



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

July 23, 2018

Dragados-Tomlinson Joint Venture  
5597 Power Road  
Ottawa, Ontario  
K1G 3N4

Attention: Mr. Kevin Stadelmann

**Re: Interim Weekly Vibration Monitoring Report – July 16 to July 22, 2018**  
**Combined Sewage Storage Tunnel (CSST) – Site 5 Operations**

Dear Mr. Stadelmann,

Attached please find the interim weekly summary report detailing the results of the vibration monitoring program developed and implemented as part of the construction operations for the Combined Sewage Storage Tunnel (CSST) Project – Site 5 Operations in Ottawa, Ontario. This monitoring program was initiated on March 31, 2017 and has been recording vibrations generated as a result of the construction equipment in order to confirm predictable levels and to guard against possible adverse impacts on the surrounding structures.

A full time on-site Vibration Monitoring Program is currently implemented to delineate vibration intensities experienced at a representative sampling of structures around the Site 5 construction areas as a result of the construction equipment in operation. The monitoring instruments installed consist of Instantel tri-directional digital seismographs capable of measuring vibration intensities up to 254mm/s at a frequency response of 2 – 250Hz or 1 – 315Hz depending on the installation. The units are programmed to measure all vibration levels continuously at a sampling rate of 1024 samples per second. Following each five minute interval, the units review the 307,200 measured vibrations and permanently records the peak particle velocity for that time interval while deleting all subordinate vibration intensities. This process is repeated for all subsequent five minute time intervals thereby providing maximum vibration intensities experienced at the monitored areas throughout the day.



Such a configuration permits continuous monitoring of vibration levels and provides complete coverage of all vibrations, construction induced or otherwise, experienced at the monitored structure. Events recorded under this program mode are marked by an “H” on the vibrations summary report. As an additional analytical tool, the seismographs are configured to record a more detailed waveform in the event that vibration intensities exceeded a pre-set trigger of 4mm/s. This feature permits advanced analysis in the event that anomalous elevated readings are recorded. Events recorded under this program mode are marked by a “W” on the vibrations summary report.

As per the Contract Specification 02482, Subsection 1.5.1.1, the following threshold, response and shutdown values are observed at Site 5:

Project Threshold, Response and Shutdown Values			
Description of Event	Threshold Value (PPV)	Response Value (PPV)	Shutdown Value (PPV)
Continuous/ Intermittent Source	4mm/s	6mm/s	7mm/s
Transient Source	5mm/s	8mm/s	9mm/s
Blasting	10mm/s	16mm/s	20mm/s

The monitoring locations itemized below were installed for the following sites on the listed days and remain installed during the construction operations:

**Site 5A/5B**

- **141/151 Stanley Avenue** – Installed on March 31, 2017
- **IOS Shaft IOS Location** (Borehole and Surface) – Installed on Oct 13, 2017
- **IOS Shaft 5A Location** (Borehole and Surface) – Removed on May 3, 2018



**Site 5C**

- **54 Queen Victoria Street** – Installed on March 31, 2017
- **51 Queen Victoria Street** – Installed on April 11, 2017
- **55 Queen Victoria Street** – Installed on January 12, 2018
- **50 Queen Victoria Street** – Installed on January 12, 2018

The following readings generated at Site 5 monitoring locations exceeded the 4mm/s trigger level during the interim monitoring period:

<b>Vibration Readings Exceeding 4mm/s During Interim Monitoring Period</b>						
<b>Ref. Event #</b>	<b>Location</b>	<b>Date</b>	<b>Time</b>	<b>Velocity (mm/s)</b>	<b>Cause of Event</b>	<b>Applicable Project Limit Exceeded</b>
<b>Site 5A/5B</b>						
1 to 3	IOS Shaft IOS – Borehole	July 16, 2018	16:50 to 18:16	<b>Up to 8.890</b>	<b>RF / Power Spikes</b>	N/A – Not Construction Related
4 to 18	IOS Shaft IOS – Borehole	July 17, 2018	00:13 to 2:33	<b>Up to 12.57</b>	<b>RF / Power Spikes</b>	N/A – Not Construction Related
19 to 22	151 Stanley Avenue	July 17, 2018	1:38 to 1:55	<b>Up to 18.29</b>	<b>RF / Power Spikes</b>	N/A – Not Construction Related
<b>Site 5C</b>						
23	55 Queen Victoria Street	July 20, 2018	16:01	<b>3.937</b>	<b>Transient</b>	Below Threshold Value

# EXPLOTECH

All recorded Histogram summaries and Waveform details for Site 5 are available for reference at anytime on the [www.constructionvibrations.com](http://www.constructionvibrations.com) website. A summary list is attached to this interim report for reference. Should you have any questions or concerns related to the information contained herein or the monitoring program undertaken, please do not hesitate to contact the undersigned at your leisure.

Kindest regards,



Mitch Malcomson, P.Eng.

**CSST - Site 5  
M7550A DTJV  
July 16, 2018 to July 22, 2018**

**Event Report: Event List - z:\to be archived\2 csst temp folders\site 5**

Type	Serial No.	Date/Time	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	PVS1 (mm/s)	Tran2 Peak (mm/s)	Vert2 Peak (mm/s)	Long2 Peak (mm/s)	PVS2 (mm/s)	Mic Peak (dB)	Description
H	BE16212	Jul 15 /18 06:06:43	2.159	2.413	1.905	2.890	0.508	0.381	0.381	0.539	***	Site 5A - IOS Shaft IOS Location
H	MP12604	Jul 16 /18 06:06:04	0.173	0.134	0.166	0.183	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE22085	Jul 16 /18 06:06:50	0.889	1.016	0.381	1.295	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE20059	Jul 16 /18 06:07:03	1.143	2.921	1.651	2.927	7.112	0.762	2.286	7.135	119.2L	Site 5AB - 141+151 Stanley Avenue
H	BE18786	Jul 16 /18 06:07:34	0.762	1.143	0.762	1.350	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE17376	Jul 16 /18 06:07:35	0.889	0.635	2.540	2.540	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE16212	Jul 16 /18 06:10:20	3.302	4.699	3.048	5.296	0.508	0.381	0.381	0.554	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 16 /18 16:50:54	0.381	4.699	2.413	5.296	0.381	0.254	0.254	0.475	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 16 /18 16:56:28	3.810	8.890	3.048	10.14	0.508	0.381	0.381	0.539	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 16 /18 17:53:33	3.810	8.890	3.048	10.14	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 16 /18 17:56:35	3.683	1.905	5.080	5.571	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 16 /18 18:16:47	2.286	0.508	5.080	5.571	0.381	0.254	0.381	0.440	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 16 /18 18:19:06	5.334	3.429	3.175	5.756	0.381	0.381	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 00:13:49	5.334	1.397	1.651	5.756	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 00:16:09	4.826	1.778	3.302	4.829	0.381	0.254	0.381	0.475	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 00:42:31	4.826	1.270	3.175	4.829	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 00:48:15	3.937	3.683	3.175	5.638	0.381	0.381	0.381	0.440	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:16:15	3.937	3.683	1.651	5.638	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:19:11	0.889	3.175	6.477	7.241	0.381	0.254	0.254	0.458	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:22:05	0.889	3.175	6.477	7.241	0.381	0.254	0.254	0.458	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:25:02	0.762	3.937	2.667	4.757	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:25:32	0.635	3.937	2.667	4.757	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:27:48	2.159	2.667	4.826	5.026	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:31:24	0.635	1.778	4.826	5.026	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:34:20	2.667	4.191	1.524	4.252	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:34:54	2.540	4.191	1.524	4.252	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:37:52	4.318	2.921	5.969	7.550	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jul 17 /18 01:38:04	0.508	0.508	0.254	0.539	7.112	0.635	0.762	7.135	<88L	Site 5AB - 141+151 Stanley Avenue
W	BE16212	Jul 17 /18 01:39:50	4.318	2.921	5.969	7.550	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jul 17 /18 01:41:23	0.889	1.016	0.381	1.024	13.21	3.048	10.16	16.67	110.6L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Jul 17 /18 01:42:46	5.842	2.159	2.413	6.679	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:42:56	5.842	2.159	2.413	6.679	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jul 17 /18 01:43:54	0.762	1.016	0.381	1.024	13.21	3.048	10.16	16.67	110.6L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Jul 17 /18 01:45:52	4.191	5.080	1.905	5.112	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:46:14	4.191	5.080	1.905	5.112	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jul 17 /18 01:47:06	0.635	0.762	0.254	0.813	4.826	0.635	0.635	4.868	94.0L	Site 5AB - 141+151 Stanley Avenue
W	BE20059	Jul 17 /18 01:47:12	0.635	0.762	0.254	0.813	4.826	0.635	0.635	4.868	94.0L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Jul 17 /18 01:49:10	3.302	7.239	4.699	7.667	0.381	0.254	0.254	0.475	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jul 17 /18 01:50:23	3.175	1.016	0.254	3.185	18.29	1.270	15.11	23.76	106.0L	Site 5AB - 141+151 Stanley Avenue
W	BE16212	Jul 17 /18 01:51:51	3.302	7.239	4.699	7.667	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 01:54:47	12.57	3.810	4.064	13.22	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 01:55:52	12.57	3.810	4.064	13.22	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE20059	Jul 17 /18 01:55:52	3.175	0.635	0.254	3.185	18.29	1.270	15.11	23.76	<88L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Jul 17 /18 01:58:08	4.191	1.524	2.667	4.461	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE20059	Jul 17 /18 01:59:04	1.270	1.397	0.254	1.403	2.159	0.635	2.286	2.300	118.6L	Site 5AB - 141+151 Stanley Avenue
W	BE16212	Jul 17 /18 01:59:14	4.191	0.889	1.524	4.461	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 02:02:13	2.286	4.064	3.302	5.242	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 02:07:21	0.381	4.064	3.302	5.242	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 02:14:55	10.41	1.905	6.223	12.14	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Jul 17 /18 02:33:34	10.41	0.508	6.223	12.14	0.381	0.254	0.254	0.381	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Jul 17 /18 02:35:49	2.286	4.064	2.286	4.747	0.381	0.254	0.381	0.458	***	Site 5A - IOS Shaft IOS Location
H	MP12604	Jul 17 /18 06:06:05	0.181	0.229	0.260	0.287	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE22085	Jul 17 /18 06:06:52	1.270	1.143	1.270	1.535	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE18786	Jul 17 /18 06:06:53	0.762	0.889	0.762	1.063	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE20059	Jul 17 /18 06:06:54	1.016	0.889	0.254	1.055	2.032	0.762	1.778	2.052	113.5L	Site 5AB - 141+151 Stanley Avenue
H	BE17376	Jul 17 /18 06:07:33	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	MP12604	Jul 18 /18 06:06:04	0.150	0.181	0.166	0.213	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE18786	Jul 18 /18 06:06:53	0.635	0.635	0.635	0.813	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE17376	Jul 18 /18 06:06:54	0.254	0.381	0.381	0.475	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE20059	Jul 18 /18 06:07:06	0.889	0.762	0.254	0.907	2.159	0.762	1.905	2.207	107.5L	Site 5AB - 141+151 Stanley Avenue
H	BE22085	Jul 18 /18 06:07:32	0.635	0.762	0.508	0.925	***	***	***	***	***	Site 5C - 50 Queen Victoria Street
H	BE17376	Jul 19 /18 06:10:20	0.889	0.254	0.381	0.907	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE18786	Jul 19 /18 06:10:20	1.143	1.651	1.270	1.818	***	***	***	***	***	Site 5C - 55 Queen Victoria Street
H	BE22085	Jul 19 /18 06:10:21	0.889	1.524	1.143	1.545	***	***	***	***	***	Site 5C - 50 Queen Victoria Street

**CSST - Site 5  
M7550A DTJV  
July 16, 2018 to July 22, 2018**

**Event Report: Event List - z:\to be archived\2 csst temp folders\site 5**

Type	Serial No.	Date/Time	Tran Peak (mm/s)	Vert Peak (mm/s)	Long Peak (mm/s)	PVS1 (mm/s)	Tran2 Peak (mm/s)	Vert2 Peak (mm/s)	Long2 Peak (mm/s)	PVS2 (mm/s)	Mic Peak (dB)	Description
H	BE20059	Jul 19 /18 06:10:29	0.889	0.762	0.381	0.898	1.143	0.762	1.016	1.276	109.5L	Site 5AB - 141+151 Stanley Aven
H	BE18786	Jul 20 /18 06:07:45	2.921	3.302	3.937	5.039	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE17376	Jul 20 /18 06:07:48	0.889	0.508	0.381	0.898	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
H	BE20059	Jul 20 /18 06:08:00	0.889	0.762	0.381	0.933	1.905	0.762	1.397	1.926	111.2L	Site 5AB - 141+151 Stanley Aven
H	BE22085	Jul 20 /18 06:10:46	0.889	0.762	0.635	1.000	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	MP12604	Jul 20 /18 10:20:26	0.087	0.110	0.118	0.136	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	MP12604	Jul 20 /18 10:24:48	0.166	0.173	0.150	0.213	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
W	BE18786	Jul 20 /18 16:01:49	2.921	3.302	3.937	5.039	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE18786	Jul 20 /18 16:04:31	1.397	2.286	1.905	2.700	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	MP12604	Jul 21 /18 06:06:30	0.087	0.173	0.197	0.239	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	BE22085	Jul 21 /18 06:06:50	1.397	0.889	1.016	1.616	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	BE17376	Jul 21 /18 06:06:54	0.381	0.381	0.254	0.421	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
H	BE18786	Jul 21 /18 06:07:28	2.921	3.683	2.540	3.923	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE20059	Jul 21 /18 06:07:45	0.762	0.762	0.381	0.813	1.778	0.762	1.397	1.836	122.0L	Site 5AB - 141+151 Stanley Aven
H	MP12604	Jul 22 /18 06:06:03	0.118	0.166	0.197	0.215	***	***	***	***	***	Site 5C - 54 Queen Victoria Stree
H	BE18786	Jul 22 /18 06:06:52	3.683	2.921	2.667	5.026	***	***	***	***	***	Site 5C - 55 Queen Victoria Stree
H	BE22085	Jul 22 /18 06:07:31	1.270	1.143	1.524	1.805	***	***	***	***	***	Site 5C - 50 Queen Victoria Stree
H	BE17376	Jul 22 /18 06:07:34	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 51 Queen Victoria Stree
H	BE20059	Jul 22 /18 06:07:43	1.270	0.762	0.254	1.295	1.397	0.762	1.143	1.470	123.9L	Site 5AB - 141+151 Stanley Aven