



VOC Destruction Efficiency Emissions Test Report

RECEIVED

JAN 31 2018

AIR QUALITY DIVISION

Prepared for:

Arvron, Inc.

Arvron, Inc.
4720 Clay Ave. SW
Grand Rapids, Michigan

Project No. 049AS-282257
January 12, 2018

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073
(248) 548-8070



EXECUTIVE SUMMARY

BT Environmental Consulting, Inc. (BTEC) was retained by Arvron, Inc. (Arvron) to conduct a volatile organic compound (VOC) Destruction Efficiency (DE) emissions test program on one RTO at the Arvron facility located in Grand Rapids, Michigan. The emissions test program was conducted on December 20, 2017.

Testing of the RTO consisted of triplicate 60-minute test runs. The emissions test program was required by MDEQ Air Quality Division Permit To Install (PTI) Number 238-94B. The results of the emission test program are summarized by Table I.

Table I
Overall Emission Summary
Test Date: December 20, 2017

Pollutant	Destruction Efficiency (%)	Emission Limit
VOC	98.4	95% DE

RECEIVED
JAN 31 2018
AIR QUALITY DIVISION



1. Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Arvron, Inc. (Arvron) to conduct a volatile organic compound (VOC) Destruction Efficiency (DE) emissions test program on one RTO at the Arvron facility located in Grand Rapids, Michigan. The emissions test program was conducted on December 20, 2017.

AQD has published a guidance document entitled “Format for Submittal of Source Emission Test Plans and Reports” (December 2013). The following is a summary of the emissions test program and results in the format suggested by the aforementioned document.

1.a Identification, Location, and Dates of Test

Sampling and analysis for the emission test program was conducted on December 20, 2017 at the Arvron facility located in Grand Rapids, Michigan. The test program included evaluation of VOC DE emissions from one RTO.

1.b Purpose of Testing

AQD issued Permit To Install No. 238-94B to Arvron. The permit limits emissions from the oxidizers as summarized by Table 1.

**Table 1
VOC DE Emission Limitations
Arvron, Inc.**

Source	Pollutant	Emission Limit
RTO	VOC	95% DE

1.c Source Description

Arvron manufactures a variety of Expanded Polystyrene (EPS) products from small EPS beads.

1.d Test Program Contacts

The contact for the source and test report is:

Mr. Doug Heyboer
President
Arvron, Inc.
4720 Clay Ave SW
Grand Rapids, Michigan 49548
(616) 530-1888

Names and affiliations for personnel who were present during the testing program are summarized by Table 2.

**Table 2
Test Personnel**

Name and Title	Affiliation	Telephone
Mr. Steve Smith Project Manager	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. David Trahan Environmental Technician	BTEC 4949 Fernlee Royal Oak, MI 48073	(248) 548-8070
Mr. Mark Horne Principal	Environmental Partner, Inc. 305 Hoover Boulevard, Suite 200 Holland, MI 49423	(616) 928-9128
Mr. Dave Patterson Technical Programs Unit	MDEQ AQD	(517) 284-6782

2. Summary of Results

Sections 2.a through 2.d summarize the results of the emissions compliance test program.

2.a Operating Data

The following process data was recorded and is available in Appendix D: RTO operating temperature, quantities and types of EPS beads processed, and pentane content of the EPS beads.

2.b Applicable Permit

The applicable permit for this emissions test program is Permit To Install (PTI) No. 238-94B.

2.c Results

RTO VOC DE test result is 98.4%, which is higher than the 95% emission limit.

3. Source Description

Sections 3.a through 3.e provide a detailed description of the process.



3.a Process Description

EPS beads are heated, expanded, and molded into various insulating and structural EPS products.

3.b Process Flow Diagram

Due to the simplicity of the thermal oxidizer, a process flow diagram is not necessary.

3.c Raw and Finished Materials

The raw material used by the process is EPS beads.

3.d Process Capacity

The process capacity is 30,000,000 lbs/yr.

3.e Process Instrumentation

Process batch mass rate.

RECEIVED

JAN 31 2018

AIR QUALITY DIVISION

4. Sampling and Analytical Procedures

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures used.

4.a Sampling Train and Field Procedures

Measurement of exhaust gas velocity, molecular weight, and moisture content were conducted using the following reference test methods codified at 40 CFR 60, Appendix A:

- Method 1 - "Sample and Velocity Traverses for Stationary Sources"
- Method 2 - "Determination of Stack Gas Velocity and Volumetric Flow rate"
- Method 3 - "Determination of Molecular Weight of Dry Stack Gas" (Fyrite)
- Method 4 - "Determination of Moisture Content in Stack Gases"
- Method 25A - "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer"

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. An S-type pitot tube with a thermocouple assembly, calibrated in accordance with Method 2 was used to measure exhaust gas velocity pressures (using a manometer) and temperatures during testing. The S-type pitot tube dimensions were within specified limits, therefore, a baseline pitot tube coefficient of 0.84 (dimensionless) was assigned.

A cyclonic flow check was performed at the sampling location. The existence of cyclonic flow is determined by measuring the flow angle at each sample point. The flow angle is the angle between the direction of flow and the axis of the stack. If the average of the absolute values of the flow angles is greater than 20 degrees, cyclonic flow exists. The null angle was determined to be less than 20 degrees at each sampling point.

The Molecular Weight of the gas stream was evaluated according to procedures outlined in Title 40, Part 60, Appendix A, Method 3. The O₂/CO₂ content of the gas stream was measured using an O₂/CO₂ Fyrite gas analyzer.

Exhaust gas moisture content was evaluated using Method 4. Exhaust gas was extracted as part of the moisture sampling and passed through (i) two impingers, each with 100 ml water, (ii) an empty impinger, and (iii) an impinger filled with silica gel. Exhaust gas moisture content is then determined gravimetrically.

Volatile Organic Compounds (USEPA Method 25A)

Volatile Organic compound (VOC) concentrations were measured according to 40 CFR 60, Appendix A, Method 25A. A sample of the gas stream was drawn through a stainless steel probe with an in-line glass fiber filter to remove any particulate, and a heated Teflon® sample line to prevent the condensation of any moisture from the sample before it enters the analyzer. Data was recorded at 4-second intervals on a PC equipped with data acquisition software. BTEC used a VIG Model 20 THC hydrocarbon analyzer to determine the VOC concentrations at the inlet, and a JUM 109A Methane/Non-Methane THC hydrocarbon analyzer to determine the VOC concentrations at the outlet.

The VIG hydrocarbon analyzer channels a fraction of the gas sample through a capillary tube that directs the sample to the flame ionization detector (FID), where the hydrocarbons present in the sample are ionized into carbon. The carbon concentration is then determined by the detector in parts per million (ppm). This concentration is transmitted to the data acquisition system (DAS) at 4-second intervals in the form of an analog signal, specifically voltage, to produce data that can be averaged over the duration of the testing program. This data is then used to determine the average ppm for total hydrocarbons (THC) using the equivalent units of propane (calibration gas).

The JUM Model 109A analyzer utilizes two flame ionization detectors (FIDs) in order to report the average ppmv for total hydrocarbons (THC), as propane, as well as the average ppmv for methane (as methane). Upon entry, the analyzer splits the gas stream. One FID ionizes all of the hydrocarbons in the gas stream sample into carbon, which is then detected as a concentration of total hydrocarbons. Using an analog signal, specifically voltage, the concentration of THC is then sent to the data acquisition system (DAS), where recordings are taken at 4-second intervals to produce an average based on the overall duration of the test. This average is then used to determine the average ppmv for THC reported as the calibration gas, propane, in equivalent units.

The second FID reports methane only. The sample enters a chamber containing a catalyst that destroys all of the hydrocarbons present in the gas stream other than methane. As with the THC sample, the methane gas concentration is sent to the DAS and recorded. The methane concentration, reported as methane, can then be converted to methane, reported as propane, by dividing the measured methane concentration by the analyzer's response factor.

The JUM analyzer was calibrated for a range of 0 to 1,000 ppm on each channel and the VIG analyzer was calibrated for a range of 0 to 10,000 ppm.

In accordance with Method 25A, a 3-point (zero, mid, and high) calibration check was performed on the THC analyzer. Calibration drift checks were performed at the completion of each run.

For analyzer calibrations, calibration gases were mixed to desired concentrations using an Environics Series 4040 Computerized Gas Dilution System. The Series 4040 consists of a single chassis with four mass flow controllers. The mass flow controllers are factory-calibrated using a primary flow standard traceable to the United States National Institute of Standards and Technology (NIST). Each flow controller utilizes an 11-point calibration table with linear interpolation, to increase accuracy and reduce flow controller nonlinearity. A field quality assurance check of the system was performed pursuant to Method 205 by setting the diluted concentration to a value identical to a Protocol 1 calibration gas and then verifying that the analyzer response is the same with the diluted gas as with the Protocol 1 gas.

4.b Recovery and Analytical Procedures

This test program did not include laboratory samples, consequently, sample recovery and analysis is not applicable to this test program.

4.c Sampling Ports

A diagram of the stack showing sampling ports in relation to upstream and downstream disturbances is included as Figures 3 and 4.

4.d Traverse Points

A diagram of the stack indicating traverse point locations and stack dimensions is included as Figures 3 and 4.

5. Test Results and Discussion

Sections 5.a through 5.k provide a summary of the test results.

5.a Results Tabulation

The overall results of the emissions test program are summarized by Table 3. Detailed results for the emissions test program are summarized by Table 4.

Table 3
Overall Emission Summary
Test Date: December 20, 2017

Pollutant	Destruction Efficiency (%)	Emission Limit
VOC	98.4	95% DE

5.b Discussion of Results

The RTO VOC DE test result is 98.4%, which is higher than the 95% emission limit.

5.c Sampling Procedure Variations

There were no procedure variations.

5.d Process or Control Device Upsets

During run 1, there was an 11 minute pause due to an RTO trip.

5.e Control Device Maintenance

Normal routine maintenance activities were performed within the last three months.

5.f Re-Test

The emissions test program was not a re-test.

5.g Audit Sample Analyses

No audit samples were collected as part of the test program.

5.h Calibration Sheets

Relevant equipment calibration documents are provided in Appendix B.



5.i Sample Calculations

Sample calculations are provided in Appendix C.

5.j Field Data Sheets

Field documents relevant to the emissions test program are presented in Appendix A.

5.k Laboratory Data

There are no laboratory results for this test program. Raw VOC data, RTO temperature, and process data are provided in Appendix D.

**Table 4
RTO Destruction Efficiency Summary
Arvron, Inc.
Grand Rapids, Michigan**

Parameter	Run 1	Run 2	Run 3	Average
Sampling Date	12/20/2018	12/20/2018	12/20/2018	
Sampling Time	8:00-8:17 8:28-9:11	9:24-10:24	10:38-11:38	
Inlet Flowrate (scfm)	7,238	7,414	7,164	7,272
Outlet Flowrate (scfm)	8,473	8,576	8,536	8,528
Inlet VOC Concentration (ppmv propane)	1020.0	1124.7	1241.5	1128.7
Inlet VOC Concentration (ppmv, corrected as per USEPA 7E)	1010.6	1098.9	1200.7	1103.4
Inlet VOC Mass Flowrate (lb/hr)	50.1	55.8	58.9	54.9
Outlet VOC Concentration (ppmv propane)	18.3	18.0	18.3	18.2
Outlet VOC Concentration (ppmv, corrected as per USEPA 7E)	18.4	18.6	18.6	18.5
Outlet CH4 Concentration (ppmv methane)	7.6	8.3	6.6	7.5
Outlet CH4 Concentration (ppmv, corrected as per USEPA 7E)	7.4	8.2	6.4	7.3
Outlet VOC Concentration (- methane)	15.1	15.0	15.7	15.3
Outlet VOC Mass Emission Rate (lb/hr)	0.9	0.9	0.9	0.9
VOC Destruction Efficiency (%)	98.3	98.4	98.4	98.4

scfm: standard cubic feet per minute
 ppmv: parts per million on a volume to volume basis
 lb/hr: pounds per hour
 VOC: volatile organic compound
 MW = molecular weight (C₃H₈ = 44.10)
 24.14: molar volume of air at standard conditions (70°F, 29.92" Hg)
 35.31: ft³ per m³
 453600: mg per lb
Equations
 lb/hr = ppmv * MW/24.14 * 1/35.31 * 1/453,600 * scfm* 60

Inlet VOC Correction			
Co	-9.42	-5.84	-7.77
Cma	1495	1495	1495
Cm	1513.41	1532.25	1547.75

Outlet VOC Correction			
Co	0.21	0.26	0.67
Cma	299	299	299
Cm	294.19	284.93	284.14

Outlet CH4 Correction			
Co	0.27	0.44	0.42
Cma	29.9	29.9	29.9
Cm	29.50	29.07	29.06

RF= 2.24

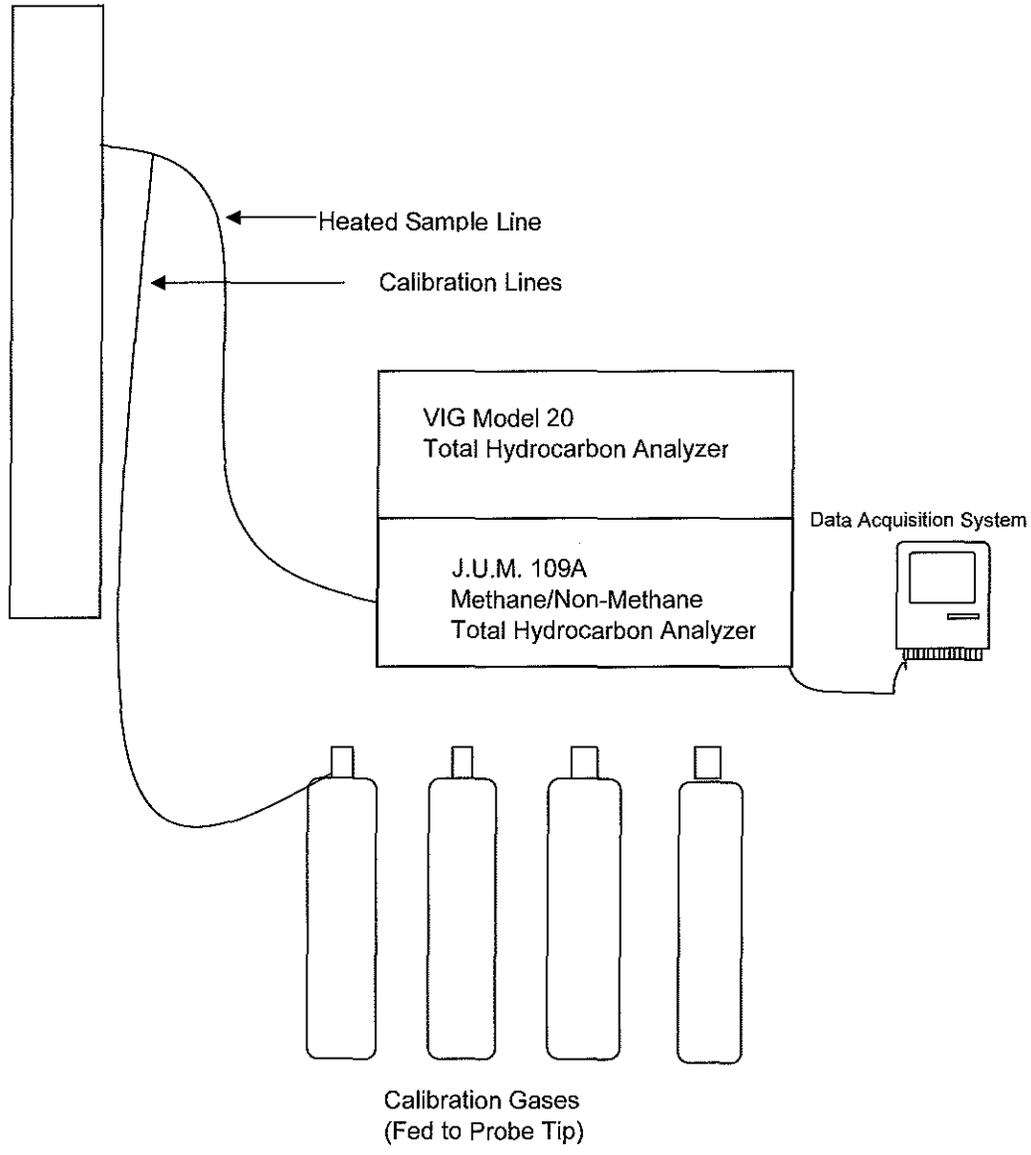


Figure No. 1

Site: USEPA Method 25A
Arvron, Inc.
Grand Rapids, Michigan

Sampling Date: December 20, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073

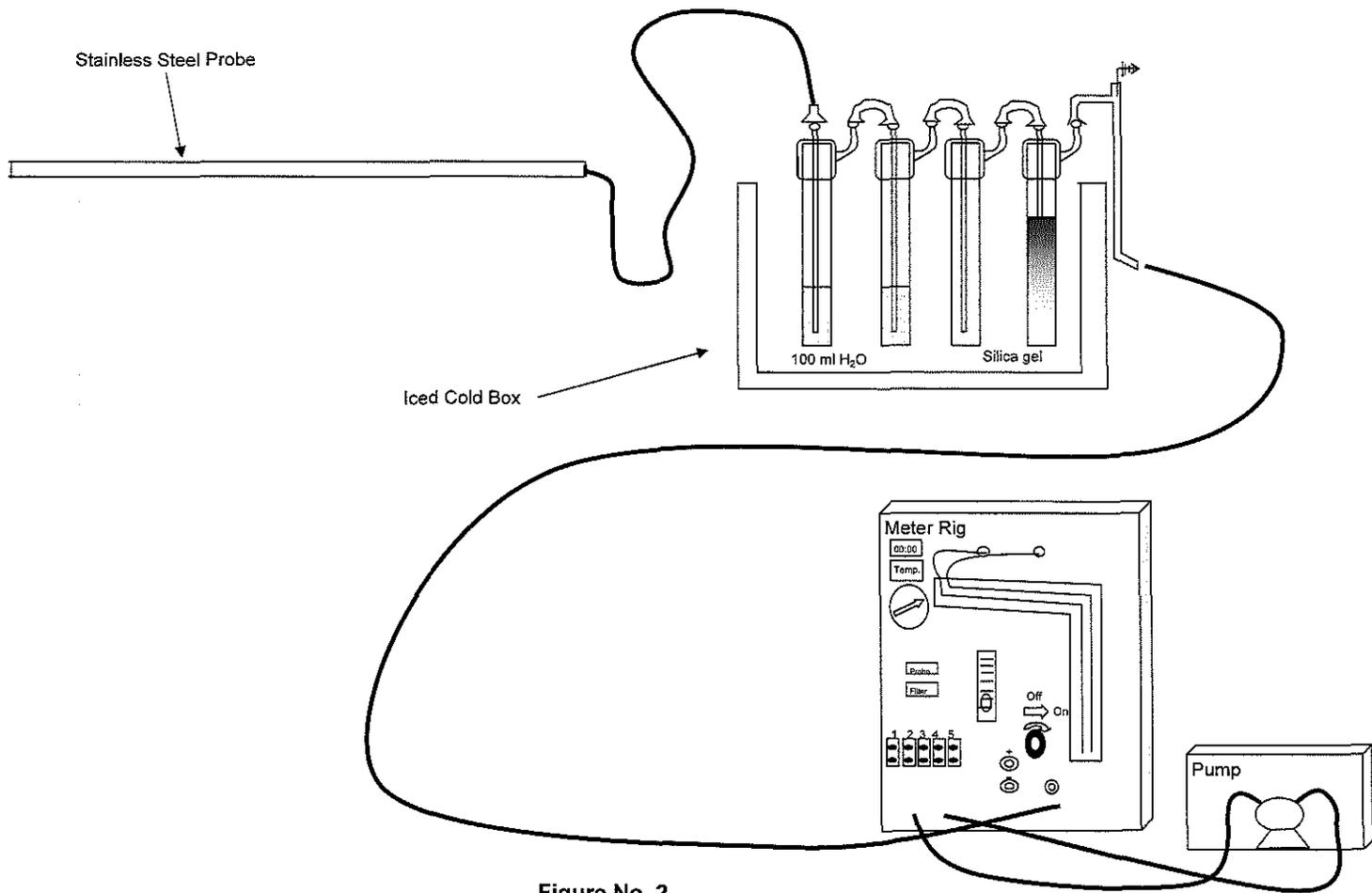


Figure No. 2

Site:
USEPA Method 4
Arvcon, Inc.
Grand Rapids, Michigan

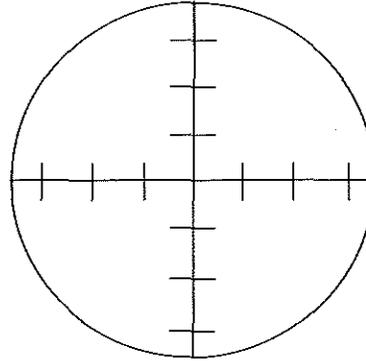
Sampling Date:
December 20, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073



diameter = 24 inches

Points	Distance "
1	1.1
2	3.5
3	7.1
4	16.9
5	20.5
6	22.9



Not to Scale

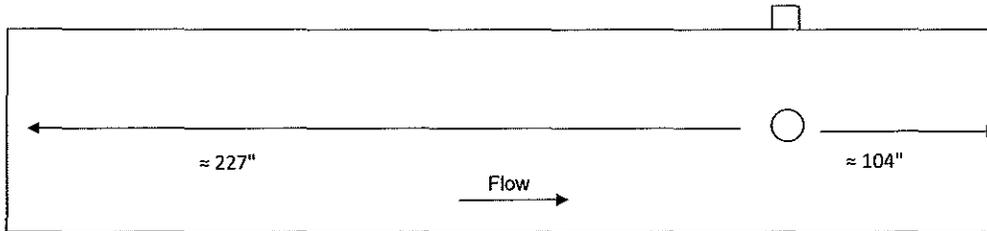


Figure No. 3

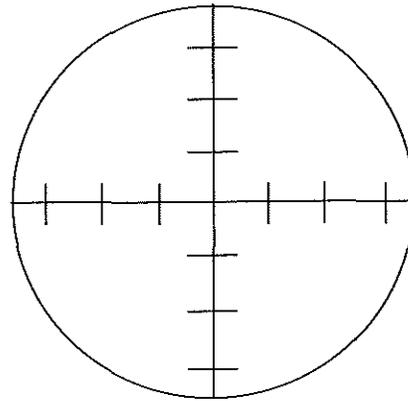
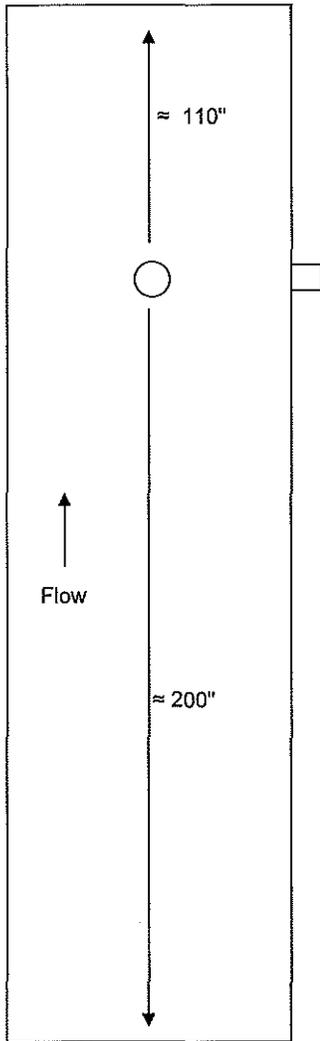
Site:
RTO Inlet
Arvron, Inc
Grand Rapids, Michigan

Sampling Date:
December 20, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073



diameter = 24 inches



Not to Scale

Points	Distance "
1	1.1
2	3.5
3	7.1
4	16.9
5	20.5
6	22.9

Figure No. 4

Site:
RTO Outlet
Arvron, Inc
Grand Rapids, Michigan

Sampling Date:
December 20, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
Royal Oak, Michigan 48073