Dispersion Modeling Analysis for Fulton County, Ohio

Lead NAAQS Partial Nonattainment Area

Introduction

The United States Environmental Protection Agency (U.S. EPA) revised the National Ambient Air Quality Standard (NAAQS) for lead on November 12, 2008, replacing the existing lead standard of 1.5 ug/m^3 with a lower standard of 0.15 ug/m^3, as a rolling three-month average.

On November 22, 2010 (75 FR 71033), effective December 31, 2010, U.S. EPA promulgated the initial lead nonattainment areas for the revised lead standard across the country. The CAA Amendments requires states with lead nonattainment areas to submit a plan within eighteen months of the effective date of the designations (June 30, 2012) detailing how the lead standard will be attained by December 31, 2015.

This document supports the Lead State Implementation Plan (SIP) for the partial Fulton County nonattainment area in the State of Ohio. This partial nonattainment area encompasses emissions from the Bunting Bearings LLC (herein referred to as "Bunting"). Bunting (Ohio EPA facility identification # 0326000015) is located at 200 Van Buren Street, Delta, Ohio, 43515. Bunting is the only source of lead emissions in this nonattainment area.

Per U.S. EPA's guidance (2008 Lead (Pb) National Ambient Air Quality Standards (NAAQS) Implementation Questions and Answers, July 8, 2011 (herein referred to as "Q&A Guidance")), "modeling for attainment demonstrations is used to show that a nonattainment area will be in attainment by the attainment date. The modeling is used to show the effectiveness of control measures on the sources."

Two dispersion modeling analyses were performed for this SIP analysis. One was an analysis relevant to a period in 2011 when exceedances were occurring and prior to Bunting implementing better housekeeping procedures (base case). This portion of Ohio EPA's analysis demonstrates the level of lead emissions that had to have occurred during a representative period when the facility was not being maintained properly. The second analysis demonstrates when the equipment is functioning properly and maintained properly, Bunting's federally enforceable permit limits will provide for attainment of the standard (future case). The two analyses are discussed in greater detail below.

The base case analysis evaluated a reasonable estimate of maximum actual emissions to determine the contribution of fugitive emissions from poor housekeeping at Bunting that contribute to the highest monitored concentrations. For this analysis, Ohio EPA selected the 3-month period of January to March 2011, when the highest three-month rolling average of 0.178 ug/m^3 occurred. Bunting does not currently have acceptable federally enforceable permit limits to ensure compliance with the lead

standard. As part of the base case analysis, Ohio EPA used stack test data for particulate emissions to determine a reasonable lead emissions rate to apply to each unit with potential lead emissions.

The future case analysis evaluated the existing controls which Ohio EPA determined were Reasonably Available Control Measures, new federally enforceable permit limits that will be applied, and the absence of fugitive emissions resulting from poor housekeeping and maintenance. Bunting has developed a Preventative Maintenance Plan (See Appendix F of the Attainment Demonstration) intended to ensure the potential for fugitive emissions of lead around the baghouses will be minimized to diminimus levels, if not eliminated in the future. Dispersion modeling was used to validate that the control strategies and permit limits will provide for attainment of the standard.

Modeling Approach

Per U.S. EPA's Q&A Guidance, modeling analyses should conform with EPA's guidelines on air quality models contained in Appendix W to 40 CFR part 51. (http://www.epa.gov/ttn/scram/guidance/guide/appw_05.pdf.) Modeling input data, including emission rates, are addressed in Section 8.0 of Appendix W. The averaging period for the 2008 Lead NAAQS is a rolling 3-month average evaluated over a 3-year period. Accordingly, modeled emissions rates should be based on concentration estimates for this same period (3-month average) as described in Section 10.2.3 of Appendix W.

The recommended dispersion model for SIP modeling for lead is the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system. There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using United States Geological Survey (USGS) Digital Elevation Data.

Meteorological Data

In order to generate meteorological input data for use with AERMOD, AERMET, along with AERSURFACE for the modeling domain was conducted to generate the surface (.sfc) and profile (.pfl). Ohio EPA used the AERMINUTE pre-processing module. This module accepts as input 1-minute ASOS meteorological surface observations, calculates an hourly average for each hour in the modeled time period, and substitutes any missing values from the co-located ISHD surface data. Use of AERMINUTE reduces the number of calm hours in the input files and is therefore considered more representative of local meteorological conditions.

Meteorological data from 2007 through 2011 from Toledo (OH) surface station (Station # 94830) and the Detroit (MI) upper air station (Station # 04830) were used in these analyses. These sites were determined to be representative of Delta, Ohio. AERSURFACE was run using twelve sectors and four seasons.

As stated above, Ohio EPA modeled two scenarios at Bunting. The base case modeling demonstrates the source and cause of the exceedance, while the attainment modeling demonstrates the control measures that ensure no future modeled exceedances.

Background

Ohio EPA does not believe a background concentration is necessitated as a part of these analyses. As discussed in greater detail in the attainment demonstration document, only point sources emissions, specifically from Bunting are addressed as a part of this submittal. This nonattainment area does not contain any additional sources of lead emissions that warrant inclusion in this analysis. In addition, as seen in the modeling conducted during the designation process[1], other lead sources did not significantly contribute to the monitor. In addition to Bunting there are 3 sources in Fulton County listed in the 2005 NEI database: Multi-Cast Corp, Sauder Woodworking Cogeneration Facility, and Northstar Bluescope Steel, LLC. The four lead sources in Fulton County are fairly widespread throughout the county and significantly further from the monitor which is located directly at the Bunting facility. It was determined during the designation process that Bunting was the source of the elevated lead concentrations in Fulton County, and therefore, Ohio EPA recommended, and U.S. EPA established a nonattainment boundary around only this facility. However, Ohio EPA did receive comment from U.S. EPA regarding the use of background concentrations. Although Ohio EPA believes the modeling conducted is extremely conservative in nature, Ohio EPA is including a background concentration analysis per U.S. EPA's request. Addition of this background results in an even greater level of conservatism in this demonstration of attainment.

Base Case Analysis

The base case analysis compared modeled predicted rolling three-month average concentrations to actual monitored concentrations during the same period. The modeled base case was a reasonable attempt to replicate actual conditions. The purpose of modeling actual conditions was to determine the cause of the exceedance and the contribution to the modeled exceedance by each source. The period for base case simulation for lead for Bunting was January-March 2011.

Emission Sources

The release points of the Bunting emission units are located within a couple of hundred meters of the monitor (Figure 1). Ohio EPA modeled each of the 22 emission units, exhausting from three stacks, and an area along the central roadway in Bunting where the air monitor is located, the baghouses are located and movement of baghouse collections bags that have been changed occurs. During a site visit, Ohio EPA employees determined poor maintenance and housekeeping issues associated with the baghouses and collection bag changing procedures were resulting in high monitor readings. Due to the potential emissions from this fugitive source, Ohio EPA included this source in the base case modeling so that an accurate representation of the emissions could be characterized to determine the source of the exceedance.

The roadway was modeled with a 1.0 pound per hour (lb/hr) emission rate. Modeled emission rates for the other lead sources venting to the baghouses at Bunting are based on likely emission rates (based on

[1] See Ohio EPA's October 5, 2009 submittal "Ohio's Recommended Nonattainment Areas for the 2008 Lead Standard."

stack test data) from the sources during the violating period. In comparing the two similar sized baghouses, A and C, baghouse A has to control a much smaller particle size (from the tundishes) than those emissions that are generated and controlled by Baghouse C. Baghouse B has a considerably lower grain loading because it is bigger and the higher flow tends to gravitate towards a lower grain loading, and because it is newer. USEPA's RACM guidance indicates that baghouses that are 10 years newer compared to a similar older one can achieve a grain loading that is twice as good as their older counter parts. The modeled rates are very close to double actual stack test data. The sources parameters were updated based on the most recent information from the facility. Table 1 below shows the point source parameters modeled.

Emissions Unit	Description of Source Emissions	Control Device	Stack Height (m)	Temperature (K)	Exit Velocity (m/s)	Stack Diameter (m)	Emission Rate (lb/hr)
P014 through P019, P028	Induction Furnaces #1-7	Baghouse B	8.53	310.93	28.75	0.91	0.014 per unit
P020 through P025, P029	Tundish's #1-7	Baghouse A	15.24	310.93	16.85	1.6	0.014 per unit
P005	Ball Crusher	Baghouse C	8.53	310.93	21.56	0.91	0.006
P006 and P007	Centrifugal Furnaces #1 and 2		8.53	310.93	21.56	0.91	0.006 per unit
P008 through P011	Centrigugal Machines #1-4		8.53	310.93	21.56	0.91	0.006 per unit
P013	Centrifugal Transport Ladle		8.53	310.93	21.56	0.91	0.006

Table 1: Base Case modeled point source parameters for Bunting.

US EPA's Haul Road Workgroup Final Report (http://www.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf) served as guidance in determining source parameters for the roadway. Table 2 below shows the roadway source parameters modeled.

Emissions Unit	Description of Source Emissions	Release Height (m)	Vertical Size (m)	Horizontal Size (m)	Emission Rate (lb/hr)
Roadway	Fugitive Volume	2.55	2.37	4.65	1.0

Table 2: Base Case modeled volume source parameters for Bunting

Building downwash from the Bunting facility was included in the modeling.

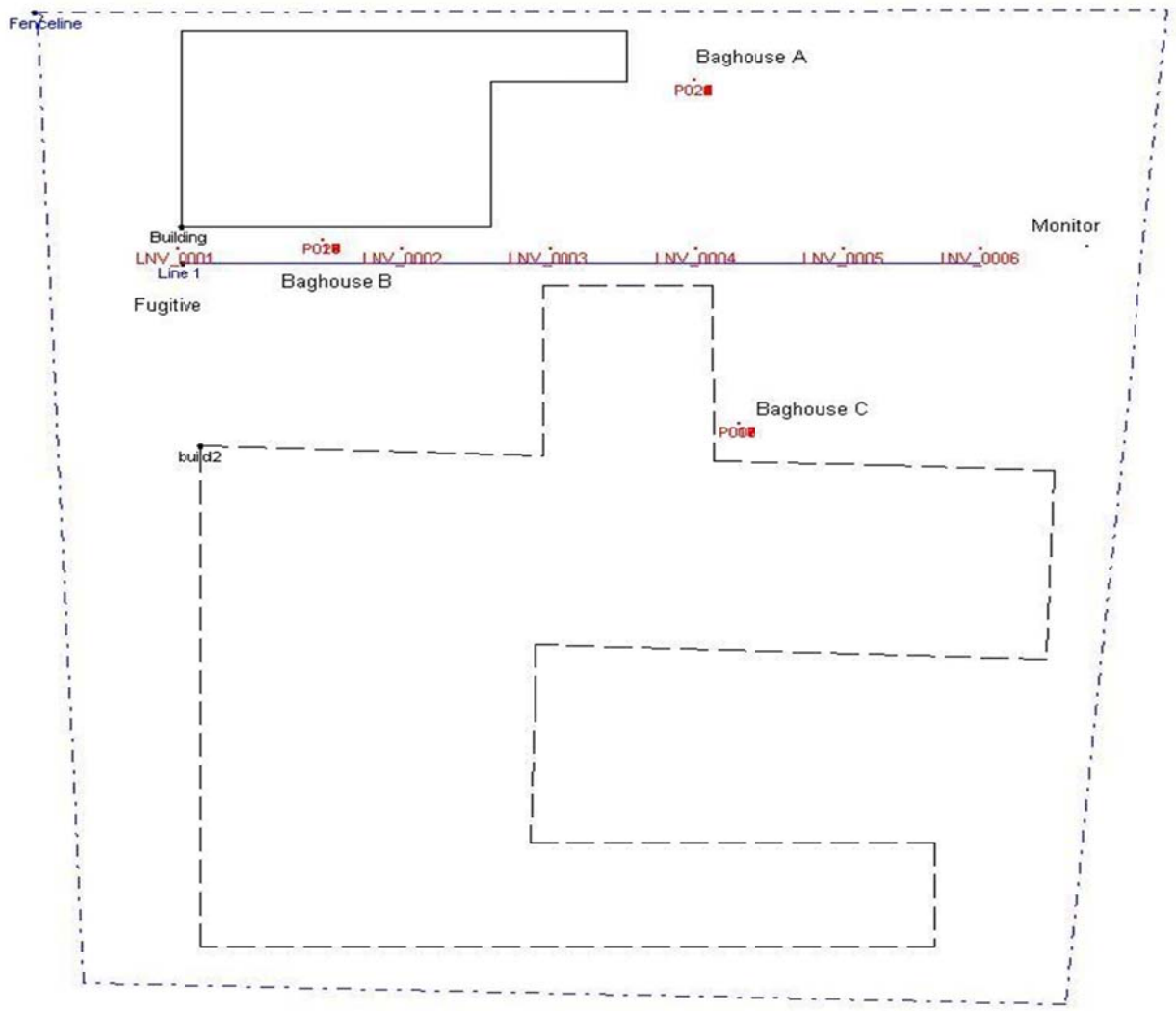

Figure 1: Bunting facility, showing point sources, the fugitive emissions source, and the lead monitor.

Receptors

It was only necessary for a single receptor, at the location of the monitor (see Figure 1 above), to be modeled for the base case as the purpose of this scenario was to duplicate the monitored exceedance. The modeled results were then compared to the 3-month rolling average for the exceedance period that occurred at the monitor and then ratioed appropriately. The maximum modeled contribution from each source is shown in Table 3. As seen in Table 3, the fugitive area dominates monitor impacts.

Emissions Unit	Description of Source Emissions	Maximum Modeled Contrbution ($\mu g/m^3$)
P014 through P019, P028	Induction Furnaces #1-7	0.00159333
P020 through P025, P029	Tundish's #1-7	0.000026667
P005	Ball Crusher	0.000020
P006 and P007	Centrifugal Furnaces #1 and 2	
P008 through P011	Centrigugal Machines #1-4	
P013	Centrifugal Transport Ladle	
Roadway	Fugitive Emissions	53.1310
Facility Total		**53.1326**

Table 3: Base Case modeled source group contribution to maximum concentration for Bunting.

Meteorology

In order to replicate actual conditions during the violating period, the base case was modeled using only 2011 meteorological data. The lead post processor was run for the exceedance period only, January 2011 to March 2011, to provide a direct comparison to the exceedance period being replicated.

Results

Post files for each source were created and contributions from each of the sources were processed by the lead post processor. Modeled results for the violating period shows the highest average to be 53.1326 ug/m^3 for the rolling three-month period ending on March, 2011.

As mentioned above, Ohio EPA applied an emissions rate of 1.0 lb/hr to the fugitive source with an actual unknown emissions rate. Because AERMOD is a linear model, it allows model result to be ratioed,

or scaled to determine the actual emission from the fugitive source that would correspond to the actual monitored average. Due to the unknown emission rate of the roadway, these results had to be scaled so the total modeled concentration matches the monitored value. The scaled value was determined by calculating each sources contribution to the maximum modeled concentration. First, Ohio EPA subtracted the contribution from each of the three baghouses from the total modeled concentration, leaving only the roadway contribution remaining. Reasonable emission rates are known, and were modeled, for the baghouses, so their contribution to the monitor will not change. The remainder was then multiplied by the modeled fugitive source emission rate and divided by the maximum modeled result. Table 4 below shows the maximum modeled concentration and the scaled values.

Emissions Unit	Description of Source Emissions	Maximum Modeled Contrbution ($\mu g/m^3$)	Monitor Normalized Contribution ($\mu g/m^3$)	Percent Contribution ($\mu g/m^3$)
P014 through P019, P028	Induction Furnaces #1-7	0.00159333	0.001593	0.895%
P020 through P025, P029	Tundish's #1-7	0.000026667	0.000027	0.015%
P005	Ball Crusher	0.000020	0.000020	0.011%
P006 and P007	Centrifugal Furnaces #1 and 2			
P008 through P011	Centrigugal Machines #1-4			
P013	Centrifugal Transport Ladle			
Roadway	Fugitive Emissions	53.1310	0.17636	99.079%
Facility Total		**53.1326**	**0.178**	**100.00%**

Table 4: Base Case scaled contribution by source to maximum concentration for Bunting.

Qualitative agreement would not be exact agreement between modeled and monitored concentrations in time and space but would represent similarity in concentration trends over time and dispersion patterns in a general area. Once the current actual conditions have been sufficiently replicated, the effectiveness of the control strategies can be estimated through the future case analysis.

Future Case Analysis

The purpose of this analysis was to evaluate the improved maintenance and housekeeping procedures that eliminate the fugitive area evaluated under the base case and to also evaluate the proposed emissions limitations that will be federally enforceable. This modeling scenario should demonstrate attainment of the 2008 lead NAAQS in this nonattainment area.

Emission Sources

The fugitive area modeled under the base case was not included in this modeling analysis. As discussed in the attainment demonstration document, Ohio EPA believes the changes made by the facility and the implementation of the Preventative Maintenance Plan will reduce fugitive emissions experienced due to poor maintenance and housekeeping from this area to diminimus levels, if not eliminate them completely. However, to be conservative, Ohio EPA modeled a very conservative, yet deminimus, amount of fugitive roadway emissions to ensure that if they do occur in the future, the area will still be able to attain the standard. The calculated potential roadway emissions were 0.00053 lbs/day[2], yet to be conservative; Ohio EPA modeled this as an hourly rate.

Table 5 below shows the modeled emission rates for the Future Case and the source parameters.

Emissions Unit	**Description of Source Emissions**	**Control Device**	**Stack Height (m)**	**Temperature (K)**	**Exit Velocity (m/s)**	**Stack Diameter (m)**	**Emission Rate (lb/hr)**
P014 through P019, P028	Induction Furnaces #1-7	Baghouse B	8.53	310.93	28.75	0.91	0.0214286 per unit
P020 through P025, P029	Tundish's #1-7	Baghouse A	15.24	310.93	16.85	1.6	0.0214286 per unit
P005	Ball Crusher	Baghouse C	8.53	310.93	21.56	0.91	0.009375
P006 and P007	Centrifugal Furnaces #1 and 2		8.53	310.93	21.56	0.91	0.009375 per unit
P008 through P011	Centrigugal Machines #1-4		8.53	310.93	21.56	0.91	0.009375 per unit
P013	Centrifugal Transport Ladle		8.53	310.93	21.56	0.91	0. 009375
	Roadway Fugitive Emissions						0.00053

Table 5: Future Case source parameters for Bunting

[2] The conservative fugitive paved roadway emissions are based upon 10% lead in particulate emissions; silt loading of 40 grains; mean vehicle weight of 25 tons; and 140 days of precipitation. This equates to an emission factor of .0233 lbs of PM10 per vehicle mile traveled. In addition, it is based upon extremely conservative traffic information supplied by Bunting of two trucks a day for the 3 meter roadway (times 2 for a back and forth trip).

U.S. EPA's Q&A guidance states "for attainment modeling, maximum allowable or federally enforceable permit limits should be the basis of the model input emissions, as described in Section 8.1 and Table 8-1 of Appendix W and the Guideline for Air Quality Models." Emission rates consistent with those identified above will be made federally enforceable as identified and described in the attainment demonstration document.

Receptors

A total of 3778 receptors, with 50 meters spacing within a 1 km radius of the facility, were modeled, as seen in Figure 2 below. A discrete receptor was added at the monitor location.

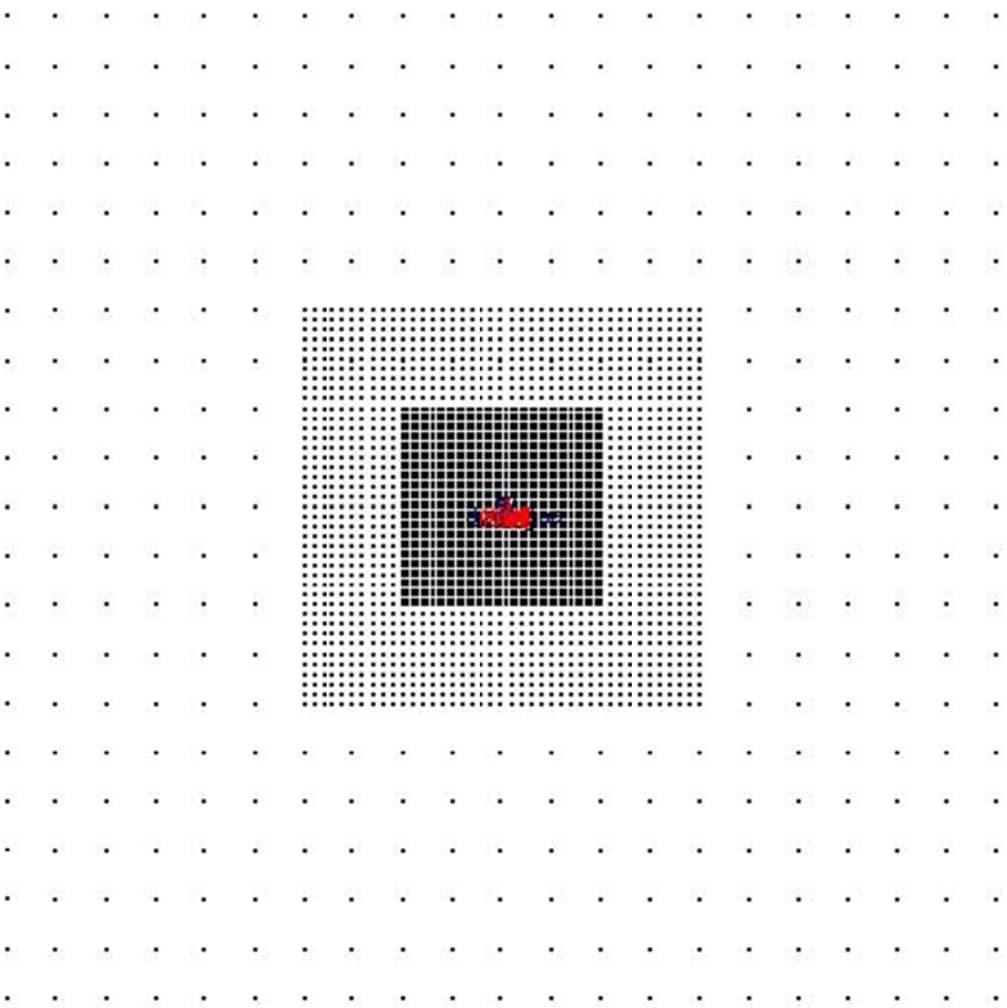

Figure 2: Bunting receptor grid, showing 50 meter spacing for the innermost receptor grid.

Meteorology

This analysis was based on 5-year meteorological data (January 2007-December 2011) as described in the general meteorology section at the beginning of this document.

Results

Three-month rolling average results from the lead post processor are shown in Table 6 below.

Emissions Unit	**Description of Source Emissions**	**Control Device**	**Maximum Modeled Contribution (ug/m3)**
P014 through P019, P028	Induction Furnaces #1-7	Baghouse B	0.0485367
P020 through P025, P029	Tundish's #1-7	Baghouse A	0.016020
P005	Ball Crusher	Baghouse C	0.0352267
P006 and P007	Centrifugal Furnaces #1 and 2		
P008 through P011	Centrigugal Machines #1-4		
P013	Centrifugal Transport Ladle		
	Roadway Fugitive Emissions		0.00869333

Table 6: Future Case Modeling Results for Bunting

The maximum modeled concentration from all sources was 0.108477 ug/m3, demonstrating the establishment of federally enforceable permit limits as identified in the attainment demonstration document (and consistent with the rates identified under Table 5 above), along with the strategies that will eliminate the fugitive emissions source, provide for attainment of the 2008 lead standard.

However, as discussed above, U.S. EPA has requested an analysis of potential background contribution to be included in this already conservative analysis. Ohio EPA analyzed monitor readings during the weekend days in 2011 when Bunting operations were not occurring.

Date	ug/m3
Sunday, January 09, 2011	0.0091
Saturday, January 15, 2011	0.0153
Sunday, February 20, 2011	0.0235
Sunday, April 03, 2011	0.0226
Saturday, April 09, 2011	0.0150
Sunday, May 15, 2011	0.0185
Saturday, May 21, 2011	0.0096
Sunday, June 26, 2011	0.0231
Sunday, August 07, 2011	0.0100
Saturday, August 13, 2011	0.0171
Sunday, September 18, 2011	0.0069
Saturday, September 24, 2011	0.0062
Sunday, October 30, 2011	0.0068
Saturday, November 05, 2011	0.0106
Average	**0.013878571**

Table 7: Background Lead concentration during weekends at Bunting for year 2011

Applying the background concentration to the already conservative modeling analysis above provides for a predicted concentration of 0.122355 ug/m3, demonstrating that with the inclusion of a background concentration, attainment of the standard occurs.