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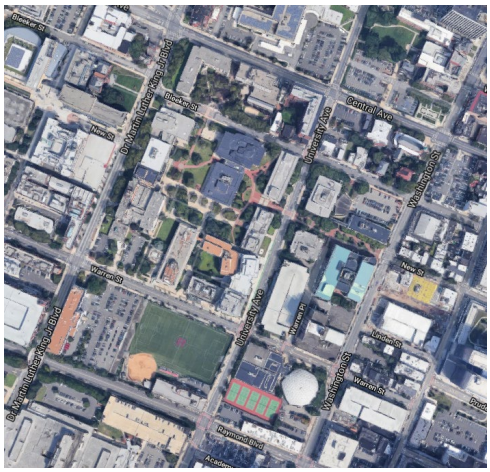
REPORT ON

PROTOCOL FOR FACILITY-WIDE RISK ASSESSMENT
RUTGERS UNIVERSITY CAMPUS
NEWARK, NEW JERSEY

PROGRAM INTEREST NUMBER: 08242



by
Haley & Aldrich, Inc.
Parsippany, New Jersey

for
Rutgers University
Newark, New Jersey

File No. 0200790-001
November 2021

HALEY ALDRICH

SIGNATURE PAGE FOR

REPORT ON

PROTOCOL FOR FACILITY-WIDE RISK ASSESSMENT
RUTGERS UNIVERSITY CAMPUS
NEWARK, NEW JERSEY

PREPARED FOR

RUTGERS UNIVERSITY
PISCATAWAY, NEW JERSEY

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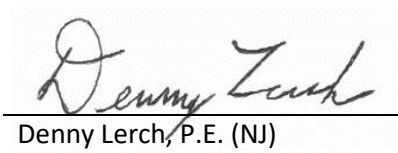

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1. Introduction

This Protocol for a Facility-wide Risk Assessment (protocol) has been prepared on behalf of Rutgers, The State University of New Jersey (Rutgers), for its Newark, New Jersey campus for review and approval by the New Jersey Department of Environmental Protection (NJDEP). In 2020, Rutgers submitted an application for renewal of their Air Operating Permit (Permit Activity Number BOP170002) for the Newark campus, which expires on 12 March 2022. During review of the application by the NJDEP, the agency identified that the potential emissions of certain air toxics are above the reporting threshold as outlined in the New Jersey Administrative Code (N.J.A.C.) 7:27-17.9. NJDEP has requested submittal of a facility-wide risk assessment for toxic air emissions following the procedures outlined in Technical Manual 1003 (*Guidance on Preparing a Risk Assessment for Air Contaminant Emissions*). Rutgers selected Haley & Aldrich, Inc. (Haley & Aldrich) to assist with preparing this risk assessment. Haley & Aldrich, on behalf of Rutgers, submitted a protocol for New Jersey Department of Environmental Protection (NJDEP) review in April 2021. Rutgers received comments on the protocol from NJDEP on 13 October 2021. This protocol has been revised in accordance with NJDEP's comments.

Rutgers proposes to complete the risk assessment using a refined air dispersion modeling analysis; therefore, Haley & Aldrich is submitting this modeling protocol as required by Technical Manual 1003 and as outlined in Technical Manual 1002 (*Guidance on Preparing an Air Quality Modeling Protocol*).

As described in Section 4.1 of Technical Manual 1002, the modeling protocol should document in detail the methods the applicant proposes to use to conduct the modeling analysis. This protocol satisfies the requirements described in the guidance document and is organized to be consistent with the elements of a modeling protocol as described in Section 4.1 and Appendix B of Technical Manual 1002.

2. Project Description

Rutgers University is an urban campus located in Newark, New Jersey. The emission sources are located on or adjacent to several buildings throughout the campus. This section describes the sources being modeled and relevant details of the surrounding area.

2.1 SOURCE INVENTORY

Based on conversations with NJDEP, it is our understanding that the source inventory selected for the facility-wide risk analysis excludes emergency equipment such as emergency generators and firepumps, does not need to account for emissions from secondary fuels that are used exclusively in case of emergency, and only includes those emission points that individually exceed NJDEP reporting thresholds. Based on the emission rates described in Section 2.4 and included in Appendix C, only two emission points meet the criteria for inclusion in the facility-wide risk assessment:

- U4: Central Heating Plan boilers rated at greater than 10 MMBtu/hr firing natural gas (3 boilers, 1 stack PT1); and
- U5: Boilers at 1 Washington Street rated at less than 10 MMBtu/hr firing natural gas (8 boilers, 1 stack PT1001).

As part of preparing this protocol, Haley & Aldrich conducted a site visit to confirm source locations and stack parameters. Based on this site visit, several updates were made for the sources and emission points under U1 as detailed below:

- PT 6, the 7237 Talbott Water Heater, was removed;
- The four (4) boilers at 15 Washington Street do not all exhaust through the same stack (PT11). Rather, they all exhaust through separate stacks (PT11, PT112, PT113, and PT114);
- The six (6) boilers at 7500 University Square do not all exhaust through the same stack (PT13). Instead, three (3) 1 MMBtu/hr boilers exhaust through PT13, and the other three (3) 2 MMBtu/hr boilers exhaust through separate stacks (PT131, PT132, and PT133);
- The emission factors used for hazardous air pollutants (HAPs) for four, 4-stroke, rich burn, natural gas-fired emergency generators (PT3, PT7, PT12, PT14, PT16, PT17, and PT17226) were updated from 2-stroke engine emission factors to 4-stroke, rich burn, engine emission factors (AP-42, Table 3.2-3).

The inventory also identified several updates to stack parameters versus what is currently provided in the permit. An e-mail communication was made to NJDEP on 3 March 2021 regarding the revisions; NJDEP advised that they will update the permit information as part of the renewal process and that the updated emission point parameters should be utilized in the risk analysis. A table summarizing the stack parameters for each emission point, identifying those that have been updated from the permit, is provided in Appendix A. The location of each emission point is identified in the plot plan provided in Appendix B.

2.2 PLOT PLAN

As outlined in Technical Manual 1002, this protocol includes a scaled plot plan with the following elements:

- An indication of true north;
- Location of emission points (stacks, vents, etc.);
- The location of all buildings and structures on the site; and
- The location of buildings and structures immediately adjacent to the applicant's property, if they are located near enough to the proposed emission points to potentially cause downwash effects.

Considering that the campus is publicly accessible, no facility fence line is proposed to be used in the modeling analysis. The base elevation and height of each building proposed for inclusion in the modeling analysis is provided in a separate table in Appendix D. A hard copy of the plot plan, stamped and certified by a Professional Engineer (P.E.) licensed in New Jersey, is included in Appendix B.

This protocol also includes an aerial figure in Appendix B that identifies the location of nearby residences and other sensitive receptors, such as hospitals, nursing homes, schools, and day care centers.

2.3 STACK PARAMETERS

Rutgers provided stack parameters for each emission point to Haley & Aldrich that were verified through a field visit. During field verification of the stack parameters, several updates have been made. An updated RADIUS file will be provided with the risk assessment results. As indicated in Appendix A, stack PT1001 is capped. Section 7 of Technical Manual 1002 provides guidance on modeling horizontal stacks and rain caps.

The guidance indicates that capped and horizontal stacks that are subject to building downwash should be modeled using the actual stack diameter and exit temperature with the exit velocity set to a nominally low value, such as 0.01 meters per second (m/s). In addition, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made.

The most current version of Technical Manual 1002 indicates that the latest version of AERMOD had incorporated the above adjustments for horizontal discharge and rain cap stacks as a Beta option to the model inputs. Under the current version of AERMOD (version 21112), these options are available as default and will be used to model capped and horizontal stacks.

Stack PT1001 will be modeled as a capped stack to account for the removal of vertical momentum at the exhaust point.

2.4 EMISSION RATES

Haley & Aldrich compared estimated emissions of air toxics to the reporting thresholds as outlined in N.J.A.C 7:27-17.9. Haley & Aldrich identified the following air toxics that exceed the reporting threshold that will be included in the risk assessment: formaldehyde, arsenic, cadmium, cobalt, and 7,12-Dimethylbenz(a)Anthracene.

Annual emission rates for each emission unit are consistent with the allowable emissions in the current permit. For grouped emission units, allowable emissions were distributed among emission points based upon maximum heat inputs for each of the emission sources. For use in modeling long-term and chronic health effects, emission rates were annualized to an average gram per second emission rate for each emission point. Short-term (hourly) emission rates were calculated using the maximum hourly input for each emission source and emission factors from the USEPA document *AP-42 - Compilation of Emission Factors.* Emissions calculations are provided in Appendix C.

As described above, calculated emission rates were compared to NJDEP reporting thresholds and only two emission points (PT1 and PT1001) are included in the facility-wide risk assessment.

3. Project Site Characteristics

3.1 LAND USE ANALYSIS

It is important to determine whether a source is in an urban or rural dispersion environment. Urban areas have more atmospheric turbulence than rural locations due to their larger surface roughness length and the nighttime convective boundary layer associated with urban heat islands. The determination of urban or rural dispersion characteristics is typically determined using one of two procedures: the land use procedure or the population density method. Of the two methods, Technical Manual 1002 indicates that the land use procedure is considered more definitive.

The land use procedure, as outlined in the guidance, requires the following:

1. Classify the land use within the total area circumscribed by a 3-kilometer radius circle about the source using the meteorological land use typing scheme shown in Table 6-1 of Technical Manual 1002; and
2. If land use types I1, I2, C1, R2, and R3 account for 50% or more of the total area, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.

However, the guidance also indicates that in some situations, professional judgment should also be used when classifying a site as urban or rural. Based upon the facility's location in a highly developed area that is central to Newark's urban heat island, we request to waive the necessity for a formal land use analysis and stipulate that urban dispersion coefficients be used with the estimated population of Newark (estimated at 281,054 in 2019 from the U.S. Census Bureau).

3.2 ATTAINMENT STATUS

This protocol addresses only air toxics; therefore, Attainment Status is not applicable.

3.3 LOCAL TOPOGRAPHY

Rutgers proposes to include elevations in the refined modeling analysis. Elevations will be assigned to receptors using AERMAP version 18081 and data from the 1/3 arc-second National Elevation Dataset (NED).

3.4 GOOD ENGINEERING PRACTICE (GEP) STACK HEIGHT ANALYSIS

Section 6.3 of Technical Manual 1002 provides NJDEP's preferred method to conduct the GEP stack height analysis. Due to the potential for building downwash to affect dispersion, Haley & Aldrich will complete a GEP stack height analysis in accordance with the USEPA stack height regulation (40 CFR 51) and the *Guideline for Determination of Good Engineering Practice Stack Height* (USEPA, 1985).

The USEPA's Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM) will be used to derive the parameters necessary to simulate directional dependent aerodynamic downwash in

the model. Haley & Aldrich used GoogleEarth's 3-dimensional (3D) interpolation of building heights and its 3D-path measuring tool to estimate building heights and tier heights of 30 buildings on and near campus with the potential to affect downwash at one or more emission points. Because all the structures are existing buildings, the building parameters were traced through the use of aerial imagery to identify their approximate dimensions.

To assist NJDEP in verifying the information provided in the analysis, the Input/Output files from the BPIPPRM program are included with this protocol in Appendix D.

3.5 METEOROLOGICAL DATA

NJDEP provided Haley & Aldrich with pre-processed meteorological data for Newark International Airport for the years 2013 through 2017. The data was processed using AERMET version 18081 as documented in NJDEP's *Processed Meteorological Files for Use in AERMOD Dispersion Modeling Analyses* (September 2019). In accordance with the supporting document, a base elevation of 3 meters above sea level was selected as the anemometer base elevation.

4. Regulatory Requirements

In accordance with Technical Manuals 1002 and 1003, it is NJDEP policy to require a health risk assessment of air toxics that exceed reporting thresholds as outlined in N.J.A.C 7:27-17.9. Accordingly, this protocol is being submitted to support the risk assessment for formaldehyde, arsenic, cadmium, cobalt, and 7,12-Dimethylbenz(a)Anthracene.

Based on conversations with NJDEP, it is our understanding that the source inventory selected for the facility-wide risk analysis excludes emergency equipment such as emergency generators and firepumps, does not need to account for emissions from secondary fuels that are used during emergencies, and only includes those emission points that individually exceed NJDEP reporting thresholds.

5. Proposed Air Quality Analysis

5.1 SCREENING ANALYSIS

NJDEP's First Level Risk Screening Worksheet (June 2020) identifies which air toxic emission sources are expected to be insignificant and which require additional review. The instructions for this worksheet indicate that it cannot be used for sources with stacks with a horizontal or downward discharge direction; NJDEP has indicated that capped stacks fall into this category. Therefore, Haley & Aldrich will perform refined modeling for each air toxic emitted above the relevant reporting threshold.

5.2 REFINED MODEL SELECTION

AERMOD is NJDEP's preferred model for air dispersion modeling analysis. Haley & Aldrich will use AERMOD version 21112 for the analysis.

5.3 METHODS FOR REFINED MODELING

Haley & Aldrich is proposing to use regulatory defaults for all modeling. The following are implemented when AERMOD's default option is selected: the elevated terrain algorithm that requires input of terrain height data, stack-tip downwash, the calms processing routines, and the missing data processing routines. Current regulatory default options also include automated handling of capped and horizontal stacks.

To ensure that receptors appropriately include all publicly accessible locations (i.e., ambient air), the modeling analysis will not include a property boundary. Receptors will be placed in a Cartesian grid at 25-meter intervals to a distance of 0.5-kilometer from the campus boundary.

5.4 SPECIAL MODELING CONSIDERATIONS FOR HEALTH RISK ASSESSMENT

As described previously, potential emissions of several air toxics are above the reporting threshold as provided in N.J.A.C. 7:27-17.9. NJDEP has requested submittal of a facility-wide risk assessment following the procedures outlined in Technical Manual 1003.

For those air toxics requiring a facility-wide analysis with refined modeling, a health risk assessment will be completed in accordance with Technical Manual 1003.

- Incremental Cancer Risk: For each air toxic for which NJDEP has issued a unit risk factor (URF), the analysis will use annual emissions to predict the maximum long-term (chronic) average concentration and its location, the applicable URF, and the calculated incremental cancer risk (source impact times the URF). The maximally impacted sensitive receptor will also be identified.
- Long-Term Hazard Quotient: For each air toxic the analysis will use annual emissions to predict the maximum long-term average concentration and its location, the reference concentration (RfC), and the calculated hazard quotient (source impact divided by the RfC). The maximally impacted sensitive receptor will also be identified.

- Short-Term Hazard Quotient: For acute health risks, the emission rate modeled will be based on the maximum short-term emission rate and the highest hourly concentrations. For each air toxic, the analysis will include the maximum predicted short-term average concentration and its location, the RfC, and the calculated hazard quotient (source impact divided by the RfC). The maximally impacted sensitive receptor will also be identified.

The table below outlines the criteria for evaluating these short-term and long-term risks.

Facility-wide Cancer Risk Guidelines	
Risk ≤ 10 in one million ($1x10^{-5}$)	Negligible risk
10 in one million < Risk < 1,000 in one million	Case-by-case review by Risk Management Committee
Risk ≥ 1,000 in one million ($1x10^{-3}$)	Unacceptable risk
Non-cancer Risk Guidelines for All Sources	
Hazard Quotient ≤ 1	Negligible risk
Hazard Quotient > 1	Case-by-case review by Risk Management Committee

Haley & Aldrich will prepare a Facility-wide Risk Assessment in accordance with an approved protocol and following the methods of Technical Manual 1003.

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APPENDIX A

Stack Parameters

PT NJID	Facility Designation	Description	Diameter (in)	Diameter (m)	Height (ft)	Dist to Prop Line (ft)	Avg Exhaust Temp. (deg F)	Avg Exhaust Temp. (deg K)	Min Exhaust Temp. (deg F)	Max Exhaust Temp. (deg F)	Avg Exhaust vol (acfm)	Min Exhaust vol (acfm)	Max Exhaust vol (acfm)	Exhaust Direction
PT2	7228 Facilit	7228 Facilities Offices Boiler	6	0.1524	45	25	160	344.2611111	140	200	850	800	906	up
PT5	7233 Gym	7233 Gyn water htr	6	0.1524	15	50	150	338.7055556	100	200	300	250	356	Horiz
PT8	7492 CLJ	7492 CLJ boiler	24	0.6096	88	50	160	344.2611111	140	200	4,500	4,000	5,000	up
PT9	7493 Blumen	7493 Blumenthal boilers	24	0.6096	60	75	200	366.4833333	180	220	1,569	1,500	1,600	up
PT10	7496 Woodwar	7496 Woodward Dorms Wtr Htr	12	0.3048	18	50	200	366.4833333	180	220	650	600	713	Down
PT11*	15 Wash Blrs	15 Washington Blr1	8	0.2032	110	500	350	449.8166667	300	400	650	600	713	Capped
PT112*	15 Wash Blrs	15 Washington Blr2	8	0.2032	110	500	350	449.8166667	300	400	650	600	713	Capped
PT113*	15 Wash Blrs	15 Washington Blr3	8	0.2032	110	500	350	449.8166667	300	400	650	600	713	Capped
PT114*	15 Wash Blrs	15 Washington Blr4	8	0.2032	110	500	350	449.8166667	300	400	650	600	713	Capped
PT 13**	7500 USH	7500 University Square Housing (3) 1 MMBTU Blrs	8	0.2032	155	100	250	394.2611111	200	300	500	356	1,068	up
PT131**	7500 USH	7500 University Square Housing Blr #1 2 MMBTU Blrs	24	0.6096	155	100	250	394.2611111	200	300	650	600	713	up
PT132**	7500 USH	7500 University Square Housing Blr #2 2 MMBTU Blrs	24	0.6096	155	100	250	394.2611111	200	300	650	600	713	up
PT133**	7500 USH	7500 University Square Housing Blr #3 2 MMBTU Blrs	24	0.6096	155	100	250	394.2611111	200	300	650	600	713	up
PT3	7229 Olson	7229 Olson EG	6	0.1524	90	50	900	755.3722222	800	1000	2,000	1,900	2,175	horiz
PT7	7492 CLJ EG	7492 Center for Law and Justice EG	4	0.1016	92	50	900	755.3722222	800	1000	2,500	2,000	2,800	horiz
PT 12	7227 Engleha	7227 Englehard EG	4	0.1016	50	50	1100	866.4833333	1000	1182	1,000	500	2,000	up
PT14	7500 USH EG	7500 University Square Housing EG	5	0.127	150	100	1250	949.8166667	1200	1350	3,100	3,000	3,268	up
PT16	15 Wash EG1	15 Washington EG#1 300 KW	8	0.2032	115	500	1050	838.7055556	1000	1120	1,600	1,500	1,753	up
PT17	15 Wash EG2	15 Washington EG#2 350 KW	8	0.2032	115	500	1050	838.7055556	1000	1120	1,900	1,800	2,011	up
PT17226	CHP EG	7226 CHP EG 4.18NG	5	0.127	30	50	1237	942.5944444	1188	1286	2,450	1,780	3,120	up
PT4	7231 Police	7231 Police Station EG	4	0.1016	30	25	900	755.3722222	800	1000	850	750	1,000	Horiz
PT15	7496 Wood EG	7496 Woodward EG	6	0.1524	40	50	1300	977.5944444	1000	1500	900	800	1,000	Horiz
PT1002***	1 Wash EG	1 Washington EG	5	0.127	210	50	1250	949.8166667	1200	1350	1,600	1,500	1,753	horiz
PT1	7226 CHP	7226 Central Heating Plant Boilers	48	1.2192	95	50	350	449.8166667	300	500	36,000	34,000	37,000	up
PT1001	1 Wash Blrs	1 Washington Street boilers (7)	24	0.6096	222	50	350	449.8166667	300	1200	12,000	4,000	30,000	Capped
PT18	Life Sci II	Life Science II EG	12	0.3048	88	200	564	568.7055556	376	752	11,471	7,648	15,295	up

* Original PT11 showed common stack where there are 4 separate stacks (one for each boiler)

**Original PT13 showed common stack for all 6 boilers where boilers #4,#5,#6 have a common stack, while boilers #1,#2,#3 have separate stacks

***Separate PT for 1 Washington Emeregncy Generator originally combined under PT1001

APPENDIX B

Plot Plan, Building Information, and Sensitive Receptors

LEGEND

LOCATION OF HOSPITAL (APPROXIMATE)

LOCATION OF SCHOOL (APPROXIMATE)

NOTES:

1. BACKGROUND IMAGE FROM BING MAPS 2021.

0 200 400 600 800

SCALE IN FEET

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Drawn By:	KFP
Designed By:	TBB
Checked By:	TBB
Approved By:	DCL

Rev.	Description	By	Date

MODELING PROTOCOL
RUTGERS UNIVERSITY
NEWARK, NEW JERSEY

DENNY LERCH, P.E.

DATE: _____
N.J. PROFESSIONAL ENGINEER NO. 24GE04195700

SENSITIVE RECEPTOR LOCATIONS

C-200

Sheet: 2 of 2

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LEGEND

PT1001 ●	DESIGNATION AND LOCATION OF EMISSION POINT (APPROXIMATE)
BLD_16, TIER 1	RUTGERS UNIVERSITY BUILDING USED IN AIR DISPERSION MODEL
BLD_28, TIER 1	BUILDINGS INCLUDED IN AIR DISPERSION MODELING THAT ARE NOT PART OF RUTGERS UNIVERSITY

NOTES:

1. BASE PLAN CREATED FROM ELECTRONIC DRAWING FILE ENTITLED "NEWARK MAIN MASTERJSB.DWG" RECEIVED ON 10 FEBRUARY 2021 FROM RUTGERS UNIVERSITY.
2. BACKGROUND IMAGE FROM BING MAPS 2021.

ID_Building	Base_Elevation (m)	Tier_Number	Tier_Height (m)
BLD_1	16.79	1	6.1
		2	9.14
		3	24.38
BLD_2	11.09	1	10.67
BLD_3	11.21	1	10.67
BLD_4	11.18	1	10.67
BLD_5	11.2	1	24.38
BLD_6	11.61	1	15.24
BLD_7	11.25	1	10.67
BLD_8	11.63	1	76.2
BLD_9	9.81	1	28.96
		2	32
		3	34.14
BLD_10	9.28	1	15.24
BLD_11	9.61	1	24.38
BLD_12	11.95	1	15.24
BLD_13	9.85	1	16.76
		2	19.81
		3	19.81
BLD_14	9.7	1	12.8
BLD_15	6.08	1	25.91
		2	28.96
BLD_16	9.31	1	9.14
		2	48.77
		3	54.86
BLD_17	9.21	1	15.24
BLD_18	10.64	1	13.72
BLD_19	8.66	1	91.44
BLD_20	24.08	1	30.48
BLD_21	21.31	1	24.38
BLD_22	23.98	1	25.91
BLD_23	13.74	1	30.48
BLD_24	11.22	1	30.48
BLD_25	10.51	1	44.2
BLD_26	10.06	1	64.01
		2	67.06
BLD_27	11.34	1	30.48
		2	67.06
		3	76.2
		4	94.49
BLD_28	11.97	1	109.73
BLD_29	11.15	1	109.73
BLD_30	10.74	1	12.19

0 160 320 480 640

SCALE IN FEET

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Designed By:	TBB
Checked By:	TBB
Approved By:	DCL

Rev.	Description	By	Date

MODELING PROTOCOL
RUTGERS UNIVERSITY
NEWARK, NEW JERSEY

DENNY LERCH, P.E.

DATE: _____
N.J. PROFESSIONAL ENGINEER NO. 24GE04195700

FACILITY PLOT PLAN

C-100

Sheet: 1 of 2

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Z:\CF\PROJECTS\0200790\001_RUTGERS NEWARK\CAD\0200790_000_0004_SITE PLAN OCT 2021.DWG

APPENDIX C

Emissions Calculations

Emissions Summary for Modeling

Annual Emissions (lb/yr) by Emission Point

Grouped Emission Unit	Emission ID	Emission Point	Source Type	Source Size (MMBtu/hr)	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	Dimethylbenz (a)Anthracene	Selenium	Benzo(a)pyrene	Nickel
Reporting Threshold (lb/yr)						*6*	*3.5*	*1.4*	*2000*	*2000*	*0.01*	*0.02*	*0.01*	*1000*	*0.6*	*2*	*0.005*	*0.0007*	*925*	*0.04*	*0.6*
U4	7226 Central Heating Plant	PT1	boiler/wat heat	36.6	NG	0.5985	21.5118	0.17385	0.969	513	0.057	0.00342	0.3135	0.399	0.1083	0.0741	0.02394	0.00456	0.00684	0.000342	0.5985
			boiler/wat heat	36.6	NG																
			boiler/wat heat	64.1	NG																
U5	1 Washington Street	PT1001	boiler/wat heat	1.54	NG	0.04074	1.464312	0.011834	0.06596	34.92	0.00388	0.0002328	0.02134	0.02716	0.007372	0.005044	0.0016296	0.0003104	0.0004656	0.00002328	0.04074
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
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			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																

Annual Emissions (lb/yr) by Operating Scenario

Grouped Emission Unit	Emission ID	Operating Scenario	Source Type	Source Size (MMBtu/hr)	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	7,12-Dimethylbenz(a)Anthracene	Selenium	Benzo(a)pyrene	Nickel
U4	7226 Central Heating Plant	OS1	boiler/wat heat	36.6	NG	0.159541879	5.734390969	0.04634312	0.2583059	136.750182	0.01519446	0.00091167	0.08356956	0.10636125	0.02886948	0.0197528	0.00638168	0.00121556	0.001823336	9.1167E-05	0.159541879
		OS2	boiler/wat heat	36.6	NG	0.159541879	5.734390969	0.04634312	0.2583059	136.750182	0.01519446	0.00091167	0.08356956	0.10636125	0.02886948	0.0197528	0.00638168	0.00121556	0.001823336	9.1167E-05	0.159541879
		OS3	boiler/wat heat	64.1	NG	0.279416242	10.04301806	0.08116377	0.4523882	239.499636	0.02661107	0.00159666	0.14636089	0.18627749	0.05056103	0.03459439	0.01117665	0.00212889	0.003193328	0.00015967	0.279416242
U5	1 Washington Street	OS1	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS2	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS3	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS4	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS5	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS6	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS7	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925
		OS8	boiler/wat heat	1.54	NG	0.0050925	0.183039	0.00147925	0.008245	4.365	0.000485	0.0000291	0.0026675	0.003395	0.0009215	0.0006305	0.0002037	0.0000388	0.0000582	0.00000291	0.0050925

Grouped Emission Unit	Emission ID	Emission Point	Source Type	Source Size	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	Dimethylbenz (a)Anthracene	Selenium	Benzo(a)pyrene	Nickel
Reporting Threshold						*6*	*3.5*	*1.4*	*2000*	*2000*	*0.01*	*0.02*	*0.01*	*1000*	*0.6*	*2*	*0.005*	*0.0007*	*925*	*0.04*	*0.6*
U1	All					0.14154	5.087352	0.041114	0.22916	121.32	0.01348	0.0008088	0.07414	0.09436	0.025612	0.017524	0.0056616	0.0010784	0.0016176	0.00008088	0.14154
U2	All					3.6814	47.765														
U3	All					0.571929	0.72334														
U4	All					0.5985	21.5118	0.17385	0.969	513	0.057	0.00342	0.3135	0.399	0.1083	0.0741	0.02394	0.00456	0.00684	0.000342	0.5985
U5	All					0.04074	1.464312	0.011834	0.06596	34.92	0.00388	0.0002328	0.02134	0.02716	0.007372	0.005044	0.0016296	0.0003104	0.0004656	0.00002328	0.04074
U6	All					1.802556	2.27976														
TOTAL (tpy)						0.0034	0.0394	0.0001	0.0006	0.3346	0.000037	0.000002	0.0002	0.0003	0.0001	0.000048	0.000016	0.000003	0.000004	0.0000002	0.0004

Emissions Summary for Modeling

Hourly Emissions (lb/hr) by Emission Point

Grouped Emission Unit	Emission ID	Emission Point	Source Type	Source Size (MMBtu/hr)	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	Dimethylbenz (a)Anthracene	Selenium	Benzo(a)pyrene	Nickel
Reporting Threshold (lb/hr)						*0.01*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
U4	7226 Central Heating Plant	PT1	boiler/wat heat	36.6	NG	0.000282676	0.0101602	8.2111E-05	0.00045767	0.24229412	2.69216E-05	1.6153E-06	0.000148069	0.00018845	5.1151E-05	3.4998E-05	1.13071E-05	2.15373E-06	3.23059E-06	1.6153E-07	0.000282676
			boiler/wat heat	36.6	NG																
			boiler/wat heat	64.1	NG																
U5	1 Washington Street	PT1001	boiler/wat heat	1.54	NG	2.53647E-05	0.00091168	7.3678E-06	4.1067E-05	0.02174118	2.41569E-06	1.4494E-07	1.32863E-05	1.691E-05	4.5898E-06	3.1404E-06	1.01459E-06	1.93255E-07	2.89882E-07	1.4494E-08	2.53647E-05
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																
			boiler/wat heat	1.54	NG																

Hourly Emissions (lb/hr) by Operating Scenario

Grouped Emission Unit	Emission ID	Operating Scenario	Source Type	Source Size (MMBtu/hr)	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	7,12-Dimethylbenz(a) Anthracene	Selenium	Benzo(a)pyrene	Nickel
U4	7226 Central Heating Plant	OS1	boiler/wat heat	36.6	NG	7.53529E-05	0.0027084	2.1888E-05	0.000122	0.06458824	7.17647E-06	4.3059E-07	3.94706E-05	5.0235E-05	1.3635E-05	9.3294E-06	3.01412E-06	5.74118E-07	8.61176E-07	4.3059E-08	7.53529E-05
		OS2	boiler/wat heat	36.6	NG	7.53529E-05	0.0027084	2.1888E-05	0.000122	0.06458824	7.17647E-06	4.3059E-07	3.94706E-05	5.0235E-05	1.3635E-05	9.3294E-06	3.01412E-06	5.74118E-07	8.61176E-07	4.3059E-08	7.53529E-05
		OS3	boiler/wat heat	64.1	NG	0.000131971	0.0047434	3.8334E-05	0.00021367	0.11311765	1.25686E-05	7.5412E-07	6.91275E-05	8.798E-05	2.388E-05	1.6339E-05	5.27882E-06	1.00549E-06	1.50824E-06	7.5412E-08	0.000131971
U5	1 Washington Street	OS1	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS2	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS3	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS4	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS5	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS6	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS7	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06
		OS8	boiler/wat heat	1.54	NG	3.17059E-06	0.00011396	9.2098E-07	5.1333E-06	0.00271765	3.01961E-07	1.8118E-08	1.66078E-06	2.1137E-06	5.7373E-07	3.9255E-07	1.26824E-07	2.41569E-08	3.62353E-08	1.8118E-09	3.17059E-06

Grouped Emission Unit	Emission ID	Emission Point	Source Type	Source Size	Fuel Type	Benzene	Formaldehyde	Naphthalene	Toluene	Hexane	Arsenic	Beryllium	Cadmium	Chromium	Manganese	Mercury	Cobalt	Dimethylbenz (a)Anthracene	Selenium	Benzo(a)pyrene	Nickel
Reporting Threshold						*0.01*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*
U1	All					6.08E-05	2.19E-03	1.77E-05	9.85E-05	5.21E-02	5.79E-06	3.48E-07	3.19E-05	4.06E-05	1.10E-05	7.53E-06	2.43E-06	4.63E-07	6.95E-07	3.48E-08	6.08E-05
U2	All					3.68E-02	4.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U3	All					6.75E-03	8.54E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U4	All					0.000282676	0.0101602	8.2111E-05	0.00045767	0.24229412	2.69216E-05	1.6153E-06	0.000148069	0.00018845	5.1151E-05	3.4998E-05	1.13071E-05	2.15373E-06	3.23059E-06	1.6153E-07	0.000282676
U5	All					2.53647E-05	0.00091168	7.3678E-06	4.1067E-05	0.02174118	2.41569E-06	1.4494E-07	1.32863E-05	1.691E-05	4.5898E-06	3.1404E-06	1.01459E-06	1.93255E-07	2.89882E-07	1.4494E-08	2.53647E-05
U6	All					0.01802556	0.0227976	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL (tpy)						0.0620	0.5222	0.0001	0.0006	0.3162	0.0000	0.0000	0.0002	0.0002	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004

APPENDIX D

Building Profile Input Program (BPIP) Input/Output Files