



# Grain Elevator Particulate Matter Emissions Test Report

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OCT 27 2014  
AIR QUALITY DIV.

*Prepared for:*

**Cooperative Elevator Co.**

Cooperative Elevator Co.  
7211 East Michigan Avenue  
Pigeon, Michigan 48755

Project No. 14-4590.00

October 16, 2014

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

**EXECUTIVE SUMMARY**

BT Environmental Consulting, Inc. (BTEC) was retained by Cooperative Elevator Co. (CEC) to evaluate exhaust gas and fugitive emissions opacity as well as filterable particulate matter (PM) emission rates. The emission test program included (1) evaluations of PM concentrations and emission rates as well as exhaust gas opacity at one baghouse exhaust stack at the CEC facility in Ruth, Michigan; (2) the evaluation of fugitive emissions opacity from one truck unloading station at the CEC facility in Ruth, Michigan; and (3) the evaluation of fugitive emissions opacity from one truck unloading station at the CEC facility in Elkton, Michigan. The purpose of the test program was to show compliance with Title 40, Part 60, Subpart DD of the Code of Federal Regulations. Emission limitations for the affected equipment are (1) 0.01 gr/dscf for PM emissions from the baghouse exhaust, (2) 0% opacity for the baghouse exhaust, and (3) 5% opacity for the truck unloading station visible emissions.

Testing consisted of triplicate 80-minute test runs. Sampling and analysis for the emission test program was conducted on August 26 and 27, 2014. The results of this test program are summarized by the following table.

**Table I  
Test Program Summary Ruth, MI**

<b>Source</b>	<b>Permit Limitation Emission Rate</b>	<b>Average PM Emission Rate</b>
Baghouse	0.01 gr/dscf	0.0003 gr/dscf
	0% Opacity	0% Opacity
Unloading Station	5% Opacity	Run 1- < 5%
		Run 2- < 5%
		Run 3- < 5%

**Table II  
Test Program Summary Elkton, MI**

<b>Source</b>	<b>Permit Limitation Emission Rate</b>	<b>Average PM Emission Rate</b>
Unloading Station	5% Opacity	Run 1- < 5%
		Run 2- < 5%
		Run 3- < 5%



## **1. Introduction**

BT Environmental Consulting, Inc. (BTEC) was retained by Cooperative Elevator Co. (CEC) to evaluate exhaust gas and fugitive emissions opacity as well as filterable particulate matter (PM) emission rate from the baghouse and unloading trucks located at 4600 S. Ruth Rd in Ruth, Michigan. Also emissions opacity at the CEC facility located at 4245 Pigeon Rd in Elkton, Michigan. The purpose of the test program was to show compliance with Title 40, Part 60, Subpart DD of the Code of Federal Regulations. Emission limitations for the affected equipment are (1) 0.01 gr/dscf for PM emissions from the baghouse exhaust, (2) 0% opacity for the baghouse exhaust, and (3) 5% opacity for the truck unloading stations visible emissions.

The Air Quality Division (AQD) of Michigan's Department of Environmental Quality 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 August 26, 2014 for both the visible emissions and the PM testing at the CEC facility in Ruth, Michigan. Changes were made to the capture system on the unloading station at the CEC facility in Ruth, Michigan and the visible emissions were retested on October 13, 2014 with passing results. Visible emissions testing was conducted on August 27, 2014 at the CEC facility in Elkton, Michigan. The test program included evaluation of PM emissions and visual emissions from the baghouse exhaust stack and visible emissions on two unloading stations.

### **1.b Purpose of Testing**

The purpose of the testing is to show that both the baghouse exhaust and the truck unloading stations are in compliance with Title 40, Part 60, Subpart DD of the Code of Federal Regulations.

### **1.c Source Description**

The Ruth and Elkton facilities store, transfer, handle, and process corn, white wheat, red wheat, and soybeans. Process operations included unloading grain from incoming trucks to the storage silos. It was anticipated that the grain transfer rate during the emissions test runs was equivalent to the typical maximum grain transfer rate of 18,000 to 20,000 bushels per hour.



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The locations for the CEC Ruth and Elkton facilities are as follows:

Cooperative Elevator Co.  
4600 S. Ruth Road  
Ruth, MI 48470

Elkton Terminal  
4245 Pigeon Road  
Elkton, MI 48731

#### **1.d Test Program Contact**

The contact for information regarding the test program as well as the test report is as follows:

Mr. Burt Eichler  
Safety Director  
Cooperative Elevator Co.  
7211 East Michigan Avenue  
Pigeon, Michigan 48755  
(989) 453-4500, ext. 577

Mr. Barry P. Boulianne  
Senior Project Manager  
BT Environmental Consulting, Inc.  
4949 Fernlee Avenue  
Royal Oak, MI 48073  
313-449-2361



## 1.e Testing Personnel

Names and affiliations for all personnel who were present during the testing program are summarized by Table 1.

**Table 1**  
**Testing Personnel**

<b>Name</b>	<b>Affiliation</b>
Barry Boulianne	BTEC
Paul Molenda	BTEC
Kenny Felder	BTEC
Burt Eichler	CEC
Gina McCann	MDEQ

## 2. Summary of Results

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

### 2.a Operating Data

Operating data is N/A for this test.

### 2.b Applicable Permit

The grain elevator equipment at the Ruth and Elkton facilities is exempt from permitting pursuant to R 336.1285(p) of the Michigan Administrative Code. However, some equipment are affected by the requirements of Title 40, Part 60, Subpart DD of the Code of Federal Regulations

### 2.c Results

Title 40, Part 60, Subpart DD of the Code of Federal Regulations limits the baghouse PM to 0.01 gr/dscf and opacity of 0% at the Ruth, Michigan location. Federal regulations also limit the truck unloading station to 5% opacity at the Ruth, Michigan location. Title 40, Part 60, Subpart DD of the Code of Federal Regulations limits the truck unloading station at the Elkton, Michigan location to 5% opacity.

At the Ruth, Michigan location the average baghouse PM emission rate was 0.0003 gr/dscf and the opacity was 0%. The unloading station at the Ruth, Michigan location was less than 5% opacity for all three runs. Emission testing at the Elkton, Michigan location had opacity of less than 5% for all three runs See Table 2 for a detailed summary of PM emissions including all the runs and Table 3 for a detailed summary of the opacity testing.

## **2.d Emission Regulation Comparison**

The results summarized by Tables 2 show that the PM emissions are below the limits summarized by section 2.c. The results summarized by Table 3 show that the opacity for the baghouse and the truck loading station are below the limits at the Ruth, Michigan location. The results from Table 3 also show that the opacity for the truck unloading station at the Elkton, Michigan location is below the limits.

## **3. Source Description**

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

### **3.a Process Description**

Truck loading and unloading operations and some grain handling operations at the Ruth facility will be exhausted through a new baghouse dust collector.

### **3.b Process Flow Diagram**

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

### **3.c Raw and Finished Materials**

Raw Material used includes soybeans, corn, and wheat.

### **3.d Process Capacity**

The baghouse dust collector is rated for approximately 55,000 cfm.

### **3.e Process Instrumentation**

Process instrumentation is N/A for this test.

## **4. Sampling and Analytical Procedures**

Sections 4.a through 4.d provide a summary of the sampling and analytical procedures that were used to test for PM emissions.

### **4.a Sampling Train and Field Procedures**

To evaluate PM mass emission rates, BTEC utilized the following reference test methods codified at Title 40, Part 60, Appendix A of the Code of Federal Regulations:

- Method 1 - *“Sample and Velocity Traverses for Stationary Sources”*
- Method 2 - *“Determination of Stack Gas Velocity and Volumetric Flowrate”*

- Method 3 - *“Gas Analysis for the Determination of Dry Molecular Weight” (Fyrite Analysis)*
- Method 4 - *“Determination of Moisture Content in Stack Gases”*
- Method 9- *“Visual Determination of the Opacity of Emissions from Stationary Sources”*
- Method 17 - *“Determination of Particulate Emissions from Stationary Sources”*

Stack gas velocity traverses were conducted in accordance with the procedures outlined in Methods 1 and 2. Figure 1 presents the test port and traverse/sampling point locations used. An S-type pitot tube and thermocouple assembly calibrated in accordance with Method 2, Section 4.1.1 was used to measure exhaust gas velocity pressures and temperatures during testing. Because the pitot tube dimensions outlined in Sections 2-6 through 2-8 were within the specified limits, the baseline pitot tube coefficient of 0.84 (dimensionless) was assigned for this testing.

Molecular weight determinations were conducted according to Method 3. The equipment used for this evaluation consisted of a one-way squeeze bulb with connecting tubing and a set of Fyrite<sup>®</sup> combustion gas analyzers. Moisture content was determined from the condensate collected in the Method 17 sampling train according to Method 4.

40 CFR 60, Appendix A, Method 17, *“Determination of Particulate Emissions from Stationary Sources”* was used to measure PM concentrations and calculate PM emission rates (see Figure 1 for a schematic of the sampling train). Triplicate 60-minute test runs were conducted on the baghouse exhaust.

BTEC’s Nutech<sup>®</sup> Model 2010 modular isokinetic stack sampling system consisted of (1) a stainless-steel nozzle, (2) an in stack stainless-steel filter housing, (3) a steel probe, (4) a set of four Greenburg-Smith (GS) impingers with the first modified and second standard GS impingers each containing 100 ml of deionized water, and with a third dry modified GS impinger and a fourth modified GS impinger containing approximately 300 g of silica gel desiccant, (5) a length of sample line, and (6) a Nutech<sup>®</sup> control case equipped with a pump, dry gas meter, and calibrated orifice.

A sampling train leak test was conducted before and after each test run. After completion of the final leak test for each test run, the filter was recovered, and the nozzle and the front half of the filter holder assembly were brushed and triple rinsed with acetone. The acetone rinses were collected in a pre-cleaned sample container.

BTEC labeled each container with the test number, test location, and test date, and marked the level of liquid on the outside of the container. In addition blank samples of the acetone and filter were collected. BTEC personnel carried all samples to BTEC's laboratory (for filter and acetone gravimetric analysis) in Royal Oak, Michigan.

Method 9, *“Visual Determination of the Opacity of Emissions from Stationary Sources”* was used to measure opacity on two truck unloading sites and the baghouse.



#### **4.b Recovery and Analytical Procedures**

Recovery and analytical procedures were described in Section 4.a.

#### **4.c Sampling Ports**

Sampling port and traverse point locations for the baghouse exhaust stack are illustrated by Figure 2.

#### **4.d Traverse Points**

Sampling port and traverse point locations for the baghouse exhaust stack are illustrated by Figure 2.

### **5. Test Results and Discussion**

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

#### **5.a Results Tabulation**

The results of the test program are summarized by Table 2-3.

#### **5.b Discussion of Results**

Federal regulation limits the PM concentration for the baghouse to 0.01 gr/dscf, and the test averaged 0.0003 gr/dscf, well below the limit. The opacity reading for the baghouse is at the limit of 0%. The opacity average for the truck unloading station at the Ruth, Michigan location is below the 5% limit. The opacity average for the truck unloading station in Elkton, Michigan location is below the 5% limit.

#### **5.c Sampling Procedure Variations**

No sampling procedure variations were used during testing.

#### **5.d Process or Control Device Upsets**

No upset conditions occurred during testing.

#### **5.e Control Device Maintenance**

No maintenance was performed during the test program.





#### **5.f Re-Test Changes**

Visible emissions testing on the unloading station in Ruth, Michigan were originally conducted on August 26, 2014 and yielded opacity greater than 5%. Changes were made to the capture system and the unloading station was retested on October 13, 2014 with passing results. Opacity data sheets from both days are available in Appendix A.

#### **5.g Audit Sample Analyses**

Audit samples were not applicable to this test program.

#### **5.h Calibration Sheets**

Relevant equipment calibration documents are provided as Appendix B.

#### **5.i Sample Calculations**

Sample calculations are provided as Appendix C.

#### **5.j Field Data Sheets**

Copies of field data sheets and relevant field notes are provided in Appendix A.

#### **5.k Laboratory Data**

Laboratory Data is provided in Appendix D

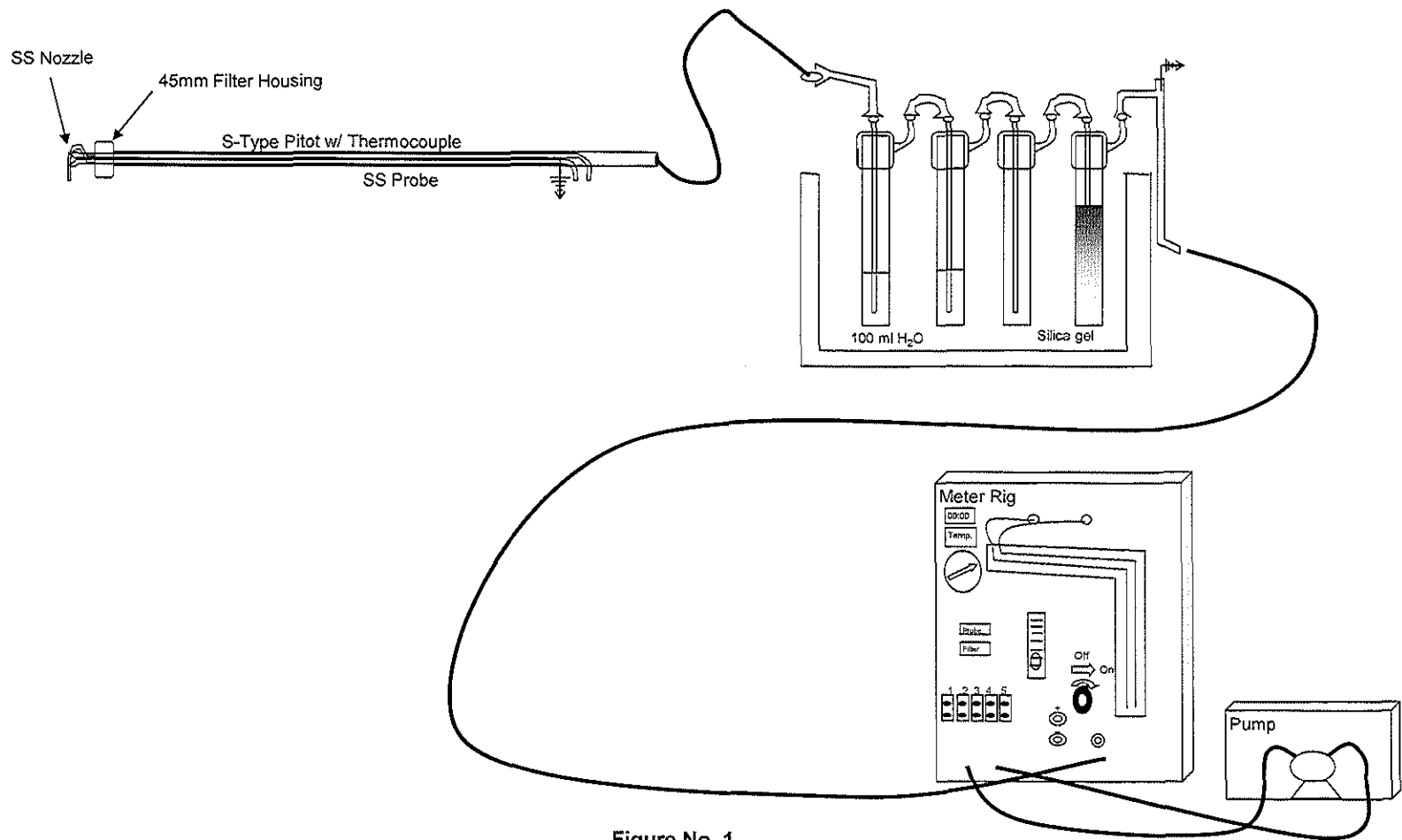
**Table 2**  
**Baghouse Particulate Matter Emission Rates**

Company Source Designation Test Date	Co-Op BH Out			Average
	8/26/2014	8/26/2014	8/26/2014	
<b>Meter/Nozzle Information</b>	P-1	P-2	P-3	
Meter Temperature Tm (F)	74.7	83.2	84.7	80.9
Meter Pressure - Pm (in. Hg)	29.4	29.4	29.4	29.4
Measured Sample Volume (Vm)	75.3	75.4	74.3	75.0
Sample Volume (Vm-Std ft3)	72.8	71.7	70.5	71.7
Sample Volume (Vm-Std m3)	2.06	2.03	2.00	2.03
Condensate Volume (Vw-std)	2.075	1.933	1.509	1.839
Gas Density (Ps(std) lbs/ft3) (wet)	0.0738	0.0738	0.0739	0.0738
Gas Density (Ps(std) lbs/ft3) (dry)	0.0745	0.0745	0.0745	0.0745
Total weight of sampled gas (m g lbs) (wet)	5.52	5.44	5.33	5.43
Total weight of sampled gas (m g lbs) (dry)	5.43	5.35	5.26	5.34
Nozzle Size - An (sq. ft.)	0.000299	0.000299	0.000299	0.000299
Isokinetic Variation - I	99.8	99.7	98.9	99.5
<b>Stack Data</b>				
Average Stack Temperature - Ts (F)	72.0	76.9	78.1	75.6
Molecular Weight Stack Gas- dry (Md)	28.8	28.8	28.8	28.8
Molecular Weight Stack Gas-wet (Ms)	28.5	28.6	28.6	28.6
Stack Gas Specific Gravity (Gs)	0.985	0.986	0.988	0.986
Percent Moisture (Bws)	2.77	2.62	2.09	2.50
Water Vapor Volume (fraction)	0.0277	0.0262	0.0209	0.0250
Pressure - Ps ("Hg)	28.6	28.6	28.6	28.6
Average Stack Velocity - Vs (ft/sec)	55.1	54.8	54.1	54.7
Area of Stack (ft2)	15.9	15.9	15.9	15.9
<b>Exhaust Gas Flowrate</b>				
Flowrate ft <sup>3</sup> (Actual)	52,600	52,277	51,629	52,169
Flowrate ft <sup>3</sup> (Standard Wet)	49,943	49,183	48,460	49,195
Flowrate ft <sup>3</sup> (Standard Dry)	48,559	47,893	47,445	47,966
Flowrate m <sup>3</sup> (standard dry)	1,375	1,356	1,344	1,358
<b>Total Particulate Weights (mg)</b>				
Nozzle/Probe/Filter	1.3	1.4	1.8	1.5
<b>Total Particulate Concentration</b>				
lb/1000 lb (wet)	0.001	0.001	0.001	0.001
lb/1000 lb (dry)	0.001	0.001	0.001	0.001
mg/dscm (dry)	0.6	0.7	0.9	0.7
gr/dscf	0.0003	0.0003	0.0004	0.0003
<b>Total Particulate Emission Rate</b>				
lb/ hr	0.12	0.12	0.16	0.13

**Table 3  
Opacity Average**

	Location:	Elkton, Michigan		Ruth, Michigan	
	Source:	Unloading Station	Unloading Station	Unloading Station	Baghouse
Run 1	1st 6-Minute Average Opacity:	0	3	0	0
	2nd 6-Minute Average Opacity:	0	1	0	0
	3rd 6-Minute Average Opacity:	0	3	0	0
	4th 6-Minute Average Opacity:	0	4	0	0
	5th 6-Minute Average Opacity:	1	3	0	0
	6th 6-Minute Average Opacity:	1	3	0	0
	7th 6-Minute Average Opacity:	3	4	0	0
	8th 6-Minute Average Opacity:	2	2	0	0
	9th 6-Minute Average Opacity:	3	3	0	0
	10th 6-Minute Average Opacity:	4	2	0	0
	11th 6-Minute Average Opacity:	NA	NA	0	0
	12th 6-Minute Average Opacity:	NA	NA	0	0
	13th 6-Minute Average Opacity:	NA	NA	0	0
	14th 6-Minute Average Opacity:	NA	NA	0	0
		Average:	1.4	2.8	0.0
Run 2	1st 6-Minute Average Opacity:	1	2	0	0
	2nd 6-Minute Average Opacity:	4	1	0	0
	3rd 6-Minute Average Opacity:	2	2	0	0
	4th 6-Minute Average Opacity:	2	2	0	0
	5th 6-Minute Average Opacity:	2	3	0	0
	6th 6-Minute Average Opacity:	3	3	0	0
	7th 6-Minute Average Opacity:	1	3	0	0
	8th 6-Minute Average Opacity:	1	4	0	0
	9th 6-Minute Average Opacity:	2	4	0	0
	10th 6-Minute Average Opacity:	2	2	0	0
	11th 6-Minute Average Opacity:	NA	NA	0	0
	12th 6-Minute Average Opacity:	NA	NA	0	0
	13th 6-Minute Average Opacity:	NA	NA	0	0
		Average:	2.0	2.6	0.0
Run 3	1st 6-Minute Average Opacity:	4	3	0	0
	2nd 6-Minute Average Opacity:	1	4	0	0
	3rd 6-Minute Average Opacity:	0	1	0	0
	4th 6-Minute Average Opacity:	2	3	0	0
	5th 6-Minute Average Opacity:	3	1	0	0
	6th 6-Minute Average Opacity:	3	2	0	0
	7th 6-Minute Average Opacity:	1	1	0	0
	8th 6-Minute Average Opacity:	0	3	0	0
	9th 6-Minute Average Opacity:	3	1	0	0
	10th 6-Minute Average Opacity:	1	4	0	0
		Average:	1.8	2.3	0.0
3-Run Average:		1.8	2.6	0.0	

**BTEC Inc.**



**Figure No. 1**

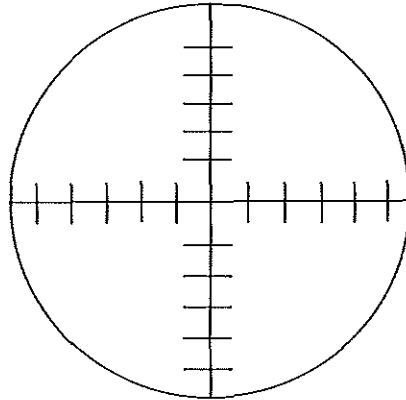
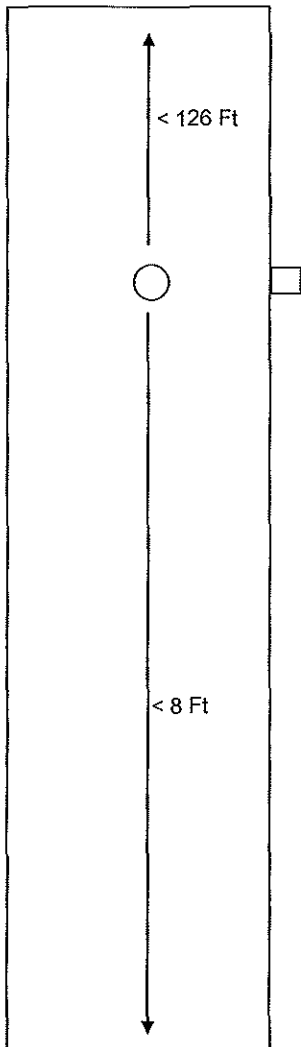
Site:  
USEPA Method 17  
Cooperative Elevator Co.  
Pigeon, Michigan

Sampling Date:  
August 26, 2014

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



diameter = 54 inches



Not to Scale

Points	Distance "
1	1.40
2	4.43
3	7.88
4	12.20
5	18.47
6	35.53
7	41.80
8	46.12
9	49.57
10	52.60

Figure No. 2

Site:  
Grain Elevator  
Cooperative Elevator Co.  
Pigeon, Michigan

Sampling Date:  
August 26, 2014

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Royal Oak, Michigan