State of Oregon
Department of Environmental Quality Memorandum

Date: 26 June 2017

To: Dave Kauth

From: Phil Allen

Subject: Bullseye Glass Modeling Report

1. Background

Bullseye Glass Company (Bullseye) is a colored art glass manufacturer and operates a facility at 3722 SE 21st Avenue in Portland, Oregon. Bullseye is subject to the Colored Art Glass Manufacturing (CAGM) Facility Rules in OAR 340-244-9000 to 9090. Under these rules, Bullseye is classified as a Tier 2 CAGM

A Tier 2 CAGM may use raw materials containing chromium in a glass-making furnace after DEQ has established annual and daily maximum allowable usage rates so that the source's impact will not exceed an annual acceptable source impact level (ASIL) of 0.08 nanograms per cubic meter of chromium VI at the nearest sensitive receptor, and a 24-hr ASIL of 5 nanograms per cubic meter of chromium VI at any off-site modeled receptor (OAR 340-244-9040).

To establish a maximum allowable usage rate for chromium, DEQ requires that source testing be conducted (OAR 340-244-9040(3)). The Tier 2 CAGM must also perform dispersion modeling to determine the annual average and daily maximum ambient concentrations that result from the Tier 2 CAGM's air emissions. Based on the dispersion modeling and the stack testing of the source, the source can request a chromium usage rate for ODEQ approval.

Bullseye completed stack testing and submitted a source test report. A modeling protocol was prepared and submitted on May 17, 2017, which DEQ approved on May 26, 2017, and subsequently a modeling report. The modeling protocol, modeling, and final report were prepared by the consulting firm Air Sciences.

2. Plant Configuration and Emissions

Plant Configuration.

Emissions from Bullseye furnaces are collected and passed through a baghouse filtration system (baghouse west, or BHW), which consists of three filtration units aligned in parallel. This three cell system provides for redundancy by allowing a cell to be taken down for servicing without interrupting furnace operation. Once filtered, exhaust from the filtration units is merged and then sent to one of two exhaust stacks on the building roof (only one stack is used at a time). This provides for a redundant system so that one stack may be serviced while the other is operating. The two stacks are identical with the same height, flow, and exit diameter, and are five feet (1.5m) apart. Since it is not known when each stack is used, AERMOD was configured to model BHW as a single stack, with a location half way between the two actual stacks. There is less than a 1-meter difference between the modeled and either of the two actual stack locations. The stack parameters are shown in Fig. 1.

Baghouse West (BHW)							
			Stk	Stk	Stk	Stk	
	utm-e	utm-n	Ht	Dia	Vel	Temp	Exhaust
	m	m	m	m	m/s	K	Type
Stack 1	527791.6	5038094.4	15.57	0.36	31.4	407	vertical

Table 1. Baghouse West parameters.

For the analysis, Bullseye used a unit emission rate of 1 g/s to determine the stack's worst-case unit concentration or dispersion factor (X/Q value) at each receptor.

The effects of building-downwash were incorporated into the modeling. The base elevation of the facility varies across the site, ranging from about 60 feet in the southwest corner to about 66 feet in the northeast corner but a relatively consistent base level was estimated to be about 65 feet (19.8m) for use in the air quality modeling. Most of the buildings have parapets, and the parapet top-to-ground height was used as the building height rather than the actual roof height.

3. Air Quality Modeling

Model

The following EPA pre-processors and dispersion model were used, and are the most recent versions:

BPIP-Prime (version 04274)
AERMAP (version 11103)
AERSURFACE (version 13016)
AERMET (version 16216)
AERMOD (version 16216r)

Receptor Grids

A set of nested receptor grids were used to identify modeled impacts:

- Property boundary receptors at 10-meter spacing
- Near-field receptors at 25-meter spacing, out to 1 km from the facility
- Far-field receptors at 100-meter spacing, between 1 km and 5 km from the facility

All receptors were processed with AERMAP to generate receptor terrain elevations and hill height values using 1/3-Arc-Second NED elevation data obtained from the National Map Seamless Server (http://www.mrlc.gov/) in a USGS GeoTIFF file format.

Sensitive receptors are identified in Table 2, below. These sensitive receptors include residences, hospitals, schools, daycare facilities, elderly housing, and convalescent facilities, in accordance with the CAGM rule.

Land Use Determination

The 2011 USGS National Land Cover Database (NLCD) shows that land use within 3 kilometers of the Bullseye facility is characterized by the urban land use categories 23 and 24 (medium and high density developed land). Urban coefficients were used in the modeling analysis. Selection of the urban boundary layer option in AERMOD also requires an estimate of the population of the urban area. For this analysis, a value to 600,000 was used based on the population in the City of Portland proper.

Meteorology

The met input files to AERMOD were calculated using four primary meteorological datasets:

1. Site specific wind speed and direction data were measured at the on-site DEQ monitor located approximately 50 m southwest of the BHW stack. The station was operated from early February 2016 to March 2017.

2. Other meteorological parameters (ambient temperature, temperature gradient, solar insolation, relative humidity, and pressure) are from the DEQ Southeast Lafayette met station approximately 3.5 km east of Bullseye.

3. Hourly met data from NWS Station #24232 at the Portland International Airport was used for cloud cover data if needed by the model.

4. Upper-air data from the Salem NWS Station #24229 was used for the twice daily soundings.

The surface parameters (surface roughness, Bowen ratio, and noon-time albedo) for the Bullseye/Southeast Lafayette station were determined using AERSURFACE, which was run for average, wet, and dry conditions on a monthly basis for 12 evenly spaced sectors. A 30-year moisture analysis for the Portland area was conducted to determine the wetness condition for each month. The data were processed with the most recent version of AERMET with the adjust U* and bulk Richardson options selected.

4. Modeling Results

AERMOD was run with emissions at 1 g/s to generate the maximum 24-hour and annual unit concentration or dispersion factor (X/Q) at each receptor. Table 2 shows the maximum 24-hour X/Q concentration for any receptor, and Table 3 shows the annual X/Q value at each of the sensitive receptors.

Maximum 24-hour X/Q at any receptor			
Receptor	utm e m	utm n m	Maximum X/Q (µg/m3)/(g/s)
56	527818.1	5038081.3	215.6

Table 2. Maximum 24-hr average X/Q at any receptor.

Sensitive Receptors				
Label	Description	utm e m	utn n m	X/Q
CHS	Cleveland High Schol	528179.2	5038352.3	0.5
CCLCDayC	Day Care (SE)	527907.7	5037876.3	5.4
DinDayC	Day Care (NE)	528276.6	5038295.7	0.4
GES	Elementary School	528631.2	5037570.5	0.3
Res01	Residence 1	527830.9	5038277	5.7
Res02	Residence 2	527741.5	5038290.9	6.5
Res03	Residence 3	527779.8	5038319.8	6.4
Res04	Residence 4	527788.9	5038061.6	7.2
Res05	Residence 5	527786.6	5038049.6	4.6
Res06	Residence 6	527805.1	5038055	31.9
Res07	Residence 7	527786.3	5038006.4	5.4
Res08	Residence 8	527788.7	5037987.5	5.4
Res09	Residence 9	527462.2	5038147.6	0.8
Res10	Residence 10	528169.4	5037952.8	0.7
Res11	Residence 11	528168.8	5038105.1	0.6
Res12	Residence 12	527664	5039317	3.3
WES	Elementary School	527295.4	5037987.6	0.8
			Total	31.9

Table 3. Location of sensitive receptors and their X/Q values.

Using the dispersion X/Q ratios, the maximum emission rate that would not exceed the annual and 24-hr ASILs was calculated. As stated in the CAGM, the ASIL for the annual average impact is 0.08 ng/m3, and for the 24-hr average impact is 5 ng/m3. The conversions are shown in Table 4.

Emission rate conversion calculations				
Period	X/Q (µg/m3)/(g/s)	ASL(ng/m3)	Qlimit g/s	Qreleased lb/period
24-hour	215.6	5	2.32E-05	0.0044
Annual	31.9	0.08	2.51E-06	0.17

Table 4. Emissions Calculations

The calculation of the maximum 24-hr and annual chromium usage rates, based on the emissions by period as shown in Table 4 and stack test results reported separately, are provided in an accompanying technical memorandum that is not part of the dispersion modeling report.

5. Conclusions

The air quality analysis of Bullseye Glass, using the emission rates, stack parameters, unit locations, and operating scenarios as provided in their report, conform to the protocol. The model version, receptor grid, building dimension data, meteorology, and other information are acceptable. Air Sciences also supplied model input files and meteorology. Using these data DEQ set up and ran the model, and was able to duplicate the modeled concentrations as provided in the report.

The air quality modeling is approved for use in calculating chromium usage rates for glass production together with separately provided stack test data.