

Queens University
99 University Avenue
Kingston, ON
K7L 3N6

April 12, 2021

Attention: Mr. Asim Malik, Project Manager

Subject: **Vibration Monitoring Report – April 2nd to April 8th, 2021**
St. Mary's of the Lake Hospital Renovations
Kingston, ON

DST File No.: 02101810.000

Dear Mr. Malik:

DST Consulting Engineers Inc. (DST) has prepared the following vibration monitoring report for the project noted above. This report aims to present the recorded vibration data of the properties within proximity to the construction activities.

1.0 Vibration Equipment Installation

A total of four (4) vibration monitors were installed on February 18, 2021 at the following locations:

- 18 Centre Street;
- 26 Centre Street;
- 31 Ellerbeck Street; and
- 365 King Street West.

Please refer to the site map "Figure 1: Monitoring Locations" attached in Appendix A to overview the monitors' locations.

The geophone sensors were placed on the ground and secured with a sandbag to ensure that vibrations are correctly recorded and limit the false triggers caused by other environmental sources.

Instantel Minimate Plus digital seismographs are being utilized for vibration monitoring and recording. This equipment can measure vibration intensities up to 254 mm/s with a frequency response range of 2 to 250 Hz. The units were programmed to continuously measure all vibration levels and their corresponding frequencies at a sampling rate of 1,024 samples per second. At every 5-minute interval, the unit reviews the measured vibration and permanently records the peak particle velocity and its corresponding frequency for the interval and deletes all subordinate vibration levels.

The seismographs are programmed to transmit data instantaneously to DST's secured server and our vibration specialist's cellular device, two (2) times per day and when vibration levels reach or exceed 20 mm/s. During construction operations, all vibration trigger levels are reviewed and monitored by DST as per Table 1 (refer to the vibration exceedance protocol in Appendix B). All seismograph equipment used on this project will have been calibrated within the last twelve (12) months.

2.0 Vibration Limits

During construction operations, all vibration trigger levels are reviewed and monitored by DST as per the protocol guideline limits outlined in Table 1; refer to the vibration exceedance protocol attached in Appendix B. Should any vibration triggers exceed the threshold limits provided in Table 1, DST will notify the client to review, adjust their construction operational parameters accordingly, or cease operations, as required. In the event of any vibration exceedance, the vibration specialist will be automatically notified and as well as the designated client's site supervisor(s) through their cellular phones (via email and/or text).

It is important to emphasize that DST has not performed any review of the structures to confirm their sensitivity or the applicability of these generic action levels.

3.0 Vibration Levels

Based on the recorded data review between April 2nd to April 8th, 2021, all vibrations were below the allowable limits outlined in Table 1 attached in Appendix B. The highest vibration level of 5.334 mm/s with a frequency of 9.846 Hz was recorded at 365 King Street West on April 8th, 2021.

Please refer to Table 2 in Appendix C, which summarizes the maximum peak particle velocities recorded by each monitor and Table 3 in Appendix C for the complete vibration monitoring data for this monitoring period.

4.0 Closure

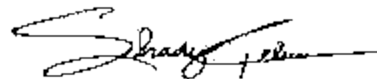
We trust the preceding will satisfy your current requirements. If you have any questions or concerns, please do not hesitate to contact us.

Yours truly,

DST Consulting Engineers, Inc.



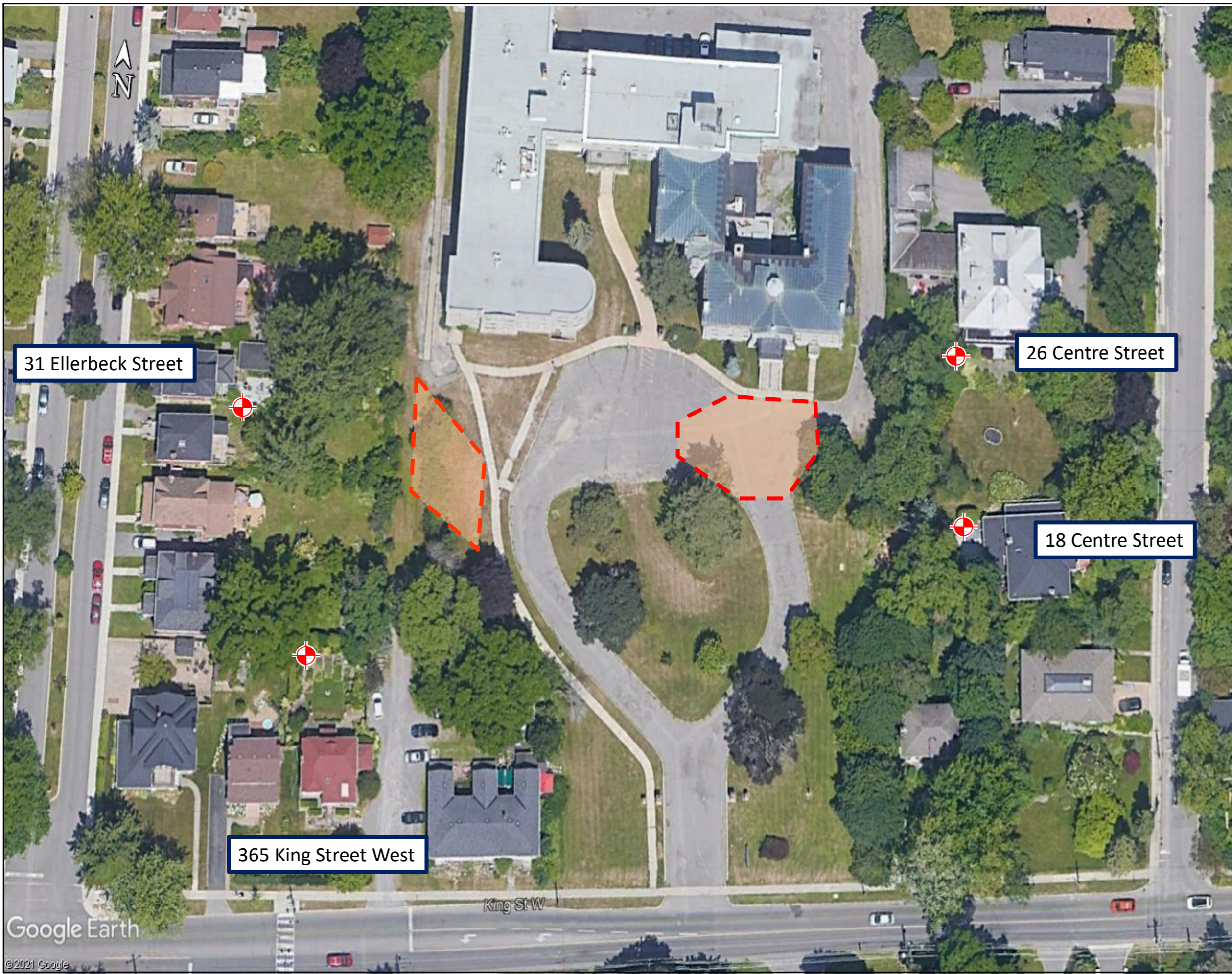
Jonathan McLaren, *Civil Technologist*
Field Technician



Shady Gebara, *P.Eng*
Team Lead, Instrumentation & Monitoring -
SouthWest / SouthEast

APPENDIX A

Monitoring Locations



- Legend**
- Approximate Location of Construction Activities
 - ⊕ Proposed Vibration Monitoring Locations

31 Ellerbeck Street

26 Centre Street

18 Centre Street

365 King Street West

0	18/02/2021	Draft	S.G
Revision	Date	Issue	Approval
Client Queens University			
Site St. Mary's Of the lake Hospital			
Report Title Vibration Monitor Locations			
Drawing Title Site Map			
Designed By	S.G	Scale	As Shown
Drawn By	C.W	Date	February 2021
Approved By	S.G	Project No.	TBD
Figure No2	1		

APPENDIX B

Vibration Exceedance Protocol

Table 1 - Vibration Exceedance Protocol at Neighboring Structures (Adopted from City of Ottawa SP. F-1201)

Frequency Hz	PPV mm/s	Required Action	Description of Event
All	PPV < 20	No Action Required	
≤ 40	PPV ≥ 20	<p>First Exceedance – Review construction operations and alter procedures as necessary. Proceed with caution with activities subject to the approval of the Contractor.</p> <p>Second Consecutive Exceedance – Contractor to cease all operations, review activities and submit revised work methodology to the Owners and Project Team.</p>	Notification email sent, vibration expert to review vibration event for contract compliance.
	PPV ≥ 50	First Exceedance – Contractor to cease all operations, review activities and submit revised work methodology to the Owners and Project Team.	Notification email sent, vibration expert to review vibration event for contract compliance.
> 40	PPV < 45	No Action Required	
	45 ≤ PPV < 50	Warning Level – Review construction operations and alter procedures if necessary. Proceed with caution with activities.	Notification email sent, vibration expert to review vibration event for contract compliance.
	PPV ≥ 50	<p>First Exceedance – Review construction operations and alter procedures as necessary. Proceed with caution with activities subject to the approval of the Contractor.</p> <p>Second Consecutive Exceedance – Contractor to cease all operations, review activities and submit revised work methodology to the Owners and Project Team.</p>	Notification email sent, vibration expert to review vibration event for contract compliance.

APPENDIX C

Vibration Monitoring Data



Subject: Vibration Monitoring Summary – April 02 to April 08, 2021
Project: St. Mary's of the Lake Renovations
Client: Queens University
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Table 2: Maximum Peak Particle Velocity

Seismograph Location	Date of Installation	Maximum Peak Particle Velocity (PPV) [mm/s]	Date of Maximum Vibration Trigger
18 Centre Street	February 19, 2021	1.778	Apr 8 /21
18 Centre Street	February 19, 2021	5.334	Apr 8 /21
365 King Street West	February 19, 2021	0.889	Apr 6 /21
St Mary's - 26 Centre Street	February 19, 2021	0.381	Apr 3 /21

GLOSSARY:

H: Histogram

W: Waveform

***: Not Available

Tran: Maximum peak particle velocity along the tranverse plane

Vert: Maximum peak particle velocity along the vertical plane

Long: Maximum peak particle velocity along the longitudinal plane

Freq: Frequency

PVS: Peak Vector Sum

 Highest Vibration level recorded at this monitoring location during this monitoring period

Table 3: Vibration Monitoring Data

Event Type	Serial Number	Event Date	Event Time	Tran (mm/s)	Tran ZC Freq (Hz)	Vert PPV (mm/s)	Vert ZC Freq (Hz)	Long PPV (mm/s)	Long ZC Freq (Hz)	Location
H	BE20913	Apr 2 /21	5:43:23	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 2 /21	17:43:25	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 3 /21	5:43:37	0.254	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 3 /21	17:43:16	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 4 /21	5:43:39	0.254	>100	0.254	>100	0.381	56.89	18 Centre Street
H	BE20913	Apr 4 /21	17:43:30	0.254	>100	0.127	***	0.254	>100	18 Centre Street
H	BE20913	Apr 5 /21	5:43:26	0.254	>100	0.127	>100	0.635	56.89	18 Centre Street
H	BE20913	Apr 5 /21	17:43:23	0.127	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 6 /21	5:43:38	0.254	>100	0.254	>100	0.508	51.2	18 Centre Street
H	BE20913	Apr 6 /21	17:43:22	0.127	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 7 /21	5:43:28	0.127	***	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 7 /21	17:43:26	0.254	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 8 /21	5:43:30	0.762	>100	1.524	>100	1.778	73.14	18 Centre Street
H	BE20913	Apr 8 /21	17:42:48	0.127	>100	0.254	>100	0.127	>100	18 Centre Street



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Event Type	Serial Number	Event Date	Event Time	Tran (mm/s)	Tran ZC Freq (Hz)	Vert PPV (mm/s)	Vert ZC Freq (Hz)	Long PPV (mm/s)	Long ZC Freq (Hz)	Location
H	BE12070	Apr 2 /21	5:42:49	0.254	>100	0.254	>100	0.381	51.2	365 King Street West
H	BE12070	Apr 2 /21	17:43:34	0.381	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 3 /21	5:43:42	0.254	>100	0.254	>100	0.381	>100	365 King Street West
H	BE12070	Apr 3 /21	17:43:16	0.381	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 4 /21	5:43:38	0.381	>100	0.254	>100	0.381	46.55	365 King Street West
H	BE12070	Apr 4 /21	17:43:31	0.254	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 5 /21	5:43:31	0.381	36.57	0.254	>100	0.508	42.67	365 King Street West
H	BE12070	Apr 5 /21	17:43:21	0.254	>100	0.254	>100	0.254	***	365 King Street West
H	BE12070	Apr 6 /21	5:43:32	0.254	>100	0.254	>100	0.381	51.2	365 King Street West
H	BE12070	Apr 6 /21	17:43:22	0.381	51.2	0.254	>100	0.381	51.2	365 King Street West
H	BE12070	Apr 7 /21	5:43:28	0.254	>100	0.254	>100	0.508	46.55	365 King Street West
H	BE12070	Apr 7 /21	17:43:26	0.254	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 8 /21	5:43:29	3.175	15.52	2.54	42.67	5.334	9.846	365 King Street West
H	BE12070	Apr 8 /21	17:43:31	0.254	>100	0.254	>100	0.254	>100	365 King Street West



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H	BE18796	Apr 2 /21	5:43:23	0.381	73.14	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 2 /21	17:43:32	0.381	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 3 /21	5:43:37	0.381	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 3 /21	17:43:26	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 4 /21	5:43:38	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 4 /21	17:43:30	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 5 /21	5:43:32	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 5 /21	17:43:25	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 6 /21	5:43:38	0.889	42.67	0.254	>100	0.762	42.67	St Mary's - 26 Centre Street
H	BE18796	Apr 6 /21	17:43:22	0.762	36.57	0.381	>100	0.635	46.55	St Mary's - 26 Centre Street
H	BE18796	Apr 7 /21	5:43:28	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 7 /21	17:43:26	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 8 /21	5:43:28	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 8 /21	17:43:30	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street



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H	BE13168	Apr 2 /21	5:43:23	0.127	***	0.254	>100	0.127	***	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 2 /21	17:43:35	0.127	>100	0.254	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 3 /21	5:43:38	0.254	>100	0.127	***	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 3 /21	17:43:16	0.381	64	0.254	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 4 /21	5:43:30	0.254	>100	0.127	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 4 /21	17:43:31	0.127	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 5 /21	5:43:31	0.127	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 5 /21	17:43:28	0.127	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 6 /21	5:43:31	0.254	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 6 /21	17:43:22	0.254	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 7 /21	5:43:28	0.254	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 7 /21	17:43:27	0.254	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 8 /21	5:43:31	0.254	>100	0.381	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 8 /21	17:43:30	0.127	>100	0.127	***	0.127	>100	St Mary's - 31 Ellerbeck Street