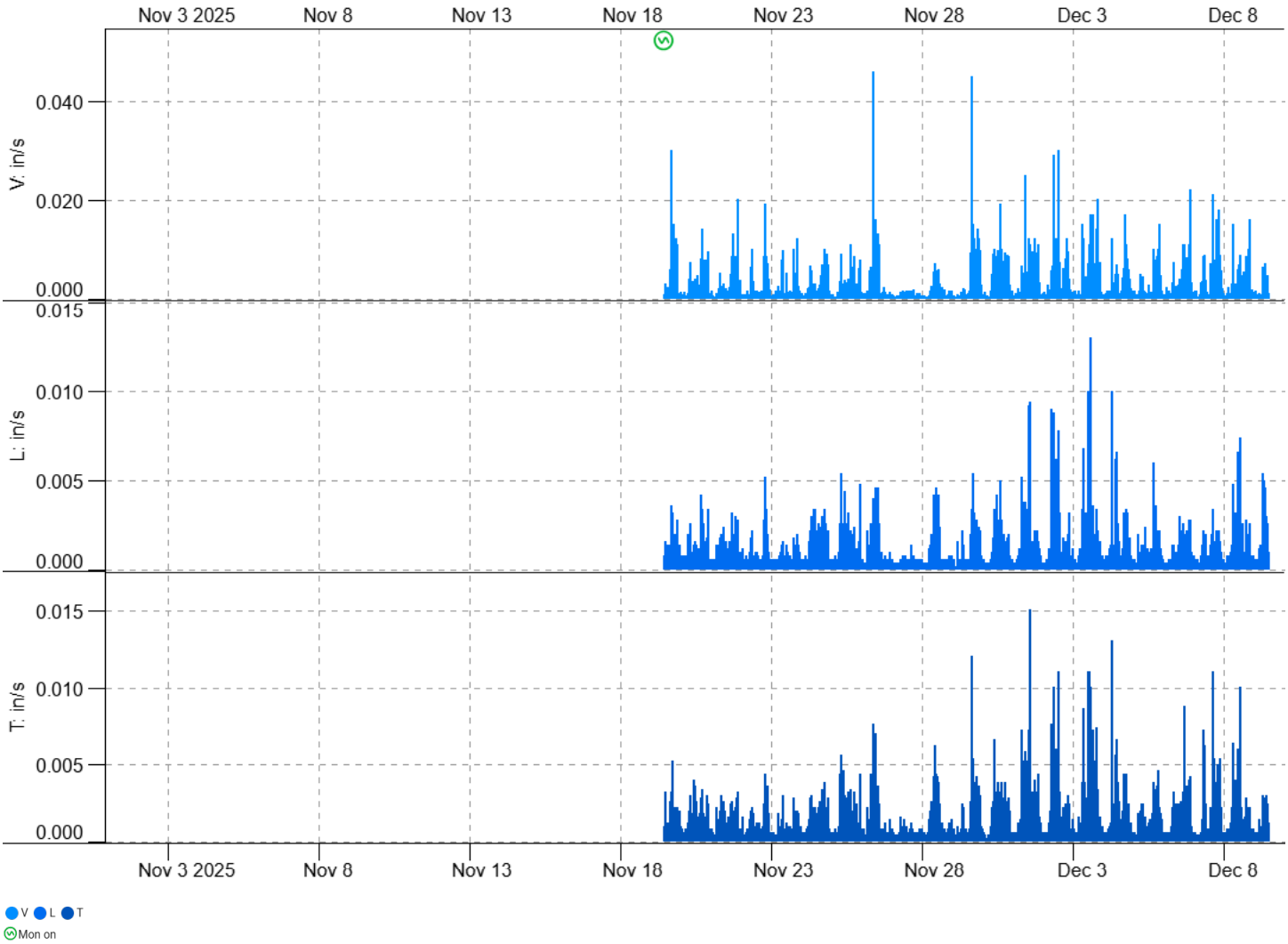
X-span	2025-11-01 00:00 - 2025-12-10 00:00		
Y-span	V: 0 - 0.05 in/s, L: 0 - 0.01 in/s, T: 0 - 0.02 in/s		
	V	**L**	**T**
Max	0.05 in/s	0.01 in/s	0.02 in/s
Date	2025-12-03	2025-12-03	2025-12-03
Time	08:30:00	12:30:00	14:30:00
Hz	16.4	3.9	5.15

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv5, 7 Sparks St., Cambridge, MA, C22, Serial number: 104002, Calibrated: 2025-07-02,



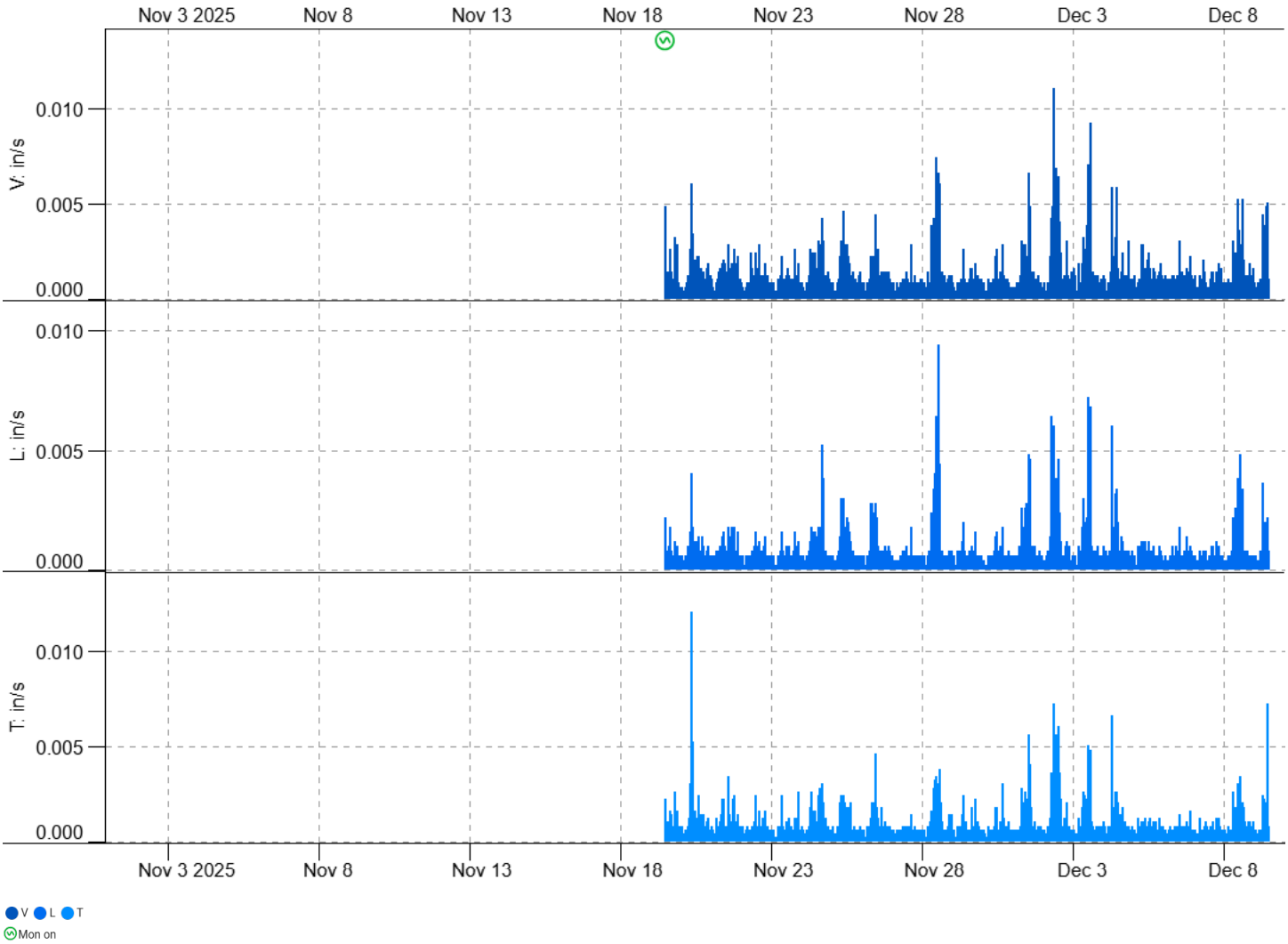
X-span	2025-11-01 00:00 - 2025-12-10 00:00		
Y-span	V: 0 - 0.05 in/s, L: 0 - 0.01 in/s, T: 0 - 0.02 in/s		
	V	**L**	**T**
Max	0.05 in/s	0.01 in/s	0.02 in/s
Date	2025-11-26	2025-12-03	2025-12-01
Time	09:30:00	14:30:00	14:30:00
Hz	20.5	5.05	5.8

Multi report

Project	Riverview Demo
Project maintainer	-
Time frame	2025-11-01 00:00 - 2025-12-10 00:00 (America/New_York)

NB!
Chart data is aggregated by 1 hour.

Riv6, 11 Sparks St., Cambrdige, MA, C22, Serial number: 110329, Calibrated: 2025-07-02,



X-span	2025-11-01 00:00 - 2025-12-10 00:00
Y-span	V: 0 - 0.01 in/s, L: 0 - 0.01 in/s, T: 0 - 0.01 in/s

	V	L	T
Max	0.01 in/s	0.01 in/s	0.01 in/s
Date	2025-12-02	2025-11-28	2025-11-20
Time	09:30:00	13:30:00	08:30:00
Hz	17.1	33.6	40.2