Revised Notice of Construction Supporting Information Report Cooling Tower Feed Water Modification Microsoft Columbia Data Center Quincy, Washington

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Prepared for

The Microsoft Corporation
One Microsoft Way
Redmond, Washington 98052

LANDAU ASSOCIATES
130 2nd Avenue South
Edmonds, WA 98020
(425) 778-0907

THIS REPORT HAS BEEN PREPARED TO PROVIDE SUPPORTING DOCUMENTATION FOR WASHINGTON STATE DEPARTMENT OF ECOLOGY FORM NO. ECY 070-410, *NOTICE OF CONSTRUCTION APPLICATION: NEW PROJECT OR MODIFICATION OF EXISTING STATIONARY SOURCE*. EACH SECTION OF THIS REPORT PROVIDES A CROSS-REFERENCE TO THE SECTION OF FORM NO. ECY 070-410 FOR WHICH SUPPORTING DOCUMENTATION IS BEING PROVIDED.

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LIST OF ABBREVIATIONS AND ACRONYMS

$\mu g/m^3$	Microgram per Cubic Meter
AERMAP	AMS/EPA Regulatory Model Terrain Pre-Processor
AERMET	AERMOD Meteorological Pre-Processor
AERMOD	AMS/EPA Regulatory Model
AMS	American Meteorological Society
ASIL	Acceptable Source Impact Level
BACT	Best Available Control Technology
BPIP	Building Profile Input Program
CFR	Code of Federal Regulations
City	City of Quincy
CO	Carbon Monoxide
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FOB	Freight-on-Board
GEP	Good Engineering Practice
HAP	Hazardous Air Pollutant
m	Meter
mg/L	Milligrams per Liter
Microsoft	The Microsoft Corporation
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	Nitrogen Dioxide
NOC	Notice of Construction
NSR	New Source Review
NWS	National Weather Service
$PM_{2.5}$	Particulate Matter with an Aerodynamic Diameter Less Than or Equal to 2.5 Microns
PM_{10}	Particulate Matter with an Aerodynamic Diameter Less Than or Equal to 10 Microns
PRIME	Plume Rise Model Enhancements
PSD	Prevention of Significant Deterioration
RCW	Revised Code of Washington
SO_2	Sulfur Dioxide
SQER	Small-Quantity Emission Rate
TAP	Toxic Air Pollutant
TDS	Total Dissolved Solids
TSP	Total Suspended Particulate Matter
VOC	Volatile Organic Compound
WAAQS	Washington Ambient Air Quality Standards
WAC	Washington Administrative Code
WCTI	Water Conservation Technology International, Inc.

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1.0 PROJECT DESCRIPTION (SECTION III OF NOC APPLICATION FORM)

1.1 REVISIONS TO THIS PERMIT APPLICATION

The Microsoft Corporation (Microsoft) operates the Columbia Data Center in Quincy, Washington (Figure 1). The data center consists of the "Columbia-1" (CO1) data center, "Columbia-2" (CO2) data center, and "Columbia-3" (CO3) data center, all of which include emitting units covered by existing Approval Order 13AQ-E497. The data center also includes "Columbia-4" (CO4), which contains no emitting units. Microsoft proposes to modify the mode of operation for the cooling towers at CO1 and CO2. Microsoft submitted a Notice of Construction (NOC) application to the Washington State Department of Ecology (Ecology) on April 18, 2014. In response to Ecology's information requests, this revised report replaces the previous version to address two changes in the design of the existing cooling towers:

- The cooling tower manufacturer (Evapco) has provided supplemental information on the efficiency of the drift eliminators. The drift eliminators originally installed on the cooling towers included a vendor guarantee of 0.001 percent to satisfy Microsoft's bid specification. In response to an inquiry from Ecology, Evapco recently advised Microsoft that the existing cooling towers, properly maintained, will meet a drift efficiency of 0.0005 percent of the recirculation flow rate. Documentation from the vendor of this capability is provided in Appendix A.
- The recirculation water flow rate in each tower is 2,170 gallons per minute (gpm), instead of the assumed 3,150 gpm that was evaluated in the original application. The flow rate in each tower is maintained at a maximum of 2,170 gpm by a permanently installed flow restrictor orifice plate.

1.2 MECHANICAL DRAFT COOLING TOWERS AND RECIRCULATION WATER BLOWDOWN

The facility currently operates under air quality conditions specified by Approval Order No. 13AQ-E497, issued on April 10, 2013. The original air quality permit application for the cooling towers included emission calculations and ambient air quality modeling (Jones & Stokes 2007).

This document has been prepared for Microsoft to support the NOC air quality permit application for changes to the water supply serving the existing mechanical draft cooling towers, and a change to how the cooling towers are operated. This action will not modify the cooling towers themselves, but the proposed changes to the feed water supply system and the method of operation will increase the particulate emissions caused by cooling tower drift.

1.2.1 MECHANICAL DRAFT COOLING TOWERS

As shown on Figure 1, the data center uses 12 Evapco Model USS-312-454 mechanical draft cooling towers to cool the computer servers inside the CO1 and CO2 data center building. Each of the 12 cooling towers is a three-cell package, with each cell equipped with its own mechanical draft ventilation fan. The cooling towers are equipped with drift eliminators.

The feed water to the cooling towers is currently taken from water supply wells. Because the well water contains scale-forming minerals (calcium and magnesium), the cooling water inside the towers can be recirculated only two to three times (i.e., the "cycles of concentration" is only 2 to 3) before much of the water must be discharged (or blown down) to the City of Quincy (City) industrial sewer system. The original 2007 permit application for the cooling towers assumed the concentration of total dissolved solids (TDS) in the recirculation water and blowdown is only 1,072 milligrams per liter (mg/L). Microsoft currently blows down a large amount of wastewater to the municipal sewer system to maintain the recirculation water TDS at that low concentration. Microsoft considers the current large amount of cooling tower blowdown water that is discharged to the City sewer system to be undesirable. To greatly reduce the amount of blowdown water discharged to the sewer system, Microsoft will change the water supply system.

1.2.2 CHANGES TO COOLING TOWER FEED WATER SYSTEM

Microsoft obtains makeup water for the CO1 and CO2 cooling systems from the City of Quincy. The City currently provides pre-softened well water, and in the future the City will be able to provide pre-softened reused wastewater. For this NOC permit application, the cooling tower water supply option that would result in the highest cooling tower emission rates is presented. The future makeup water to the cooling towers is, therefore, assumed to be pre-treated wastewater from the City's industrial wastewater treatment plant. The pre-treated wastewater will be treated further by the City before being provided to Microsoft, using a polishing treatment process consisting of a combination of coagulation, sand filtration, and possibly reverse osmosis treatment. It is uncertain at this time if the pre-treated water fed to the cooling towers will require chlorine disinfection, so for this air quality permit application it was conservatively assumed that the water will be disinfected, and the emission inventory accounted for residual chlorine disinfection byproducts that would volatilize from the cooling towers. The approximate concentrations of trace metals and chlorine disinfection byproducts that were assumed to be present in the cooling tower makeup water are provided in Appendix A.

This project will not modify the cooling towers, but it will change the chemical composition of the makeup water recycled through the cooling towers. The recirculation water in the cooling towers will be pre-softened by the City to replace scale-forming mineral compounds (i.e., calcium and magnesium)

with other non-toxic, non-scaling mineral compounds (i.e., sodium). The water softening system is owned and operated by the City, and is located within the Columbia Data Center property. Water is supplied to all of the cooling towers by the City's single common softening system. Microsoft will use the pre-softened City feed water to run the towers with very high cycles of concentration of up to 100, while conducting the daily and weekly monitoring of the recirculation water under the protocol licensed by Water Conservation Technology International (WCTI). The elevated cycles of concentration will cause TDS in the recirculation water to reach concentrations of 150,000 mg/L without causing mineral scale, while inhibiting biological growth in the tower, and without having to routinely blow down water to the City sewer system. By using the WCTI system, Microsoft will be able to cease using the scale inhibitor chemicals and biocides it has been adding to the feed water since the data center began operation. This combination of steps will provide a water quality benefit because Microsoft will require less makeup water and will discharge only relatively low volumes of cooling tower blowdown to the municipal sewer system. However, the elevated TDS concentrations in the recirculation water will increase the drift particulate emissions from the cooling towers compared to similar towers that do not use the WCTI pre-treatment system.

For the purpose of estimating drift emission rates, the key operational parameters for the cooling towers are as follows:

- Number of active cooling towers: The data center is equipped with 12 cooling towers. However, even under the most severe cooling requirement the facility will use only 10 cooling towers, with the remaining two cooling towers serving as standby units. Therefore, the emission calculations assume operation of 10 cooling towers.
- Cooling tower feed water supply: The City will provide an average of 266 gallons per minute of feed water to the cooling towers. For this permit modification, it is assumed that the City will provide pre-treated industrial wastewater, which is chlorinated, before the water is fed to the cooling towers. The estimated TDS concentration in the feed water is 1,500 mg/L.
- Cooling tower feed water additives: Because Microsoft will pre-treat the cooling tower makeup water using the WCTI softening system, water treatment chemicals will not need to be added to prevent corrosion or scaling.
- Water recirculation flow rate in each of the 10 operational cooling towers: 2,170 gallons per minute, which is the rated capacity of the flow restrictor orifice plate in each tower (Fierbaugh, D., 2014, personal communication).
- TDS concentration in recirculation water: 150,000 mg/L (100 cycles of concentration compared to the estimated TDS concentration of 1,500 mg/L in the cooling tower makeup water provided by the City). This is the highest TDS concentration that would likely eliminate the need to routinely blow down recirculation water to the sewer system, while using pre-treated wastewater as the cooling tower feed water supply.
- Drift eliminator efficiency: Drift droplets limited to 0.0005 percent of recirculation flow rate, as described by the Evapco documentation in Appendix A.

Changing the feed water system to use the WCTI water softening system will greatly reduce the amount of blowdown to the sewer system. However, as described in Section 2.0, this change will increase particulate emissions from the cooling towers. As described in Section 5.0, the increased cooling tower emission rates will not cause the ambient air pollutant concentrations to exceed federal or state ambient air quality standards.

1.3 COMPLIANCE WITH STATE AND FEDERAL REGULATIONS

The engines on the proposed generators will comply with the following applicable air regulations, in accordance with the Clean Air Act. These requirements are specified in:

- Chapter 70.94 Revised Code of Washington (RCW) (Washington Clean Air Act)
- Chapter 173-400 Washington Administrative Code (WAC) (General Regulations for Air Pollution Sources)
- Chapter 173-460 WAC (Controls for New Sources of Toxic Air Pollutants).

Specifically, the proposed project includes sources of air contaminants and will follow applicable air contaminant regulations as listed in:

- RCW 70.94.152
- WAC 173-400-113
- WAC 173-460-040.

The facility is located in an attainment area for all Clean Air Act criteria pollutants. Since, as described in Section 2.4, the proposed modifications to the mode of operation for the cooling towers will cause a net increase in the potential-to-emit for any criteria air pollutant of 9.4 tons per year or less and the total facility-wide emissions for any criteria air pollutant will be less than 100 tons per year, the permittee is applying for an approval order to meet minor New Source Review (NSR) requirements. Facilities that produce more than 100 tons per year of any criteria pollutant are considered major sources under the federal regulation 40 CFR Part 70 and the state regulation WAC 173-401 et seq., and those that produce less than 100 tons per year are considered minor sources. Potential-to-emit estimates provided in Section 2.4 demonstrate that the facility will emit:

- Less than 100 tons per year of any criteria pollutant [particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and volatile organic compounds (VOCs). Total suspended particulate matter (TSP) is not a federally regulated air pollutant, so TSP emissions exceeding 100 tons per year do not trigger a definition as a major source.
- Less than 10 tons per year of any U.S. Environmental Protection Agency (EPA) hazardous air pollutant (HAP)
- Less than 25 tons per year of total HAPs.

As a result, neither a Prevention of Significant Deterioration NSR pre-construction permit nor a Title V operating permit is required.

The mechanical draft cooling towers are not subject to the federal National Emission Standards for Hazardous Air Pollutants or NESHAP (40 CFR Part 63 Subpart Q, Industrial Process Cooling Towers) because the Columbia Data Center will not emit HAPs at rates high enough to designate the facility as a major source. Regardless, Microsoft will comply with the main operational restriction that would be required under NESHAP. Microsoft will not use chromium-containing chemicals to pre-treat the cooling tower makeup water.

2.0 COOLING TOWER EMISSIONS ESTIMATES (SECTIONS V AND VI OF NOC APPLICATION FORM)

Air pollutant emission rates were calculated for the sources identified in Section 1.0 per the requirements of WAC 173-400-113 and WAC 173-460-050. Emission rates were quantified for criteria pollutants and toxic air pollutants (TAPs). The basis for emission calculations is described in the following sections. Emission calculation spreadsheets are provided in Appendix A.

2.1 EMISSION CALCULATION ASSUMPTIONS

The emission rates for criteria pollutants and TAPs emitted from the 10 operating cooling towers were calculated using mass balances. The cooling tower emission rates were calculated using the following approach:

- The cooling towers will be operated with 100 "cycles of concentration," which will cause the TDS concentration in the recirculation water to increase to 150,000 mg/L. The recirculation flow rate in each tower is 2,170 gallons per minute.
- The cooling towers are equipped with drift eliminators to reduce the drift droplet rate to 0.0005 percent of the recirculation water flow rate.
- The aqueous concentrations of non-volatile TAP constituents in the makeup water provided by the City will be present in the recirculation water by a factor of 100 cycles of concentration, then will be emitted via drift droplets that evaporate to form solid particles.
- The vapor emission rates of volatile chlorine disinfection byproducts (chloroform, bromoform, and bromodichloromethane) present in the cooling tower makeup water provided by the City were calculated based on an estimated facility-wide makeup water flow rate of 266 gallons per minute (Cheng, R., 2014, personal communication), and based on historical aqueous concentrations of chlorine disinfection constituents found in City water (see Appendix A, Figure A-6 for analytical data). It was assumed that all of the volatile constituents in the makeup water (chloroform, bromoform, and bromodichloromethane) will be emitted as vapors.

2.2 SIZE DISTRIBUTIONS FOR DRIFT DROPLETS AND EVAPORATED SOLID PARTICLES

It is understood that the size distribution of the liquid droplets that penetrate the drift eliminators on the mechanical draft cooling towers is large, so if the TDS concentration of the droplets is high then after the droplets evaporate most of the resulting solid particles will also be large, with only a small fraction of the droplets smaller than 2.5 microns in diameter.

The calculation procedures developed by Joel Reisman and Gordon Frisbie of Graystone Environmental Industries (Reisman and Frisbie 2002) were used to calculate the particle size distribution for the evaporated solid particles. For any given diameter of a liquid drift droplet emitted from a cooling tower, the diameter of the evaporated solid particle is forecast using the following equation:

$$D_p = D_d [(TDS)(d_w/d_p)]^{1/3}, \text{ where}$$

D_p is the diameter of the evaporated solid particle (microns).

D_d is the diameter of the liquid droplet.

TDS is the TDS concentration within the cooling tower recirculation stream (weight fraction).

d_w is the specific gravity of water (1.0).

d_p is the specific gravity of the evaporated salt particle (2.2 for sodium chloride particles).

This calculation is performed for liquid droplets in each size category of the known droplet size distribution. The resulting size distribution for the evaporated solid particles is then inspected to determine the cumulative fractions of particles smaller than 10 microns and 2.5 microns.

The cooling towers at the Columbia Data Center are equipped with mist eliminators with an efficiency of 0.0005 percent (see the Evapco documentation in Appendix A). Evapco representatives indicated that they have no droplet size distribution data for any of their cooling towers (Schmaltz, J., 2014, personal communication). Therefore, for this analysis the published droplet size distributions for mechanical draft cooling towers of similar design from a different manufacturer (SPX/Marley Cooling Systems) were used. Droplet size distributions for an SPX/Marley tower configuration with a drift rate of 0.0005 percent are shown in Appendix A.

This droplet size distribution was used to derive the evaporated particle size distribution from the Microsoft cooling towers, for the existing condition and the proposed change using the WCTI treatment system. As reported by Reisman and Frisbie and shown in Table 1, the evaporated particle size distribution is largest when the TDS concentration in the recirculation water is high. The overall calculation of TSP, PM_{10} and $PM_{2.5}$ emissions was a two-step process:

- The TSP emission rate was calculated by mass balance based on the Evapco cooling tower mist eliminator efficiency of 0.0005 percent, and a recirculation water TDS concentration of 150,000 mg/L. TSP is not a regulated air pollutant, but the TSP emission rate is an intermediate value used to calculate the emission rates for the other regulated particulate air pollutant.
- The PM_{10} emission rate and the $PM_{2.5}$ emission rate were calculated by multiplying the TSP emission rate by the PM_{10} fraction (42 percent) and the $PM_{2.5}$ fraction (13 percent), respectively. These particulate size fractions were calculated as shown in Appendix A, Figure A-3.

A similar process was used to calculate emissions from the existing cooling towers prior to switching to the WCTI pre-treatment system. The recirculation water TDS concentration and the TDS concentration in the emitted liquid drift droplets is 1,072 mg/L, the calculated PM_{10} fraction of the evaporated solid drift particles is 100 percent, and the $PM_{2.5}$ fraction of the evaporated drift particles is 60 percent. These particulate size fractions were calculated as shown in Appendix A, Figure A-4.

2.3 COOLING TOWER EMISSION RATES

Table 2 lists the emissions increases in $PM_{2.5}$ and PM_{10} for the 10 operating cooling towers from implementation of the WCTI treatment system. Based on the droplet size analysis described above, the proposed future PM_{10} and $PM_{2.5}$ emission rates from the cooling towers are 11.3 tons per year and 3.5 tons per year, respectively, and the emissions increases in these pollutants are 9.4 and 2.4 tons per year.

Table 2 lists the TAP emission rates for the trace metals and chlorination byproduct compounds in the cooling tower makeup water. The maximum potential-to-emit emission rates for each of those TAPs will be less than their respective Small-Quantity Emission Rates (SQERs). Therefore, no ambient air quality assessment is required for any TAPs.

2.4 FACILITY-WIDE EMISSION RATES

Table 3 lists the existing facility-wide emission rates and the future facility-wide emission rates based on this proposed cooling tower system change.

3.0 EMISSION STANDARD COMPLIANCE (SECTION VII OF NOC APPLICATION FORM)

The proposed mechanical draft cooling towers are not subject to any EPA New Source Performance Standards. The operational restrictions specified by EPA's NESHAP for "Industrial Process Cooling Towers," 40 CFR Part 63, Subpart Q, do not apply because the facility will not be a major source of HAP emissions (40 CFR 63.400). That regulation prohibits the use of water treatment chemicals containing hexavalent chromium. Microsoft will not use any such water treatment compounds.

4.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS (SECTION VIII OF NOC APPLICATION FORM)

This proposed change to the cooling tower feed water supply would not require any modification to the cooling towers, but it would increase the particulate drift emission rate from the cooling towers. This section evaluates potential options to reduce the particulate drift emission rates.

Best available control technology (BACT) is an emission limitation based on the maximum degree of reduction that can be feasibly achieved for each air pollutant emitted from any new or modified stationary source. Most Washington State Department of Ecology (Ecology) permit writers determine BACT using a "top-down" approach as described in the EPA's draft *New Source Review Workshop Manual: Prevention of Significant Deterioration and Non-Attainment Area Permitting* (EPA 1990). The evaluations for the top-down BACT evaluation process are described in the following sections.

4.1 EVALUATION OF TECHNOLOGICAL FEASIBILITY

The CO1 and CO2 cooling towers are currently equipped with the most efficient drift eliminators that are commercially available for this application. New mechanical draft cooling towers designed for Microsoft's required cooling capacity with drift efficiencies lower than the current 0.0005 percent are not commercially available (Wilder 2014). Accordingly, the only options for Microsoft to reduce particulate emissions from the existing cooling towers after Microsoft switches to the WCTI system would be to reduce the TDS concentration in the recirculation water (i.e., reduce the cycles of concentration) or the recirculation water flow rate. However, neither of those options is practicable or desirable. It is not technically feasible to reduce the recirculation flow rate, because the recirculation flow rate in the towers is governed by the data center's cooling requirement. It is not practicable or desirable to reduce the cycles of concentration because the overall objective of switching to the WCTI system is to increase the cycles of concentration to the design value described in this application in order to reduce routine blowdown to the sewer system. Therefore, reducing the cycles of concentration would reduce or negate the entire objective of the project, which is to reduce water consumption and blowdown to the sewer system. Based on these considerations, Microsoft does not propose to reduce the cycles of concentration or the recirculation flow rate.

4.2 COST-EFFECTIVENESS ANALYSIS

No cost-effectiveness evaluation is required, because the existing cooling towers designed for a 0.0005 percent drift rate are the most efficient towers that are commercially available.

4.3 RECOMMENDATION FOR BEST AVAILABLE CONTROL TECHNOLOGY

Based on the preceding evaluations, none of the available options to reduce the particulate drift rate are technologically feasible. Microsoft proposes that BACT should consist of continued use of the existing cooling towers with their existing mist eliminators (0.0005 percent efficiency).

5.0 AMBIENT AIR QUALITY IMPACT ANALYSIS (SECTION IX OF NOC APPLICATION FORM)

This section presents the air dispersion modeling results and provides a comparison of the results to the National Ambient Air Quality Standards (NAAQS) and Washington Ambient Air Quality Standards (WAAQS) for criteria pollutants and the Washington State Acceptable Source Impact Levels (ASILs) for TAPs. Air dispersion model input values are provided in Appendix B. Electronic modeling files have been provided to Ecology under separate cover, as cited in Appendix C.

As described in the following sections, the ambient impacts caused by cooling tower emissions are less than the NAAQS and WAAQS, after adding local and regional background levels. The potential-to-emit emission increases for all TAPs are less than their respective SQERs, so no ambient impact evaluation is required for any TAP.

5.1 AIR DISPERSION MODELING – MODEL AND MODEL ASSUMPTIONS

Air dispersion modeling was conducted in general accordance with the EPA's *Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions; Final Rule* (EPA 2005). The American Meteorological Society (AMS)/EPA Regulatory Model (AERMOD) was used to estimate ambient pollutant concentrations at the facility's boundary associated with emissions from the facility. AERMOD was used to calculate maximum ambient impact concentrations of criteria pollutants and TAPs that would be emitted from the facility. AERMOD requires input from several models in order to process meteorological parameters, downwash parameters, and terrain heights. The following sections contain a description of these input models, as provided in EPA, Electric Power Research Institute, and Lakes Environmental guidance documents.

5.1.1 STACK HEIGHTS AND BUILDING DOWNWASH INPUT PARAMETER MODELING

All cooling towers were modeled to be 15-foot-tall vertical exhaust fans on the individual cooling tower enclosures. The parapet walls of the adjacent data center buildings were modeled to be 30 feet above ground.

Building downwash occurs when the aerodynamic turbulence induced by nearby buildings causes a pollutant emitted from an elevated source to be mixed rapidly toward the ground (downwash), resulting in higher ground-level concentrations. The Building Profile Input Program with Plume Rise Model Enhancements was used to determine if exhaust from emission units would be affected by nearby building structures. In general, these determinations are made if a stack's height is less than the height

defined by the EPA's Good Engineering Practice (GEP) stack height. GEP stack height is defined as the height of the nearby structure(s) measured from the ground-level elevation at the base of the stack, plus 1.5 times the lesser dimension, height, or projected width of the nearby structure(s). All of the facility's cooling towers are lower than the nearby data center buildings, so all the cooling stacks are lower than GEP stack height.

5.1.2 RECEPTOR GRID SPACING AND TERRAIN HEIGHT INPUT MODELING

Receptor heights were set at 1.5 meters (m) above ground height to approximate the human breathing zone height. To model complex terrain, AERMOD requires information about the surrounding terrain. This information includes a height scale and a base elevation for each receptor. The AMS/EPA Regulatory Model Terrain Pre-Processor (AERMAP) was used to obtain a height scale and the base elevation for a receptor, and to develop receptor grids with terrain effects.

The receptor grid beyond the facility boundary consists of Cartesian flagpole receptor grids placed at a height of 1.5 m above ground. Two sets of receptor grids were used for this assessment.

First, a regional receptor grid was used to model ambient impacts solely from the cooling towers within the Columbia Data Center, to demonstrate the maximum ambient impacts will occur along the facility boundary. The regional grid spacing varies with distance from the facility boundary, as listed below:

- 10-m spacing from emission source to 350 m
- 25-m spacing from 350 m to 800 m
- 50-m spacing from 500 m to 2,000 m
- 100 m spacing beyond 2,000 m.

Second, for purposes of modeling the combined impacts from the cooling towers within the Columbia Data Center facility combined with the "local background" sources, a receptor grid consisting of receptors placed at 10-m spacing along the facility boundary was used. This facility boundary receptor grid was used to model the combined emissions from Columbia Data Center cooling towers and the following "local background" sources:

- Columbia Data Center generators
- Dell Data Center generators
- Project Oxford generators and cooling towers
- Con-Agra Foods stack emissions.

AERMAP requires the use of topography data to estimate surface elevations above mean sea level. Digital topographical data (in the form of Digital Elevation Model files) for the analysis region were obtained from the Web GIS website (www.webgis.com) and processed for use in AERMOD. The

Shuttle Radar Topography Mission data used for this project have a resolution of approximately 30 m (1 arc-second).

AERMAP produces a Receptor Output File (*.rou) containing the calculated terrain elevations and scale height for each receptor. The *.rou file was used as an input runstream file (AERMOD Input File) for the Receptor Pathway in the Terrain Options page of the Control Pathway. AERMAP also produces a Source Output File (*.sou). This file contains the calculated base elevations for all sources.

5.1.3 METEOROLOGICAL INPUT PARAMETER MODELING

The AERMOD Meteorological Pre-Processor (AERMET) is the pre-processor model that estimates boundary layer parameters for use in AERMOD. AERMET processes three types of meteorological input data in three stages, and from this process it generates two input files for the AERMOD model. The two AERMOD input files produced by AERMET are the Surface File with hourly boundary layer parameter estimates and the Profile File with multi-level observations of wind speed, wind direction, temperature, and standard deviations of fluctuating wind components. The three types of AERMET input data are described below and consist of surface observations, upper air soundings, and site-specific data.

Five years of hourly surface data were used for AERMET from the National Weather Service (NWS) hourly surface observations, taken from Moses Lake, Washington. The 5 years of data processed cover the period 2001 to 2005.

Five years of upper air data were used for AERMET from the NWS twice-daily upper air soundings from Spokane, Washington. The 5 years of data processed cover the period 2001 to 2005.

The site-specific data required for AERMET consist of albedo, Bowen ratio, and surface roughness. Albedo is a measure of the solar radiation reflected back from earth into space. The Bowen ratio is an evaporation-related measurement and is defined as the ratio of sensible heat to latent heat. The surface roughness length is the theoretical height above ground where the wind speed becomes zero. Source information for the hourly surface air, upper air, and site-specific meteorological data is summarized in Table 4.

AERSURFACE was used to approximate the albedo, Bowen ratio, and surface roughness within 12 equal sectors of a circle that has a 1-kilometer radius and is centered on the surface station tower at Grant County International Airport in Moses Lake, Washington. Looking at each sector individually, AERSURFACE determined the percentage of land use type within each sector. Land cover data from the U.S. Geological Survey National Land Cover Data 1992 archives were used as an input to AERSURFACE (USGS 1992). Default seasonal categories were used in AERSURFACE to represent the four seasonal categories as follows: 1) midsummer with lush vegetation; 2) autumn with unharvested

cropland; 3) late autumn after frost and harvest, or winter with no continuous snow; and 4) transitional spring with partial green coverage or short annuals.

5.1.4 AERMOD AIR DISPERSION MODELING

The AERMOD interface provided by Lakes Environmental was used for all Columbia Data Center facility air dispersion modeling. This version of the Lakes Environmental software incorporates the most recent version of AERMOD (version 13350). AERMOD incorporates the data from the pre-processors described above with emission estimates and physical emission point characteristics to model ambient impacts at and beyond the property boundary.

The AERMOD model was used to estimate the short-term ambient impacts (i.e., 24-hour average or less) of PM_{10}, $PM_{2.5}$, and manganese emissions, and long-term impacts (i.e., annual average) of PM_{10} and $PM_{2.5}$ emissions.

The previous Notice of Construction Supporting Information Report dated April 18, 2014 included the AERMOD model runs listed in Table 5, which modeled higher cooling tower emission rates. For this revised analysis using lower emission rates, the AERMOD results from the earlier analysis were scaled downward linearly according to the ratio of the emission rates. For example, the previously modeled $PM_{2.5}$ emission rate was 40 lbs/day and the modeled AERMOD ambient impact was 4.4 micrograms per cubic meter ($\mu g/m^3$), but for this analysis the $PM_{2.5}$ emission rate was revised downward to 25.4 lbs/day. Therefore, the ambient $PM_{2.5}$ impact caused solely by Microsoft's cooling towers was scaled downward to 2.8 $\mu g/m^3$ (4.4 x (25.4/40) = 2.8).

5.2 ASSUMED BACKGROUND CONCENTRATIONS

This evaluation included "regional background" values contributed by existing regional emission sources in the project vicinity (e.g., permitted sources, highway vehicles, area sources) and "local background" values contributed by the other data centers in the vicinity. Project coordinate-specific regional background values were obtained from the Washington State University NW Airquest website (WSU website 2013). The reported regional background values were:

- PM_{10} (24-hour average) 81 $\mu g/m^3$
- $PM_{2.5}$ (annual average) 6.5 $\mu g/m^3$
- $PM_{2.5}$ (24-hour average) 21 $\mu g/m^3$.

"Local background" values for PM_{10} and $PM_{2.5}$ consist of the ambient impacts, at any point along the Columbia Data Center boundary, caused by emissions from the nearby emergency generators, cooling towers, and industrial emission sources at the Dell Data Center, Project Oxford Data Center, and ConAgra Foods facility. Emissions from each of those facilities were assumed to be equal to their respective

permit limits. AERMOD was used to model the "local background" ambient impacts caused by simultaneous activity at each of the adjacent data centers and industrial facilities. The modeled "local background" sources of particulate matter were as follows:

- Columbia Data Center generators: Two generators were assumed to operate for 24 hours at 85 percent load for "electrical bypass transformer maintenance." All particulate matter was assumed to be PM_{10} and $PM_{2.5}$.
- Project Oxford Data Center generators: Four generators were assumed to operate for 24 hours at 80 percent load for "electrical bypass transformer maintenance." All particulate matter was assumed to be PM_{10} and $PM_{2.5}$.
- Project Oxford Data Center cooling towers: 32 cooling towers were assumed to operate at their rated capacity. All particulate matter was assumed to be PM_{10} and $PM_{2.5}$.
- Dell Data Center diesel generators: It was assumed that Dell would test seven of its permitted generators for 1 hour at high load on the same calendar day, for routine monthly testing. All particulate matter was assumed to be PM_{10} and $PM_{2.5}$.
- Con-Agra Foods: It was assumed that Con-Agra would emit particulate matter at its permitted rates. All particulate matter was assumed to be PM_{10} and $PM_{2.5}$.

5.3 CRITERIA AIR POLLUTANT IMPACTS

NAAQS set by the EPA include both primary and secondary standards for criteria pollutants. Primary standards are designed to establish limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

A summary of NAAQS compliance modeling is provided in Table 5, and the locations of the maximum modeled ambient impacts are shown on Figure 1. The listed ambient impact modeling results account for the cooling towers, local background sources, and regional background. The modeled concentrations of PM_{10} and $PM_{2.5}$ are all less than the allowable limits.

The maximum ambient impacts occur at the northern facility boundary adjacent to the cooling towers during a period when the wind blows generally from the south with substantial overlap from the Con Agra Foods plume. As shown on Figure 1, the ambient impacts are lower when the wind blows from the west or north with overlapping plumes from the Dell Data Center or the Project Oxford Data Center.

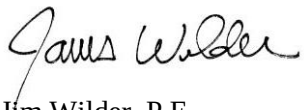
5.4 FIRST-TIER SCREENING OF TOXIC AIR POLLUTANT IMPACTS

As listed in Table 2, the forecast increases in the emission rates for all TAPs are less than their respective SQERs. Therefore, no ambient impact assessment is required for any TAP.

6.0 SIGNATURES

This document has been prepared under the supervision and direction of the following key staff.

LANDAU ASSOCIATES, INC.



Jim Wilder, P.E.
Senior Associate

JMW/MWB/ccy

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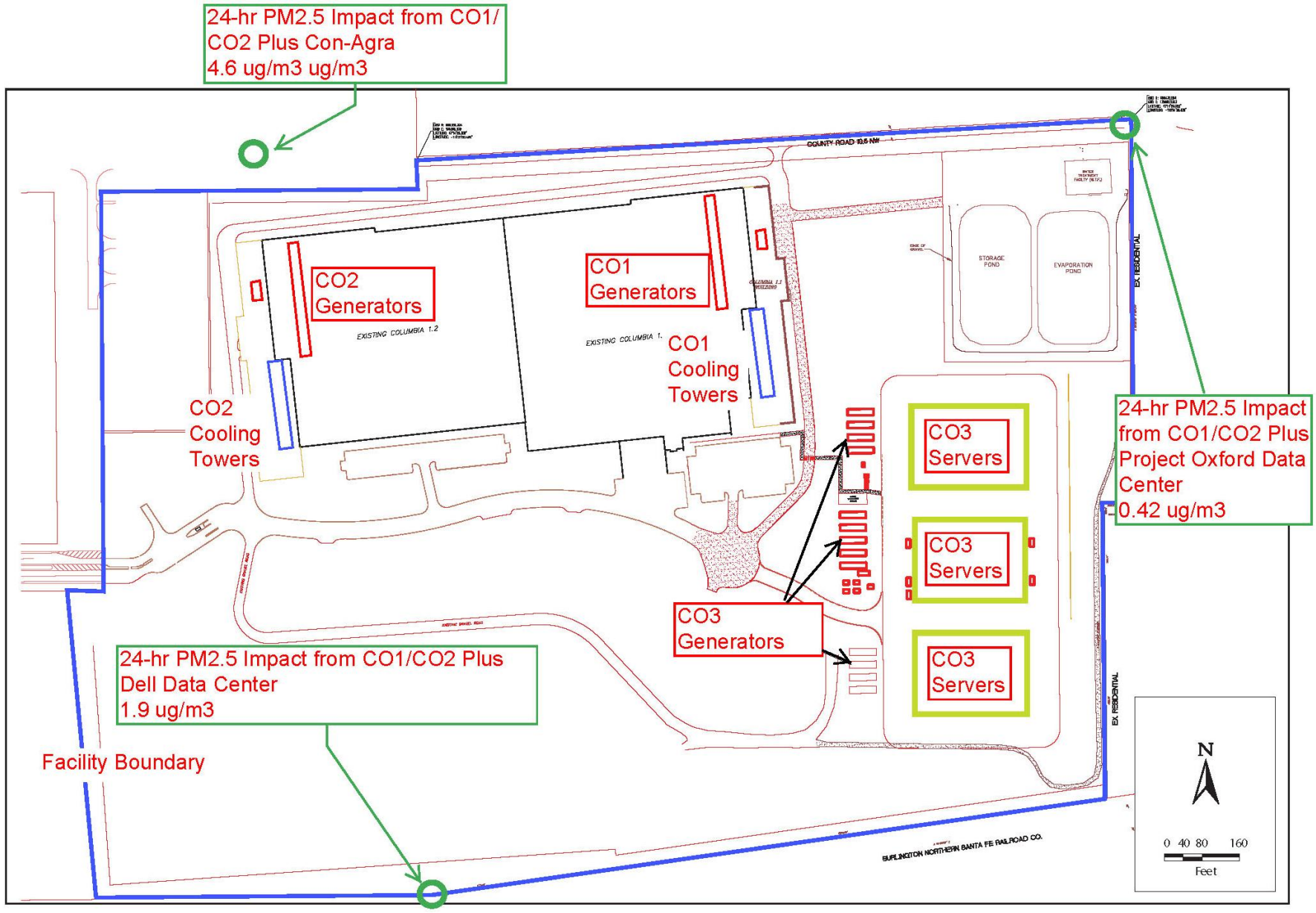

LANDAU ASSOCIATES	Microsoft Columbia Data Center Quincy, Washington	**Project Plan and AERMOD Impact Locations**

Figure
1

TABLE 1
COMPARISON OF PARTICLE SIZE FRACTIONS
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Parameter	Existing Cooling Towers with High-Efficiency Mist Eliminator (0.0005%)	Proposed WCTI System with High Efficiency Mist Eliminator (0.0005%)
TDS Concentration in Recirculation Water (mg/L)	1,072	150,000
TSP Size Fraction	100%	100%
PM_{10} Size Fraction	100%	42%
$PM_{2.5}$ Size Fraction	60%	13%

TDS = Total dissolved solids
TSP = Total suspended particulate matter
mg/L = Milligrams per liter

TABLE 2
COOLING TOWER EMISSION SUMMARY (POTENTIAL-TO-EMIT)
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Parameter	Existing System		New WCTI System		Net Increase		TAP Small-Quantity Emission Rate	AERMOD Modeling Required?
	lbs/day	tons/year	lbs/day	tons/year	lbs/day	tons/year		
Water Supply	Well water (chlorinated)		Treated wastewater (chlorinated)		--		--	--
Recirculation Water TDS	1,072 mg/L		150,000 mg/L		--		--	--
PM_{10} Fraction	100%		42%		--		--	--
$PM_{2.5}$ Fraction	60%		13%		--		--	--
Criteria Air Pollutant Emissions								
PM_{10} Emissions	13.7	1.85	82.1	11.3	68.4	9.45		Yes
$PM_{2.5}$ Emissions	8.2	1.1	25.4	3.5	17.2	2.45	--	Yes
Toxic Air Pollutant Emissions								
Fluoride	0.0109	--	0.0404	--	0.0295	--	1.71 lbs/day	No
Manganese	0.0011	--	0.0039	--	0.0028	--	0.0053 lbs/day	No
Copper	0.000015 lbs/hr	--	0.0000543lbs/hr	--	0.000039lbs/hr	--	0.219 lbs/hr	No
Chloroform	--	0.35 lbs/yr	--	0.35lbs/yr	--	0	8.35 lbs/yr	No
Bromo Dichloromethane	--	0.35 lbs/yr	--	0.35 lbs/yr	--	0	5.18 lbs/yr	No
Bromoform	--	9.2 lbs/yr	--	9.2lbs/yr	--	0	174 lbs/yr	No

TAP = Toxic air pollutant
TDS = Total dissolved solids
mg/L = Milligrams per liter

TABLE 3
REVISED FACILITY-WIDE EMISSION RATES
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Parameter (tons per year)	PM_{10}	$PM_{2.5}$
Existing Facility-Wide Potential-to-Emit		
Cooling Towers. The current approval order sets no limits on cooling tower emissions. These emission rates are based on the cooling tower parameters described in the original permit application (Jones & Stokes 2007).	1.85	1.11
Generators	1.03	1.03
Total	2.88	2.14
Proposed Future Facility-Wide Potential-to-Emit		
Cooling Towers	11.3	3.5
Generators	1.03	1.03
Total	12.3	4.4
Net Increase		
Cooling Towers	9.4	2.4
Generators		
Total increase	9.4	2.4

TABLE 4
AERMET MODEL INPUT PARAMETERS
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Data Type	Source (a)	Source IDs	Station Type	Latitude	Longitude
Hourly Surface Observations 2001-2005	Grant County International Airport Moses Lake, Washington	72782 24111	ASOS-FAA	47.19N	119.31W
Twice-Daily Upper Air Soundings 2001-2005	Spokane, Washington	72785 4106	NEXRAD	47.67N	117.62W
Site-Specific Data	AERMET User's guide AERSURFACE	N/A	N/A	47.19N	119.31W

ASOS-FAA = Automated Surface Observation System as defined by the Federal Aviation Administration
NEXRAD = Next Generation Radar
N/A = Not applicable

(a) Surface and upper air data purchased from the National Climatic Data Center.

TABLE 5
SUMMARY OF AIR DISPERSION MODELING RESULTS
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Criteria Pollutant and Averaging Period	Standards in µg/m^3			Maximum Project-Only Ambient Concentration (µg/m^3)	AERMOD Filename	Background Concentrations (µg/m^3) (a)	Total Concentration (µg/m^3)
	National Standards		Washington State Standards				
	Primary	Secondary					
Particulate Matter (PM_{10})							
1st-Highest 24-hour	150	150	150	10.5	PM10 04172014A	81 (Regional) 0.6 (Local)	92
Particulate Matter ($PM_{2.5}$)							
Annual	12	15	--	0.75	PM25 04172014A	6.5 (Regional) 0.7 (Local)	8
8th-highest 24-hour	35	35	--	2.8	PM25 04172014A (b)	21 (Regional) + 1.2 (Local)	26

µg/m^3 = Micrograms per cubic meter
ASIL = Acceptable source impact level

(a) Sum of "regional background" plus "local background" values. Regional background concentrations obtained from WSU NW Airquest website (WSU website 2013). Local background concentrations derived from AERMOD modeling.

(b) For the purpose of determining the 3-year average, five separate models were run (one for each year of meteorological data) to determine the 98th percentile concentration for each year based on the NAAQS.

APPENDIX A

Cooling Tower Emission Calculations

Jim Wilder

From: Troy Reineck [treineck@evapco.com]
Sent: Thursday, May 15, 2014 2:08 PM
To: Ray Cheng
Subject: Existing Evapco Cooling Tower Drift Rate Review

Ray,

To summarize what you have, and our discussion, see below.

You have (12) USS 312-454; serial numbers 6-293653-293664
Each USS 312-454 is designed to cool 3,150 gpm @ 95/85/78
I understand your actual flow rate is 2,170 gpm

These units were sold in 2006 and the published guaranteed drift rate was 0.001%
Based on flow rate (design and actual) and CFM, these units (as sold) are capable of 0.0005% drift rate, with properly maintained drift eliminators
Well maintained towers and drift eliminators will continue to perform with very low drift rate; in this case 0.0005%

Let me know if you have any questions.

Thank you,
Troy J. Reineck
Global Cooling Tower Product Manager
410-756-2600
treineck@evapco.com

Figure A-1

0.0005%, RESTRICTED-FLOW PROPOSED WCTI FUTURE COOLING TOWER EMISSIONS
BASIS OF CALCULATION: 0.0005% DRIFT RATE; FLOW RESTRICTOR PLATE = 2,170 GPM EACH OF 12 TOWERS
Feedwater = Industrial Re-Use Water at 100 cycles

No of Operational Towers	10	towers				
Recirc Water TDS	150,000	mg/L				
Feedwater TDS	1,500	mg/L				
Cycles of Concentration (Wastewater)	100.0	cycles				
Recirc Water Flow Each Tower	**2,170**	**gpm, based on Jan-2007 application with flow reducer plate**				
Drift Rate	0.0005	percent of recirc flow				
Annual-average Cooling Load	75%	percent of maximum cooling				
Liquid Drift Droplet Emissions	54	lbs/hour combined towers	5.43	lbs/hr/tower		
Evaporated Solid TSP Emissions	8.14	lbs/hour combined towers	0.81	lbs/hr/tower	0.103	TSP, g/sec/tower
Combined Make Up Water for 10 towers	266	gallons/minute				
Basis for droplet size distribution	SPX/Marley cooling tower data, based on 0.0005% drift rate					

Facility-Wide Non-Volatile Particulate Matter and TAPs Emitted As Evaporated Solid Drift Droplets

Toxic Air Pollutant in Industrial Wastewater	**Conc. In CT Feedwater, mg/L**	**Hourly Emission Facility-Wide (lbs/hr)**	**Daily Emission Facility-Wide (lbs/day)**	**Annual Emission Facility-Wide (lbs/yr)**	**Small Quantity Emission Rate**	
Fluoride	0.31	0.0017	0.0404	11.06	1.71	lbs/day
Manganese	0.03	0.0002	0.0039	1.07	0.0053	lbs/day
Copper	0.01	0.0000543	0.001303	0.48	0.219	lbs/1-hour
Total Suspended Particulate	1,500	8.14	195.5	53,506	TSP Fraction =	100%
PM10 Based on Droplet Size Distribution	1,500	3.42	82.09	22,473	PM10 Fraction =	42%
PM2.5 Based on Droplet Size Distribution	1,500	1.059	25.409	6,956	PM2.5 Fraction =	13%

Volatile Chlorine Disinfection TAPs (Assume 100% of VOC content of makeup water stream is evaporated)

Toxic Air Pollutant	**Conc. In CT Makeup Water, mg/L**	**Annual Emission (lbs/yr)**	**Small Quantity Emission Rate**	
Chloroform	0.0004	0.350	8.35	lbs/yr
Bromo Dichloromethane	0.0004	0.350	5.18	lbs/yr
Bromoform	0.0105	9.2	174	lbs/yr

P:\897\004\FileRm\R\WCTI Air Quality NOC Application Apr-2014\WCTI Emission Calcs\[0005 percent Revised WCTI-CO1 Drift Emissions 5-19-2014.xlsx]Existing 2007 CTs

Figure A-2

EXISTING (2007 APPLICATION) 0.001%, RESTRICTED-FLOW COOLING TOWER EMISSIONS
BASIS OF CALCULATION: 0.001% DRIFT RATE; FLOW RESTRICTOR PLATE = 2,170 GPM EACH OF 12 TOWERS
Feedwater = 1,072 mg/l in 2007 Permit Application

No of Operational Towers	6	phases				
Recirc Water TDS	1,072	mg/L				
Feedwater TDS	383	mg/L				
Cycles of Concentration	2.8	cycles				
Recirc Water Flow Each Tower	**17,500**	**gpm per phase, based on Jan-2007 application**				
Drift Rate	0.001	percent of recirc flow				
Annual-average Cooling Load	75%	percent of maximum cooling				
Liquid Drift Droplet Emissions	525	lbs/hour combined towers	87.57	lbs/hr/tower		
Evaporated Solid TSP Emissions	0.56	lbs/hour combined towers	0.09	lbs/hr/tower	0.012	TSP, g/sec/tower
Combined Make Up Water for 10 towers	266	gallons/minute				
Basis for droplet size distribution	2007 permit assumed all PM = TSP = PM10 = PM2.5					

Facility-Wide Non-Volatile Particulate Matter and TAPs Emitted As Evaporated Solid Drift Droplets

Toxic Air Pollutant in Industrial Wastewater	**Conc. In CT Feedwater, mg/L**	**Hourly Emission Facility-Wide (lbs/hr)**	**Daily Emission Facility-Wide (lbs/day)**	**Annual Emission Facility-Wide (lbs/yr)**	**Small Quantity Emission Rate**	
Fluoride	0.31	0.0005	0.0109	3.00	1.71	lbs/day
Manganese	0.03	0.0000	0.0011	0.29	0.0053	lbs/day
Copper	0.01	0.0000147	0.000353	0.13	0.219	lbs/1-hour
Total Suspended Particulate	383	0.563	13.5	3,701	TSP Fraction =	100%
PM10 Based on Droplet Size Distribution	383	0.563	13.5	3,701	PM10 Fraction =	100%
PM2.5 Based on Droplet Size Distribution	383	0.563	13.5	3,701	PM2.5 Fraction =	100%

Volatile Chlorine Disinfection TAPs (Assume 100% of VOC content of makeup water stream is evaporated)

Toxic Air Pollutant	**Conc. In CT Makeup Water, mg/L**	**Annual Emission (lbs/yr)**	**Small Quantity Emission Rate**	
Chloroform	0.0004	0.350	8.35	lbs/yr
Bromo Dichloromethane	0.0004	0.350	5.18	lbs/yr
Bromoform	0.0105	9.2	174	lbs/yr

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Figure A-3

Future Proposed WCTI Cooling Tower Drift Droplet and Evaporated Particle Size Distributions
High-Efficiency Drift Configuration = 0.0005%

Methodology for calculating the evaporated solid particle size distribution based on the droplet size distribution is taken from "Calculating Realistic PM10 Emissions from Cooling Towers", Reisman and Frisbie, Environmental Progress, July 2002.

Cooling Tower	SPX Cooling Technology for 0.0005% drift eliminator	
Drift Efficiency	0.0005%	
Recirc. Water TDS Conc., mg/L	150,000	Industrial re-use water (1,500 mg/L) with 100 cycles
Drift Droplet Density, g/cc	1.0	
Evaporated salt particle density, g/cc	2.2	

Diameter of Drift Droplets or Evaporated Particles (microns)	Liquid Droplet Size Distribution (percent)	Percent Smaller Size Distribution	Evaporated Solid Particle Diameter (microns)
10	13	13	4.1
20	18.5	31.5	8.2
30	24.1	55.6	12.3
40	22.2	77.8	16.4
50	16.7	94.5	20.4
60	5.5	100	24.5
70			
80			
90			
100			
110			
120			
Total	100		

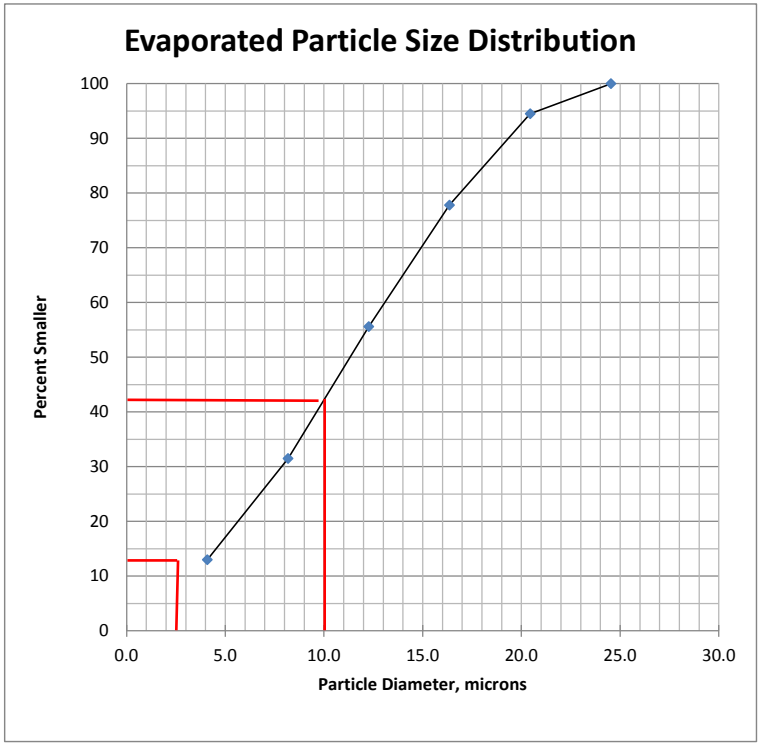

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Figure A-4

Existing 2007 Application Cooling Tower Drift Droplet and Evaporated Particle Size Distributions
High-Efficiency Drift Configuration = 0.0005%

Methodology for calculating the evaporated solid particle size distribution based on the droplet size distribution is taken from "Calculating Realistic PM10 Emissions from Cooling Towers", Reisman and Frisbie, Environmental Progress, July 2002.

Cooling Tower	SPX Cooling Technology for 0.0005% drift eliminator	
Drift Efficiency	0.0005%	
Recirc. Water TDS Conc., mg/L	1,072	TDS in May 2007 report by Jones & Stokes
Drift Droplet Density, g/cc	1.0	
Evaporated salt particle density, g/cc	2.2	

Diameter of Drift Droplets or Evaporated Particles (microns)	Liquid Droplet Size Distribution (percent)	Percent Smaller Size Distribution	Evaporated Solid Particle Diameter (microns)
10	13	13	0.8
20	18.5	31.5	1.6
30	24.1	55.6	2.4
40	22.2	77.8	3.2
50	16.7	94.5	3.9
60	5.5	100	4.7
70			
80			
90			
100			
110			
120			
Total	100		

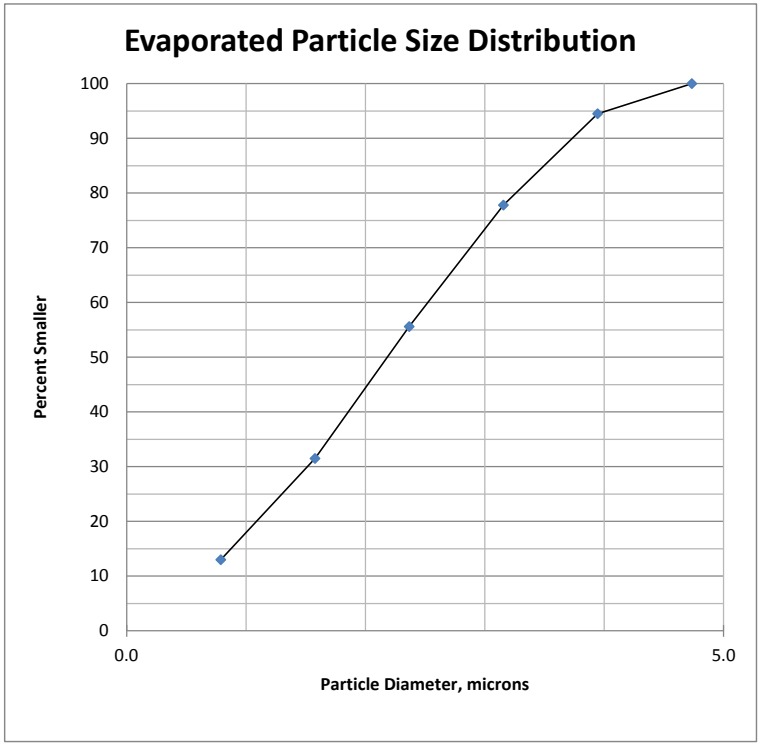

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Figure A-5

Trace Metals In City Industrial Wastewater Fed To Cooling Tower Pretreatment (Coagulation, Filtration, Water Softening)

Table E3: IWTP Effluent Analysis. One twenty-four hour composite sample was taken each day on seven separate days.

Parameter	1/23/2008	1/24/2008	1/25/2008	1/28/2008	1/29/2008	1/30/2008	1/31/2008	Average	Units	PQL	Method
Alkalinity	571	569	568	570	571	569	567	**569.29**	mg/L	10	SM2320B
Aluminum	0.0138	0.0148	0.0149	0.0201	0.0166	0.0135	0.0134	**0.02**	mg/L	0.01	EPA 200.8
NH3-N	0.401	0.577	0.397	0.467	0.433	0.442	0.572	**0.47**	mg/L	0.05	SM4500NH3G
Fecal Coliform	13	1600	220	220	140	500	500	**456.14**	MPN/100mL	2	SM9221E
Total Coliform	80	1600	300	500	500	500	500	**568.57**	MPN/100mL	2	SM9221B
Barium	0.0199	0.0226	0.0213	0.0238	0.0249	0.0245	0.0248	**0.02**	mg/L	0.001	EPA 200.8
Bicarbonate	571	569	568	570	571	569	567	**569.29**	mg/L	10	SM2320B
BOD	5.1	5.45	5.09	4.02	4.22	4.57	3.9	**4.62**	mg/L	2	SM5210B
Boron	0.0295	0.0331	0.034	0.0356	0.0448	0.0462	0.0451	**0.04**	mg/L	0.01	EPA 200.8
Bromide	ND	ND	ND	ND	ND	ND	ND		mg/L	0.1	EPA 300.0
Cadmium	ND	ND	ND	ND	ND	ND	ND		mg/L	0.001	EPA 200.8
Calcium	43.3	47.3	42.6	43.4	46	46.1	44.5	**44.74**	mg/L	0.01	EPA 200.8
Carbonate	ND	ND	ND	ND	ND	ND	ND		mg/L	10	SM2320B
Chloride	286	296	273	274	291	289	261	**281.43**	mg/L	2	EPA 300.0
Chromium	ND	ND	ND	ND	ND	ND	ND		mg/L	0.001	EPA 200.8
COD	38.1	12.1	32	39.3	29	39.4	34	**31.99**	mg/L	5	EPA 410.4
Conductivity	2080	2160	2130	2160	2173	2153	2194	**2,150.00**	µmhos/cm	10	SM2510B
Copper	0.00256	0.00313	0.00276	0.00288	0.00926	0.00715	0.012	**0.01**	mg/L	0.001	EPA 200.8
Fluoride	0.371	0.34	0.352	0.221	0.319	0.22	0.323	**0.31**	mg/L	0.1	EPA 300.0
Hardness	209	227	206	213	218	223	215	**215.86**	mg/L	1	EPA 200.8
Magnesium	24.4	26.3	24.1	25.4	25.1	26.1	25.1	**25.21**	mg/L	0.1	EPA 200.8
Iron	0.0479	0.0606	0.0594	0.061	0.0704	0.0591	0.0453	**0.06**	mg/L	0.01	EPA 200.8
Lead	ND	ND	ND	ND	ND	ND	ND		mg/L	0.001	EPA 200.8
Lithium	ND	ND	ND	ND	ND	ND	ND		mg/L	0.001	EPA 200.8
Manganese	0.0142	0.0257	0.0254	0.0296	0.0421	0.0378	0.0369	**0.03**	mg/L	0.001	EPA 200.8
Molybdenum	0.00128	0.00116	0.0011	0.00109	ND	ND	ND		mg/L	0.001	EPA 200.8
Nickel	ND	ND	ND	ND	ND	ND	ND		mg/L	0.001	EPA 200.8
NO3/N	4.67	1.65	0.975	0.95	0.305	0.206	0.482	**1.32**	mg/L	0.1	EPA 300.0
NO2/N	ND	ND	ND	ND	ND	ND	ND		mg/L	0.1	EPA 300.0
pH	7.91	7.86	7.87	7.98	7.76	7.95	7.94	**7.90**	ph Units		EPA 150.1
PO4/P	4.95	1.89	5.2	1.11	1.85	2.79	1.22	**2.72**	mg/L	0.05	EPA 300.0
Potassium	249	279	246	274	315	362	353	**296.86**	mg/L	0.01	EPA 200.8
Silica (as SiO2)	25.8	27.2	24.8	25.9	25.7	25.9	25	**25.76**	mg/L	1	EPA 200.8
Silica (Molybdate)*	38.5	42.1	31.7	39	43.2	57.6	57.1	**44.17**	mg/L	10	SM 4500 SIO2C
Sodium	247	250	221	228	216	249	234	**235.00**	mg/L	0.1	EPA 200.8
TDS (measured)	1353	1370	1328	1253	1392	1325	1343	**1,337.71**	mg/L	10	EPA 160.1
TSS	5	228	0	6	6	7	7	**37.00**	mg/L	5	EPA 160.2
TVS	277	276	249	989	741	640	380	**507.43**	mg/L	5	SM2540E
Strontium	0.221	0.223	0.213	0.227	0.204	0.211	0.208	**0.22**	mg/L	0.01	EPA 200.8
Sulfate	80.4	83.1	82.6	83.1	82.1	85.5	83.5	**82.90**	mg/L	2	EPA 300.0
Sulfide	0.0826	0.0885	0.0671	0.0667	0.0831	0.0819	0.0814	**0.08**	mg/L	0.05	SM4500S2F
Sulfite	ND	ND	ND	ND	ND	ND	ND		mg/L	0.5	SM 4500 SO3B
TKN	2.48	2.49	2.61	2.39	1.66	1.05	1.15	**1.98**	mg/L	0.1	SM4500NORGC
TOC	9.07	9.52	8.7	8.64	9.07	8.73	8.54	**8.90**	mg/L	1	SM5310C
Total P	5.08	3.82	5.63	3.55	2.09	3.08	1.45	**3.53**	mg/L	0.01	SM4500PF
Total Residual Chlorine	0.28	0.07	0.07	0.1	0.08	0.14	0.08	**0.12**	mg/L	0.01	SM 4500CL-G
Vanadium	0.0273	0.0251	0.0238	0.025	0.0158	0.0162	0.0201	**0.02**	mg/L	0.001	EPA 200.8
Zinc	0.0159	0.0181	0.0178	0.0238	0.0235	0.0229	0.0222	**0.02**	mg/L	0.001	EPA 200.8

Equivalence values	
Monovalent cations:	17.84 meq
Divalent cations:	4.31 meq
M:R ratio;	4.14

Charge balance verification	
Cations:	22.1 meq
Anions:	19.1 meq
Variance from average:	7.5%

City water comparison	
Cations:	6.1 meq
Anions:	5.3 meq
Variance from average:	7.0%

Total Anions	**938.26**	Major: bicarbonate, chloride, sulfate
Total Cations	**602.01**	Major: Ca, Mg, Na, K
TDS - summed	**1,540.27**	

Per Higgins and Novak, 1997a and b, typical M:D of <2:1 is indicative of good settling sludge.

Figure A-6

Chlorine Disinfection Byproducts in Chlorinated City Water

WATER MANAGEMENT LABORATORIES INC.
1515 80th St. E.
Tacoma, WA 98404
(253) 531-3121

DRINKING WATER VOLATILE ORGANIC CHEMICALS (VOC's) ANALYSIS REPORT
EPA TEST METHOD - EPA 524.2/TTHM's
WA DOH TEST PANEL: TTHM

System ID No.: 704501		DOH Source No*: S92	Lab Sample No: SEE BELOW
System Name: City of Quincy			Group: A
Multiple Source Nos.: N/A		Date Collected: 09/12/11	Date Received: 09/14/11
Sample Type: A	Purpose: C	Date Analyzed: 09/16/11	Analyst: LHL
County: Grant		Date Reported: 09/18/11	Supervisor: JMB
Specific Sample Location: SEE BELOW			
Send To: Cascade Analytical Inc. 3019 G.S. Center Road Wenatchee, WA 98801			Comments: **11C-18577 thru 18581** **PO# 158150091311**

* Generally S92 for Distribution Sample

DOH #	27	28	29	30	31
SRL	0.25 µg/L	0.5 µg/L	0.5 µg/L	0.5 µg/L	0.5 µg/L
MCL	-	-	-	-	80 µg/L

All results are in micrograms per Liter (ppB)

Lab Sample No:	Collect Date	Analysis Date	Site / Location	0.40 ug/L Chloroform	0.40 ug/L Bromo dichloro methane	Chloro dibromo methane	10.5 ug/L Bromoform	Total Trihalo-methanes
08970948	09/12/11	09/16/11	1010 Yahoo Way	0.7	0.9	4.5	14.8	20.9
08970949	09/12/11	09/16/11	1400 13th Ave. SW (Monument & Elem)	0.9	ND	2.2	11.2	14.3
08970950	09/12/11	09/16/11	1801 F Street SW (Double Diamond) - TP1	ND	0.6	3.4	8.7	12.7
08970951	09/12/11	09/16/11	Rd "Q" NW & Martin Road - TP5	ND	ND	2.4	11.0	13.4
08970952	09/12/11	09/16/11	1720 Central Ave. S. (QCBid) - TP3	ND	ND	2.5	7.1	9.6
			SQER	8.35 #/yr	5.18 #/yr	—	174 #/yr	
			De-Min	0.417 #/yr	0.259 #/yr	—	8.72 #/yr	

NOTES:

SRL (State Reporting Level): Indicates the minimum reporting level required by the Washington Department of Health (DOH).

MCL (Maximum Contaminant Level): If the contaminant amount exceeds the MCL, immediately contact your regional DOH office.

NA (Not Analyzed): In the RESULTS column indicates this compound was not included in the current analysis.

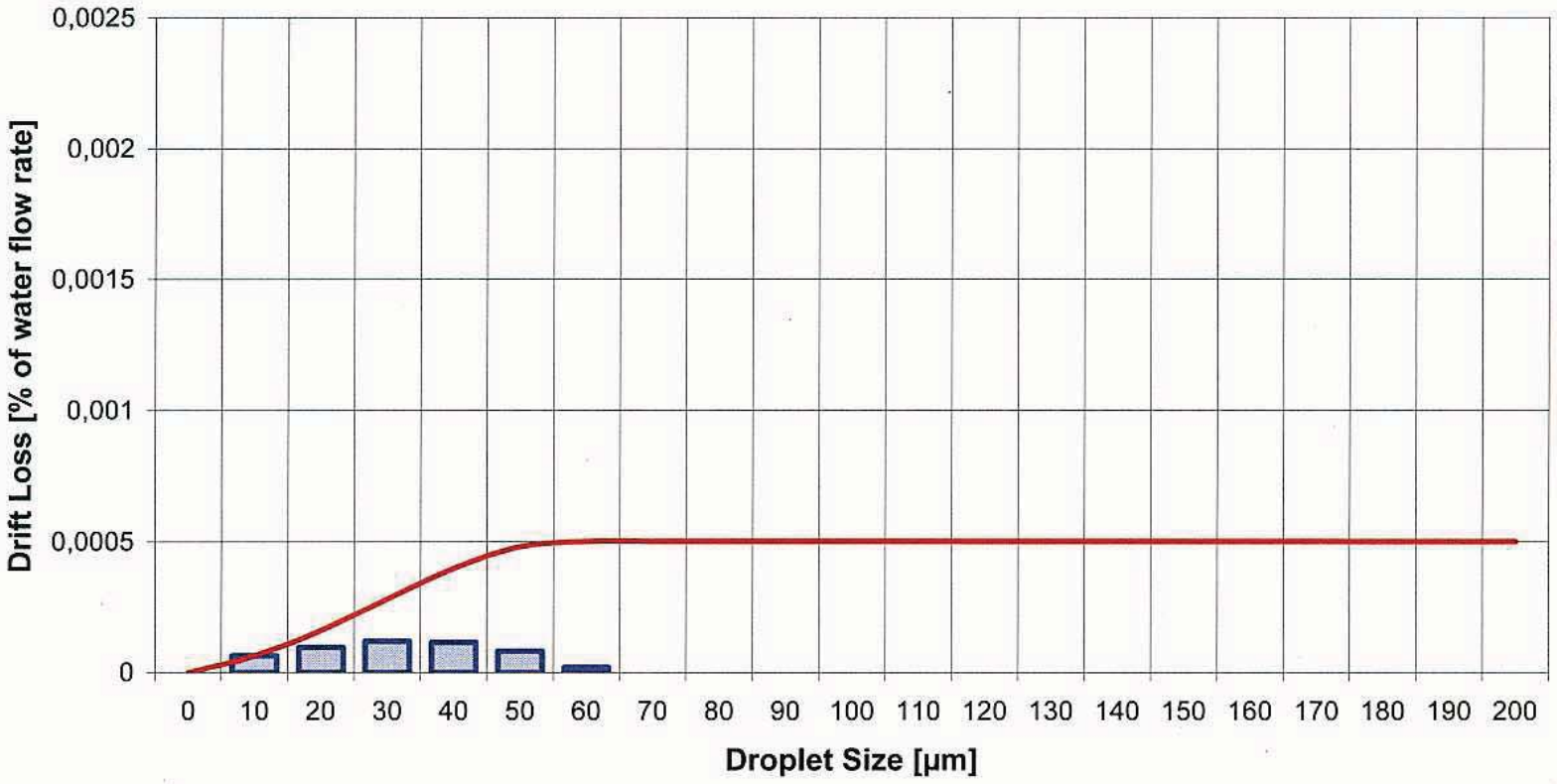
ND (Not Detected): In the RESULTS column indicates this compound was analyzed and not detected at a level greater than or equal to the SRL.

< : Indicates less than.

Comments: A maximum contaminant level of 80ug/L Total Trihalomethanes (Compounds 27-30) is allowed 524.2:TTHM's

Figure A-7

Drift Loss as a Function of the Droplet Size
(Total Drift Loss = 0.0005% of water flow rate)



APPENDIX B

AERMOD Input Data

TABLE B-1
LAKES AERMOD VIEW SOURCE PARAMETER OUTPUT VARIABLES
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

AERMOD View - Source Parameters
MS Excel - Lakes Format: Version 2.0
Supported Source Types: Point, Rectangular Area, Circular Area, Polygon Area, Volume, Open Pit, Line Volume, Line Area

Parameters	Units	Description
Type		POINT, AREA, AREA_CIRC, AREA_POLY, VOLUME, OPEN_PIT, LINE, LINE_VOLUME, LINE_AREA
ID		Source ID up to 12 characters
Desc		Optional description
SourceID_Prefix		Text prefix up to 4 characters long for generated LINE_VOLUME and LINE_AREA sources
Base_Elev	[m]	Source base elevation above mean sea level
Height	[m]	Release height above ground
Diam	[m]	Inner stack diameter (POINT) or circular area radius (AREA_CIRC)
Exit_Vel	[m/s]	Exit velocity (POINT only)
Exit_Temp	[K]	Exit temperature (POINT only)
Release Type		VERTICAL, HORIZONTAL, CAPPED (POINT only) - HORIZONTAL and CAPPED are non-default beta options
SigmaY	[m]	Initial sigma Y (VOLUME only)
SigmaZ	[m]	Initial sigma Z (AREA, AREA_CIRC, AREA_POLY, VOLUME, LINE, and LINE_AREA only; optional for AREA, AREA_CIRC, AREA_POLY, and LINE)
Length_X	[m]	X side length (AREA, VOLUME, OPEN PIT, and LINE_AREA only; optional for VOLUME, will be used to calculate SigmaY)
Length_Y	[m]	Y side length (AREA and OPEN PIT only); width for LINE sources
Rotation_Angle	[degrees]	Clockwise rotation from North of Y side (AREA and OPEN PIT only)
Pit_Volume	[m^3]	Volume of the open pit (OPEN PIT only)
Emission_Rate	[g/s or g/s/m2]	Emission rate (g/s for POINT, VOLUME, and LINE_VOLUME; g/s/m2 for AREA, AREA_CIRC, AREA_POLY, OPENPIT, LINE, and LINE_AREA)
Configuration		LINE_VOLUME configuration: Separated or Adjacent
LineVolumeHeight	[m]	Plume Height or Building Height for LINE_VOLUME source
PlumeWidth	[m]	Plume width for LINE_VOLUME source
LineVolumeType		LINE_VOLUME type: None, Surface-Based, Elevated, Elevated Building
LineArea_Ratio1		Ratio 1 for LINE_AREA sources
Num_Coords		Number of coordinate pairs (POINT, AREA, AREA_CIRC, VOLUME, OPENPIT = 1; AREA_POLY >= 3; LINE = 2; LINE_AREA, LINE_VOLUME >=2)
X1	[m]	X coordinate of source location [m]
Y1	[m]	Y coordinate of source location [m]
X2	[m]	Secondary X coordinate of source location [m] (AREA_POLY, LINE, LINE_VOLUME, LINE_AREA sources only)
Y2	[m]	Secondary Y coordinate of source location [m] (AREA_POLY, LINE, LINE_VOLUME, LINE_AREA sources only)
X3	[m]	Additional X coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA only)
Y3	[m]	Additional Y coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA only)
X4	[m]	Additional X coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA only)
Y4	[m]	Additional Y coordinate of source location [m] (AREA_POLY, LINE_VOLUME, LINE_AREA only)
Base_Elev_m	[m]	Base Elevation for LINE_VOLUME, LINE_AREA Nodes
Rel_Height_m	[m]	Release height for LINE_VOLUME, LINE_AREA Nodes

TABLE B-2
MODEL-SPECIFIC SOURCE IDS
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Source ID	Description
ECBOIL	Con Agra Boiler
ECS	Con Agra Scrubbers
EDGEN	Dell Generators
EMCT	Microsoft Columbia Cooling Towers
CO3GEN	Microsoft Columbia Generators
CT	Microsoft Oxford Cooling Towers
GEN	Microsoft Oxford Generators

TABLE B-3
TOTAL SUSPENDED PARTICULATE MATTER SOURCE PARAMETERS FOR MODEL TSP-04092014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN01	2.5 MW	406.25	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281707.79	5235853.92
POINT	GEN02	2.5 MW	406.2	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281762.90	5235851.07
POINT	GEN03	2.5 MW	405.83	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281699.67	5235774.10
POINT	GEN04	2.5 MW	405.75	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281757.61	5235771.95
POINT	GEN05	2.5 MW	406.18	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281845.72	5235848.56
POINT	GEN06	2.5 MW	406.13	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281898.12	5235846.91
POINT	GEN07	2.5 MW	405.67	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281840.79	5235767.61
POINT	GEN08	2.5 MW	405.57	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281895.36	5235764.70
POINT	GEN09	2.5 MW	405.73	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281698.45	5235752.83
POINT	GEN10	2.5 MW	405.59	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281756.75	5235750.33
POINT	GEN11	2.5 MW	405.26	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281699.58	5235673.87
POINT	GEN12	2.5 MW	405.21	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281751.43	5235672.98
POINT	GEN13	2.5 MW	405.55	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281839.76	5235746.57
POINT	GEN14	2.5 MW	405.45	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281895.40	5235745.46
POINT	GEN15	2.5 MW	405.08	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281837.99	5235669.69
POINT	GEN16	2.5 MW	404.97	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281893.59	5235666.70
POINT	GEN17	2.5 MW	406.65	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281405.78	5235867.33
POINT	GEN18	2.5 MW	406.45	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281456.90	5235865.41
POINT	GEN19	2.5 MW	406.24	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281401.68	5235788.31
POINT	GEN20	2.5 MW	406.13	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281454.11	5235786.59
POINT	GEN21	2.5 MW	406.3	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281545.57	5235860.91
POINT	GEN22	2.5 MW	406.24	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281598.83	5235858.95
POINT	GEN23	2.5 MW	405.96	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281540.53	5235782.63
POINT	GEN24	2.5 MW	405.89	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281595.30	5235780.46
POINT	GEN25	2.5 MW	406.11	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281401.41	5235765.88
POINT	GEN26	2.5 MW	406.02	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281453.90	5235764.25
POINT	GEN27	2.5 MW	405.73	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281398.71	5235689.58
POINT	GEN28	2.5 MW	405.64	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281449.16	5235687.01
POINT	GEN29	2.5 MW	405.85	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281539.89	5235759.83
POINT	GEN30	2.5 MW	405.77	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281594.33	5235757.83
POINT	GEN31	2.5 MW	405.51	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281536.26	5235681.93
POINT	GEN32	2.5 MW	405.38	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281591.22	5235678.66
POINT	GEN33	1.5 MW	405.64	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281628.31	5235739.09
POINT	GEN34	1.5 MW	405.63	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281668.59	5235735.42
POINT	GEN35	1.5 MW	404.88	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281622.98	5235596.55

TABLE B-3
TOTAL SUSPENDED PARTICULATE MATTER SOURCE PARAMETERS FOR MODEL TSP-04092014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN36	1.5 MW	404.83	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281663.38	5235593.94
POINT	GEN37	1.5 MW	405.31	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281958.47	5235732.42
POINT	EDGEN01		405.9	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.06	5236141.79
POINT	EDGEN02		405.93	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.27	5236149.10
POINT	EDGEN03		405.94	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.09	5236156.84
POINT	EDGEN04		406.02	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.26	5236165.69
POINT	EDGEN05		406.03	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236173.85
POINT	EDGEN06		406.04	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236182.90
POINT	EDGEN07		406.07	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.36	5236190.26
POINT	ECBOIL01	Boiler	401.82	14.7	1.32	10.16	450	VERTICAL	0.37925362	1	282670.31	5235207.81
POINT	EMCT01		403.4	4.57	3.05	9.15	300	VERTICAL	0.099	1	283138.87	5235815.29
POINT	EMCT02		403.36	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283145.06	5235815.52
POINT	EMCT03		403.34	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283151.94	5235815.70
POINT	EMCT04		403.34	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283139.17	5235805.85
POINT	EMCT05		403.33	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283145.56	5235806.13
POINT	EMCT06		403.32	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283152.31	5235806.31
POINT	EMCT07		403.33	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283139.48	5235797.30
POINT	EMCT08		403.31	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283146.01	5235797.89
POINT	EMCT09		403.3	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283152.03	5235798.32
POINT	EMCT10		403.31	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283139.67	5235789.00
POINT	EMCT11		403.28	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283146.51	5235789.30
POINT	EMCT12		403.25	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283152.51	5235789.45
POINT	EMCT13		403.27	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283140.13	5235780.28
POINT	EMCT14		403.24	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283146.13	5235780.43
POINT	EMCT15		403.23	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283152.07	5235780.73
POINT	EMCT16		403.23	4.57	2.7432	9.15	300	VERTICAL	0	1	283141.18	5235771.45
POINT	EMCT17		403.22	4.57	2.7432	9.15	300	VERTICAL	0	1	283146.76	5235772.00
POINT	EMCT18		403.21	4.57	2.7432	9.15	300	VERTICAL	0	1	283152.38	5235772.09
POINT	EMCT19		402.83	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283462.66	5235836.55
POINT	EMCT20		402.83	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283468.03	5235836.56
POINT	EMCT21		402.84	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283473.43	5235837.10
POINT	EMCT22		402.75	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283462.69	5235828.63
POINT	EMCT23		402.76	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283468.69	5235829.04
POINT	EMCT24		402.76	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283474.53	5235829.37
POINT	EMCT25		402.66	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283463.80	5235819.76

TABLE B-3
TOTAL SUSPENDED PARTICULATE MATTER SOURCE PARAMETERS FOR MODEL TSP-04092014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	EMCT26		402.67	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283469.20	5235820.38
POINT	EMCT27		402.68	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283474.95	5235820.81
POINT	EMCT28		402.57	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283464.37	5235810.75
POINT	EMCT29		402.58	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283469.77	5235811.20
POINT	EMCT30		402.58	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283475.24	5235811.55
POINT	EMCT31		402.51	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283464.45	5235802.39
POINT	EMCT32		402.5	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283470.11	5235802.73
POINT	EMCT33		402.5	4.57	2.7432	9.15	300	VERTICAL	0.099	1	283475.59	5235803.18
POINT	EMCT34		402.44	4.57	2.7432	9.15	300	VERTICAL	0	1	283464.62	5235793.75
POINT	EMCT35		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283470.45	5235794.17
POINT	EMCT36		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283475.75	5235794.54
POINT	ECS01		400.47	14.097	1.225296	6.68402071	318.15	VERTICAL	0.340194278	1	282894.20	5235154.64
POINT	ECS02		402.15	6.4008	1.207008	4.53707267	359.261111	VERTICAL	0.214196397	1	282761.47	5235284.58
POINT	ECS03		400.89	9.7536	0.509016	8.963755	330.927778	VERTICAL	0.028979513	1	282676.24	5235141.62
POINT	CT05		406.12	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281857.24	5235844.95
POINT	CT06		406.13	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281886.25	5235844.78
POINT	CT07		405.63	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281852.58	5235763.94
POINT	CT08		405.62	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281881.44	5235763.13
POINT	CT01		406.24	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281719.59	5235850.03
POINT	CT02		406.19	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281750.83	5235849.49
POINT	CT03		405.82	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281714.20	5235771.91
POINT	CT04		405.74	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281744.37	5235769.76
POINT	CT09		405.67	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281712.58	5235750.90
POINT	CT10		405.6	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281744.37	5235748.74
POINT	CT11		405.26	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281711.50	5235671.16
POINT	CT12		405.2	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281738.44	5235671.16
POINT	CT13		405.5	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281851.58	5235743.90
POINT	CT14		405.45	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281882.29	5235744.43
POINT	CT15		405.04	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281849.97	5235666.85
POINT	CT16		405.01	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281879.60	5235664.16
POINT	CT17		406.56	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281417.70	5235863.65
POINT	CT18		406.49	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281443.06	5235863.65
POINT	CT19		406.19	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281414.71	5235785.28
POINT	CT20		406.13	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281441.57	5235784.89
POINT	CT21		406.28	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281556.80	5235857.30

TABLE B-3
TOTAL SUSPENDED PARTICULATE MATTER SOURCE PARAMETERS FOR MODEL TSP-04092014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	CT22		406.25	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281587.16	5235855.74
POINT	CT23		405.95	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281552.52	5235777.88
POINT	CT24		405.87	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281582.49	5235778.66
POINT	CT25		406.04	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281413.54	5235762.31
POINT	CT26		406.01	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281441.57	5235761.15
POINT	CT27		405.68	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281410.42	5235685.62
POINT	CT28		405.61	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281436.51	5235683.29
POINT	CT29		405.84	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281552.13	5235755.70
POINT	CT30		405.76	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281582.49	5235754.92
POINT	CT31		405.45	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281547.84	5235677.84
POINT	CT32		405.34	5.340096	2.54508	25.984453	300	VERTICAL	0.020663652	1	281577.43	5235673.55
POINT	CO3GEN01		402.15	9.4488	0.45698664	30.001754	670.927778	VERTICAL	0.0399	1	283527.96	5235775.31
POINT	CO3GEN02		402.11	9.4488	0.45698664	30	670.927778	VERTICAL	0.0399	1	283527.59	5235765.43

TABLE B-4
PM_{10} SOURCE PARAMETERS FOR MODEL PM10-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Type	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN01	2.5 MW	406.25	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281707.79	5235853.92
POINT	GEN02	2.5 MW	406.2	14.097	0.4572	14.632168	568.15	VERTICAL	0.020663652	1	281762.90	5235851.07
POINT	GEN03	2.5 MW	405.83	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281699.67	5235774.10
POINT	GEN04	2.5 MW	405.75	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281757.61	5235771.95
POINT	GEN05	2.5 MW	406.18	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281845.72	5235848.56
POINT	GEN06	2.5 MW	406.13	14.097	0.4572	14.632168	568.15	VERTICAL	0.020663652	1	281898.12	5235846.91
POINT	GEN07	2.5 MW	405.67	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281840.79	5235767.61
POINT	GEN08	2.5 MW	405.57	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281895.36	5235764.70
POINT	GEN09	2.5 MW	405.73	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281698.45	5235752.83
POINT	GEN10	2.5 MW	405.59	14.097	0.4572	14.632168	568.15	VERTICAL	0.020663652	1	281756.75	5235750.33
POINT	GEN11	2.5 MW	405.26	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281699.58	5235673.87
POINT	GEN12	2.5 MW	405.21	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281751.43	5235672.98
POINT	GEN13	2.5 MW	405.55	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281839.76	5235746.57
POINT	GEN14	2.5 MW	405.45	14.097	0.4572	14.632168	568.15	VERTICAL	0.020663652	1	281895.40	5235745.46
POINT	GEN15	2.5 MW	405.08	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281837.99	5235669.69
POINT	GEN16	2.5 MW	404.97	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281893.59	5235666.70
POINT	GEN17	2.5 MW	406.65	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281405.78	5235867.33
POINT	GEN18	2.5 MW	406.45	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281456.90	5235865.41
POINT	GEN19	2.5 MW	406.24	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281401.68	5235788.31
POINT	GEN20	2.5 MW	406.13	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281454.11	5235786.59
POINT	GEN21	2.5 MW	406.3	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281545.57	5235860.91
POINT	GEN22	2.5 MW	406.24	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281598.83	5235858.95
POINT	GEN23	2.5 MW	405.96	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281540.53	5235782.63
POINT	GEN24	2.5 MW	405.89	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281595.30	5235780.46
POINT	GEN25	2.5 MW	406.11	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281401.41	5235765.88
POINT	GEN26	2.5 MW	406.02	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281453.90	5235764.25
POINT	GEN27	2.5 MW	405.73	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281398.71	5235689.58
POINT	GEN28	2.5 MW	405.64	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281449.16	5235687.01
POINT	GEN29	2.5 MW	405.85	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281539.89	5235759.83
POINT	GEN30	2.5 MW	405.77	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281594.33	5235757.83
POINT	GEN31	2.5 MW	405.51	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281536.26	5235681.93
POINT	GEN32	2.5 MW	405.38	14.097	0.4572	14.632168	568.15	VERTICAL	0	1	281591.22	5235678.66
POINT	GEN33	1.5 MW	405.64	14.097	0.356616	12.814197	568.15	VERTICAL	0	1	281628.31	5235739.09
POINT	GEN34	1.5 MW	405.63	14.097	0.356616	12.814197	568.15	VERTICAL	0	1	281668.59	5235735.42
POINT	GEN35	1.5 MW	404.88	14.097	0.356616	12.814197	568.15	VERTICAL	0	1	281622.98	5235596.55

TABLE B-4
PM_{10} SOURCE PARAMETERS FOR MODEL PM10-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Type	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN36	1.5 MW	404.83	14.097	0.356616	12.814197	568.15	VERTICAL	0	1	281663.38	5235593.94
POINT	GEN37	1.5 MW	405.31	14.097	0.356616	12.814197	568.15	VERTICAL	0	1	281958.47	5235732.42
POINT	EDGEN01		405.9	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.06	5236141.79
POINT	EDGEN02		405.93	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.27	5236149.10
POINT	EDGEN03		405.94	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.09	5236156.84
POINT	EDGEN04		406.02	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.26	5236165.69
POINT	EDGEN05		406.03	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236173.85
POINT	EDGEN06		406.04	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236182.90
POINT	EDGEN07		406.07	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.36	5236190.26
POINT	ECBOIL01	Boiler	401.82	14.7	1.32	10.16	450	VERTICAL	0.37925362	1	282670.31	5235207.81
POINT	EMCT01		403.4	4.57	3.05	9.15	300	VERTICAL	0.04158	1	283138.87	5235815.29
POINT	EMCT02		403.36	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283145.06	5235815.52
POINT	EMCT03		403.34	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283151.94	5235815.70
POINT	EMCT04		403.34	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283139.17	5235805.85
POINT	EMCT05		403.33	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283145.56	5235806.13
POINT	EMCT06		403.32	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283152.31	5235806.31
POINT	EMCT07		403.33	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283139.48	5235797.30
POINT	EMCT08		403.31	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283146.01	5235797.89
POINT	EMCT09		403.3	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283152.03	5235798.32
POINT	EMCT10		403.31	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283139.67	5235789.00
POINT	EMCT11		403.28	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283146.51	5235789.30
POINT	EMCT12		403.25	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283152.51	5235789.45
POINT	EMCT13		403.27	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283140.13	5235780.28
POINT	EMCT14		403.24	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283146.13	5235780.43
POINT	EMCT15		403.23	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283152.07	5235780.73
POINT	EMCT16		403.23	4.57	2.7432	9.15	300	VERTICAL	0	1	283141.18	5235771.45
POINT	EMCT17		403.22	4.57	2.7432	9.15	300	VERTICAL	0	1	283146.76	5235772.00
POINT	EMCT18		403.21	4.57	2.7432	9.15	300	VERTICAL	0	1	283152.38	5235772.09
POINT	EMCT19		402.83	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283462.66	5235836.55
POINT	EMCT20		402.83	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283468.03	5235836.56
POINT	EMCT21		402.84	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283473.43	5235837.10
POINT	EMCT22		402.75	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283462.69	5235828.63
POINT	EMCT23		402.76	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283468.69	5235829.04
POINT	EMCT24		402.76	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283474.53	5235829.37
POINT	EMCT25		402.66	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283463.80	5235819.76

TABLE B-4
PM_{10} SOURCE PARAMETERS FOR MODEL PM10-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Type	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	EMCT26		402.67	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283469.20	5235820.38
POINT	EMCT27		402.68	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283474.95	5235820.81
POINT	EMCT28		402.57	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283464.37	5235810.75
POINT	EMCT29		402.58	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283469.77	5235811.20
POINT	EMCT30		402.58	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283475.24	5235811.55
POINT	EMCT31		402.51	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283464.45	5235802.39
POINT	EMCT32		402.5	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283470.11	5235802.73
POINT	EMCT33		402.5	4.57	2.7432	9.15	300	VERTICAL	0.04158	1	283475.59	5235803.18
POINT	EMCT34		402.44	4.57	2.7432	9.15	300	VERTICAL	0	1	283464.62	5235793.75
POINT	EMCT35		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283470.45	5235794.17
POINT	EMCT36		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283475.75	5235794.54
POINT	ECS01		400.47	14.097	1.225296	6.6840207	318.15	VERTICAL	0.340194278	1	282894.20	5235154.64
POINT	ECS02		402.15	6.4008	1.207008	4.5370727	359.2611111	VERTICAL	0.214196397	1	282761.47	5235284.58
POINT	ECS03		400.89	9.7536	0.509016	8.963755	330.9277778	VERTICAL	0.028979513	1	282676.24	5235141.62
POINT	CT05		406.12	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281857.24	5235844.95
POINT	CT06		406.13	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281886.25	5235844.78
POINT	CT07		405.63	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281852.58	5235763.94
POINT	CT08		405.62	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281881.44	5235763.13
POINT	CT01		406.24	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281719.59	5235850.03
POINT	CT02		406.19	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281750.83	5235849.49
POINT	CT03		405.82	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281714.20	5235771.91
POINT	CT04		405.74	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281744.37	5235769.76
POINT	CT09		405.67	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281712.58	5235750.90
POINT	CT10		405.6	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281744.37	5235748.74
POINT	CT11		405.26	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281711.50	5235671.16
POINT	CT12		405.2	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281738.44	5235671.16
POINT	CT13		405.5	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281851.58	5235743.90
POINT	CT14		405.45	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281882.29	5235744.43
POINT	CT15		405.04	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281849.97	5235666.85
POINT	CT16		405.01	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281879.60	5235664.16
POINT	CT17		406.56	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281417.70	5235863.65
POINT	CT18		406.49	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281443.06	5235863.65
POINT	CT19		406.19	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281414.71	5235785.28
POINT	CT20		406.13	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281441.57	5235784.89
POINT	CT21		406.28	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281556.80	5235857.30

TABLE B-4
PM_{10} SOURCE PARAMETERS FOR MODEL PM10-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Type	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	CT22		406.25	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281587.16	5235855.74
POINT	CT23		405.95	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281552.52	5235777.88
POINT	CT24		405.87	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281582.49	5235778.66
POINT	CT25		406.04	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281413.54	5235762.31
POINT	CT26		406.01	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281441.57	5235761.15
POINT	CT27		405.68	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281410.42	5235685.62
POINT	CT28		405.61	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281436.51	5235683.29
POINT	CT29		405.84	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281552.13	5235755.70
POINT	CT30		405.76	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281582.49	5235754.92
POINT	CT31		405.45	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281547.84	5235677.84
POINT	CT32		405.34	5.3401	2.54508	25.984453	300	VERTICAL	0.011503606	1	281577.43	5235673.55
POINT	CO3GEN01		402.15	9.4488	0.456987	30.001754	670.9277778	VERTICAL	0.0399	1	283527.96	5235775.31
POINT	CO3GEN02		402.11	9.4488	0.456987	30	670.9277778	VERTICAL	0.0399	1	283527.59	5235765.43

TABLE B-5
$PM_{2.5}$ SOURCE PARAMETERS FOR MODEL PM25-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN01	2.5 MW	406.25	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281707.79	5235853.92
POINT	GEN02	2.5 MW	406.2	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281762.90	5235851.07
POINT	GEN03	2.5 MW	405.83	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281699.67	5235774.10
POINT	GEN04	2.5 MW	405.75	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281757.61	5235771.95
POINT	GEN05	2.5 MW	406.18	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281845.72	5235848.56
POINT	GEN06	2.5 MW	406.13	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281898.12	5235846.91
POINT	GEN07	2.5 MW	405.67	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281840.79	5235767.61
POINT	GEN08	2.5 MW	405.57	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281895.36	5235764.70
POINT	GEN09	2.5 MW	405.73	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281698.45	5235752.83
POINT	GEN10	2.5 MW	405.59	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281756.75	5235750.33
POINT	GEN11	2.5 MW	405.26	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281699.58	5235673.87
POINT	GEN12	2.5 MW	405.21	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281751.43	5235672.98
POINT	GEN13	2.5 MW	405.55	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281839.76	5235746.57
POINT	GEN14	2.5 MW	405.45	14.097	0.4572	14.6321682	568.15	VERTICAL	0.020663652	1	281895.40	5235745.46
POINT	GEN15	2.5 MW	405.08	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281837.99	5235669.69
POINT	GEN16	2.5 MW	404.97	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281893.59	5235666.70
POINT	GEN17	2.5 MW	406.65	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281405.78	5235867.33
POINT	GEN18	2.5 MW	406.45	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281456.90	5235865.41
POINT	GEN19	2.5 MW	406.24	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281401.68	5235788.31
POINT	GEN20	2.5 MW	406.13	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281454.11	5235786.59
POINT	GEN21	2.5 MW	406.3	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281545.57	5235860.91
POINT	GEN22	2.5 MW	406.24	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281598.83	5235858.95
POINT	GEN23	2.5 MW	405.96	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281540.53	5235782.63
POINT	GEN24	2.5 MW	405.89	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281595.30	5235780.46
POINT	GEN25	2.5 MW	406.11	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281401.41	5235765.88
POINT	GEN26	2.5 MW	406.02	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281453.90	5235764.25
POINT	GEN27	2.5 MW	405.73	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281398.71	5235689.58
POINT	GEN28	2.5 MW	405.64	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281449.16	5235687.01
POINT	GEN29	2.5 MW	405.85	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281539.89	5235759.83
POINT	GEN30	2.5 MW	405.77	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281594.33	5235757.83
POINT	GEN31	2.5 MW	405.51	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281536.26	5235681.93
POINT	GEN32	2.5 MW	405.38	14.097	0.4572	14.6321682	568.15	VERTICAL	0	1	281591.22	5235678.66
POINT	GEN33	1.5 MW	405.64	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281628.31	5235739.09
POINT	GEN34	1.5 MW	405.63	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281668.59	5235735.42
POINT	GEN35	1.5 MW	404.88	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281622.98	5235596.55

TABLE B-5
$PM_{2.5}$ SOURCE PARAMETERS FOR MODEL PM25-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	GEN36	1.5 MW	404.83	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281663.38	5235593.94
POINT	GEN37	1.5 MW	405.31	14.097	0.356616	12.8141966	568.15	VERTICAL	0	1	281958.47	5235732.42
POINT	EDGEN01		405.9	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.06	5236141.79
POINT	EDGEN02		405.93	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.27	5236149.10
POINT	EDGEN03		405.94	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.09	5236156.84
POINT	EDGEN04		406.02	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.26	5236165.69
POINT	EDGEN05		406.03	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236173.85
POINT	EDGEN06		406.04	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.11	5236182.90
POINT	EDGEN07		406.07	17.6784	0.508	43.7	705	VERTICAL	0.00408	1	283020.36	5236190.26
POINT	ECBOIL01	Boiler	401.82	14.7	1.32	10.16	450	VERTICAL	0.37925362	1	282670.31	5235207.81
POINT	EMCT01		403.4	4.57	3.05	9.15	300	VERTICAL	0.00693	1	283138.87	5235815.29
POINT	EMCT02		403.36	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283145.06	5235815.52
POINT	EMCT03		403.34	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283151.94	5235815.70
POINT	EMCT04		403.34	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283139.17	5235805.85
POINT	EMCT05		403.33	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283145.56	5235806.13
POINT	EMCT06		403.32	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283152.31	5235806.31
POINT	EMCT07		403.33	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283139.48	5235797.30
POINT	EMCT08		403.31	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283146.01	5235797.89
POINT	EMCT09		403.3	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283152.03	5235798.32
POINT	EMCT10		403.31	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283139.67	5235789.00
POINT	EMCT11		403.28	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283146.51	5235789.30
POINT	EMCT12		403.25	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283152.51	5235789.45
POINT	EMCT13		403.27	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283140.13	5235780.28
POINT	EMCT14		403.24	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283146.13	5235780.43
POINT	EMCT15		403.23	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283152.07	5235780.73
POINT	EMCT16		403.23	4.57	2.7432	9.15	300	VERTICAL	0	1	283141.18	5235771.45
POINT	EMCT17		403.22	4.57	2.7432	9.15	300	VERTICAL	0	1	283146.76	5235772.00
POINT	EMCT18		403.21	4.57	2.7432	9.15	300	VERTICAL	0	1	283152.38	5235772.09
POINT	EMCT19		402.83	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283462.66	5235836.55
POINT	EMCT20		402.83	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283468.03	5235836.56
POINT	EMCT21		402.84	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283473.43	5235837.10
POINT	EMCT22		402.75	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283462.69	5235828.63
POINT	EMCT23		402.76	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283468.69	5235829.04
POINT	EMCT24		402.76	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283474.53	5235829.37
POINT	EMCT25		402.66	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283463.80	5235819.76

TABLE B-5
$PM_{2.5}$ SOURCE PARAMETERS FOR MODEL PM25-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	EMCT26		402.67	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283469.20	5235820.38
POINT	EMCT27		402.68	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283474.95	5235820.81
POINT	EMCT28		402.57	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283464.37	5235810.75
POINT	EMCT29		402.58	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283469.77	5235811.20
POINT	EMCT30		402.58	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283475.24	5235811.55
POINT	EMCT31		402.51	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283464.45	5235802.39
POINT	EMCT32		402.5	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283470.11	5235802.73
POINT	EMCT33		402.5	4.57	2.7432	9.15	300	VERTICAL	0.00693	1	283475.59	5235803.18
POINT	EMCT34		402.44	4.57	2.7432	9.15	300	VERTICAL	0	1	283464.62	5235793.75
POINT	EMCT35		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283470.45	5235794.17
POINT	EMCT36		402.41	4.57	2.7432	9.15	300	VERTICAL	0	1	283475.75	5235794.54
POINT	ECS01		400.47	14.097	1.225296	6.68402071	318.15	VERTICAL	0.340194278	1	282894.20	5235154.64
POINT	ECS02		402.15	6.4008	1.207008	4.53707267	359.261111	VERTICAL	0.214196397	1	282761.47	5235284.58
POINT	ECS03		400.89	9.7536	0.509016	8.963755	330.927778	VERTICAL	0.028979513	1	282676.24	5235141.62
POINT	CT05		406.12	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281857.24	5235844.95
POINT	CT06		406.13	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281886.25	5235844.78
POINT	CT07		405.63	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281852.58	5235763.94
POINT	CT08		405.62	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281881.44	5235763.13
POINT	CT01		406.24	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281719.59	5235850.03
POINT	CT02		406.19	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281750.83	5235849.49
POINT	CT03		405.82	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281714.20	5235771.91
POINT	CT04		405.74	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281744.37	5235769.76
POINT	CT09		405.67	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281712.58	5235750.90
POINT	CT10		405.6	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281744.37	5235748.74
POINT	CT11		405.26	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281711.50	5235671.16
POINT	CT12		405.2	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281738.44	5235671.16
POINT	CT13		405.5	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281851.58	5235743.90
POINT	CT14		405.45	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281882.29	5235744.43
POINT	CT15		405.04	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281849.97	5235666.85
POINT	CT16		405.01	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281879.60	5235664.16
POINT	CT17		406.56	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281417.70	5235863.65
POINT	CT18		406.49	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281443.06	5235863.65
POINT	CT19		406.19	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281414.71	5235785.28
POINT	CT20		406.13	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281441.57	5235784.89
POINT	CT21		406.28	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281556.80	5235857.30

TABLE B-5
$PM_{2.5}$ SOURCE PARAMETERS FOR MODEL PM25-04172014a.isc
MICROSOFT COLUMBIA DATA CENTER
QUINCY, WASHINGTON

Type	ID	Desc	Base_Elev	Height	Diam	Exit_Vel	Exit_Temp	Release_Typ	Emission_Rate	Num_Coords	X1	Y1
			[m]	[m]	[m]	[m/s]	[K]				[m]	[m]
POINT	CT22		406.25	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281587.16	5235855.74
POINT	CT23		405.95	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281552.52	5235777.88
POINT	CT24		405.87	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281582.49	5235778.66
POINT	CT25		406.04	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281413.54	5235762.31
POINT	CT26		406.01	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281441.57	5235761.15
POINT	CT27		405.68	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281410.42	5235685.62
POINT	CT28		405.61	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281436.51	5235683.29
POINT	CT29		405.84	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281552.13	5235755.70
POINT	CT30		405.76	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281582.49	5235754.92
POINT	CT31		405.45	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281547.84	5235677.84
POINT	CT32		405.34	5.340096	2.54508	25.984453	300	VERTICAL	0.002683755	1	281577.43	5235673.55
POINT	CO3GEN01		402.15	9.4488	0.45698664	30.001754	670.927778	VERTICAL	0.0399	1	283527.96	5235775.31
POINT	CO3GEN02		402.11	9.4488	0.45698664	30	670.927778	VERTICAL	0.0399	1	283527.59	5235765.43

APPENDIX C

AERMOD Files

(Provided Under Separate Cover)