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Heavy Oil

Controlled Document

Quest CCS Project

Quest Emissions to air, soil or water – Performance 2016

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Revision History

REVISION STATUS			APPROVAL		
Rev.	Date	Description	Originator	Reviewer	Approver
0	2017-02-16	Updated for Annual Report	Celina Duong		

- All signed originals will be retained by the UA Document Control Center and an electronic copy will be stored in Livelink

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2017-02-16	Originator	Celina Duong	Celina Duong

Summary

All emissions (non-CO₂) to air, soil and water caused by the introduction of a CO₂ capture process should be identified and reported by its concentration measured. Concentration measured in the streams to the environment from the capture facilities.

Keywords

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1. PURPOSE

The actual non-CO₂ emissions to air, soil and water reported by its concentration measured in ppm during operational period

1.1. Air Monitoring as per EPEA Approval 49785-01-05

The primary source of air emissions from the Quest Project is the CO₂ capture facility at Scotford, which increases NO_x from the Hydrogen Manufacturing Units (HMUs). As a result, the amendment to the Upgrader's Environmental Protection and Enhancement Act Approval No. 49785-01-05 (incorporated Quest Capture Facility) required the following non-CO₂ emissions monitoring:

- Increased NO_x emissions limits for three HMU Steam Reformer stacks.
- Requirement to monitor NO_x emissions continuously for each HMU stack and conduct two stack surveys per year.
- Shell is required to participate in the Fort Air Partnership ambient air monitoring program and was required to install a NO_x analyzer for the Scotford 2 monitoring station. Lamont station monitors for PM_{2.5} as required by the Upgrader's operating approval.
- Note: as part of the Quest CCS Project Environmental Impact Assessment, air quality dispersion modeling showed that the Quest Project will not increase PM_{2.5} emissions.

1.2. Soil and Groundwater Monitoring as per EPEA Approval 49785-01-05

The Quest capture facility is integrated with the Scotford Upgrader and therefore all water use and treatment follows the terms and conditions. As well, groundwater and soil monitoring are conducted as an ongoing part of the operating approval.

Quest Emissions to air, soil or water – Performance 2016		1
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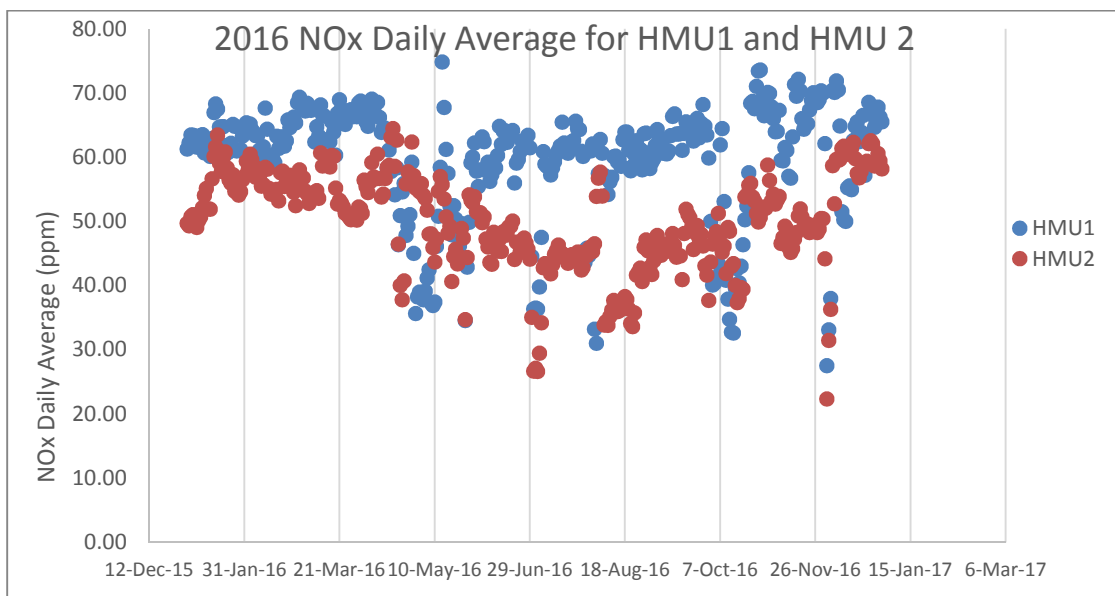
2016 Emissions Performance

1.3. Glycol Losses and Amine Losses

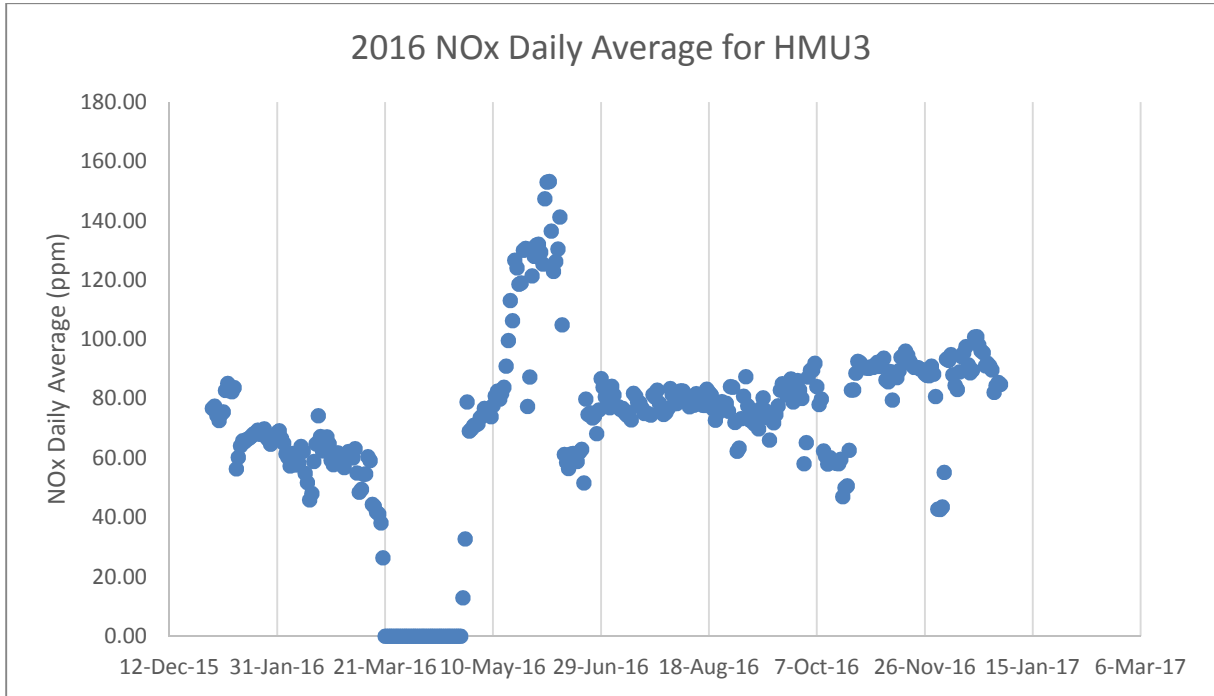
The total glycol volume is lost to a combination of sources including the glycol regenerator/stripper vent, glycol circulation pump seals, and lastly to the pipeline. The glycol circulation pump seals are a major source of glycol loss.

	Amine Make-up t/month	TEG losses kg/month
Design/Reference	10	3833
Jan-16	0	608
Feb-16	0	640
Mar-16	0	637
Apr-16	0	557
May-16	17	700
Jun-16	0	719
Jul-16	0	537
Aug-16	0	648
Sep-16	21	558
Oct-16	0	500
Nov-16	0	366
Dec-16	0	408

1.4. 2016 NOx Daily Average (ppm) for the Hydrogen Manufacturing Units



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Note: From March 21 until April 26 the NOx values for HMU 3 were affected by Turnaround activities.

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APPENDIX 1. NOX DATA

	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-Jan-16	61.30	49.71	76.76
2-Jan-16	62.24	49.35	77.54
3-Jan-16	63.50	50.76	74.42
4-Jan-16	63.43	51.09	72.65
5-Jan-16	63.32	50.41	74.84
6-Jan-16	61.60	49.10	75.62
7-Jan-16	63.04	50.18	82.80
8-Jan-16	63.38	50.72	85.20
9-Jan-16	63.55	52.17	82.76
10-Jan-16	60.68	54.09	82.45
11-Jan-16	61.81	55.18	83.79
12-Jan-16	62.23	51.96	56.45
13-Jan-16	60.14	51.95	60.31
14-Jan-16	62.93	56.68	64.14
15-Jan-16	66.99	60.15	65.85
16-Jan-16	68.33	61.63	65.59
17-Jan-16	67.51	63.49	66.33
18-Jan-16	64.76	59.13	66.78
19-Jan-16	64.72	57.83	67.45
20-Jan-16	64.81	60.01	68.19
21-Jan-16	61.84	60.87	68.62
22-Jan-16	60.69	58.35	69.43
23-Jan-16	60.91	56.52	68.06
24-Jan-16	62.18	55.98	69.09
25-Jan-16	65.13	57.32	69.85
26-Jan-16	64.84	54.70	66.97
27-Jan-16	61.01	54.75	66.11
28-Jan-16	61.15	54.11	64.76
29-Jan-16	61.18	54.68	66.29
30-Jan-16	63.35	56.49	67.06
31-Jan-16	63.78	57.06	68.66
1-Feb-16	65.40	59.41	69.25
2-Feb-16	64.42	58.12	66.69
3-Feb-16	65.21	60.51	65.08
4-Feb-16	64.29	59.59	61.53
5-Feb-16	63.91	58.38	60.28
6-Feb-16	63.39	56.92	57.39
7-Feb-16	63.41	58.27	61.56
8-Feb-16	61.14	56.84	59.37
9-Feb-16	59.51	55.52	57.75
10-Feb-16	61.65	55.76	58.43
11-Feb-16	67.69	58.47	63.92
12-Feb-16	64.38	58.15	62.33
13-Feb-16	59.52	55.16	54.89
14-Feb-16	60.25	54.28	51.73
15-Feb-16	59.68	54.75	45.95
16-Feb-16	59.14	54.68	48.13
17-Feb-16	63.28	55.03	58.83
18-Feb-16	61.42	53.23	64.82
19-Feb-16	63.14	57.61	74.29
20-Feb-16	63.17	57.84	67.27
21-Feb-16	61.73	55.44	62.48
22-Feb-16	62.60	56.19	62.75
23-Feb-16	65.84	56.42	67.23
24-Feb-16	64.63	57.19	64.83
25-Feb-16	65.93	55.60	59.35
26-Feb-16	66.28	54.59	57.82
27-Feb-16	65.37	52.50	58.58
28-Feb-16	68.53	56.33	61.85
29-Feb-16	69.39	58.07	61.29

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	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-Mar-16	68.24	56.64	59.50
2-Mar-16	68.44	56.81	56.80
3-Mar-16	67.24	54.75	60.54
4-Mar-16	68.44	54.32	62.19
5-Mar-16	67.48	52.82	61.61
6-Mar-16	67.33	54.00	60.03
7-Mar-16	67.65	54.10	63.22
8-Mar-16	62.41	54.55	55.00
9-Mar-16	64.78	54.83	48.50
10-Mar-16	63.33	53.62	49.48
11-Mar-16	68.18	60.71	54.61
12-Mar-16	66.62	58.68	54.70
13-Mar-16	66.41	58.76	60.45
14-Mar-16	62.77	59.25	59.20
15-Mar-16	62.65	60.10	44.47
16-Mar-16	62.47	58.51	43.82
17-Mar-16	65.55	60.28	41.88
18-Mar-16	63.96	60.14	41.16
19-Mar-16	60.36	55.23	38.19
20-Mar-16	66.90	52.73	26.41
21-Mar-16	68.96	53.34	0.00
22-Mar-16	67.57	52.85	0.00
23-Mar-16	67.30	52.28	0.00
24-Mar-16	65.15	51.30	0.00
25-Mar-16	66.34	51.26	0.00
26-Mar-16	66.32	50.70	0.00
27-Mar-16	67.43	50.28	0.00
28-Mar-16	66.36	50.96	0.00
29-Mar-16	66.89	50.56	0.00
30-Mar-16	66.32	50.25	0.00
31-Mar-16	68.47	52.27	0.00
1-Apr-16	68.78	52.02	0.00
2-Apr-16	67.21	51.27	0.00
3-Apr-16	67.88	56.49	0.00
4-Apr-16	65.55	55.47	0.00
5-Apr-16	64.86	54.50	0.00
6-Apr-16	66.20	56.16	0.00
7-Apr-16	69.10	59.19	0.00
8-Apr-16	67.33	56.98	0.00
9-Apr-16	66.60	56.67	0.00
10-Apr-16	68.57	60.49	0.00
11-Apr-16	66.23	56.70	0.00
12-Apr-16	63.87	53.82	0.00
13-Apr-16	64.55	54.27	0.00
14-Apr-16	64.54	56.71	0.00
15-Apr-16	58.28	58.43	0.00
16-Apr-16	61.15	58.77	0.00
17-Apr-16	57.80	63.13	0.00
18-Apr-16	58.49	64.49	0.00
19-Apr-16	54.18	58.62	0.00
20-Apr-16	58.36	62.70	0.00
21-Apr-16	46.39	46.50	0.00
22-Apr-16	50.93	40.07	0.00
23-Apr-16	54.64	37.80	0.00
24-Apr-16	55.95	40.78	0.00
25-Apr-16	47.84	55.86	0.00
26-Apr-16	49.30	57.75	12.95
27-Apr-16	51.10	56.09	32.82
28-Apr-16	59.28	62.40	78.93
29-Apr-16	45.04	57.16	69.10
30-Apr-16	35.67	55.20	69.86

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	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-May-16	38.25	55.97	71.05
2-May-16	39.02	54.67	71.21
3-May-16	38.33	55.94	71.56
4-May-16	37.81	54.10	73.67
5-May-16	39.15	53.65	74.43
6-May-16	41.20	51.80	76.81
7-May-16	42.49	48.02	75.84
8-May-16	37.34	48.07	74.68
9-May-16	36.92	45.93	73.95
10-May-16	37.46	43.70	77.79
11-May-16	46.15	47.31	81.02
12-May-16	50.83	54.70	82.61
13-May-16	58.46	57.03	79.87
14-May-16	74.86	55.77	81.87
15-May-16	67.79	53.52	83.86
16-May-16	61.24	50.74	91.00
17-May-16	57.51	48.21	99.67
18-May-16	52.48	49.30	113.09
19-May-16	47.94	40.68	106.31
20-May-16	52.46	44.54	126.76
21-May-16	50.41	45.72	124.14
22-May-16	44.88	43.38	118.64
23-May-16	46.26	44.53	119.03
24-May-16	49.70	48.94	130.05
25-May-16	49.52	47.44	130.68
26-May-16	34.56	34.72	77.44
27-May-16	42.90	44.42	87.36
28-May-16	49.88	54.18	121.49
29-May-16	59.16	53.33	128.04
30-May-16	60.04	52.96	131.78
31-May-16	62.27	53.85	132.15
1-Jun-16	57.86	51.52	129.44
2-Jun-16	55.45	51.32	125.45
3-Jun-16	58.05	51.37	147.38
4-Jun-16	63.18	49.86	153.03
5-Jun-16	62.46	50.73	153.23
6-Jun-16	57.94	47.27	136.57
7-Jun-16	59.24	46.07	122.95
8-Jun-16	56.27	43.67	126.33
9-Jun-16	57.29	43.37	130.47
10-Jun-16	59.38	48.33	141.24
11-Jun-16	58.37	46.23	104.91
12-Jun-16	60.32	45.40	61.29
13-Jun-16	64.82	47.27	58.58
14-Jun-16	62.05	45.35	56.56
15-Jun-16	64.07	48.42	61.38
16-Jun-16	64.13	47.90	61.61
17-Jun-16	62.37	47.96	58.91
18-Jun-16	63.32	49.17	58.86
19-Jun-16	63.18	49.28	62.06
20-Jun-16	64.20	50.11	62.93
21-Jun-16	56.00	44.10	51.62
22-Jun-16	59.11	46.78	79.95
23-Jun-16	59.69	46.75	74.70
24-Jun-16	60.94	45.35	75.27
25-Jun-16	62.54	45.25	73.58
26-Jun-16	61.81	47.43	74.18
27-Jun-16	62.05	46.63	68.30
28-Jun-16	63.45	45.71	76.21
29-Jun-16	61.51	44.16	86.77
30-Jun-16	44.57	35.06	83.93

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	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-Jul-16	36.36	26.71	80.70
2-Jul-16	36.55	27.15	78.14
3-Jul-16	36.38	26.67	77.05
4-Jul-16	39.82	29.52	84.22
5-Jul-16	47.52	34.25	81.27
6-Jul-16	60.89	42.81	77.39
7-Jul-16	58.98	43.46	77.34
8-Jul-16	58.60	43.00	76.45
9-Jul-16	58.52	43.15	76.79
10-Jul-16	57.27	41.88	75.30
11-Jul-16	58.40	43.31	74.38
12-Jul-16	59.35	44.91	75.36
13-Jul-16	60.49	45.50	72.88
14-Jul-16	61.07	46.34	81.86
15-Jul-16	61.82	45.22	80.84
16-Jul-16	65.49	45.07	78.80
17-Jul-16	62.27	44.66	78.58
18-Jul-16	62.12	44.16	76.84
19-Jul-16	60.65	43.49	75.03
20-Jul-16	61.31	43.75	75.23
21-Jul-16	62.47	44.86	74.98
22-Jul-16	62.65	44.45	74.58
23-Jul-16	65.62	44.49	81.40
24-Jul-16	64.50	45.26	80.54
25-Jul-16	64.34	45.17	82.94
26-Jul-16	60.97	42.46	78.53
27-Jul-16	60.16	42.88	77.08
28-Jul-16	43.67	45.19	74.76
29-Jul-16	45.85	44.71	75.38
30-Jul-16	44.68	45.74	76.81
31-Jul-16	61.00	46.07	83.52
1-Aug-16	62.09	45.33	81.43
2-Aug-16	33.26	46.55	78.35
3-Aug-16	31.04	53.91	78.38
4-Aug-16	57.48	56.78	80.94
5-Aug-16	62.82	57.69	82.75
6-Aug-16	60.65	53.96	82.60
7-Aug-16	57.19	33.90	81.40
8-Aug-16	56.88	34.43	80.49
9-Aug-16	54.23	33.81	77.35
10-Aug-16	56.20	35.22	78.94
11-Aug-16	56.91	36.24	77.86
12-Aug-16	60.12	37.71	81.72
13-Aug-16	60.22	36.18	78.76
14-Aug-16	59.33	35.99	79.28
15-Aug-16	59.56	36.10	77.87
16-Aug-16	58.61	36.31	77.75
17-Aug-16	62.75	37.64	83.31
18-Aug-16	63.96	38.35	82.18
19-Aug-16	63.96	37.90	81.34
20-Aug-16	61.15	36.36	76.57
21-Aug-16	57.90	34.13	72.85
22-Aug-16	58.59	33.66	75.20
23-Aug-16	60.45	35.76	78.01
24-Aug-16	62.60	41.66	79.09
25-Aug-16	59.77	42.10	77.08
26-Aug-16	61.25	42.75	78.50
27-Aug-16	58.06	40.65	75.77
28-Aug-16	63.69	46.01	84.14
29-Aug-16	63.81	47.15	83.87
30-Aug-16	60.68	45.43	72.07
31-Aug-16	58.24	42.93	62.31

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	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-Sep-16	59.24	41.78	63.40
2-Sep-16	59.79	43.89	73.31
3-Sep-16	61.84	45.65	80.84
4-Sep-16	64.36	47.82	87.48
5-Sep-16	63.11	46.26	77.70
6-Sep-16	60.68	44.75	72.75
7-Sep-16	61.61	46.05	74.44
8-Sep-16	60.59	45.85	71.51
9-Sep-16	60.54	46.51	72.38
10-Sep-16	61.03	45.38	69.86
11-Sep-16	63.41	46.18	76.76
12-Sep-16	66.39	48.13	80.40
13-Sep-16	66.80	46.31	76.12
14-Sep-16	63.63	44.47	73.61
15-Sep-16	63.66	44.74	66.09
16-Sep-16	63.71	44.66	73.08
17-Sep-16	61.10	40.96	71.93
18-Sep-16	63.72	48.14	74.74
19-Sep-16	65.52	51.94	77.67
20-Sep-16	65.13	51.11	82.94
21-Sep-16	65.14	50.56	85.10
22-Sep-16	64.61	49.23	83.14
23-Sep-16	62.54	45.63	81.28
24-Sep-16	64.89	48.26	82.86
25-Sep-16	66.10	49.40	86.67
26-Sep-16	63.03	47.32	78.98
27-Sep-16	65.35	48.05	81.16
28-Sep-16	68.22	46.20	86.17
29-Sep-16	64.88	43.11	83.02
30-Sep-16	63.51	41.64	80.13
1-Oct-16	59.93	37.73	58.11
2-Oct-16	50.02	43.72	65.25
3-Oct-16	40.13	46.47	87.34
4-Oct-16	40.39	47.74	89.60
5-Oct-16	41.35	48.44	89.72
6-Oct-16	43.45	51.30	91.98
7-Oct-16	61.96	47.99	84.11
8-Oct-16	64.49	45.26	78.07
9-Oct-16	53.14	46.18	79.86
10-Oct-16	40.85	41.92	62.39
11-Oct-16	37.94	49.09	60.74
12-Oct-16	34.76	48.50	58.06
13-Oct-16	32.81	43.07	60.20
14-Oct-16	32.62	43.46	58.62
15-Oct-16	39.65	40.06	58.67
16-Oct-16	42.67	37.38	58.23
17-Oct-16	40.45	38.01	58.09
18-Oct-16	43.05	39.71	59.69
19-Oct-16	46.38	39.47	47.06
20-Oct-16	50.27	53.82	50.01
21-Oct-16	52.41	54.17	50.65
22-Oct-16	57.59	55.69	62.70
23-Oct-16	68.45	55.97	82.97
24-Oct-16	68.74	53.81	83.01
25-Oct-16	67.56	53.21	88.61
26-Oct-16	71.09	51.30	92.65
27-Oct-16	73.48	49.94	92.18
28-Oct-16	73.62	50.68	91.19
29-Oct-16	69.11	51.83	90.60
30-Oct-16	66.49	52.30	90.39
31-Oct-16	67.62	52.09	90.26

Quest Emissions to air, soil or water – Performance 2016		1
Heavy Oil		

	Hydrogen Manufacturing Unit (S-24103) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-24203) Steam Reformer Stack	Hydrogen Manufacturing Unit (S-44103) Steam Reformer Stack
	NOx Daily Average ppm	NOx Daily Average ppm	NOx Daily Average ppm
1-Nov-16	70.14	58.79	90.78
2-Nov-16	69.96	56.43	90.63
3-Nov-16	67.87	53.21	91.46
4-Nov-16	66.03	54.25	92.32
5-Nov-16	64.00	52.75	90.93
6-Nov-16	64.05	53.37	91.82
7-Nov-16	67.34	53.93	93.72
8-Nov-16	59.55	46.60	86.38
9-Nov-16	59.47	47.53	85.77
10-Nov-16	61.55	49.30	89.23
11-Nov-16	61.10	48.77	79.63
12-Nov-16	57.08	45.95	88.34
13-Nov-16	56.76	45.19	87.17
14-Nov-16	63.20	45.77	89.56
15-Nov-16	71.38	47.28	94.06
16-Nov-16	69.50	48.27	94.56
17-Nov-16	72.16	50.86	96.10
18-Nov-16	70.38	51.95	94.66
19-Nov-16	66.03	50.75	92.79
20-Nov-16	64.37	49.17	91.42
21-Nov-16	65.06	49.05	90.57
22-Nov-16	65.24	49.66	90.56
23-Nov-16	67.40	48.29	90.49
24-Nov-16	68.92	49.09	89.94
25-Nov-16	70.08	48.63	89.68
26-Nov-16	69.11	49.48	88.39
27-Nov-16	68.55	48.27	87.90
28-Nov-16	69.03	48.83	87.84
29-Nov-16	70.39	50.50	91.05
30-Nov-16	70.01	50.43	88.33
1-Dec-16	62.15	44.22	80.78
2-Dec-16	27.56	22.38	42.80
3-Dec-16	33.16	31.47	42.71
4-Dec-16	38.01	36.32	43.55
5-Dec-16	70.49	58.69	55.24
6-Dec-16	70.11	52.79	93.39
7-Dec-16	71.93	59.72	92.98
8-Dec-16	70.51	59.57	94.89
9-Dec-16	64.89	59.73	88.08
10-Dec-16	51.55	61.38	84.57
11-Dec-16	50.27	61.74	83.11
12-Dec-16	50.03	60.56	89.13
13-Dec-16	55.29	60.48	94.24
14-Dec-16	55.58	61.38	95.59
15-Dec-16	54.95	61.39	97.56
16-Dec-16	62.63	62.36	91.44
17-Dec-16	64.86	59.83	88.79
18-Dec-16	65.52	57.53	89.57
19-Dec-16	62.44	56.79	100.83
20-Dec-16	63.92	57.80	100.98
21-Dec-16	66.54	59.17	98.19
22-Dec-16	57.23	58.90	96.23
23-Dec-16	63.25	59.38	95.59
24-Dec-16	68.58	62.13	91.13
25-Dec-16	67.10	62.58	92.00
26-Dec-16	66.63	62.14	91.09
27-Dec-16	64.67	58.66	89.72
28-Dec-16	65.59	59.07	82.23
29-Dec-16	67.82	60.60	84.46
30-Dec-16	66.30	59.46	85.58
31-Dec-16	65.52	58.20	84.86

Quest Emissions to air, soil or water – Performance 2016		1
Heavy Oil		