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Queens University
99 University Avenue
Kingston, ON
K7L 3N6

April 30, 2021

Attention: Mr. Asim Malik, *Project Manager*

Subject: **Vibration Monitoring Report – April 23rd to April 29th, 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 23rd to April 29th, 2021, all vibrations were below the allowable limits outlined in Table 1 attached in Appendix B. The highest vibration level of 1.143 mm/s with a frequency of 64 Hz was recorded at 26 Centre Street on April 27th, 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,

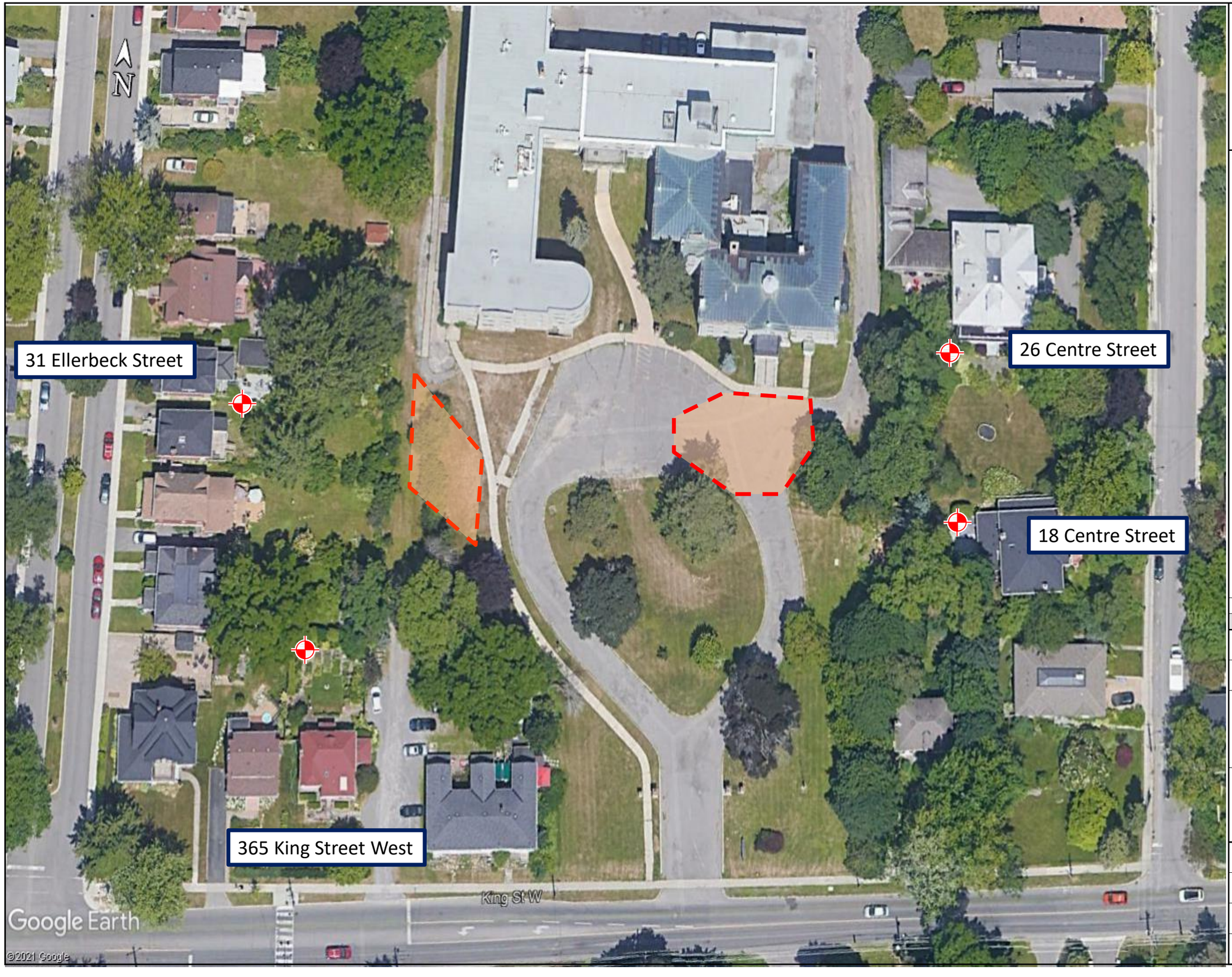
DST Consulting Engineers, Inc.

Jonathan McLaren, *Civil Technologist*
Field Technician

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

APPENDIX A

Monitoring Locations



DST consulting engineers a division of Englobe

Legend

- Approximate Location of Construction Activities
- Proposed Vibration Monitoring Locations

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**

DrawingTitle: **Site Map**

Designed By	Scale
S.G	As Shown
Drawn By	**Date**
C.W	February 2021
Approved By	**Project No.**
S.G	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	First Exceedance – Review construction operations and alter procedures as necessary. Proceed with caution with activities subject to the approval of the Contractor. Second Consecutive 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.
	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	First Exceedance – Review construction operations and alter procedures as necessary. Proceed with caution with activities subject to the approval of the Contractor. Second Consecutive 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.

APPENDIX C

Vibration Monitoring Data

Subject: Vibration Monitoring Summary – April 23 to April 29, 2021
Project: St. Mary's of the Lake Renovations
Client: Queens University
Ref No: 02101810.000

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	0.762	Apr 25 /21
365 King Street West	February 19, 2021	0.762	Apr 29 /21
St Mary's - 26 Centre Street	February 19, 2021	1.143	Apr 27 /21
St Mary's - 31 Ellerbeck Street	February 19, 2021	0.508	Apr 28 /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

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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 23 /21	5:42:51	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 23 /21	17:43:38	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 24 /21	5:43:30	0.254	>100	0.254	>100	0.381	64	18 Centre Street
H	BE20913	Apr 24 /21	17:43:24	0.127	***	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 25 /21	5:43:28	0.381	85.33	0.254	>100	0.762	56.89	18 Centre Street
H	BE20913	Apr 25 /21	17:43:27	0.254	>100	0.127	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 26 /21	5:43:45	0.254	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 26 /21	17:43:35	0.127	***	0.127	***	0.254	>100	18 Centre Street
H	BE20913	Apr 27 /21	5:43:32	0.127	***	0.254	>100	0.381	73.14	18 Centre Street
H	BE20913	Apr 27 /21	17:42:56	0.254	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 28 /21	5:42:49	0.127	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 28 /21	17:44:01	0.127	>100	0.254	>100	0.127	>100	18 Centre Street
H	BE20913	Apr 29 /21	5:43:16	0.127	>100	0.254	>100	0.254	>100	18 Centre Street
H	BE20913	Apr 29 /21	17:43:25	0.127	>100	0.254	>100	0.254	>100	18 Centre Street

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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	BE12070	Apr 23 /21	5:43:30	0.254	>100	0.254	>100	0.381	56.89	365 King Street West
H	BE12070	Apr 23 /21	17:43:38	0.254	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 24 /21	5:43:37	0.381	51.2	0.254	>100	0.381	51.2	365 King Street West
H	BE12070	Apr 24 /21	17:43:29	0.254	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 25 /21	5:43:27	0.254	>100	0.254	>100	0.381	18.29	365 King Street West
H	BE12070	Apr 25 /21	17:43:23	0.381	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 26 /21	5:43:44	0.381	64	0.635	56.89	0.635	56.89	365 King Street West
H	BE12070	Apr 26 /21	17:43:36	0.381	51.2	0.254	>100	0.508	34.13	365 King Street West
H	BE12070	Apr 27 /21	5:43:37	0.381	42.67	0.254	>100	0.381	73.14	365 King Street West
H	BE12070	Apr 27 /21	17:42:42	0.254	>100	0.254	>100	0.508	46.55	365 King Street West
H	BE12070	Apr 28 /21	5:43:45	0.381	39.38	0.381	73.14	0.381	64	365 King Street West
H	BE12070	Apr 28 /21	17:43:39	0.381	>100	0.254	>100	0.254	>100	365 King Street West
H	BE12070	Apr 29 /21	5:43:29	0.508	36.57	0.381	>100	0.762	42.67	365 King Street West
H	BE12070	Apr 29 /21	17:42:48	0.254	>100	0.254	>100	0.254	>100	365 King Street West

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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	BE18796	Apr 23 /21	5:43:31	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 23 /21	17:43:38	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 24 /21	5:43:44	0.508	46.55	0.381	>100	0.889	42.67	St Mary's - 26 Centre Street
H	BE18796	Apr 24 /21	17:43:28	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 25 /21	5:43:27	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 25 /21	17:43:39	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 26 /21	5:43:45	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 26 /21	17:43:21	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 27 /21	5:43:38	1.143	64	0.254	>100	0.381	85.33	St Mary's - 26 Centre Street
H	BE18796	Apr 27 /21	17:42:56	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 28 /21	5:43:43	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 28 /21	17:43:36	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 29 /21	5:43:29	0.254	>100	0.254	>100	0.254	>100	St Mary's - 26 Centre Street
H	BE18796	Apr 29 /21	17:43:28	0.381	46.55	0.254	>100	0.381	85.33	St Mary's - 26 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	BE13168	Apr 23 /21	5:43:31	0.254	>100	0.127	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 23 /21	17:43:38	0.127	***	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 24 /21	5:43:44	0.254	>100	0.254	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 24 /21	17:42:48	0.127	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 25 /21	5:43:31	0.127	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 25 /21	17:43:26	0.127	***	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 26 /21	5:43:30	0.254	>100	0.254	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 26 /21	17:43:37	0.127	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 27 /21	5:43:32	0.254	>100	0.254	>100	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 27 /21	17:42:28	0.254	>100	0.254	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 28 /21	5:43:54	0.381	>100	0.508	73.14	0.254	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 28 /21	17:43:37	0.127	>100	0.127	>100	0.127	***	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 29 /21	5:43:29	0.127	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street
H	BE13168	Apr 29 /21	17:43:35	0.127	>100	0.127	>100	0.127	>100	St Mary's - 31 Ellerbeck Street