



Specialists in Explosives, Blasting and Vibration  
Consulting Engineers

November 6, 2017

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

Attention: Mr. Kevin Stadelmann

**Re: Interim Weekly Vibration Monitoring Report – October 30 to November 5, 2017  
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
- **133 Stanley Avenue** – Installed on August 4, 2017
- **IOS Shaft 5A Location** (Borehole and Surface) – Installed on Sept 5, 2017
- **IOS Shaft IOS Location** (Borehole and Surface) – Installed on Oct 13, 2017



**Site 5C**

- **54 Queen Victoria Street** – Installed on March 31, 2017
- **51 Queen Victoria Street** – Installed on April 11, 2017

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

Vibration Readings Exceeding 4mm/s During Interim Monitoring Period						
Ref. Event #	Location	Date	Time	Velocity (mm/s)	Cause of Event	Applicable Project Limit Exceeded
<b>Site 5A/5B</b>						
1	133 Stanley Avenue	Oct 31, 2017	1:55	32.77	Localized Impacts	N/A – Not Construction Related
2	IOS Shaft 5A - Surface	Nov 1, 2017	9:19	5.207	Transient Source	N/A – Surface is for information purposes only
3	IOS Shaft 5A - Borehole	Nov 1, 2017	14:15	6.096	Blasting	Below Threshold Value
4	IOS Shaft 5A - Borehole	Nov 3, 2017	12:48	8.636	Blasting	Below Threshold Value
5	133 Stanley Avenue	Nov 4, 2017	4:15	67.69	Localized Impacts	N/A – Not Construction Related
6	151 Stanley Avenue	Nov 4, 2017	21:46	3.937	RF / Power Spikes	N/A – Not Construction Related
7 to 9	IOS Shaft IOS - Surface	Nov 5, 2017	4:22 to 21:34	Up to 5.969	RF / Power Spikes	N/A – Not Construction Related
<b>Site 5C</b>						
N/A	No Events	N/A	N/A	N/A	N/A	N/A

# 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  
M750A DTJV  
Oct 30, 2017 to Nov 5, 2017**

**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	BE15997	Oct 30 /17 06:04:18	0.381	0.254	0.254	0.381	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE11685	Oct 30 /17 06:06:54	32.77	0.635	0.762	32.77	***	***	***	***	121.1L	Site 5AB - 133 Stanley Avenue
H	BE20061	Oct 30 /17 06:07:38	0.381	0.381	0.254	0.475	1.905	3.175	1.778	3.744	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Oct 30 /17 06:07:46	0.508	0.635	0.254	0.684	2.286	0.635	1.651	2.706	124.3L	Site 5AB - 141+151 Stanley Avenue
H	BE17376	Oct 30 /17 06:08:14	0.635	0.381	0.254	0.660	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE16212	Oct 30 /17 09:55:45	0.508	0.635	0.508	0.898	0.508	0.762	0.508	0.880	***	Site 5A - IOS Shaft IOS Location
H	BE14293	Oct 30 /17 10:07:50	0.508	1.016	0.381	1.085	1.651	0.381	1.397	1.675	125.2L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Oct 30 /17 10:23:10	2.413	2.159	1.524	2.750	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
W	BE11685	Oct 31 /17 01:55:49	32.77	0.635	0.762	32.77	***	***	***	***	95.9L	Site 5AB - 133 Stanley Avenue
H	BE11685	Oct 31 /17 01:58:06	0.508	0.127	0.254	0.524	***	***	***	***	109.9L	Site 5AB - 133 Stanley Avenue
H	BE15997	Oct 31 /17 06:01:52	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE11685	Oct 31 /17 06:06:45	0.508	0.381	0.254	0.539	***	***	***	***	117.6L	Site 5AB - 133 Stanley Avenue
H	BE16212	Oct 31 /17 06:07:14	0.762	0.508	0.762	0.889	0.508	0.889	0.508	0.967	***	Site 5A - IOS Shaft IOS Location
H	BE20061	Oct 31 /17 06:07:34	0.381	0.381	0.254	0.458	1.651	3.302	2.667	3.921	***	Site 5A - IOS Shaft 5A Location
H	BE17376	Oct 31 /17 06:07:35	0.635	0.254	0.381	0.648	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE14293	Oct 31 /17 06:07:48	0.635	0.635	0.635	0.852	2.286	0.889	1.651	2.293	126.0L	Site 5AB - 141+151 Stanley Avenue
H	BE15997	Nov 1 /17 06:01:55	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE20061	Nov 1 /17 06:06:54	0.381	0.254	0.254	0.402	4.699	5.207	1.905	5.264	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Nov 1 /17 06:07:06	1.270	1.016	0.889	1.442	1.651	0.762	1.397	1.651	116.3L	Site 5AB - 141+151 Stanley Avenue
H	BE11685	Nov 1 /17 06:07:34	0.508	1.143	0.381	1.212	***	***	***	***	115.4L	Site 5AB - 133 Stanley Avenue
H	BE17376	Nov 1 /17 06:07:34	0.762	0.381	0.254	0.773	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE16212	Nov 1 /17 06:07:36	1.397	0.889	1.651	1.769	0.508	0.889	0.508	0.933	***	Site 5A - IOS Shaft IOS Location
W	BE20061	Nov 1 /17 09:19:06	0.254	0.254	0.254	0.284	4.699	5.207	1.905	5.264	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 1 /17 09:21:50	5.715	5.715	6.096	7.283	1.397	2.286	3.048	3.737	***	Site 5A - IOS Shaft 5A Location
W	BE20061	Nov 1 /17 14:15:46	5.715	5.715	6.096	7.283	1.016	2.286	3.048	3.737	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 1 /17 14:17:52	0.381	0.381	0.254	0.475	2.159	2.667	2.540	3.410	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Nov 2 /17 06:01:52	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE11685	Nov 2 /17 06:06:54	0.508	0.254	0.254	0.539	***	***	***	***	112.8L	Site 5AB - 133 Stanley Avenue
H	BE17376	Nov 2 /17 06:06:54	0.508	0.254	0.254	0.524	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE16212	Nov 2 /17 06:06:57	2.286	2.032	2.286	2.808	0.381	0.254	0.381	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE14293	Nov 2 /17 06:07:09	0.508	1.143	0.381	1.178	2.032	0.635	2.032	2.479	116.1L	Site 5AB - 141+151 Stanley Avenue
H	BE20061	Nov 2 /17 06:07:31	0.381	0.381	0.254	0.458	3.048	2.286	2.413	3.341	***	Site 5A - IOS Shaft 5A Location
H	BE15997	Nov 3 /17 06:02:32	0.381	0.254	0.508	0.539	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE20061	Nov 3 /17 06:06:54	7.747	8.636	6.604	11.40	1.651	2.667	2.794	3.124	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Nov 3 /17 06:07:08	1.143	1.143	0.635	1.157	1.651	0.635	1.651	1.746	116.6L	Site 5AB - 141+151 Stanley Avenue
H	BE17376	Nov 3 /17 06:07:34	1.016	0.762	0.635	1.157	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE11685	Nov 3 /17 06:07:35	67.69	1.778	1.905	67.70	***	***	***	***	116.9L	Site 5AB - 133 Stanley Avenue
H	BE16212	Nov 3 /17 06:07:36	1.651	1.524	2.032	2.524	0.508	0.889	0.381	1.000	***	Site 5A - IOS Shaft IOS Location
W	BE20061	Nov 3 /17 12:48:29	7.747	8.636	6.604	11.40	1.524	1.905	2.794	3.124	***	Site 5A - IOS Shaft 5A Location
H	BE20061	Nov 3 /17 12:51:21	0.381	0.381	0.254	0.458	1.905	1.905	2.159	2.446	***	Site 5A - IOS Shaft 5A Location
W	BE11685	Nov 4 /17 04:15:17	67.69	1.778	1.905	67.70	***	***	***	***	<88L	Site 5AB - 133 Stanley Avenue
H	BE11685	Nov 4 /17 04:17:34	0.508	0.127	0.254	0.524	***	***	***	***	<88L	Site 5AB - 133 Stanley Avenue
H	BE15997	Nov 4 /17 06:02:34	0.254	0.254	0.381	0.458	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE11685	Nov 4 /17 06:06:43	0.254	0.254	0.254	0.284	***	***	***	***	113.5L	Site 5AB - 133 Stanley Avenue
H	BE16212	Nov 4 /17 06:06:55	5.969	3.048	3.556	6.953	0.762	0.381	0.889	0.967	***	Site 5A - IOS Shaft IOS Location
H	BE17376	Nov 4 /17 06:07:35	0.508	0.254	0.254	0.508	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE14293	Nov 4 /17 06:07:45	1.397	1.524	0.889	1.529	3.048	1.143	3.937	4.702	111.2L	Site 5AB - 141+151 Stanley Avenue
H	BE20061	Nov 4 /17 06:11:56	0.381	0.381	0.254	0.421	2.794	2.540	2.540	3.350	***	Site 5A - IOS Shaft 5A Location
W	BE14293	Nov 4 /17 21:46:50	0.381	0.635	0.254	0.648	2.413	0.889	3.937	4.702	91.5L	Site 5AB - 141+151 Stanley Avenue
H	BE14293	Nov 4 /17 21:50:11	0.508	0.635	0.254	0.696	3.302	0.635	2.667	3.314	119.8L	Site 5AB - 141+151 Stanley Avenue
H	BE16212	Nov 5 /17 03:25:27	2.413	2.794	2.032	3.503	0.381	0.254	0.254	0.381	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Nov 5 /17 04:22:33	5.969	0.508	3.556	6.953	0.254	0.254	0.254	0.311	***	Site 5A - IOS Shaft IOS Location
H	BE15997	Nov 5 /17 05:01:52	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE11685	Nov 5 /17 05:06:53	0.254	0.127	0.254	0.381	***	***	***	***	105.5L	Site 5AB - 133 Stanley Avenue
H	BE20061	Nov 5 /17 05:06:54	0.254	0.254	0.254	0.381	0.254	0.381	0.254	0.381	***	Site 5A - IOS Shaft 5A Location
H	BE14293	Nov 5 /17 05:06:57	0.508	0.508	0.254	0.582	2.159	0.508	1.905	2.279	106.5L	Site 5AB - 141+151 Stanley Avenue
H	BE17376	Nov 5 /17 05:07:35	0.254	0.254	0.127	0.311	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE15997	Nov 5 /17 06:02:22	0.254	0.254	0.254	0.311	***	***	***	***	***	Site 5C - 54 Queen Victoria Street
H	BE17376	Nov 5 /17 06:06:42	0.508	0.254	0.254	0.508	***	***	***	***	***	Site 5C - 51 Queen Victoria Street
H	BE11685	Nov 5 /17 06:06:43	0.508	0.254	0.254	0.524	***	***	***	***	120.5L	Site 5AB - 133 Stanley Avenue
H	BE20061	Nov 5 /17 06:06:44	0.381	0.381	0.254	0.421	0.254	0.381	0.254	0.421	***	Site 5A - IOS Shaft 5A Location
H	BE16212	Nov 5 /17 06:06:45	4.572	3.048	5.080	7.483	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location
H	BE14293	Nov 5 /17 06:06:51	1.270	1.397	0.762	1.403	3.556	1.016	3.048	3.592	121.4L	Site 5AB - 141+151 Stanley Avenue
W	BE16212	Nov 5 /17 19:58:31	4.572	3.048	5.080	7.483	0.254	0.254	0.254	0.311	***	Site 5A - IOS Shaft IOS Location

**CSST - Site 5**  
**M7550A DTJV**  
**Oct 30, 2017 to Nov 5, 2017**

**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	Nov 5 /17 20:01:20	4.445	1.778	2.032	4.461	0.381	0.254	0.254	0.402	***	Site 5A - IOS Shaft IOS Location
W	BE16212	Nov 5 /17 21:34:38	4.445	0.381	0.381	4.461	0.254	0.254	0.254	0.311	***	Site 5A - IOS Shaft IOS Location
H	BE16212	Nov 5 /17 21:36:42	2.540	2.286	2.921	3.795	0.381	0.254	0.254	0.421	***	Site 5A - IOS Shaft IOS Location