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# Kimley *Whorn*

### **MEMORANDUM**

To:	Scott Galati DayZen LLC
From:	Andrew Scanlon
	Kimley-Horn and Associates, Inc.
Date:	October 20, 2022
Subject:	Lafayette Data Center Plume Airspace Analysis

On behalf of DayZen LLC (Client) Kimley-Horn conducted an airspace study to analyze potential aeronautical impacts of the thermal plume for a proposed 576,120 square foot datacenter with an associate backup generator facility and chiller system located near Norman Y. Mineta San Jose International Airport (SJC). As discussed in this document, an overall approximated building/ generator/chiller footprint was analyzed. The building has previously been analyzed by the FAA and a Determination of No Hazard was issued. These determinations are attached to this study. Height of the thermal plumes to be analyzed were provided by the Client and adjusted by the Client to represent the maximum height from the ground. Therefore, Kimley-Horn did not adjust the thermal plume heights to account for any stacks or exhaust cowls.

### **Proposed Site**

The site is located at 2825 Lafayette Street, shown in Figure 1. The site is within 0.19 nautical miles (nm) of the physical end of Runway 12R. Table 1 provides points analyzed which approximates the overall potential footprint of the plume location. The client provided Electrical Site Plan has been annotated with point numbers which correlates to the tabular data represented in Table 1 and is included as an attachment.

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Figure 1 – Project Site

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Latitude	Longitude
37° 22' 25.15" N	121° 56' 55.02" W
37° 22' 23.91" N	121° 56' 48.27" W
37° 22' 23.66" N	121° 56' 48.32" W
37° 22' 23.34" N	121° 56' 46.57" W
37° 22' 22.90" N	121° 56' 46.69" W
37° 22' 22.78" N	121° 56' 45.96" W
37° 22' 21.50" N	121° 56' 46.13" W
37° 22' 19.98" N	121° 56' 46.62" W
37° 22' 20.46" N	121° 56' 49.27" W
37° 22' 21.33" N	121° 56' 49.03" W
37° 22' 22.41" N	121° 56' 54.80" W
37° 22' 22.14" N	121° 56' 54.91" W
37° 22' 22.83" N	121° 56' 59.15" W
37° 22' 23.27" N	121° 56' 59.18" W
37° 22' 24.39" N	121° 56' 58.75" W
37° 22' 25.40" N	121° 56' 57.51" W
	Latitude 37° 22' 25.15" N 37° 22' 23.91" N 37° 22' 23.66" N 37° 22' 23.34" N 37° 22' 22.90" N 37° 22' 22.78" N 37° 22' 22.78" N 37° 22' 21.50" N 37° 22' 21.50" N 37° 22' 20.46" N 37° 22' 20.46" N 37° 22' 22.41" N 37° 22' 22.41" N 37° 22' 22.83" N 37° 22' 23.27" N 37° 22' 24.39" N

### Table 1 – Points Analyzed

For the site, two plume heights were evaluated: the diesel generator plume which was calculated to be 112.9 feet Above Ground Level (AGL, rounded to 113 feet for this analysis) and the chiller plume which was calculated to be 132.4 feet AGL (rounded to 133 feet for this analysis). For the purposes of

Page 2

this evaluation, a site elevation of 40 feet was assumed and added to the plume heights to get a top Mean Sea Level (MSL) elevation of 153 and 173 feet for the diesel and chiller plumes, respectively.

The plume heights were provided by others and were calculated assuming a max height associated with a velocity of 5.3 m/s which represents the minimum velocity to cause light turbulence. The Vertical Plume Velocity Assessment Report is attached to this analysis for reference.

### **Methodology**

Kimley-Horn modeled the airport imaginary surfaces at SJC, as defined in 14 Code of Federal Regulations (CFR) Part 77 (Part 77) and evaluated applicable airport design standards set forth in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/300-13B, Airport Design.

Kimley-Horn also modeled the obstacle clearance surfaces as defined in FAA Order 8260-3E, United States Standard for Terminal Instrument Procedures (TERPS), including Change 1. Specifically, Kimley-Horn modeled:

- TERPS 40:1 Departure Surface for Runways 30L and 30R
- ILS<sup>1</sup> or LOC<sup>2</sup> Runway (RWY) 12R
- RNAV<sup>3</sup> RNP<sup>4</sup> Approach to RWY 12R
- RNAV GPS<sup>5</sup> Approach to RWY 12R
- RNAV RNP Approach to RWY 12L
- RNAV GPS Approach to RWY 12L

### **Assumptions and Limitations**

Ultimately, the FAA is responsible for making the final determination regarding the cumulative impacts resulting from this development. The results of Kimley-Horn's modeling should be used for informational purposes only.

This analysis is limited to an airspace study and does not include the investigation of potential impacts of the proposed development to navigational facilities (i.e., interference).

It is also important to note that the FAA evaluates the elevations of proposed construction with respect to MSL. Often, civil engineers and surveyors report elevation values using other vertical datums, which, when compared with MSL, can cause discrepancies between the proposed and evaluated elevations. It is recommended that the Client consult with their surveyor prior to setting final building elevations, as to ensure consistency with the elevation values. The FAA requires the

- <sup>1</sup> ILS Instrument Landing System
- <sup>2</sup> LOC Localizer
- <sup>3</sup> RNAV Area Navigation
- <sup>4</sup> RNP Required Navigation Approach
- <sup>5</sup> GPS Global Positioning System

coordinates in North American Datum of 1983 (NAD83) and elevations in North American Vertical Datum of 1988 (NAVD88).

### **Findings**

The following includes findings for the project site.

### PART 77

The site is very near the Runway 12R end and falls mostly within the Transitional Surface and partially within the Horizontal Surface for SJC. The Transitional Surface is a sloping surface, that gains one foot vertically for every seven feet horizontally, as it extends perpendicular to the runway centerline. The Horizontal Surface is a flat plane, 150 feet above the airport elevation. At SJC, the Horizontal Surface is 212.16 feet MSL. A graphical depiction of the site and overlying Part 77 surfaces is found in Figure 2. The Transitional Surface is represented in green, and the Horizontal Surface is represented in blue. Table 2 presents the results at each of the 16 points evaluated. Negative numbers represent penetrations to the Part 77 Surfaces.



Figure 2 – Part 77 Transitional Surface

	Ta	ble 2 – Part 77 Allow	able MSL		
Point	Latitude	Longitude	Surface Elevation (in MSL)	Diesel Plume Results	Chiller Plume Results
Point 1	37° 22' 25.15" N	121° 56' 55.02" W	174	21	1
Point 2	37° 22' 23.91" N	121° 56' 48.27" W	128	-25	-45
Point 3	37° 22' 23.66" N	121° 56' 48.32" W	131	-22	-42
Point 4	37° 22' 23.34" N	121° 56' 46.57" W	119	-34	-54
Point 5	37° 22' 22.90" N	121° 56' 46.69" W	124	-29	-49
Point 6	37° 22' 22.78" N	121° 56' 45.96" W	119	-34	-54
Point 7	37° 22' 21.50" N	121° 56' 46.13" W	133	-20	-40
Point 8	37° 22' 19.98" N	121° 56' 46.62" W	152	-1	-21
Point 9	37° 22' 20.46" N	121° 56' 49.27" W	170	17	-3
Point 10	37° 22' 21.33" N	121° 56' 49.03" W	160	7	-13
Point 11	37° 22' 22.41" N	121° 56' 54.80" W	199	46	26
Point 12	37° 22' 22.14" N	121° 56' 54.91" W	202	49	29
Point 13	37° 22' 22.83" N	121° 56' 59.15" W	212	59	39
Point 14	37° 22' 23.27" N	121° 56' 59.18" W	212	59	39
Point 15	37° 22' 24.39" N	121° 56' 58.75" W	212	59	39
Point 16	37° 22' 25.40" N	121° 56' 57.51" W	194	41	21
Negative numb	ers represent penetratio	ns to the Part 77 Surfac	es.		

Penetrations to the Part 77 Transitional Surface are common occurrences at airports. Based upon the currently FAA approved Airport Layout Plan (ALP), SJC features over 100 obstacles which currently penetrate the Part 77 Transitional Surfaces. Aircraft will not be regularly flying over this area at these low elevations. It is assumed that the plumes will not represent a hazard to air navigation because it does not impact any of the published approach, missed approach, or departure procedures for SJC (see subsequent sections in this report).

### AIRPORT DESIGN SURFACES

The project site is outside of Airport Design Surfaces and therefore does not adversely impact the airport design surfaces at SJC. However, the San Jose VOR/DME<sup>6</sup> is near the project site and is within the 1,000-foot VOR critical area (see Figure 3). Solid or fixed structures will represent a more critical concern for the VOR critical area than the plumes. As previously noted, a 7460 for the proposed building was submitted to the FAA for review. The FAA analyzed potential impacts to air navigation, inclusive of this navigational aid, and made a "Determination of No Hazard" for the building. The determinations are attached to this report.

<sup>&</sup>lt;sup>6</sup> VOR/DME – Very High Frequency Omni-Directional Range/Distance Measuring Equipment

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Figure 3 – VOR Critical Area Over Project Site

### DEPARTURE SURFACE FOR RUNWAYS 30L AND 30R (TERPS)

The northeastern portion of the project site lies within the TERPS 40:1 Departure Surfaces for Runways 30L and 30R. Specifically, Points 2 through 6 are within the lateral limits of the TERPS 40:1 Departure Surfaces. Neither the diesel plume, nor the chiller plume, impacts the TERPS 40:1 Departure Surfaces. The lowest elevation of the Runway 30L TERPS 40:1 Departure Surface is at Point 4, where it is about 351 feet MSL and 368 feet MSL for the Runway 30R TERPS 40:1 Departure Surface.

### ILS OR LOC RWY 12R

The ILS or LOC RWY 12 instrument approach procedure consists of Vertically Guided (ILS) and Non-Vertically Guided (Localizer) components. The northeastern portion of the site, specifically Points 2 through 7, is within the obstacle identification surface for both the ILS and Localizer components. At the studied MSLs, the diesel and chiller plumes do not impact the ILS or Localizer components. The maximum top elevation before adversely impacting the Localizer approach to Runway 12R is 196 feet MSL.

### RNAV (GPS) RWY 12R

The RNAV (GPS) RWY 12R instrument approach procedure consists of Precision Vertically Guided (LPV), Non-Precision Vertically Guided (LNAV/VNAV) and Non-Precision (LNAV) lines of minima. Each are discussed below.

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**LPV:** The LPV uses the same obstacle identification surfaces as the above-mentioned ILS procedure. Thus, Points 2 through 7 are within the obstacle identification surface and do not penetrate the LPV procedure.

**LNAV/VNAV:** Points 2 through 7 are within the obstacle identification surface of the LNAV/VNAV procedure. The plumes – diesel and chiller – do not adversely impact the existing LNAV/VNAV procedure. The required Decision Altitude (DA) to clear the plumes is 371 feet MSL, which matches the currently published DA. Any increase in site elevation will impact this procedure.

**LNAV:** The Points 2 through 7 are also within the LNAV obstacle identification surface. The existing LNAV procedure is not adversely impacted by the diesel and chiller plumes.

<u>Missed Approach</u>: For the RNAV (GPS) RWY 12R approach procedure, there is a missed approach segment. This protects for aircraft executing an aborted landing maneuver when the runway is not in sight at the specified DA or Minimum Descent Altitude (MDA). The entire site is within Missed Approach surface and the chiller plume is clear by at least 37 feet.

### RNAV (RNP) RWY 12R

The RNAV (RNP) RWY 12R instrument approach procedure consists of Vertically Guided (RNP) segments that have different obstacle evaluation areas to accommodate aircraft with advanced avionics. The project site is partially within the obstacle evaluation areas and does not represent an obstacle at the evaluated heights.

### RNAV (GPS) RWY 12L

The RNAV (GPS) RWY 12L instrument approach procedure also consists of LPV, LNAV/VNAV, and LNAV lines of minima.

LPV: There are no penetrations to the LPV procedure.

**LNAV/VNAV:** The plumes – diesel and chiller – do not adversely impact the existing LNAV/VNAV procedure.

**LNAV:** The LNAV procedure is also not adversely impacted by the diesel and chiller plumes.

<u>Missed Approach</u>: The site is also within the Missed Approach surfaces associated with this instrument approach procedure and does not cause an adverse impact at either plume height. The chiller plume height is clear of the Missed Approach surface by 7 feet.

### RNAV (RNP) RWY 12L

The project site is partially within the RNAV (RNP) RWY 12L obstacle evaluation areas and does not represent an obstacle at the evaluated points and heights. None of the points analyzed are within the missed approach surface.

### Conclusions

Table 3 summarizes the results presented in the analysis above. While the plumes will penetrate the Part 77 Transitional Surfaces, they will likely not represent a hazard to air navigation due to no impacts to any published approaches. A portion of the site is within the San Jose VOR/DME critical area. However, the building received a Determination of No Hazard from the FAA which represents a more critical obstruction to the VOR/DME than the thermal plumes.

	Table 3 –	Summary	of Results		
Component Analyzed	Thermal Plume Impacts				Additional Information
	Yes	No			
Part 77		1	Penetrations are common within the		
Fait //	•		Part 77 Transitional Surface		
Airport Design Surfaces		1	Fixed building was determined to not		
Aliport Design Sunaces		•	be a hazard to air navigation		
Departure Surface for		1	Clear by at least 178 feet.		
Runways 30L and 30R			Clear by at least 170 leet.		
ILS/LOC RWY 12R		✓	Must remain below 196 feet MSL.		
RNAV (GPS) RWY 12R		✓	MSL cannot be increased.		
RNAV (RNP) RWY 12R		✓			
RNAV (GPS) RWY 12L		✓	Must remain below 180 feet MSL.		
RNAV (RNP) RWY 12L		$\checkmark$			

Attachments:

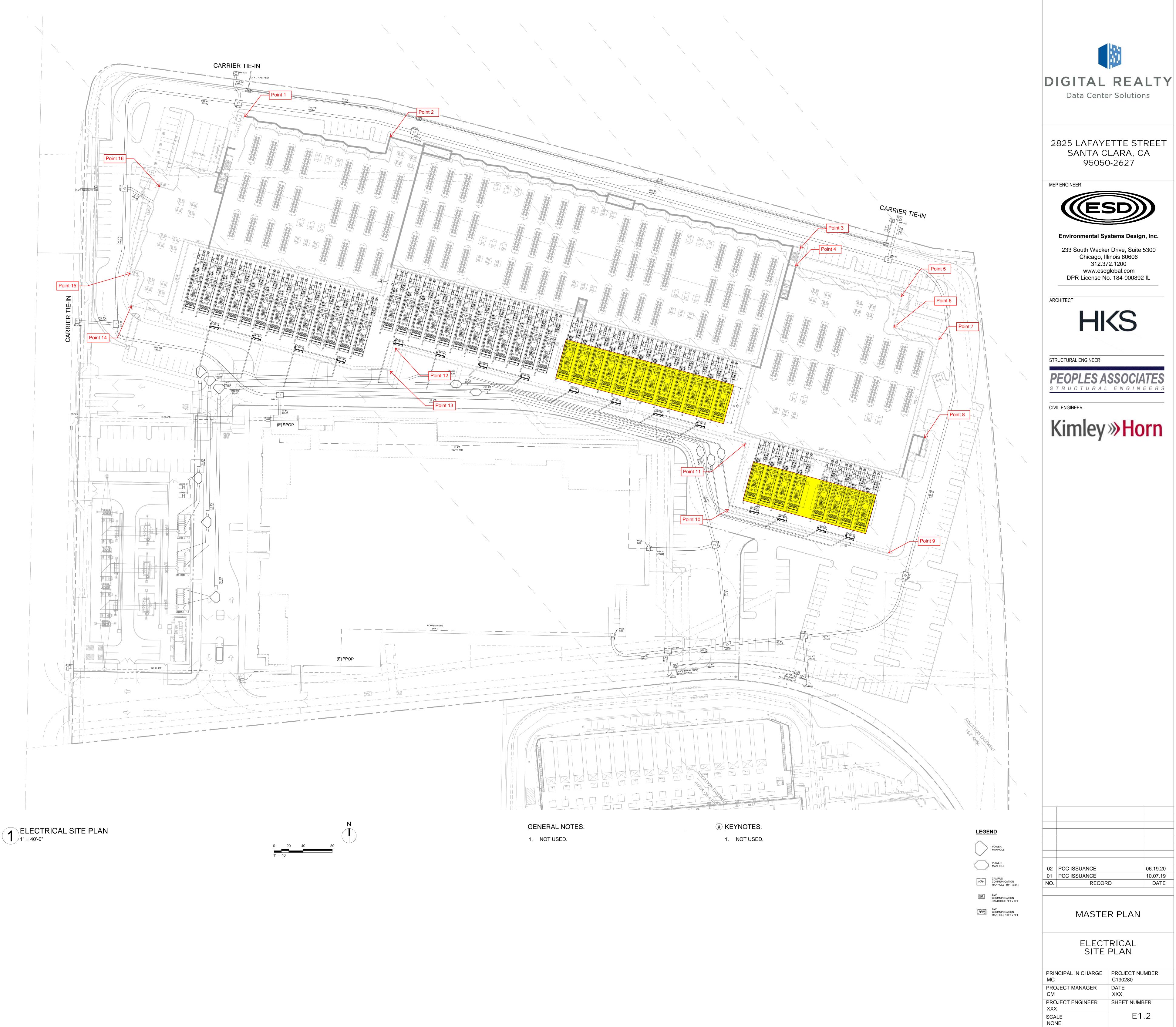
- A: Project Site Plan
- **B:** Thermal Plume Calculation & Analysis

\*

C: 7460 Notice of Determination

\* \* \* \* \* \*

Please do not hesitate to contact me at 909.991.4398 (mobile), or <u>Andrew.scanlon@kimley-horn.com</u> to discuss further or if you have any questions or comments.



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## **Vertical Plume Velocity Assessment**

# Lafayette Backup Generating Facility

Santa Clara, California

Submitted to California Energy Commission

Submitted by



Prepared by

Atmospheric Dynamics, Inc.



May 2022

### Introduction

This report presents the evaluation of the Lafayette Backup Generating Facility (LBGF) source generated plumes from the 46 Cummins diesel engines and 88 rooftop chillers on the effects on airport/aircraft operations. The Normal Y. Mineta San Jose International Airport is located approximately 0.38 miles east southeast of the LBGF. This report is based upon an analysis prepared by Atmospheric Dynamics, Inc. in accordance with the California Energy Commission (CEC) application requirements for a Small Power Plant Exemption (SPPE) pursuant to the power plant siting regulations. This analysis is but one part of a larger analysis, which seeks an SPPE Decision from the CEC.

Based on the stack parameter data, an analysis of the potential plume characteristics from the routine operation the diesel engines and rooftop chillers on vertical winds was prepared and compared to the California Energy Commission (CEC) significance criteria of 5.3 meters per second (m/s) for the average vertical plume velocities as described below.

Atmospheric Dynamics, Inc. (ADI) prepared a screening level plume vertical velocity assessment which are based on the calm wind Spillane methodology outlined in the "Aviation Safety and Buoyant Plumes" paper (Peter Best, et. al., presented at the Clean Air Conference, Newcastle, New South Wales, Australia, 2003). This methodology is also recognized as a screening tool for aviation safety set out by the Australian Civil Aviation Safety Authority (CASA) and presented in "AC 139-5(1) Plume Rise Assessments (CASA, 2012)".

The aim of this screening assessment is to conservatively determine the potential for turbulence generated by the diesel engines and rooftop chillers waste heat exhaust plumes. Part 139.370 of the Australian Civil Aviation Safety Regulations (1998, 2004) provides that CASA may determine that plume velocities in excess of 4.3 m/s is or will be a potential hazard to aircraft operations. The *Manual of Aviation Meteorology* (Australian Bureau of Meteorology 2003) defines severe turbulence as a vertical wind gust velocity in excess of 10.6 m/s. The assumed critical vertical velocity used as a CEC significance threshold is 5.3 meters per second\* (m/s) but it should be noted that the basis of the original CASA derived threshold of 4.3 m/s has been lost in antiquity and that CASA no longer relies on the 1998 and 2004 regulations that established this critical threshold other than to note that a more rigorous analysis, which includes site specific meteorology, should be used if the 4.3 m/s and 10.6 m/s screening thresholds are exceeded. The screening method uses absolute worst-case assumptions of calm winds and neutral atmospheric conditions for the entire vertical extent of the plume to determine these worst-case impacts. It should be noted that these results are extremely conservative in that these worst-case conditions typically only occur during a few hours each year.

The Spillane methodology is generally applied to a limited number of plume source geometry's (turbines, power plant boilers, etc.) with the stacks arranged linearly (in a single straight-line) and separated by distances that typically exceed the individual stack diameters. For the diesel engines, this assumption was maintained. Only one engine stack was modeled consistent with the normal operational testing schedule of the emergency generator engines. For the chiller assessment, a conservative assumption was made in order to use the Spillane methodology on an atypical chiller plume configuration, which is made up of 88 chillers arranged on a two-dimensional surface. Here, the methodology, as described below, assumed that all sixteen chiller cells for each chiller were merged into a single stack with an effective diameter based on the combined area of all sixteen chiller cells. In other words, a single stack was assumed to initially

\*For the Puente Power Project (Docket#15-AFC-01, TN#213674, 9/15/2016), "CEC staff ... concluded that an average velocity of 5.3 m/s is the appropriate velocity ... (for a plume velocity threshold)." The CEC staff "Plume Background Threshold" attached to the docketed document concludes with "...(CEC) staff will use 10.6 m/s peak vertical plume velocity as the new threshold. The altitude at which a plume would have a peak vertical velocity of 10.6 m/s would be the same altitude at which a plume would have an average vertical velocity of half that, 5.3 m/s."



describe the release parameters of the combined chiller cells in each of the 88 individual chillers. The effective plume diameter is appropriate for each individual chiller based on the close proximity and arrangement of the sixteen chiller cells.

### Screening Methodology and Vertical Plume Velocity Calculations

The Spillane methodology is based on worst-case calm wind neutral stability conditions to assess the average plume vertical velocity as a function of height. The methodology is based on wellverified laboratory and theoretical treatments of the rise and spread of a buoyant jet, both into a still ambient environment and into a light crosswind. This treatment covers in detail the initial dynamics of the plume as it exits the stack and the entrainment of ambient air into the plume as it rises directly above the stack. In addition to providing clarifications and algebraic solutions to the Spillane methodology, the 2003 Peter Best paper provides additional methodologies that also consider the enhancement of vertical velocities that may occur if the plumes from multiple identical stacks merge and form a higher buoyancy combined plume (referred to here as the enhanced Spillane methodology).

The vertical plume assessment will involve several stages of development. For individual plumes, the stages are:

- (a) In the first stage very close to the stack exit, the high plume momentum will result in a short section in which the conditions at the center of the plume are relatively unaffected by ambient and plume buoyancy conditions. This jet phase extends from the stack exit to approximately a distance of 6.25 D above the stack (where D is the stack diameter) in calm conditions. At the end of this stage, the plume-averaged vertical velocity has decreased to half of the stack exit velocity, with a corresponding increase, or doubling, in effective plume diameter.
- (b) In the second stage, the plume responds to differences between ambient and plume buoyancy conditions, with much cooler and less turbulent ambient air being entrained into the plume from the outside regions of the plume towards the plume centerline. The momentum and buoyancy of the plume significantly influences plume rise and subsequently the dilution of the stack exhaust to decrease plume vertical velocities. This dilution is very sensitive to ambient wind speed, so the calm wind conditions considered here are extremely conservative.
- (c) In the third stage of plume development, plume rise is due entirely to the buoyancy of the plume and continues from some distance until there is an equalization of turbulence conditions within and outside the plume. This final rise is often only achieved at considerable heights/distances from the stack where the effective average vertical velocity is then close to zero. Since there is very little turbulence and near-zero vertical velocities, this stage of plume development is usually not considered for this type of analysis.

In the second stage of development, the analytical solution of the governing equations under these conditions is given by:



Where the subscript 'o' refers to values of the parameters at the stack outlet and the variables are:

- a plume radius (m)
- V average vertical velocity (m/s)
- z height above stack top (m)
- $z_v$  virtual source height (m)
- D stack diameter (m)
- $F_o$  buoyancy flux evaluated at the stack outlet (m<sup>4</sup>s<sup>-3</sup>)

These are the two primary equations governing the growth of a single plume in the second stage of development under neutral calm wind conditions. Additional equations governing the first stage of single plume development as well as the interaction of multiple plumes in the second stage of development are discussed in detail in the Best paper.

For multiple stacks in the enhanced Spillane methodology, the equations governing the second stage are calculated from the point when the plumes begin to merge until they are fully merged. The plume merging begins at the height where the plume diameters equal the stack separations and the plumes are fully merged at the height where the plume diameters are equal to 2d(N-1)/2 for three or more stacks or 2d for two stacks. At the fully merged height, the merged plume diameter and velocity is enhanced by the fourth root of the number of stacks. Above the fully merged plume height, the enhanced plume diameter and plume velocities follow the regular equations given for the second stage. Below the fully merged plume height for the merging phase, plume velocities are linearly interpolated by height from the single plume velocity at the height where the plumes begin to merge to the enhanced plume velocity at the fully merged plume height.

### Vertical Plume Velocity Calculations for the Diesel Engines

The LBGF is comprised of 44 individual large and one (1) small diesel emergency generator stacks. The small diesel emergency generator was not assessed as it would have smaller plume vertical velocities. Generator stack parameter data (plume exit velocity, plume exit temperature and stack exit diameter) were provided by Cummins. Only one (1) engine will be tested during any one hour. While the engines will be tested at minimum loads, the 100 percent load case was utilized for the worst-case plume analysis. For the engine analysis, two ambient conditions were considered: 41.0°F, the minimum monthly mean of daily minimum temperatures, and 84.3°F, the maximum monthly mean of daily maximum temperatures for the San Jose Airport (*"Climatology of the United States No. 81 – Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 – California"*, February 2002, and *"Climatology of the United States No 20 – Monthly Station Climate Summaries, 1971-2000 – California"*, February 2004. These data is summarized in Table 1.



T Cummins Diesel Stack Characteris	able 1 tics for Vertical	Plume Velocity A	nalysis
	Case #	1	2
Ambient Temperature (°F)*		41.0	41.0
Stack Diameter (m)		0.7112	0.7112
Exhaust Velocity (m/s)*		31.20	31.20
Exhaust Temperature (K)*		912.0	912.0
Stack Release Height (m)		22.86	22.86
Stack Buoyancy Flux (m <sup>4</sup> /s <sup>3</sup> )		24.58	23.35
*Stack data provided by Cummins at 100% load			

Screening level vertical plume velocity assessments were made for two ambient temperatures with calm winds and neutral atmospheric conditions for the cases presented in Table 1 which are based on 100 percent load. The results based on the two ambient conditions are presented in Table 2 and the output from the calculation spreadsheet provided in Attachment A.

The initial jet phase extends to a height of about 90 feet above grade level (ft-agl) for both cases. After the jet phase, plume temperature buoyancy characteristics modeled in the Spillane methodology cause a uniform decrease in plume-averaged vertical velocities, with the critical plume-averaged vertical velocity of 5.3 m/s occurring at about 113 ft-agl for both cases

Table 2 Diesel Engine Vertical Plume Velocity Analysis Re	sults for Referen	ce Height
Case #	1	2
Ambient Temperature (°F)	41.0	84.3
Single Plume Results:		
Plume-Averaged Vertical Velocity at 200 feet-agl (m/s)	2.77	2.73
Height of 5.3 m/s Plume-Averaged Vertical Velocity (feet-agl)	112.8	112.9

These screening results indicate that mechanical and thermal turbulence levels due to the flow from the diesel engine always remain in the light turbulence category and below the significance level of 5.3 m/s at all heights above about 113 ft-agl. Even light wind speeds can dramatically decrease the predicted plume-averaged vertical velocities, so the above results are very conservative indications of adverse conditions. The important factor for a given location is the appropriateness of available information for estimating true wind and temperature profiles throughout a typical year. Theoretical calculations, as shown in the tables above, are likely to overestimate the expected vertical velocities, for the following reasons:

- The wind profile is assumed constant with height with no occurrence of wind-shear when realistically, there is a considerable variation with height, especially in light winds;
- Worst-case scenarios are based on very light-wind, near-neutral atmospheric conditions with maximum loading.

### Vertical Plume Velocity Calculations for the Rooftop Chillers

The 88 rooftop chillers are each comprised of 20 individual cells, with a cell fan diameter of 34 inches. The 88 chillers are generally arranged 24 along the longer building length (averaging 15 feet between adjacent chillers) by three along the shorter building width (averaging 15 feet between adjacent chillers). It should be noted that the chillers are arranged differently on the two-story part of the data center (8x2). Based on the groupings of chillers, the single and merged



plumes were based on the 24 (3x8) chiller arrangement my merging plumes along the length (3 merged stacks) and width (8 merged stacks). Chiller stack parameter data (exit velocity and temperature) were provided by the applicant. An effective stack diameter for all 20 cells was utilized for each chiller. The chillers will utilize variable speed fans and the number of fans that are operational are dependent upon ambient temperature and plant load. However, to be conservative, all chillers/cells were assumed to be operating at full load. These data are summarized in Table 3 for the same ambient temperatures used for the engine analysis.

	tics for Vertical Plum Case #	1	2
Ambient Temperature (°F)*		41.0	84.3
Effective Stack Diameter (m)**		3.86	3.86
Exhaust Velocity (m/s)*		8.06	8.06
Exhaust Temperature (K)*		289.26	313.32
Stack Release Height (m)		23.81	23.81
Stack Buoyancy Flux (m <sup>4</sup> /s <sup>3</sup> )		11.33	10.45

\*\* Calculated value based on the cell diameter of 34 inches multiplied by the square of the number of operating cells, or  $D_{eff} = 34$ "\* $\sqrt{20}$ 

The Spillane methodology was originally developed to treat multiple individual stacks that are arranged along a linear x or y direction, but not both directions at once, with stack separations much greater than the stack diameters, typical of boilers/turbines at large power plants. As noted above, the 88 chillers are generally arranged in a 3 x 8 pattern. Therefore, the enhanced Spillane methodology was based on calculating the total merging height for the largest linear direction of chiller placements (which is eight chillers spaced 24.6 feet apart along the longer length of the building). The largest grouping of 48 (3x16) chillers were considered in the calculation of vertical velocity plume enhancement (both at and above the totally merged height, and for the interpolation down to the plume touching height. Again, the effective single stack diameter of each chiller was based on the combined 20 cells.

Screening level vertical plume velocity assessments were made for the same ambient temperatures with calm winds and neutral atmospheric conditions as was done for the emergency generator engines. The results are presented in Table 4 and the output from the calculation spreadsheets are provided in Attachment A.

The initial jet phase extends to a height of about 157.3 ft-agl for both cases. The critical plumeaveraged vertical velocity of 5.3 m/s occurs in the jet phase at about 132.4 ft-agl for both cases. The plumes touch (begin to merge) at about 246 ft-agl and are fully merged at about 1,233 ft-agl for both cases. Under the enhanced Spillane methodology, the merged plume-averaged vertical velocities never approach 5.3 m/s (either above the totally merged height or when interpolated down to the touching height).



Table 4 Chiller Vertical Plume Velocity Analysis Resul	ts for Reference H	eight
Case #	1	2
Ambient Temperature (°F)	41.0	84.3
Single Plume Results:		
Height of 5.3 m/s Plume-Averaged Vertical Velocity (Within the Jet Phase, feet-agl)	132.4	132.4
Merged Plume Results:		
Plume-Averaged Vertical Velocity at 1,000 feet-agl (m/s)	3.50	3.42

From these results and for each ambient condition, the vertical plume velocities are less than the threshold value of 5.3 m/s for all heights above about 132 ft-agl and above for the chillers. The heights at which plume-averaged vertical velocities exceed 5.3 m/s only occur during the jet phase for both cases. These cases also represent worst-case conditions of calm winds at all levels of a neutral atmosphere.

These screening results indicate that mechanical and thermal turbulence levels due to the flow from the chillers always remain in the light turbulence category and below the significance level of 5.3 m/s at all heights above about 132 ft-agl. Even light wind speeds can dramatically decrease the predicted plume-averaged vertical velocities so the above results are very conservative indications of adverse conditions. The important factor for a given location is the appropriateness of available information for estimating true wind and temperature profiles throughout a typical year. Theoretical calculations, as shown in the tables above, are likely to overestimate the expected vertical velocities, for the following reasons:

- The wind profile is assumed constant with height with no occurrence of wind-shear when realistically, there is a considerable variation with height, especially in light winds;
- Worst-case scenarios are based on very light-wind, near-neutral atmospheric conditions with maximum loading.



## Attachment A Spillane Method Plume Velocity Calculations



	"Aviation Sa	fety and Buo	yant Plumes	," Peter Be	st, et. al.			
	"The Evaluat	ion of Maxin	num Updraft	Speeds for	Calm Con	ditions at V	arious Heights in the Plum	e
		from a Gas-	Turbine Pow	er Station a	at Oakey, G	ueensland	, Australia ," Dr. K.T. Spilla	ne
mbient Conditions:					Constants:	Assume n	eutral conditions (dθ/dz=0 or	θa=θe)
Ambient Potential Temp 0	278.15	Kelvins	41.0	°F		0.3048	meters/feet	
lume Exit Conditions:					Gravity g	9.81	m/s <sup>2</sup>	
Maximum Stack Height h	22.86	meters	75	feet-inches	λ	1.11		
Stack Diameter	0.7112	meters	28	inches	λο	~1.0		
Stack Velocity Vex	31.20	m/s	102.37	ft/sec				
Volumetric Flow	12.39	cu.m/sec	26,264	ACFM	πV <sub>exit</sub> D <sup>2</sup> /4			Sect.2/¶1
Stack Potential Temp 0		Kelvins	912					
Initial Stack Buoyancy Flux F					qV <sub>ev#</sub> D <sup>2</sup> (1-	θ <sub>°</sub> /θ <sub>°</sub> )/4 = V	ol.Flow(g/π)(1-θ <sub>a</sub> /θ <sub>s</sub> )	Sect.2/¶1
Plume Buoyancy Flux F		m <sup>4</sup> /s <sup>3</sup>					,θ <sub>p</sub> at plume height (see belo	
No.of Stacks N				1 000			cation Factor (N <sup>0.25</sup> )	,
10.01 012013 1				1.000	Multiple 31			
onditions at End (Top) of Jet Phase:								
Height above Stack z <sub>ie</sub>	4 445	meters*	14.6	feet*	- 6.050	) motorot	motoro obour otook too	Cost 2/61
Height above Stack Z <sub>je</sub> Height above Ground Z <sub>jet</sub> +h		meters	89.6		Zjet = 0.25L	J, meters =	meters above stack top	Sect.3/¶1
					V 0.5V	N/ /0		
Vertical Velocity V <sub>je</sub>				ft/sec		$e_{xit} = V_{exit}/2$		
Plume Top-Hat Diameter 2aje	1.422	meters	4.7	feet	$2a_{jet} = 2D$		Conservation of momentum	
oillane Methodology - Analytical Solutions	for Calm Con	ditions for P	lume Height	s above Je	t Phase			
Single Plume-averaged Vertical Velocity				er where P				
Plume Top-Hat Radius a	S	olutions in 1	able Below				crease with height	Sect.2/Eq.6
Virtual Source Height z	1.760	meters*	5.8	feet*	6.25D[1-(0	$[\theta_{s})^{1/2}]$ , met	ers*=meters above stack top	Sect.2/Eq.6
Height above Ground zv+h	24.620	meters	80.8	feet			where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	0.6042
Vertical Velocity V		olutions in T	able Below		{(Va) <sub>o</sub> <sup>3</sup> + 0	.12F <sub>o</sub> [ (z-z,	$(1/3)^{2} - (6.25D-z_{v})^{2}]^{(1/3)} / a$	Sect.2.1(6)
Product (Va)		m²/s			V <sub>exit</sub> D/2(θ <sub>e</sub> /			
						37		
Solve for plume-averaged vertical velo	city at height	200.0	feet	60.08	meters abo	we around (	: z'+b_)	
Gives the following Height above Stack z		meters*	125.0		abu	sis ground (	- · · · a/	
				feet	2a'=2*0.16	(=' = )		Sect.2/Eq.6
Plume Top-Hat Diameter 2a		meters					(1/3)/(2a'/2)	
Vertical Velocity \	2.769	m/s	9.09	ft/sec	V={(Va) <sub>o</sub> "+	0.12F₀[(z-z	v)=-(6.25D-zv)=]}****/(2a/2)	Sect.2/Eq.6
Solve for Height of CASC critical vertica			m/s plume-a					> Top of Jet (Spilla
Find Height above Stack z <sub>cr</sub>	11.519	meters	37.8	feet			ultaneously in both eqs. (i.e.,	
Height above Ground zcrit+h	34.379	meters	112.8	feet	for V=4.3 r	n/s using th	e cubic equation ax3+bx2+cx	+d=0, where
						a=1, c=0,	and b=-(0.12F <sub>o</sub> )/(4.3 <sup>3</sup> 0.16 <sup>3</sup> )=	-4.8
Interpolated Height of critical vertical	elocity in Jet	Phase:			and o	d=[0.12F <sub>o</sub> (6	.25D-z <sub>v</sub> ) <sup>2</sup> -(Va) <sub>o</sub> <sup>3</sup> ]/(4.3 <sup>3</sup> 0.16 <sup>3</sup> )=	-459
Find Height above Stack z <sub>cr</sub>	#N/A	meters	#N/A	foot			http:/	/www.1728.org/cubic.h
				ieei				
Height above Ground z <sub>crit</sub> +h	#N/A	meters	#N/A			give		
Height above Ground z <sub>crit</sub> +h	#N/A	meters				give	es the real solution x = z-zv =	9.75
Height above Ground z <sub>crit</sub> +h	#N/A	meters				give	es the real solution x = z-zv = or z(m/above stack) =	9.75 11.5
			#N/A	feet	nd of jet rh		es the real solution x = z-zv =	9.75
able of Plume Top-Hat Diameters (2a) and	Plume-Averaç	ed Vertical	#N/A Velocities sta	feet arting at er	nd of jet ph		es the real solution x = z-zv = or z(m/above stack) =	9.75 11.5
able of Plume Top-Hat Diameters (2a) and Height (feet	Plume-Averaç (meters)	ed Vertical Plume	#N/A Velocities sta SingleStk	feet arting at er Plume			es the real solution x = z-zv = or z(m/above stack) =	9.75 11.5
able of Plume Top-Hat Diameters (2a) and Height (feet above ground	Plume-Averag (meters) above stack	ed Vertical Plume Radius(m)	#N/A Velocitiessta SingleStk VertVel(m/s)	feet arting at er Plume Temp(K)			es the real solution x = z-zv = or z(m/above stack) =	9.75 11.5
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <u>Stack.Rel.Ht = 75.0</u>	Plume-Averag (meters) above stack 0.00	ed Vertical Plume Radius(m) 0.356	#N/A Velocities sta SingleStk VertVel(m/s) 31.20	feet arting at er Plume Temp(K)			is the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) =	9.7 11. 11
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <i>Stack.Rel.Ht</i> = 75.0 80.0	Plume-Averag (meters) above stack 0.00 1.52	ed Vertical Plume Radius(m) 0.356 0.477	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86	arting at er Plume Temp(K)			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs:	9.7 11. 11
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <i>Stack.Rel.Ht</i> = 75.( 80.( 85.(	Plume-Average (meters) above stack 0.000 1.52 3.05	ed Vertical Plume Radius(m) 0.356 0.477 0.599	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52	feet arting at er Plume Temp(K)			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R	9.7 11. 11
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack.Rel.Ht = 75. 80. 85. Top of jet = 89.6	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60	feet arting at er Plume Temp(K)			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations:	9,7 11. 11 11 11 11 11 11 11 11 11 11 11 11
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <i>Stack.Rel.Ht</i> = 75.( 80.( 85.(	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60	feet arting at er Plume Temp(K)			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: V <sub>plume</sub> =((Va) <sub>0</sub> <sup>3</sup> +0.12F <sub>2</sub> ((z-z,) <sup>2</sup> -(6.2	9,7 11. 11 11 11 11 11 11 11 11 11 11 11 11
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack.Rel.Ht = 75. 80. 85. Top of jet = 89.6	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 4.57	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450	#N/A Velocities st: SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93	feet arting at er Plume Temp(K) 465.22			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 11 5 foot interv kelHit to Top of Jet 55D-2,) <sup>2</sup> ]) <sup>10</sup> / a <b>10 foot interv</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <i>Stack.Rel.Ht = 75.0</i> 80.0 85.0 <b>Top of jet = 89.0</b> 90.0	Plume-Average (meters) above stack 0.000 1.522 3.05 4.45 4.57 7.62	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73	feet arting at er Plume Temp(K) 465.22 361.34			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: V <sub>plume</sub> =((Va) <sub>0</sub> <sup>3</sup> +0.12F <sub>2</sub> ((z-z,) <sup>2</sup> -(6.2	9.7 11. 11 5 foot interv kelHit to Top of Jet 55D-2,) <sup>2</sup> ]) <sup>10</sup> / a <b>10 foot interv</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.0</b> 90.0 100.0	Plume-Averag (meters) above stack 0.000 1.52 3.05 4.45 0.4.55 4.57 7.62 10.67	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425	#N/A Velocities st SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62	feet Plume Temp(K) 465.22 361.34 327.69			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 11 81-Ht to Top of Jet (5D-z,) <sup>2</sup> ) <sup>1,0</sup> / a <b>10 foot Inter</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground <i>Stack. Rel. Ht = 75.</i> 80. 80. <b>Top of jet = 89.</b> 90. 100. 110.	Plume-Averag (meters) above stack 0.000 1.52 3.05 4.45 0.4.57 0.7.62 10.67 11.52	ed Vertical <sup>1</sup> Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562	#N/A Velocities st. SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 11 81-Ht to Top of Jet (5D-z,) <sup>2</sup> ) <sup>1,0</sup> / a <b>10 foot Inter</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. H = 75.6 80. 85. Top of jet = 89.6 90. 100.0 100. 5pillane 5.3 m/s Height = 112.8	Plume-Averaç (meters) above stack above st	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913	#N/A Velocities st. SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 1 <b>5 foot Intern</b> exIHt to Top of Jet (5D-2,) <sup>2</sup> ) <sup>1,0</sup> / a <b>10 foot Intern</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 <b>Top of jet = 89.0</b> 90.0 100.0 110.0 <b>Spillane 5.3 m/s Height = 112.6</b> 120.0 130.0	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.4.55 0.4.55 0.4.55 0.4.55 0.4.55 0.4.55 0.4.55 0.4.55 0.4.55 0.13.72 0.13.72 0.13.72	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401	#N/A SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.64	feet Plume Temp(K) 465.22 361.34 322.07 311.42 302.17			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 11. 5 foot Interv el-Ht to Top of Jet 50-52,7 <sup>3</sup> ) <sup>1/3</sup> / a 10 foot Interv me <sup>*</sup> (a <sup>2</sup> *λ <sup>2</sup> )))
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 80.0 700 of jet = 89.0 90.0 100	Plume-Average (meters) above stack above s	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888	#N/A Velocities st. SingleStk VertVel(m/s) 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =( $Ve_{10}$ , <sup>a</sup> +0.12F <sub>a</sub> ((z-z,) <sup>2</sup> -(6.2) a = 0.16(z-z,)	9.7 11. 11. 5 foot Interv el-Ht to Top of Jet 50-52,7 <sup>3</sup> ) <sup>1/3</sup> / a 10 foot Interv me <sup>*</sup> (a <sup>2</sup> *λ <sup>2</sup> )))
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 80. 80. 70p of jet = 89.6 90. 100. 100. 5pillane 5.3 m/s Height = 112.8 120. 130. 140. 130.	Plume-Average (meters) above stack above s	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376	#N/A Velocities st. SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.49			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el-Ht to Top of Jet 50-52,7 <sup>3</sup> ) <sup>1/3</sup> / a 10 foot Interv me <sup>*</sup> (a <sup>2</sup> *λ <sup>2</sup> )))
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 Top of jet = 89.0 90.0 100.0 1100.0 Spillane 5.3 m/s Height = 112.2 120.0 130.0 140.0 150.0 160.0	Plume-Averag (meters) above stack 0.00 1.52 3.05 4.45 9.4.57 7.62 1.0.67 11.52 9.13.72 9.16.76 1.3.72 9.16.76 1.9.81 1.9.22.66	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.662 1.913 2.401 2.888 3.376 3.864	#NVA Velocities sta Single Stk VertVel(m/s) 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.466 3.26	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 292.49 289.77			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el-Ht to Top of Jet 50-52,7 <sup>3</sup> ) <sup>1/3</sup> / a 10 foot Interv me <sup>*</sup> (a <sup>2</sup> *λ <sup>2</sup> )))
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0. 80.0 85.0 Top of jet = 89.0 90.0 100	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45 0.7.62 0.7.62 0.10.67 11.52 0.13.72 0.	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351	#N/A SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.26 3.10	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.49 289.778 287.78			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el.Ht to Top of Jet 5D-2,2 <sup>3</sup> ) <sup>1/2</sup> /a 10 foot Interv m <sup>a</sup> <sup>2</sup> <sup>α</sup> <sup>2</sup> λ <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 00.0 10	Plume-Average (meters) above stack above s	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790	#N/A Velocities st. SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.48 289.77 287.78 282.84			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el.Ht to Top of Jet 5D-2,2 <sup>3</sup> ) <sup>1/2</sup> /a 10 foot Interv m <sup>a</sup> <sup>2</sup> <sup>α</sup> <sup>2</sup> λ <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 50.000000000000000000000000000000000	Plume-Average (meters) above stack above s	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228	#N/A Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.288 4.64 4.09 3.72 3.466 3.26 3.10 2.61 2.34	feet arting at er Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 296.48 289.77 287.78 282.84 280.99			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el.Ht to Top of Jet 5D-2,2 <sup>3</sup> ) <sup>1/2</sup> /a 10 foot Interv m <sup>a</sup> <sup>2</sup> <sup>α</sup> <sup>2</sup> λ <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 00.0 10	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45 0.4.57 0.7.62 0.10.67 11.52 0.13.72 0.	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228	#NVA Velocities st. SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.772 3.466 3.26 3.10 2.61 3.10 2.61 2.34	feet arting at er Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 296.44 289.77 287.78 282.84 280.99			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 <b>5 foot Intern</b> el.Ht to Top of Jet 50-2,2 <sup>1</sup> ) <sup>1,a</sup> / a <b>10 foot Intern</b> m <sup>a</sup> <sup>(a<sup>2</sup>/k<sup>2</sup>))) Max&lt;5.30</sup>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 50.000000000000000000000000000000000	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.4.57 0.7.62 0.10.67 11.52 0.13.72 0.1	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.933 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667	#NVA Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16	feet Plume Temp(K) 465.222 361.34 327.69 322.07 311.42 302.17 296.43 289.77 287.78 282.84 289.97 287.88 280.08			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 5 foot Interv el.Ht to Top of Jet 5D-2,2 <sup>3</sup> ) <sup>1/2</sup> /a 10 foot Interv m <sup>a</sup> <sup>2</sup> <sup>α</sup> <sup>2</sup> λ <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 <b>Top of jet = 89.0</b> 90.0 100.0 <b>Spillane 5.3 m/s Height = 112.6</b> 120.0 130.0 140.0 150.0 170.0 220.0 270.0 320.0	Plume-Average (meters) above stack 0.000 1.52 3.35 4.45 0.4.57 0.7.62 0.10.67 11.52 0.13.72 0.13.72 0.13.72 0.13.72 0.13.72 0.13.74 0.22.86 0.25.91 0.28.96 0.29.96 0.	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105	#N/A SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 4.2.16 2.02	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.49 289.77 287.78 282.84 280.99 280.09 28			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 <b>5 foot Intern</b> el.Ht to Top of Jet 50-2,2 <sup>1</sup> ) <sup>1,a</sup> / a <b>10 foot Intern</b> m <sup>a</sup> <sup>(a<sup>2</sup>/k<sup>2</sup>))) Max&lt;5.30</sup>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0. 80.0 90.0 10	Plume-Average (meters) above stack above s	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.364 4.351 6.790 9.228 11.667 714.105 16.543	#NVA Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.14 2.34 2.16 2.02 2.34 2.19 2.19 2.19 2.19 2.19 2.19 2.19 2.19	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.48 289.77 287.78 282.84 280.99 280.08 279.26 279.23			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 <b>5 foot Intern</b> el.Ht to Top of Jet 50-2,2 <sup>1</sup> ) <sup>1,a</sup> / a <b>10 foot Intern</b> m <sup>a</sup> <sup>(a<sup>2</sup>/k<sup>2</sup>))) Max&lt;5.30</sup>
able of Plume Top-Hat Diameters (2a) and Height (feet above groum Stack.Rel.Ht = 75.0 00000000000000000000000000000000000	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 9.4.57 7.62 9.10.67 11.52 9.13.72 9.16.76 9.22.66 9.22.66 9.22.69 9.22.69 9.22.69 9.22.69 9.22.69 9.22.69 9.22.69 9.22.69 9.25.91 9.28.90 9.29.90 9.29.90 9.29.90 9.29.90 9.29.90 9.29.90 9.29.90 9.20 9.2	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982	#NVA Velocities sta Single Stk VertVel(m/s) 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.772 3.466 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 292.49 289.77 282.84 289.77 282.84 280.99 280.08 279.56 279.52 279.56			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 <b>5 foot Intern</b> el.Ht to Top of Jet 50-2,2 <sup>1</sup> ) <sup>1,a</sup> / a <b>10 foot Intern</b> m <sup>a</sup> <sup>(a<sup>2</sup>/k<sup>2</sup>))) Max&lt;5.30</sup>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 70p of jet = 89.0 90.0 100.	Plume-Average (meters) above stack 0.000 1.52 3.005 4.45 0.4.57 0.7.62 0.10.67 11.52 0.13.72 0	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420	#NVA Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 2.183 3.176	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 294.37 287.78 283.77 287.78 283.74 289.08 279.03 279.03 279.25 279.25 27			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
Able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 90.0 100	Plume-Average (meters) above stack 0 0.00 1.52 3.3.05 4.45 0 4.57 7 7.62 0 10.67 11.52 0 13.72 0 13.72 0 13.72 0 13.72 0 13.72 0 13.74 0 25.91 0 22.86 0 25.91 0 28.96 0 25.91 0 25.91	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 11.667 14.105 2.21.420 2.6.297	#N/A Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 4.216 2.02 1.83 1.76 1.64	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.49 289.77 287.78 282.84 280.99 280.09 279.56 279.23 279.01 278.65 278.65			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.6 80. 500. 100. 100. 100. 100. 100. 100. 10	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.7.62 10.67 11.52 0.13.72 0.16.76 19.81 0.22.86 0.25.91 0.25.94 0.25.9	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.938 1.425 1.562 1.913 2.401 2.888 3.376 3.364 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174	#NVA Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 <b>15.60</b> 14.93 7.73 5.62 <b>5.28</b> 4.64 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55	feet arting at er Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 295.44 289.77 287.78 282.84 280.99 280.08 279.56 279.56 278.85 278.85 278.85 278.85 278.53			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
Able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 70p of jet = 89.0 90.0 1100.0 1100.0 5pillane 5.3 m/s Height = 112.6 120.0 130.0 140.0 150.0 170.0 220.0 270.0	Plume-Average (meters) above stack 0.00 1.52 3.3.05 4.45 0.4.57 1.52 0.1.57 1.52 0.1.57 0.1.52 0.1.57 0.1.52 0.1.57 0.1.5	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.933 1.425 1.562 1.933 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 3.1654 3.882 21.420 26.297 31.174 36.051	#NVA Velocities sta Single Sta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 4.55 5.28	feet Plume Temp(K) 465.222 361.34 327.69 322.07 311.42 302.17 296.49 289.77 287.78 282.84 289.77 287.78 282.84 289.08 279.56 279.53 278.65 278.55			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above grouns Stack. Rel. H = 75.0. 80.0 80.0 80.0 80.0 100.0	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45 0.4.57 1.52 1.52 1.52 1.52 1.52 1.52 1.52 1.52	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.730 9.228 11.667 14.105 16.543 18.982 2.1.420 2.6.297 3.1.774 3.6.051 40.927	#N/A Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 4.64 3.26 3.10 2.61 2.34 4.64 1.65 1.47 1.41	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 297.49 289.77 287.78 282.84 289.99 280.99 280.08 279.56 279.23 279.49 280.99 280.78 527.85 278.85			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
Able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 70p of jet = 89.0 90.0 1100.0 1100.0 5pillane 5.3 m/s Height = 112.6 120.0 130.0 140.0 150.0 170.0 220.0 270.0	Plume-Average (meters) above stack 0.000 1.52 3.05 4.45 0.4.57 1.52 1.52 1.52 1.52 1.52 1.52 1.52 1.52	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.730 9.228 11.667 14.105 16.543 18.982 2.1.420 2.6.297 3.1.774 3.6.051 40.927	#N/A Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 4.64 3.26 3.10 2.61 2.34 4.64 1.65 1.47 1.41	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 297.49 287.78 287.78 287.78 287.78 287.78 289.99 280.99 279.56 279.23 279.23 279.65 279.23 279.65 278.85 27			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above grouns Stack. Rel. Ht = 75.0. 80.0 85.0 Top of jet = 89.0 90.0 100	Plume-Average (meters) above stack 0.000 1.522 3.3.05 4.45 0.4.57 0.7.62 0.10.67 1.1.52 0.13.72 0.13.72 0.13.72 0.13.72 0.13.72 0.13.72 0.13.74 0.25.91 0.25.91 0.25.91 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.95 0.25.9	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 11.6543 18.982 21.420 26.297 31.174 36.051 40.927 45.804	#NVA Velocities sta Single Stk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.34 6.20 2.34 6.3.26 3.10 2.61 2.34 1.92 1.92 1.92 1.92 1.83 1.76 1.64 1.65 1.65 1.47 1.41	feet arting at er Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 296.37 292.49 289.77 287.78 282.84 280.99 280.08 279.23 279.01 278.85 278.85 278.85 278.85 278.45 278.55 27			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 90.0 100	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 9.4.57 7.62 9.10.67 11.52 9.13.72 9.16.76 9.22.66 9.22.66 9.22.69 9.22.69 9.22.69 9.22.69 9.25.94 9.22.66 9.44.20 9.5.94 9.25.94 9.120.40 9.135.64 9.166.12 9.166.62 9.267.06 9.227.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06 9.277.06	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 50.681	#NVA Velocities sta Single Stk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.772 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.36 1.32	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 292.44 289.77 282.84 289.77 282.84 289.28 280.08 279.56 279.53 278.45 278.55 278.45 278.45 278.39 278.45 278.35 278.45 278.35 278.45 278.35 278.45 278.35 278.			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
Able of Plume Top-Hat Diameters (2a) and Height (feet above groum Stack. Rel. Ht = 75.0 80.0 85.0 70p of jet = 89.0 90.0 100.0	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.152 1.52 1.52 1.52 0.152 0.152 0.152 0.2289 0.2289 0.2289 0.2289 0.2899 0.2899 0.2899 0.2899 0.2899 0.2899 0.10516 0.227.08 0.257.56 0.227.08 0.257.56 0.227.08 0.257.56 0.288.00 0.227.08 0.257.56 0.227.08 0.227.08 0.257.56 0.227.08 0.228.04 0.227.08 0.228.04 0.227.08 0.228.04 0.227.08 0.228.04 0.227.08 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.228.04 0.227.080 0.228.04 0.228.04 0.239.0400000000000000000000000000000000000	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 55.558	#NVA Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 2.183 1.76 1.65 1.47 1.41 1.32 2.128	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 296.37 298.77 287.78 289.77 287.78 289.28 289.08 279.56 279.53 278.65 278.55 278.65 278.55 278.65 278.55			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
Able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 90.0 10	Plume-Average (meters) above stack 0.000 1.52 3.3.55 4.4.54 0.1.52 0.1.5	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 50.681 15.558 60.435	#NVA Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 4.216 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.36 1.32 1.28	feet arting at er Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 292.49 287.78 278.55 278.55 278.35 278.35 278.35 278.32 278.27 27			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9,7 11 1 5 foot Inter at Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1/2</sup> / a 10 foot Inter m <sup>2</sup> (a <sup>2</sup> γλ <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75. 80. 500000000000000000000000000000000	Plume-Average (meters) above stack 0.000 1.52 3.3.05 4.45 0.4.57 7.62 0.10.67 1.1.52 0.13.72 0.13.72 0.13.72 0.13.72 0.13.74 0.22.86 0.25.91 0.22.86 0.25.91 0.22.86 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.94 0.25.95 0.28.96 0.25.95 0.28.94 0.25.95 0.25.95 0.28.94 0.25.95 0.25.95 0.25.95 0.25.95 0.25.95 0.25.95 0.25.95 0.25.95 0.25.95 0.27.95 0	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 55.558 60.435 65.311	#NVA Velocities sta Single Stk VertVel(m/s) 31.20 25.86 20.52 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.36 1.32 1.28	feet Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 292.44 280.97 282.84 280.99 280.08 279.23 279.01 278.45 278.65 278.53 278.45 278.32 278.26			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
Able of Plume Top-Hat Diameters (2a) and Height (feet above groum Stack. Rel. Ht = 75.0 80.0 85.0 70p of jet = 89.0 90.0 100.0 1100.0 5pillane 5.3 m/s Height = 112.6 120.0 130.0 140.0 150.0 170.0 220.0 27	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.45 0.152 1.52 0.152 0.152 0.152 0.152 0.152 0.152 0.152 0.228 0.442 0.155 0.289 0.289 0.289 0.289 0.289 0.289 0.152 0.289 0.152 0.289 0.152 0.289 0.152 0.289 0.152 0.289 0.152 0.289 0.152 0.289 0.152 0.257.56 0.227.08 0.257.56 0.227.08 0.257.56 0.228,04 0.318,52 0.339,00 0.379,44 0.318,52 0.379,44 0.319,52 0.379,444 0.379,444,440,444,444,440,444,44,440,444,44,440,444,44,440,444,44,440,444,44,440	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 1.933 1.425 1.562 1.933 2.401 2.888 3.376 3.864 4.351 6.730 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 55.558 60.435 55.558 66.311 70.188	#NVA Velocities sta Single Stk VertVel(m/s) 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.32 2.128 1.28 1.28 1.28 1.28 1.28 1.28 1.	feet Plume Temp(K) 465.222 361.34 327.69 322.07 311.42 302.17 292.44 289.77 287.78 288.44 289.97 289.28 280.08 279.63 278.05 278.55 278.65 278.55 278.55 278.55 278.39 278.35 278.35 278.35 278.27 278.26 278.27 278.25 278.27 278.25			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack. Rel. Ht = 75.0 80.0 85.0 Top of jet = 89.0 90.0 100.	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 0.4.57 1.52 1.52 1.52 1.52 1.52 0.10.67 1.152 0.13.72 0.16.76 0.13.72 0.13.72 0.16.76 0.22.89 0.23.89 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.23.99 0.25.99 0	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.804 55.588 60.435 65.311 70.188 75.065	#NVA Velocities sta SingleSta VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 2.183 3.1.76 1.64 1.55 5.1.47 1.41 1.36 1.32 1.28 1.24 1.21 1.28 1.28 1.28 1.24 1.21 1.28 1.28 1.28 1.28 1.28 1.28 1.28	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 296.37 296.37 297.49 280.77 287.78 287.78 287.78 287.78 289.77 287.78 289.77 287.78 289.78 289.78 278.53 278.65 278.53 278.45 278.53 278.45 278.26 278.27 278.26 278.26 278.27 278.26			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 <b>5 foot Inter</b> 8/FK to Top of Jet 5/50-52,7 <sup>2</sup> ) <sup>1/0</sup> / a <b>10 foot Inter</b> (a <sup>2</sup> /λ <sup>2</sup> ))) <b>Max&lt;5.30</b> <b>50 foot Inter</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack, Rel, H = 75.0 80.0 90.0 100.	Plume-Average (meters) above stack 0.000 1.52 3.3.05 4.45 0.4.57 10.67 11.52 0.13.74 0.13.64 0.120.40 0.13.64 0.14.64 0.14.64	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 18.982 2.1.420 2.6.297 31.174 36.051 40.927 45.804 55.558 60.435 65.311 70.188 75.065 79.942	#NVA Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.69 3.72 3.46 3.26 3.10 2.61 2.34 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.36 1.32 1.28 1.24 1.21 1.18 1.13	feet Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 292.44 280.99 280.08 279.23 279.01 278.85			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above groums Stack. Rel. H = 75.0 80.0 85.0 Top of jet = 89.0 90.0 100.0	Plume-Average (meters) above stack 0.000 1.52 3.3.05 4.45 0.4.57 10.67 11.52 0.13.74 0.13.64 0.120.40 0.13.64 0.14.64 0.14.64	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 11.667 14.105 16.543 18.982 2.1.420 2.6.297 31.174 36.051 40.927 45.804 55.558 60.435 65.311 70.188 75.065 79.942	#NVA Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 5.28 4.64 4.69 3.72 3.46 3.26 3.10 2.61 2.34 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.36 1.32 1.28 1.24 1.21 1.18 1.13	feet Plume Temp(K) 465.22 361.34 322.07 311.42 302.17 292.44 280.99 280.08 279.23 279.01 278.85			es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma}$ =(( $Ve_{3})_{a}^{a}$ +0.12 $F_{a}$ (( $z$ -z, $)^{2}$ -(6.2 a = 0.16( $z$ -z,)	9.7 11. 11 81-Ht to Top of Jet (5D-z,) <sup>2</sup> ) <sup>1,0</sup> / a <b>10 foot Inter</b>
able of Plume Top-Hat Diameters (2a) and Height (feet above ground Stack, Rel, H = 75.0 80.0 90.0 100.	Plume-Average (meters) above stack 0.00 1.52 3.05 4.45 7.7.62 10.67 11.52 13.77 16.76 2.13.77 16.76 2.2.86 0.22.86 0.22.89 0.22.89 0.22.89 0.22.89 0.28.90 0.29.90 0.2	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 45.864 50.681 55.558 66.311 70.188 75.065 65.311	#NVA Velocities sta Single Stk VertVel(m/s) 31.20 25.86 20.52 5.28 4.64 4.09 3.773 5.62 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.64 1.55 1.47 1.41 1.32 1.28 1.28 1.24 1.13 1.11	feet Plume Temp(K) 465.22 361.34 327.69 322.07 311.42 302.17 292.49 289.07 289.77 282.84 289.77 282.84 289.97 282.84 289.08 279.56 279.53 278.45 278.55 278.45 278.32 278.29 278 278.29 278.29 278 278 278 278 278 278 278 278 278 278			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 11. 11. 5 foot Interv Al-Ht to Top of Jet 5(D-2,) <sup>2</sup> ) <sup>1,4</sup> / a 10 foot Interv m <sup>2</sup> ( <sup>2</sup> <sup>4</sup> <sup>2</sup> <sup>3</sup> ))) Max<5.30
able of Plume Top-Hat Diameters (2a) and Height (feet above groum: Stack.Rel.Ht = 75.0 000 000 000 000 000 000 000 000 000	Plume-Average (meters) above stack 0.000 1.52 3.3.05 4.45 4.57 1.52 1.52 1.52 1.52 1.52 1.52 1.52 1.52	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.450 0.938 1.425 1.562 1.913 2.401 2.888 3.376 3.864 4.351 6.790 9.228 11.667 14.105 16.543 18.982 21.420 26.297 31.174 36.051 40.927 41.36.558 60.435 55.558 60.435 65.311 70.188 75.065 79.942 84.819 89.695	#N/A Velocities st: SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.93 7.73 5.62 4.64 4.09 3.72 3.46 3.26 3.10 2.61 2.34 2.16 2.02 1.92 1.83 1.76 1.65 1.47 1.41 1.36 1.32 1.28 1.24 1.24 1.21 1.18 1.15 1.15 1.13 1.11 1.09	feet Plume Temp(K) 465.222 361.34 327.69 322.07 311.42 302.17 296.47 302.17 296.47 287.78 288.47 289.77 287.78 282.84 289.97 287.78 282.84 279.56 279.55 278.45 278.45 278.45 278.45 278.39 278.27 278.27 278.27 278.27 278.27 278.22 278.22 278.24 278.23 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.25 278.24 278.25 278.25 278.24 278.25			is the real solution $x = z - zv = $ or $z(m/above stack) = $ z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{pluma} = (Va)_a^3+0.12F_a((z-z_a)^2-(6.2a))$	9.7 11. 1 5 foot Intern al-Ht to Top of Jet 50-52,7 <sup>2</sup> ) <sup>1,6</sup> / a 10 foot Intern m <sup>2</sup> (a <sup>2</sup> /k <sup>2</sup> ))) Max<5.30

NOAA Sources: culmatography of the United States No.81 Monthly Station Normals of Temperatures, Precipitation, and Heating and Cooling Degree Days, 1971-2000 California" and Climatography of the United States No. 20 "Monthly Station Climate Summaries, 1971-2000 California"



	"Aviation Sa	fety and Buo	yant Plumes	," Peter Be	st, et. al.			
	"The Evaluat	ion of Maxin	num Updraft	Speeds for	Calm Cond	litions at V	arious Heights in the Plume	9
		from a Gas-	Turbine Pow	er Station a	at Oakey, Q	ueensland,	, Australia," Dr. K.T. Spilla	ne
nbient Conditions:					Constants:	Assume ne	eutral conditions (d0/dz=0 or	θ <sub>a</sub> =θ <sub>e</sub> )
Ambient Potential Temp θ <sub>a</sub>	302.21	Kelvins	84.3	°F		0.3048	meters/feet	
ume Exit Conditions:					Gravity g	9.81	m/s <sup>2</sup>	
Maximum Stack Height hs	22.86	meters	75	feet-inches	λ	1.11		
Stack Diameter D	_	meters	28	inches	λο	~1.0		
Stack Velocity Vexit	31.20		102.37		Ū			
Volumetric Flow		cu.m/sec		ACFM	πV <sub>exit</sub> D <sup>2</sup> /4			Sect.2/¶1
Stack Potential Temp 0 <sub>s</sub>		Kelvins	912		IIV exitD /4			3601.2/ [[1
Initial Stack Buoyancy Flux Fo	23.3543		912	F	-> -> -> -> -> -> -> -> -> -> -> -> -> -	10 14 - 14		0
							ol.Flow(g/ $\pi$ )(1- $\theta_a/\theta_s$ )	Sect.2/¶1
Plume Buoyancy Flux F	N/A	m <sup>4</sup> /s <sup>3</sup>					,θ <sub>p</sub> at plume height (see belo	w)
No.of Stacks N	1			1.000	Multiple Sta	ack Multipli	cation Factor (N <sup>0.25</sup> )	
nditions at End (Top) of Jet Phase:								
Height above Stack z <sub>jet</sub>	4.445	meters*	14.6	feet*	$z_{jet} = 6.25D$	, meters*=	meters above stack top	Sect.3/¶1
Height above Ground z <sub>jet</sub> +hs	27.305	meters	89.6	feet				
Vertical Velocity V <sub>jet</sub>	15.600	m/s	51.18	ft/sec	$V_{jet} = 0.5V_{e}$	$e_{xit} = V_{exit}/2$		
Plume Top-Hat Diameter 2a <sub>jet</sub>	1.422	meters	4.7	feet	$2a_{jet} = 2D$		Conservation of momentum	
llane Methodology - Analytical Solutions	for Calm Con	ditions for P	lume Height	s above Je	Phase			
Single Plume-averaged Vertical Velocity			-			nivon by o	quations below:	
				er where r				Cast O/Ear C
Plume Top-Hat Radius a		olutions in T					crease with height	Sect.2/Eq.6
Virtual Source Height z <sub>v</sub>		meters*		feet*	6.25D[1-(θ <sub>e</sub>	/θ <sub>s</sub> ) <sup>1/2</sup> ], mete	ers*=meters above stack top	Sect.2/Eq.6
Height above Ground zv+hs	24.506	meters	80.4	feet			where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	0.6297
Vertical Velocity V	S	olutions in T	able Below		${(Va)_0}^3 + 0.$	12F <sub>o</sub> [ (z-z.	$(0, 25D-z_v)^2]^{(1/3)} / a$	Sect.2.1(6)
Product (Va)	6.987				V <sub>exit</sub> D/2(θ <sub>e</sub> /			x-7
	0.007	,0			- CAIL D, 2(08/	3/		
Solvo for plume everage deserves	oltry at he ! - ! -		faat				i i i i i i i i i i i i i i i i i i i	
Solve for plume-averaged vertical velo		200.0			meters abo	ve ground (	z +n <sub>s</sub> )	
Gives the following Height above Stack z'		meters*	125.0					
Plume Top-Hat Diameter 2a		meters	38.3	feet	2a'=2*0.16(			Sect.2/Eq.6
Vertical Velocity V	2.731	m/s	8.96	ft/sec	V={(Va) <sub>o</sub> <sup>3</sup> +	0.12F <sub>o</sub> [(z-z	v)2-(6.25D-zv)2])(1/3)/(2a1/2)	Sect.2/Eq.6
Solve for Height of CASC critical vertical	velocity V <sub>crit</sub>	5.30	m/s plume-a	veraged v	ertical velo	city	Critical VV	> Top of Jet (Spil
Find Height above Stack z <sub>crit</sub>		meters	37.9	-			ultaneously in both eqs. (i.e.,	
						,		,
Height above Ground z <sub>crit</sub> +hs	34.423	meters	112.9	feet	for V=4.3 m	•	e cubic equation ax <sup>3</sup> +bx <sup>2</sup> +cx	
							and b=-(0.12F <sub>o</sub> )/(4.3 <sup>3</sup> 0.16 <sup>3</sup> )=	-4
Interpolated Height of critical vertical v	elocity in Jet	Phase:			and d	l=[0.12F <sub>o</sub> (6	.25D-z <sub>v</sub> ) <sup>2</sup> -(Va) <sub>o</sub> <sup>3</sup> ]/(4.3 <sup>3</sup> 0.16 <sup>3</sup> )=	-5
Find Height above Stack z <sub>crit</sub>	#N/A	meters	#N/A	feet			http://	/www.1728.org/cubi
Height above Ground zcrit+hs	#N/A	motors					a the seal a shellow of a second	9
		meters	#N/A	feet		give	es the real solution x = z-zv =	
		meters	#N/A	feet		give		
		meters	#N/A	feet		give	or z(m/above stack) =	1
hie of Plume Ton-Hat Diamotore (2c) and 1	Plume-Avora				d of ict pb			1
ble of Plume Top-Hat Diameters (2a) and F		ed Vertical	Velocities sta	arting at er	d of jet pha		or z(m/above stack) =	1
Height (feet)	(meters)	ed Vertical Plume	Velocities sta SingleStk	arting at er Plume	d of jet pha		or z(m/above stack) =	1
Height (feet) above ground	(meters) above stack	ed Vertical Plume Radius(m)	Velocities sta SingleStk VertVel(m/s)	arting at er Plume	d of jet pha		or z(m/above stack) =	1
Height (feet)	(meters)	ed Vertical Plume	Velocities sta SingleStk	arting at er Plume	d of jet pha		or z(m/above stack) =	1
Height (feet) above ground	(meters) above stack	ed Vertical Plume Radius(m)	Velocities sta SingleStk VertVel(m/s)	arting at er Plume	d of jet pha		or z(m/above stack) =	1
Height (feet) above ground <u>Stack.Rel.Ht = 75.0</u>	(meters) above stack <i>0.00</i>	ed Vertical Plume Radius(m) 0.356	Velocities sta SingleStk VertVel(m/s) 31.20	arting at er Plume	d of jet pha		or z(m/above stack) = z(ft/above ground) =	5 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht</i> = 75.0 80.0 85.0	(meters) above stack 0.00 1.52 3.05	ed Vertical Plume Radius(m) 0.356 0.477 0.599	Velocities sta SingleStk VertVel(m/s) 25.86 20.52	arting at er Plume	d of jet ph		or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R	5 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht = 75.0</i> 80.0 85.0 <b>Top of jet = 89.6</b>	(meters) above stack 0.00 1.52 3.05 4.45	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711	Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60	arting at er Plume Temp(K)			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations:	1 5 foot Inte el.Hit to Top of Jet
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468	Velocities sta SingleStk VertVel(m/s) 25.86 20.52 15.60 14.95	arting at er Plume Temp(K) 480.36			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: V <sub>pume</sub> =((Va) <sub>o</sub> <sup>3</sup> 40.12F <sub>o</sub> ((z-z,) <sup>2</sup> -(6.2	5 foot Inte el.Ht to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>10</sup> / a
Height (feet) above ground <i>Stack.Rel.Ht = 75.0</i> 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956	Velocities sta SingleStk VertVel(m/s) 25.86 20.52 15.60 14.95 7.83	Arting at er Plume Temp(K) 480.36 383.84			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5(۲-۲.,) <sup>2</sup> )) <sup>10</sup> / a 10 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht = 75.0</i> 85.0 70p of jet = 89.6 90.0 100.0 110.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67	ed Vertical <sup>1</sup> Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444	Velocities sta SingleStk VertVel(m/s) 25.86 20.52 15.60 14.95 7.83 5.67	arting at er Plume Temp(K) 480.36 383.84 351.66			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: V <sub>pume</sub> =((Va) <sub>o</sub> <sup>3</sup> 40.12F <sub>o</sub> ((z-z,) <sup>2</sup> -(6.2	1 5 foot Inte el.Ht to Top of Jet 5(۲-۲.,) <sup>2</sup> )) <sup>10</sup> / a 10 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht = 75.0</i> 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956	Velocities sta SingleStk VertVel(m/s) 25.86 20.52 15.60 14.95 7.83	Arting at er Plume Temp(K) 480.36 383.84			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z,) <sup>2</sup> ) <sup>10</sup> / a 10 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht = 75.0</i> 85.0 70p of jet = 89.6 90.0 100.0 110.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67	ed Vertical <sup>1</sup> Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444	Velocities sta SingleStk VertVel(m/s) 25.86 20.52 15.60 14.95 7.83 5.67	arting at er Plume Temp(K) 480.36 383.84 351.66			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z,) <sup>2</sup> ) <sup>10</sup> / a 10 foot Inte
Height (feet) above ground <i>Stack.Rel.Ht =</i> 75.0 85.0 70p of jet = 89.6 90.0 100.0 110.0 Spillane 5.3 m/s Height = 112.9	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67 11.56	ed Vertical <sup>1</sup> Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587	Velocities st SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.95 7.83 5.67 5.30	480.36 383.84 351.66 345.97			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5(۲-۲.,) <sup>2</sup> )) <sup>10</sup> / a 10 foot Inte
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0 110.0 <b>Spillane 5.3 m/s Height = 112.9</b> 120.0 130.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67 11.56 13.72 16.76	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419	Velocities str SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.95 7.83 5.67 5.30 4.66 4.08	480.36 383.84 351.66 345.97 335.83 326.68			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte eLHt to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> <sup>(2<sup>2</sup>*Å<sup>2</sup>)))</sup>
Height (feet) above ground Stack.Rel.Ht = 75.0 85.0 70p of jet = 89.6 90.0 110.0 5pillane 5.3 m/s Height = 112.9 120.0 130.0 140.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67 11.56 13.72 16.76	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907	Velocities sta SingleStk VertVel(m/s) 31.20 25.86 20.52 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70	arting at er Plume Temp(K) 480.36 383.84 351.66 345.97 335.83 326.68 320.89			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}((z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte eLHt to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> <sup>(2<sup>2</sup>*Å<sup>2</sup>)))</sup>
Height (feet) above ground Stack.Rel.Ht = 75.0 85.0 70p of jet = 88.6 90.0 110.0 5pillane 5.3 m/s Height = 112.9 120.0 130.0 140.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67 11.56 13.72 16.76 19.81 22.86	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.907 3.394	Velocities stat Single Stik VertVel(m/s) 31.202 25.86 20.525 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70 3.43	480.36 383.84 351.66 345.97 335.83 326.68 320.89 316.98			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte eLHt to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> <sup>(2<sup>2</sup>*Å<sup>2</sup>)))</sup>
Height (feet) above ground Stack.Rel.Ht = 75.0 85.0 70p of jet = 89.6 90.0 100.0 110.0 Spillane 5.3 m/s Height = 112.9 120.0 130.0 140.0 150.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91	ed Vertical ' Plume Radius(m) 0.356 0.477 0.599 0.771 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.344 3.882	Velocities stat Single Stk VertVel(m/s) 25.86 20.52 15.60 14.95 7.83 5.67 <b>5.30</b> 4.66 4.08 3.70 3.70 3.43	480.36 383.84 351.66 345.97 335.83 320.89 316.98 314.21			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte eLHt to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> <sup>1</sup> <sup>2<sup>2</sup>*<sup>2</sup>)))</sup>
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0 110.0 <b>Spillane 5.3 m/s Height = 112.9</b> 120.0 130.0 140.0 150.0 160.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96	ed Vertical * Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370	Velocities stat Single Stk VertVel(m/s) 31.20 25.868 20.52 15.60 14.95 7.833 5.67 <b>5.30</b> 4.66 4.68 3.70 3.43 3.23 3.07	480.36 383.84 351.66 345.97 335.83 320.88 320.89 316.98 314.21 312.18			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 50.0 70p of jet = 89.6 90.0 100.0 100.0 5pillane 5.3 m/s Height = 112.9 120.0 130.0 140.0 140.0 140.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96	ed Vertical ' Plume Radius(m) 0.356 0.477 0.599 0.771 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.344 3.882	Velocities stat Single Stk VertVel(m/s) 31.20 25.868 20.52 15.60 14.95 7.833 5.67 <b>5.30</b> 4.66 4.68 3.70 3.43 3.23 3.07	480.36 383.84 351.66 345.97 335.83 320.89 316.98 314.21 312.18			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0 110.0 <b>Spillane 5.3 m/s Height = 112.9</b> 120.0 130.0 140.0 150.0 160.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96	ed Vertical * Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370	Velocities stat Single Stk VertVel(m/s) 31.20 25.86 20.525 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70 3.43 3.70 3.43 3.23 3.07 2.58	480.36 383.84 351.66 345.97 335.83 326.68 320.89 316.98 314.21 312.18 307.10			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
Height (feet) above ground Stack.Rel.Ht = 75.0 85.0 70p of jet = 89.6 90.0 110.0 5pillane 5.3 m/s Height = 112.9 120.0 130.0 140.0 150.0 160.0 170.0 220.0	(meters) above stack 0.00 1.52 3.05 4.45 4.57 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 22.86 44.20 59.44	ed Vertical Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370 6.808	Velocities stat Single Stik VertVel(m/s) 31.20 20.55.86 20.55.7 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70 3.43 3.22 3.07 2.585 2.30	480.36 383.84 351.66 345.97 335.83 320.89 316.98 314.21 312.18 307.10 305.17			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 70p of jet = 89.6 100.0 110.0 Spillane 5.3 m/s Height = 112.9 120.0 130.0 140.0 150.0 177.0 220.0 270.0 320.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96 44.20 59.44	ed Vertical ' Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370 6.808 9.246 11.685	Velocities stat SingleStk VertVel(m/s) 31.20 25.868 20.52 15.60 14.95 7.83 5.67 5.30 4.666 4.08 3.70 3.43 3.23 3.07 2.58 2.30 2.12	480.36 383.84 351.66 345.97 335.83 326.68 320.89 316.21 312.18 307.10 305.17 304.22			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
Height (feet) above ground Stack.Rel. Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 100.0 110.0 <b>Spillane 5.3 m/s Height = 112.9</b> 120.0 130.0 140.0 150.0 170.0 220.0 270.0 320.0 370.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96 44.20 59.44 74.68	ed Vertical ************************************	Velocities stat Single Stk VertVel(m/s) 31.20 25.666 20.525 15.60 14.95 7.833 5.67 5.30 4.66 4.60 3.70 3.43 3.23 3.07 2.58 2.30 2.12 1.99	480.36 383.84 351.66 345.97 335.83 320.89 316.98 314.21 312.18 307.10 305.17 304.22 303.68			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot Inte el.Ht to Top of Jet 5D-z., <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot Inte m <sup>2</sup> (a <sup>2+</sup> λ <sup>2</sup> ))) Max <5.3
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Height (feet) above ground Stack.Rel.Ht = 75.0 80.0 85.0 <b>Top of jet = 89.6</b> 90.0 110.0 <b>Spillane 5.3 m/s Height = 112.9</b> 120.0 130.0 140.0 150.0 220.0 270.0 370.0 370.0 420.0 370.0 420.0 370.0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96 44.20 59.44 74.68 89.92 105.16 120.40 135.64	ed Vertical * Plume Radius(m) 0.356 0.477 0.599 0.711 0.468 0.956 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370 6.808 9.246 11.685 14.123 16.562 19.000 21.438	Velocities stat Single Stk VertVel(m/s) 31.20 25.868 20.52 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70 3.43 3.22 3.07 2.58 2.30 2.11 9.99 1.88 1.80 1.73	480.36 383.84 351.66 345.97 335.83 320.89 316.98 314.21 312.18 307.10 305.17 304.22 303.68 30.34 303.34 303.11 302.95			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	1 5 foot inte el.Ht to Top of Jet 5D-z.,) <sup>2</sup> ]) <sup>1/2</sup> / a 10 foot inte m <sup>2</sup> <sup>(2+λ<sup>2</sup>)</sup> )) Max < 5.3 50 foot inte
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Height (feet) above ground Stack. Rel. Ht = 75.0 80.0 50.0 70p of jet = 89.6 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	(meters) above stack 0.00 1.52 3.05 4.45 7.62 10.67 11.56 13.72 16.76 19.81 22.86 25.91 28.96 44.20 59.44 74.68 89.92 105.16 120.40 135.64 120.40 135.64 166.12 196.60 227.08 257.56 228.04 318.52 349.00 379.48 409.96 440.44 470.92 501.40 531.88 562.36	ed Vertical ' Plume Radius(m) 0.356 0.477 0.599 0.711 0.466 1.444 1.587 1.931 2.419 2.907 3.394 3.882 4.370 6.808 9.246 11.685 14.123 16.562 19.000 21.438 26.315 31.192 36.069 40.946 45.822 50.699 55.576 60.453 36.530 70.206 75.083 70.206 84.837	Velocities stat Single Stk VertVel(m/s) 31.20 25.686 20.52 15.60 14.95 7.83 5.67 5.30 4.66 4.08 3.70 3.43 3.23 3.07 2.58 2.30 2.12 1.99 1.88 1.80 1.73 1.61 1.52 1.45 1.33 1.34 1.52 1.45 1.33 1.34 1.34 1.32 1.25 1.45 1.33 1.34 1.34 1.34 1.33 1.34 1.34 1.34	480.36 383.84 351.66 348.351.66 346.97 335.83 326.68 320.89 314.21 312.18 307.10 305.17 304.22 303.68 303.34 303.11 302.95 302.73 302.60 303.24 302.42 302.49 302.42 302.43 302.42 302.43 302.42 302.28 302.28			or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack R Spillane Equations: $V_{plume}=((Va)_{n}^{-k}0.12F_{n}](z-z_{n})^{2}-(6.2$ $a = 0.16(z-z_{n})$	5 foot Inte el.Ht to Top of Jet 5(D-z.,) <sup>2</sup> ) <sup>10</sup> / a 10 foot Inte

NUJAA Sources: climatography of the United States No.81 "Monthly Station Normals of Temperatures, Precipitation, and Heating and Cooling Degree Days, 1971-2000 California" and Climatography of the United States No. 20 "Monthly Station Climate Summaries, 1971-2000 California"



INGLE/Approximated Plume Average Vertic ased on 48 chillers w/ 20 cells/chiller. Calc'	"Aviation Sa		-					
ff.diam for each chiller with each cell at 34" ID		-	-			litions at V	arious Heights in the Plume	•
220,110 ACFM total for each chiller).				-			, Australia," Dr. K.T. Spillar	
mbient Conditions:					Constants:	Assume ne	eutral conditions (dθ/dz=0 or θ	θ <sub>a</sub> =θ <sub>e</sub> )
Ambient Potential Temp $\theta_a$	278.15	Kelvins	41.0	°F		0.3048	meters/feet	
lume Exit Conditions:					Gravity g	9.81	m/s <sup>2</sup>	
Stack Height hs	23.81	meters	78 2/12	feet-inches	λ	1.11		
Individual Chiller Stack Diameter D	3.8621	meters	152.1	inches	λο	~1.0		
Stack Velocity V <sub>exit</sub>	8.06	m/s	26.45	ft/sec	4Vol/(60πD	<sup>2</sup> )		
Individual Chiller Volumetric Flow	94.44	cu.m/sec	200,110	ACFM	$\pi V_{exit} D^2/4$			Sect.2/¶1
Stack Potential Temp $\theta_s$		Kelvins	61.0	°F				
Initial Stack Buoyancy Flux Fo	11.3279		20.0	ΔT(°F)	-		ol.Flow(g/π)(1-θ <sub>a</sub> /θ <sub>s</sub> )	Sect.2/¶1
Plume Buoyancy Flux F		m <sup>4</sup> /s <sup>3</sup>					$\theta_{p}$ at plume height (see below	N)
Number of Chillers n	48			2.632	Multiple Sta	ack Multipli	cation Factor (n <sup>0.25</sup> )	
onditions at End (Top) of Jet Phase:								
Height above Stack z <sub>jet</sub>		meters*		feet*	$z_{jet} = 6.25L$	), meters*=	meters above stack top	Sect.3/¶1
Height above Ground z <sub>jet</sub> +h <sub>s</sub>		meters	157.3			V /2		
Vertical Velocity V <sub>jet</sub>	4.031			ft/sec	$V_{jet} = 0.5V_{e}$	$e_{xit} = V_{exit}/2$		
Plume Top-Hat Diameter 2a <sub>jet</sub>	1.124	meters	25.5	feet	2a <sub>jet</sub> = 2D		Conservation of momentum	
nillana Mathadalamy Analytical Salytiana	ar Calm Can	ditions for D	uma Haight	ahava lai	Dhoos			
pillane Methodology - Analytical Solutions			-			uiven hv e		
Single Plume-averaged Vertical Velocity Plume Top-Hat Radius a		olutions in T	-	si where P			-	Sect.2/Eq.6
Virtual Source Height z <sub>v</sub>		meters*		feet*			crease with height ers*=meters above stack top	Sect.2/Eq.6
Height above Ground z <sub>v</sub> +h <sub>s</sub>		meters		feet	5.20D[1-(0e	, <sub>SS</sub> , ], men	where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	
Vertical Velocity V		olutions in T			$\{(V_a)_{a}^3 \pm 0\}$	12F。[ /⁊-⁊	$(\theta_{a}/\theta_{s})^{2} - (\theta_{e}/\theta_{s})^{2} = (\theta_{e}/\theta_{s})^{2} + (\theta_{$	Sect.2.1(6)
Product (Va) <sub>o</sub>	15.265				$V_{exit}D/2(\theta_e/$		,, (0.200 zv)]; /a	0001.2.1(0)
ingle Chiller Results:	13.203	/3			2 exit D/ ∠(Ue/	- 5/		
Solve for plume-averaged vertical velo	city at height	940.0	feet	286.512	meters abo	ve around (	z'+h。)	
Gives the following Height above Stack z'	262.698		861.9			. <u>a</u> . sana (		
Plume Top-Hat Diameter 2a'		meters	275.3		2a'=2*0.16(	z'-z <sub>v</sub> )		Sect.2/Eq.6
Vertical Velocity V	1.092			ft/sec			v) <sup>2</sup> -(6.25D-zv) <sup>2</sup> ]} <sup>(1/3)</sup> /(2a'/2)	Sect.2/Eq.6
					. (()0 .			
Solve for Height of CASC critical vertical	velocity V <sub>crit</sub>	5.30	m/s plume-a	averaged v	ertical velo	citv	Critical	VV < Top of .
Find Height above Stack z <sub>crit</sub>		meters	#N/A				ultaneously in both eqs. (i.e.,	
Height above Ground z <sub>crit</sub> +h <sub>s</sub>	<b>*</b>	meters	#N/A				ubic equation ax <sup>3</sup> +bx <sup>2</sup> +cx+d=	
						-	and b=-(0.12F <sub>o</sub> )/(V <sub>crit</sub> <sup>3</sup> 0.16 <sup>3</sup> )=	-2.229
Interpolated Height of critical vertical ve	elocity in Jet	Phase:			and d		$(25D-z_v)^2 - (Va)_o^3 / (V_{crit}^3 0.16^3) =$	-4584.
Find Height above Stack z <sub>crit</sub>	16.537	meters	54.3	feet			http://www.17	28.org/cubic.h
Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub>		meters meters	54.3 1 <b>32.4</b>			give	$\frac{http://www.17}{bttp://www.17}$ s the real solution x = z-zv =	
						give	es the real solution x = z-zv =	28.org/cubic.ht 17.38 17.8
						give		17.38
	40.352	meters	132.4	feet	d of jet pha		es the real solution x = z-zv = or z(m/above stack) =	17.38 17.8
Height above Ground $z_{\text{crit}} + h_{\text{s}}$	40.352	meters	132.4	feet arting at en	d of jet pha		es the real solution x = z-zv = or z(m/above stack) =	17.38 17.8
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F	40.352 Iume-Averag (meters)	meters ed Vertical ' Plume	132.4 Velocities sta	feet arting at en Plume	d of jet pha		es the real solution x = z-zv = or z(m/above stack) =	<mark>17.38</mark> 17.8
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet)	40.352 Iume-Averag (meters)	meters ed Vertical ' Plume	132.4 /elocities sta SingleStk	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) =	17.38 17.8
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and P Height (feet) above ground	40.352 Iume-Averag (meters) above stack	meters ed Vertical Plume Radius(m)	132.4 Velocities sta SingleStk VertVel(m/s)	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) =	17.38 17.8
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and P Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1	40.352 Iume-Averag (meters) above stack 0.00	meters ed Vertical <sup>1</sup> Plume Radius(m) 1.931	132.4 Velocities sta SingleStk VertVel(m/s) 8.06	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) =	17.38 17.8 13 20 ft Interval
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 80.0	40.352 Plume-Averag (meters) above stack 0.00 0.57	meters ed Vertical V Plume Radius(m) 1.931 1.977	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs:	17.3 17.3 13 20 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 80.0 100.0	40.352 Plume-Averag (meters) above stack 0.00 0.57 6.67	ed Vertical Plume Radius(m) 1.931 1.977 2.464	/elocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) = z(t/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Re	17.3 17.3 13 20 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht = 78.1</i> 80.0 100.0 120.0	40.352 Iume-Averag (meters) above stack 0.00 0.57 6.67 12.76	meters ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93	feet arting at en Plume Temp(K)	d of jet pha		es the real solution x = z-zv = or z(m/above stack) = z(t/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Re	17.3 17.1 13 13 20 ft Interva I.Ht to Top of Je
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4	40.352 lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54	ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30	feet arting at en Plume Temp(K)	d of jet pha		s the real solution x = z-zv = or z(m/above stack) = z(t/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Re Spillane Equations:	17.3 17.1 13 13 20 ft Interva I.Ht to Top of Je
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0	40.352 lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 <b>16.54</b> 18.86	meters ed Vertical <sup>1</sup> Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440	/elocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91	feet arting at en Plume Temp(K)	d of jet pha		is the real solution $x = z \cdot zv =$ or $z(m/above stack) =$ z(tf/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Re Spillane Equations: $V_{plume}=((Va)_o^3+0.12F_o[(z-z_v)^2-(6.2))^2)$	17.3 17.1 13 20 ft Interval 9.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14	eed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03	feet arting at en Plume Temp(K) 282.49			The real solution $x = z \cdot zv =$ or $z(m/above stack) =$ z(t/above ground) = <b>Jet Phase Eqs:</b> Linearly interpolated from Stack Rd <b>Spillane Equations:</b> $V_{plume} = \{(Va)_n^3 + 0.12F_n\}(z - z_n)^2 \cdot (6.2)$ $a = 0.16(z - z_n)$ $B_p = B_n (1 + (1 - (B_n/B_n))^* (V_{exit}) D^2/(c)$ <b>CEC Staff Equation:</b>	17.3 17. 13 20 ft Interva 9. Ht to Top of Je 5D-z_v) <sup>2</sup> ]) <sup>10</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = <b>78.1</b> 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = <b>132.4</b> 140.0 <b>Top of Single jet = 157.3</b> 160.0	40.352 lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95	ed Vertical ' Plume Radius(m) 1.937 1.937 2.464 2.952 3.254 3.440 3.440 3.462 3.918	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92	feet Plume Temp(K) 282.49 282.49			The real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Ro Spillane Equations: $V_{plume}=(Va)_o^3+0.12F_o[(z-z_v)^2-(6.2)a) = 0.16(z-z_v)$ $\theta_p=\theta_n(1+(1-(\theta_n/\theta_n))^*(Vexit)^2/(4))$	17.3 17.1 13 20 ft Interval 9.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0	40.352 Jume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84	feet Plume Temp(K) 282.49 282.49 282.49 281.49			In the real solution $x = z - zv =$ or $z(m/above stack) =$ z(fr/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Rt Spillane Equations: $V_{plume} = ((Va)_n^2 + 0.12F_e](z-z_n)^2 - (6.2)$ $a = 0.16(z-z_n)$ $\theta_p = \theta_n (1 + (1 - (\theta_n/\theta_n))^* (V_{exit} D^2)/c$ CEC Staff Equation: $V_{mp} = \theta_n^{2/2} V_{sp}$ Brigg's Equation:	17.3 17.3 20 ft Interva al.Ht to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0 200.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15	ed Vertical V Plume Radius(m) 1.931 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84	feet arting at en Plume Temp(K) 282.49 282.49 282.49 282.49 282.49 283.82			s the real solution $x = z - zv =$ or $z(m/above stack) =$ z(t/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Ro Spillane Equations: $V_{plome} = (V(a)_o^3 + 0.12F_o[(z - z_v)^2 - (6.2; a = 0.16(z - z_v)) = 0.9(z - (2, -2)) = 0.16(z - z_v) = 0.9(z - (2, -2)) = 0.16(z - z_v) = 0.9(z - (2, -2)) = 0.16(z - z_v) = 0.9(z - (2, -2)) = 0.16(z - z_v) = 0.9(z - (2, -2)) = 0.16(z - z_v) = 0.16(z - z_v$	17.3 17. 13 20 ft Interva al.Ht to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 140.0 <i>Top of Single jet = 157.3</i> 160.0 220.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24	ed Vertical <sup>1</sup> Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54	feet arting at en Plume Temp(K) 282.49 282.49 281.49 280.82 280.34			In the real solution $x = z - zv =$ or $z(m/above stack) =$ z(fr/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Rt Spillane Equations: $V_{plume} = ((Va)_n^2 + 0.12F_e](z-z_n)^2 - (6.2)$ $a = 0.16(z-z_n)$ $\theta_p = \theta_n (1 + (1 - (\theta_n/\theta_n))^* (V_{exit} D^2)/c$ CEC Staff Equation: $V_{mp} = \theta_n^{2/2} V_{sp}$ Brigg's Equation:	17.3 17. 13 20 ft Interva al.Ht to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 8000 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0 220.0 220.0 220.0	40.352 lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34	ed Vertical	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.24 2.24	feet Plume Temp(K) 282.49 282.49 282.49 283.48 280.82 280.34 280.82 280.34			s the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Rt Spillane Equations: $V_{plume} = (Va)_n^3 + 0.12F_0[(z-z_v)^2 - (6.2)a = 0.16(z-z_v)\theta_p = \theta_n (1 + (1-(\theta_n/\theta_n))^* (V_{exit})D^2/(4CEC Staff Equation:V_{mp} = n^{0.27} V_{sp}Brigg's Equation:V_{Bargu's} = (2/3) \times 1.6^{(5/2)} \times F_{mp}^{(1/2)} \times t$	17.3 17. 13 20 ft Interva al.Ht to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0 220.0 220.0 220.0 220.0 220.0	40.352 lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.53 2.16	feet arting at en Plume Temp(K) 282.49 282.49 281.49 280.82 280.34 279.98 279.71			s the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Rt Spillane Equations: $V_{plume} = (Va)_n^3 + 0.12F_0[(z-z_v)^2 - (6.2)a = 0.16(z-z_v)\theta_p = \theta_n (1 + (1-(\theta_n/\theta_n))^* (V_{exit})D^2/(4CEC Staff Equation:V_{mp} = n^{0.27} V_{sp}Brigg's Equation:V_{Bargu's} = (2/3) \times 1.6^{(5/2)} \times F_{mp}^{(1/2)} \times t$	17.3 17.3 17.3 20  ft Interva $al.Ht to Top of Je 5D-z_{\nu})^{2}]_{1/3} / a4V_{plume} * a^{2} * \lambda^{2}).$
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 200.0 220.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20.0 2	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 45.543 61.53	ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74	feet arting at en Plume Temp(K) 282.49 282.49 283.49 280.32 280.34 279.98 279.98 279.71 279.49 279.32			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20  ft Interva al.Ht to Top of Je $5D-z_{\nu}^{2}$ ]) <sup>1/3</sup> / a $1V_{\text{plume}} * a^{2*}\lambda^{2}$ ).
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 220.0 220.0 220.0 220.0 240.0 260.0 280.0 300.0 350.0 400.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 61.53 67.63	ed Vertical <sup>1</sup> Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.93 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93	feet arting at en Plume Temp(K) 282.49 282.49 283.49 280.32 280.34 279.98 279.98 279.71 279.49 279.32			s the real solution x = z-zv = or z(m/above stack) = z(ft/above ground) = Jet Phase Eqs: Linearly interpolated from Stack Rt Spillane Equations: $V_{plume} = (Va)_n^3 + 0.12F_0[(z-z_v)^2 - (6.2)a = 0.16(z-z_v)\theta_p = \theta_n (1 + (1-(\theta_n/\theta_n))^* (V_{exit})D^2/(4CEC Staff Equation:V_{mp} = n^{0.27} V_{sp}Brigg's Equation:V_{angus} = (2/3) \times 1.6^{(5/2)} \times F_{mp}^{(1/2)} \times t$	17.3 17.3 17.3 20  ft Interva al.Ht to Top of Je $5D-z_{\nu}^{2}$ ]) <sup>1/3</sup> / a $1V_{\text{plume}} * a^{2*}\lambda^{2}$ ).
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht</i> = 78.1 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0 200.0 220.0 240.0 280.0 330.0	40.352 Plume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 61.53 67.63 82.87	ed Vertical	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74	feet Plume Temp(K) 282.49 282.49 282.49 280.42 280.82 280.82 279.98 279.91 279.49 279.49 279.49 279.49 279.49			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20  ft Interva al.Ht to Top of Je $5D-z_{\nu}^{2}$ ]) <sup>1/3</sup> / a $1V_{\text{plume}} * a^{2*}\lambda^{2}$ ).
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 140.0 <i>Top of Single jet = 157.3</i> 160.0 220.0 220.0 220.0 220.0 220.0 240.0 250.0 280.0 300.0 350.0 350.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 61.53 67.63 82.87 98.11 113.35 128.59	ed Vertical <sup>1</sup> Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43	feet arting at en Plume Temp(K) 282.49 281.49 280.82 280.34 279.98 279.71 279.98 279.91 279.92 279.01 278.28 278.68			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 12 <b>20 ft Interva</b> al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> )
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 180.0 200.0 240.0 240.0 240.0 240.0 350.0 350.0 355.0	40.352 Plume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 67.63 82.87 98.11 113.35 128.59 143.83	ed Vertical	132.4 /elocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37	feet arting at en Plume Temp(K) 282.49 282.49 283.49 280.32 280.34 279.98 279.98 279.93 279.01 278.82 279.01 278.82 278.68 278.58			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 12 <b>20 ft Interva</b> al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> )
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 80.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 220.0 220.0 220.0 220.0 240.0 280.0 300.0 280.0 300.0 550.0 650.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 49.34 49.34 49.34 49.34 49.34 49.34 49.34 49.34 49.34 15.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07	ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376	132.4 Velocities sta Single Stk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31	feet Plume Temp(K) 282.49 282.49 283.49 280.82 280.34 279.94 279.49 279.49 279.49 279.49 279.49 279.68 278.68 278.68 278.68			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 12 <b>20 ft Interva</b> al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> )
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack. Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 240.0 220.0 240.0 280.0 280.0 300.0 350.0 400.0 650.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 455.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31	ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.93 4.91 4.03 3.92 3.26 2.84 2.54 2.54 2.54 2.54 2.54 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.34 279.96 279.71 279.49 279.32 279.60 279.82 278.68 278.58 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 12 <b>20 ft Interva</b> al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> )
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 1400.0 <i>Top of Single jet = 157.3</i> 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 240.0 250.0 250.0 250.0 250.0 260.0 250.0 26	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 37.15 37.15 43.24 49.34 55.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55	ed Vertical 1 Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252	132.4 /elocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.93 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23	feet arting at en Plume Temp(K) 282.49 281.49 280.82 280.34 279.98 279.71 279.49 279.92 279.01 279.49 279.32 279.01 278.48 278.51 278.56 278.51 278.68 278.51 278.68 278.51 278.64 278.51 278.42			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a $W_{plume} * a^{2} * λ^{2})$ ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 800 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 140.0 <i>Top of Single jet</i> = 157.3 160.0 200.0 200.0 240.0 260.0 240.0 260.0 300.0 355.0 650.0 550.0 600.0 650.0 770.0 800.0	40.352 "lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03	ed Vertical	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.23 1.16	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.32 280.34 279.98 279.98 279.93 279.93 279.93 279.93 279.84 278.85 278.46 278.51 278.46 278.46 278.46 278.51 278.46 278.46 278.51 278.46 278.46 278.51 278.46 278.46 278.46 278.51 278.46 278.46 278.46 278.51 278.46 278.46 278.46 278.46 278.46 278.46 278.46 278.46 278.46 278.46 278.82 278.46 278.82 278.82 278.46 278.82 278.46 278.82 278.46 278.82 278.83 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a $W_{plume} * a^{2} * λ^{2})$ ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 230.0 350.0 350.0 400.0 5500.0 5500.0 5500.0 600.0 680.0 800.0 800.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.35 49.32 49.35 49.32 49.35 49.35 49.35 49.35 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51	ed Vertical	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11	feet arting at en Plume Temp(K) 282.49 282.49 282.49 281.49 280.82 278.48 279.71 279.49 279.932 279.61 278.68 278.82 278.83 278.94 278.83 278.83 278.83 2			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a $W_{plume} * a^{2} * λ^{2})$ ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack. Rel. Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 20	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 455.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 280.91 280.99	ed Vertical V Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 3.92 3.26 2.84 2.54 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.27 1.23 1.16 1.11 1.07	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.82 280.34 279.98 279.71 279.49 279.49 279.42 278.68 278.58 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a $W_{plume} * a^{2} * λ^{2})$ ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 880.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 255.0 600.0 655.0 655.0 665.0 600.0 655.0 600.0 655.0 600.0 1000.0 1000.0	40.352 "Jume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 37.15 43.24 49.34 55.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47	ed Vertical V Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 6.27.814 30.252 35.129 40.006 44.883 49.760	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 6.95 5.93 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.107 1.03	feet arting at en Plume Temp(K) 282.49 281.49 280.82 280.34 279.98 279.71 279.49 279.92 279.68 278.51 278.68 278.52 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 12 <b>20 ft Interva</b> al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a tV <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> ) <sup>(1/2)</sup> x z <sup>(-1/2)</sup> <b>50 ft Interva</b>
Height above Ground z <sub>ent</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 1400 <i>Top of Single jet</i> = 157.3 160.0 200.0 200.0 240.0 260.0 240.0 260.0 240.0 260.0 330.0 355.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 800.0 1000.0 1000.0 1000.0 1100.0	40.352 "lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 220.51 280.99 311.47 341.95	meters ed Vertical 1 Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.34 279.98 279.98 279.93 279.01 278.82 278.68 278.51 278.46 278.46 278.48 278.53 278.33 278.30 278.25 278.55 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 17. 20 ft Interva al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ) <sup>(1/2)</sup> x z <sup>(-1/2)</sup> 50 ft Interva
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack. Rel. Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 250.0 250.0 280.0 350.0 280.0 355.0 400.0 555.0 600.0 655.0 655	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 45.543 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97	feet arting at en Plume Temp(K) 282.49 282.49 281.49 280.82 278.08 279.71 279.49 279.20 279.01 278.82 278.68 278.58 278.58 278.46 278.42 278.42 278.43 278.33 278.33 278.30 278.27 278.24 278.24 278.33 278.33 278.30 278.27 278.24 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 17. 20 ft Interva al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ) <sup>(1/2)</sup> x z <sup>(-1/2)</sup> 50 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack. Rel. Ht</i> = 78.1 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height</i> = 132.4 1400 <i>Top of Single jet</i> = 157.3 160.0 200.0 200.0 240.0 240.0 240.0 240.0 240.0 350.0 300.0 355.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 600.0 655.0 800.0 1000.0 1000.0 1100.0	40.352 "lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 55.43 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 220.51 280.99 311.47 341.95	meters ed Vertical 1 Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00	feet arting at en Plume Temp(K) 282.49 282.49 281.49 280.82 278.08 279.71 279.49 279.20 279.01 278.82 278.68 278.58 278.58 278.46 278.42 278.42 278.43 278.33 278.33 278.30 278.27 278.24 278.24 278.33 278.33 278.30 278.27 278.24 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 17. 20 ft Interva al.Ht to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/2</sup> / a tV <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ) <sup>(1/2)</sup> x z <sup>(-1/2)</sup> 50 ft Interva
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 250.0 280.0 355.0 400.0 555.0 600.0 555.0 600.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 45.543 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.82 280.34 279.98 279.71 279.49 279.92 279.01 278.82 278.68 278.55 278.52 278.58 278.58 278.58 278.55 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a $W_{plume} * a^{2} * λ^{2})$ ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 200.	40.352 'lume-Averag (meters) above stack 0.00 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 49.34 49.34 49.34 155.43 61.53 67.63 82.87 98.11 113.55 128.59 143.83 159.07 174.31 189.55 220.03 220.03 220.51 280.99 311.47 341.95 372.43 402.91	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.464 3.460 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513 64.390	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 5.93 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.63 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97 0.94	feet arting at en Plume Temp(K) 282.49 281.49 280.34 279.98 279.71 279.49 279.32 279.01 279.49 279.32 279.01 278.42 278.58 278.51 278.42 278.33 278.30 278.23 278.23 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.24 278.25 278.24 278.24 278.24 278.25 278.24 278.24 278.25 278.24 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17. 13 20 ft Interva al.H to Top of Je SD-z <sub>v</sub> ) <sup>2</sup> ]) <sup>10</sup> / a W <sub>plume</sub> *a <sup>2+</sup> λ <sup>2</sup> ) ( <sup>(1/2)</sup> x z <sup>(+1/2)</sup> 50 ft Interva 100 ft Interva
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 800 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 1400.0 <i>Top of Single jet = 157.3</i> 160.0 220.0 200.	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 37.15 43.24 49.34 55.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 128.099 311.47 341.95 372.43 402.91 433.39	ed Vertical 1 Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 6.27.814 30.252 35.129 40.006 44.833 49.760 54.636 59.513 64.390 69.267	132.4 /elocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97 0.94 0.92	feet Plume Temp(K) 282.49 282.49 282.49 283.49 280.82 280.34 279.91 279.49 279.49 279.49 279.49 279.49 279.49 279.49 279.49 278.82 278.68 278.51 278.68 278.51 278.68 278.53 278.42 278.33 278.30 278.27 278.25 278.24 278.23 278.24 278.23 278.24 278.23 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.24 278.25 278.25 278.24 278.25			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20 ft Interval al-H to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a W <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ); ( <sup>(1/2)</sup> × z <sup>(1/2)</sup> 50 ft Interval 100 ft Interval
Height above Ground z <sub>ent</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 160.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 220.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 300.0 280.0 280.0 280.0 300.0 280.0 300.0	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 45.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 340.95 372.43 372.43 372.43 372.43 372.43 372.43 372.43 372.43 372.45 375.45 375.45 375.45 375.45 375.45 375.45 375.45 375.45 375.45 375.45	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.662 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513 64.390 69.267 93.651	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 7.97 6.95 5.93 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.77 1.03 1.00 0.97 0.94 0.92 0.84 0.92 0.94 0.92 0.93 0.92 0.93 0.92 0.92 0.92 0.93 0.92 0.93 0.93 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.92 0.94 0.94 0.94 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95 0.95	feet arting at en Plume Temp(K) 282.49 282.49 282.49 280.34 279.98 279.71 279.49 279.92 279.01 279.49 279.32 279.01 278.48 278.51 278.68 278.51 278.64 278.53 278.30 278.30 278.32 278.30 278.22 278.25 278.24 278.23 278.25 278.24 278.23 278.25 278.24 278.25 278.55 278.55 278.55 278.55 278.55 278.55 278.55 278.55 278.55 278.55 278.55 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20 ft Interval al-H to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a W <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ); ( <sup>(1/2)</sup> × z <sup>(1/2)</sup> 50 ft Interval 100 ft Interval
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 800 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 1400.0 <i>Top of Single jet = 157.3</i> 160.0 220.0 200.	40.352 'lume-Averag (meters) above stack 0.00 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 45.5.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 260.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19	ed Vertical 1 Plume Radius(m) 1.937 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 6.27.814 30.252 18.060 22.937 6.27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513 64.390 69.267 93.651 118.035 142.419 166.803	132.4 /elocities sta SingleSta /ertVel(m/s) 8.06 7.97 6.95 5.93 4.91 4.03 3.92 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97 0.94 0.92 0.84 0.92 0.84 0.92 0.84 0.92 0.84 0.92 0.84 0.92 0.92 0.92 0.93 0.72 0.68	feet arting at en Plume Temp(K) 282.49 281.49 280.82 280.34 279.98 279.71 279.49 279.92 279.01 279.49 279.32 279.01 278.42 278.68 278.51 278.42 278.33 278.30 278.25 278.24 278.24 278.25 278.24 278.23 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.25 278.24 278.24 278.24 278.25 278.24 278.24 278.24 278.24 278.25 278.24 278.24 278.24 278.24 278.24 278.25 278.24 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.38 17.3 13 20 ft Interval al.Ht to Top of Je 5D-z.,) <sup>2</sup> ]) <sup>1/3</sup> / a
Height above Ground z <sub>ent</sub> +h <sub>s</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground Stack.Rel.Ht = 78.1 80.0 100.0 120.0 Single Jet 5.3 m/s Height = 132.4 140.0 Top of Single jet = 157.3 180.0 200.0 220.0 240.0 280.0 280.0 305.0 400.0 5550.0 660.0 6550.0 600.0 6550.0 600.0 6550.0 600.0 1000.0 1100.0 1100.0 1100.0 1100.0 1200.0 300.0	40.352 'lume-Averag (meters) above stack 0.00 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 49.34 45.543 61.53 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 220.99 311.47 341.95 372.43 402.91 343.39 565.79 738.19 890.59 1042.99 1195.39	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.662 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513 64.390 69.267 93.651 118.035	132.4 Velocities sta SingleStk VertVel(m/s) 8.06 7.97 6.95 5.93 5.30 4.91 4.03 3.92 3.26 2.84 2.54 2.33 2.16 2.04 1.93 1.74 1.60 1.51 1.43 1.37 1.31 1.27 1.23 1.16 1.11 1.07 1.03 1.00 0.97 0.92 0.83 0.77 0.72 0.88 0.68 0.68 0.65 0.55 0	feet arting at en Plume Temp(K) 282.49 282.49 284.49 284.49 280.82 280.34 279.71 279.49 279.68 278.51 278.68 278.51 278.68 278.53 278.53 278.54 278.68 278.53 278.54 278.53 278.52 278.68 278.53 278.54 278.52 278.68 278.53 278.52 278.68 278.53 278.54 278.54 278.52 278.62 278.52 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20 ft Interval al-H to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a W <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ); ( <sup>(1/2)</sup> × z <sup>(1/2)</sup> 50 ft Interval 100 ft Interval
Height above Ground z <sub>crit</sub> +h <sub>8</sub> able of Plume Top-Hat Diameters (2a) and F Height (feet) above ground <i>Stack.Rel.Ht = 78.1</i> 880.0 100.0 120.0 <i>Single Jet 5.3 m/s Height = 132.4</i> 1400.0 <i>Top of Single jet = 157.3</i> 160.0 220.0 20	40.352 'lume-Averag (meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 24.95 31.05 37.15 43.24 49.34 455.43 61.53 67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 200.03 220.03 200.03 220.03 200.05 200.03 200.05 200.03 200.05 200.	ed Vertical 1 Plume Radius(m) 1.931 1.977 2.464 2.952 3.254 3.440 3.862 3.918 4.893 5.868 6.844 7.819 8.795 9.770 10.745 13.184 15.622 18.060 20.499 22.937 25.376 27.814 30.252 35.129 40.006 44.883 49.760 54.636 59.513 64.390 69.267 93.651 118.035 142.419 166.803 191.187 215.571	132.4 Velocities sta SingleSta VertVel(m/s) 8.06 5.93 5.93 5.93 5.93 5.93 5.93 5.93 5.93 6.95 5.93 5.93 6.95 5.93 6.95 5.93 6.95 5.93 6.95 5.93 6.95 5.93 6.95 6.95 6.95 7.97 1.74 1.60 1.51 1.61 1.61 1.74 1.60 1.51 1.61 1.74 1.63 1.61 1.11 1.07 1.03 1.00 0.97 0.94 0.92 0.83 0.77 0.72 0.68 0.65 0.63	feet arting at en Plume Temp(K) 282.49 282.49 284.49 280.42 280.34 279.94 279.94 279.92 279.01 278.82 278.68 278.58 278.58 278.58 278.42 278.46 278.42 278.30 278.27 278.25 278.22 278.25 278.24 278.29 278.27 278.25 278.24 278.27 278.25 278.27 27			The real solution $x = z - zv = 0$ or $z(m/above stack) = z(ft/above stack) = z(ft/above ground) = z(ft/above gro$	17.3 17.3 17.3 20 ft Interval al-H to Top of Je 5D-z <sub>v</sub> ) <sup>2</sup> ]) <sup>1/3</sup> / a W <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> ); ( <sup>(1/2)</sup> × z <sup>(1/2)</sup> 50 ft Interval 100 ft Interval

NOAA Sources: Climatography of the United



	"Aviation Sa		ette Chillers u voyant Plumes					
						ditions at V	arious Heights in the Merge	əd
							, Queensland, Australia," D	
mbient Conditions:							utral conditions (dθ/dz=0 or θ	
Ambient Potential Temp θ <sub>a</sub>	278.15	Kelvins	41.0	°F		0.3048	meters/feet	
lume Exit Conditions:					Gravity g	9.81	m/s <sup>2</sup>	
Stack Height hs	23.81	meters	78 2/12	feet-inches	λ	1.11		
Individual Stack Diameter D	3.86213661	meters	152.1	inches	λο	~1.0		
Stack Velocity V <sub>exit</sub>	8.06	m/s	26.45	ft/sec	4Vol/(60πD	<sup>2</sup> )		
Individual Volumetric Flow	94.44	cu.m/sec	200,110	ACFM	$\pi V_{exit} D^2/4$			Sect.2/¶1
Stack Potential Temp θ <sub>s</sub>	289.26	Kelvins	61.0	°F				
Initial Stack Buoyancy Flux Fo		m <sup>4</sup> /s <sup>3</sup>	20.0	ΔT(°F)				Sect.2/¶1
Plume Buoyancy Flux F		m <sup>4</sup> /s <sup>3</sup>			λ²gVa²(1-θ <sub>ε</sub>	<sub>a</sub> /θ <sub>p</sub> ) for a,V	$\theta_p$ at plume height (see below	N)
Total Number of Stacks n	48							
Average Adjacent Stack Separation d		meters	53.5	feet			plume treatment in Peter Be	
Number of Stacks along Orientation N	3						sed by N <sup>0.25</sup> at the height wher	
					fully merge	d (interp. be	low ht, single merged stack al	pove ht)
Conditions at End (Top) of Jet Phase:	04.400		70.0	e	0.055			0
Height above Stack z <sub>jet</sub>		meters*		feet*	$z_{jet} = 6.25L$	), meters*=	meters above stack top	Sect.3/¶1
Height above Ground z <sub>jet</sub> +h <sub>s</sub>		meters	157.3			N/ /0		
Vertical Velocity V <sub>jet</sub>	4.031	m/s meters	13.22	ft/sec	$V_{jet} = 0.5V_{e}$	$e_{xit} = V_{exit}/2$	Conservation of momentum	
Plume Top-Hat Diameter 2a <sub>jet</sub>	7.724	meters	25.3	reet	$2a_{jet} = 2D$		Conservation of momentum	
pillane Methodology - Analytical Solutions								
Single Plume-averaged Vertical Velocity								
Single Plume Values: Plume Top-Hat Radius a			Merging Onl	-			r increase with height	Sect.2/Eq.6
Virtual Source Height zv		meters*		feet*	z <sub>v</sub> = 6.25D	$[1-(\theta_{e}/\theta_{s})^{1/2}]$	, meters*=meters above stack top	
Height above Ground zv+hs		meters	79.7				where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	
Single Plume Values: Vertical Velocity V			Merging Onl	у			) <sup>2</sup> - (6.25D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>(1/3)</sup> / a	Sect.2.1(6)
Product (Va) <sub>o</sub>	15.265	m²/s			V <sub>exit</sub> (D/2)(θ	<sub>e</sub> /θ <sub>s</sub> ) <sup>1/2</sup>		
Plume Merging - Based on Single Plume Cal	culations wh	ere:						Sect.3/¶3
Begin Merging Plume Top-Hat Diameter 2atouch	16.310	meters	53.5	feet	2a <sub>touch</sub> =d, (	or atouch=d/	2)	
Height above Stack ztouch		meters*	168.8	feet*			meters*=meters above stack	top
Height above Ground ztouch+hs	75.251	meters	246.9	feet				
Vertical Velocity Vtouch	2.268	m/s	7.4	ft/sec	Vtouch = {(V	a) <sub>o</sub> <sup>3</sup> + 0.12	$= (z-z_v)^2 - (6.25D-z_v)^2 $	a
Total Merging Plume Top-Hat Diameter 2afull	32.620	meters	107.0	feet	2a <sub>full</sub> =2d(N-	-1)/2, (or aft	II=d(N-1)/2) FOR 2 STACKS,	2a <sub>full</sub> =2d
Height above Stack z <sub>full</sub>	102.406	meters*	336.0	feet*			meters*=meters above stack	
Height above Ground zfull+hs	126.220		414.1	feet				
Vertical Velocity V <sub>full</sub>	1.574			ft/sec	V <sub>full</sub> = {(Va)	$a^{3} + 0.12F_{a}$	$[(z_{full}-z_v)^2 - (6.25D-z_v)^2]$	/ a
Product (V <sup>3</sup> a) <sub>full</sub>		m <sup>4</sup> /s <sup>3</sup>			- 1011 ((1)	0		, en di
Conditions at End (Top) of Merging Phase - D			nd acui in Merc	ed Plume c	alculations (	based on T	OTAL number of stacks):	
Merged Plume Values: Plume Diameter 2a			Table Below	eu Fluine c				oight
-				for ant			r <sub>full</sub> )), or linear increase with h	leight
Revised Merged Plume Radius am		meters	140.8				nere Total Merging Occurs	
Revised Merged Plume Velocity Vm	4.143			ft/sec			here Total Merging Occurs	
Revised Virtual Source Height zfull	102.406		336.0	feet*			ere Total Merging Occurs (sh	
Revised Vertical Velocity V	S	olutions in	Tables Below				eights above total merging ele	vation
					V=V <sub>touch</sub> +(V		-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> )	
Aultiple Plume Calculations							for heights below total mergin	ng elevation
Solve for plume-averaged vertical veloc					meters abo		z+h <sub>s</sub> )	
Gives the following Height above Stack z	262.698		861.9		REGULAR			
Plume Top-Hat Radius a	68.577		225.0		a=a <sub>m</sub> +0.16			
Vertical Velocity V		m/s	11.63	ft/sec	V={n(V <sup>3</sup> a) <sub>fu</sub>	/a}¹/3 if z>	Z <sub>full</sub>	
	3.544				N/ N/ . 0		z'-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> ) if z <sub>touch</sub> <	z <z<sub>full</z<sub>
	3.544							
					V=V <sub>touch</sub> +( V'=single p		if z <z<sub>touch</z<sub>	
Solve for Height of CASC critical vertical		5.30	m/s			lume values		VV < Top of .
	velocity V <sub>crit</sub>			feet	V'=single p BEFORE T	lume values OUCHING		VV < Top of .
Solve for Height of CASC critical vertical	velocity V <sub>crit</sub> JET	5.30	JET		V'=single p BEFORE T z <sub>crit</sub> = z <sub>full</sub> +	lume values OUCHING ⊦ {[n(V <sup>3</sup> a) <sub>full</sub>	Critical	VV < Top of 、 it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>ent</sub>	velocity V <sub>crit</sub> JET	5.30 meters	JET	feet	V'=single p BEFORE T z <sub>crit</sub> = z <sub>full</sub> +	lume values OUCHING ⊦ {[n(V <sup>3</sup> a) <sub>full</sub>	<b>Critical</b> /(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> }/0.16 <b>if</b> V <sub>crit</sub> <v<sub>m</v<sub>	
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub>	velocity V <sub>crit</sub> JET JET	5.30 meters meters	JET JET	feet feet	V'=single p BEFORE T z <sub>crit</sub> = z <sub>full</sub> + z <sub>crit</sub> =z <sub>touch</sub> +	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> ·(z <sub>full</sub> -z <sub>touch</sub> )	Critical /(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> )/0.16 if V <sub>crit</sub> <v<sub>m *(V<sub>crit</sub>-V<sub>touch</sub>)/(V<sub>m</sub>-V<sub>touch</sub>) if V<sub>cr</sub></v<sub>	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>ent</sub> Height above Ground z <sub>ent</sub> +h <sub>s</sub>	velocity V <sub>crit</sub> JET JET	5.30 meters meters rting at Tou	JET JET Iching Height	feet feet	V'=single pl BEFORE T z <sub>crit</sub> = z <sub>full</sub> + z <sub>crit</sub> =z <sub>touch</sub> +	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> ·(z <sub>full</sub> -z <sub>touch</sub> ) me Eqns (se	Critical /(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> }/0.16 if V <sub>crit</sub> <v<sub>m (V<sub>crit</sub>-V<sub>touch</sub>)/(V<sub>m</sub>-V<sub>touch</sub>) if V<sub>cr</sub> the Single Plume spreadsheet,</v<sub>	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub>	velocity V <sub>crit</sub> JET JET JET /elocities sta (meters)	5.30 meters meters rting at Tou Plume	JET JET Iching Height Vert.	feet feet	V'=single pl BEFORE T z <sub>crit</sub> = z <sub>full</sub> + z <sub>crit</sub> =z <sub>touch</sub> +	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) me Eqns (se <sup>3</sup> +0.12F <sub>0</sub> [(z-z	Critical /(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> )/0.16 if V <sub>crit</sub> <v<sub>m *(V<sub>crit</sub>-V<sub>touch</sub>)/(V<sub>m</sub>-V<sub>touch</sub>) if V<sub>cr</sub></v<sub>	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical V Height (feet) above ground	velocity V <sub>crit</sub> JET JET Velocities sta (meters) above stack	5.30 meters meters rting at Tou Plume Radius(m)	JET JET Iching Height Vert. Vel(m/s)	feet feet	V'=single p BEFORE T $z_{crit} = z_{full} + z_{crit} = z_{touch} + Single PlumV_{plume}={(Va)_o} = 0.16(z-z)$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> ·(z <sub>full</sub> -z <sub>touch</sub> ) me Eqns (se <sup>3</sup> +0.12F <sub>0</sub> [(z-z. z <sub>v</sub> )	$\label{eq:critical} \begin{split} & \textbf{Critical} \\ (V_{crit})^3]\text{-}a_m)/0.16 \text{ if } V_{crit}\text{-}V_m \\ (V_{crit}\text{-}V_{touch})/(V_m\text{-}V_{touch}) \text{ if } V_{crit} \\ & \text{se Single Plume spreadsheet,} \\ & y^2-(6.25\text{-}z_*)^2])^{1/2}/a \end{split}$	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>ent</sub> Height above Ground z <sub>ent</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical Height (feet) above ground Begin Merging (touch) = 246.9	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44	5.30 meters meters rting at Tou Plume Radius(m) 8.155	JET JET Iching Height Vert. Vel(m/s) 2.27	feet feet	$eq:started_st$	lume values OUCHING ⊢ {[n(V <sup>3</sup> a) <sub>full</sub> ·(z <sub>full</sub> -z <sub>touch</sub> ) <i>me Eqns</i> (se <i>a</i> <sup>3</sup> +0.12F <sub>0</sub> [(z-z- z <sub>v</sub> ) ·(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub>	$\begin{split} & \text{Critical} \\ & \text{(V_{cm})}^3]\text{-}a_m)/0.16 \text{ if } \text{V}_{crit}\text{-}\text{V}_m \\ & \text{(V_{crit}-V_{touch})}(\text{V}_m\text{-}\text{V}_{touch}) \text{ if } \text{V}_{cr} \\ & \text{es Single } Plume \text{ spreadsheet}, \\ & \beta^2(626\text{D}\text{c}_2)^2)^{1/3} / a \\ & \text{crit} D^2((4\text{V}_{plume} * a^{2*}\lambda^2))) \end{split}$	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>e</sub> Table of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 260.0	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack <i>51.44</i> 55.43	5.30 meters meters Plume Radius(m) 8.155 #N/A	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42	feet feet	$eq:started_st$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>ont</sub> Height above Ground z <sub>ont</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 280.0 280.0	velocity V <sub>crit</sub> JET JET /elocities sta (meters) above stack 51.44 55.43 61.53	5.30 meters meters Plume Radius(m) 8.155 #N/A #N/A	JET JET Vert. Vel(m/s) 2.42 2.42 2.64	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\begin{split} & \text{Critical} \\ & \text{(V_{cm})}^3]\text{-}a_m)/0.16 \text{ if } \text{V}_{crit}\text{-}\text{V}_m \\ & \text{(V_{crit}-V_{touch})}(\text{V}_m\text{-}\text{V}_{touch}) \text{ if } \text{V}_{cr} \\ & \text{es Single } Plume \text{ spreadsheet}, \\ & \beta^2(626\text{D}\text{c}_2)^2)^{1/3} / a \\ & \text{crit} D^2((4\text{V}_{plume} * a^{2*}\lambda^2))) \end{split}$	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>ent</sub> Height above Ground z <sub>ent</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical Height (feet) above ground Begin Merging (touch) = 246.9 280.0 280.0 300.0	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63	5.30 meters meters Plume Radius(m) 8.155 #N/A #N/A #N/A	JET JET uching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 280.0 280.0 300.0 320.0	velocity V <sub>crit</sub> JET JET /elocities sta (meters) above stack 51.44 55.43 61.53 67.63 67.63 73.72	5.30 meters meters Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A	JET JET Uching Height Vert. Vel(m/s) 2.42 2.64 2.86 3.09	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 260.0 280.0 300.0 320.0 340.0	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 61.53 61.53 73.72 79.82	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A	JET JET Uching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical Height (feet) above ground Begin Merging (touch) = 246.9 280.0 280.0 300.0 320.0 340.0 360.0 360.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 61.53 67.63 73.72 79.82 85.91	5.30 meters meters Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Iching Height Vert. Vel(m/s) 2.42 2.64 2.86 3.09 3.31 3.54	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>erit</sub> Height above Ground z <sub>erit</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 260.0 280.0 3300.0 3300.0 340.0 340.0 380.0 380.0	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 77.72 79.82 85.91 92.01	5.30 meters meters Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A	JET JET uching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.57	feet feet	$\label{eq:states} \begin{split} &V\!\!=\!\!single\ p\\ &BEFORE\ T\\ &z_{crit}\!=\!z_{full}+\\ &z_{crit}\!=\!z_{touch}+\\ &Single\ Plum\\ &V_{pluma}\!=\!\{(Va)_o\\ &a=0.16(z-z)\\ &\theta_p\!=\!\theta_s(1\!+\!(1\!-\!lnterpolates)) \end{split}$	lume values OUCHING + {[n(V <sup>3</sup> a) <sub>full</sub> -(z <sub>full</sub> -z <sub>touch</sub> ) ne Eqns (se <sup>3</sup> +0.12F₀[(z-z. z <sub>v</sub> ) -(θ <sub>e</sub> /θ <sub>s</sub> ))*(V <sub>e</sub> d Layer Eqn	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>e</sub> fable of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 260.0 280.0 300.0 320.0 340.0 340.0 380.0 400.0	velocity V <sub>crit</sub> JET JET /elocities sta (meters) above stack 51.44 55.43 61.53 61.53 67.63 73.72 79.82 85.91 92.01 98.11	5.30 meters meters ting at Tou Plume <b>Radius(m)</b> 8.155 #W\A #N\A #N\A #N\A #N\A #N\A #N\A #N\A	JET JET uching Height Vert. Vel(m/s) 2.27 2.42 2.64 3.69 3.31 3.54 3.59 3.51 3.58 3.76 3.98	feet feet	$\begin{array}{l} V'=single \ p\\ BEFORE \ T\\ z_{crit}=z_{full} + z\\ z_{rit}=z_{touch} + z\\ single \ Plum \\ V_{pluma}=\{(Va)_{o}\\ a=0.16(z-a)\\ p_{p}=b_{a}(1+(1-a))\\ Interpolated \\ V'=V_{touch} + (1-a) \\ \end{array}$	$\begin{split} & \text{lume values}\\ & \text{OUCHING} \\ & + \left\{ [n(V^3a)_{rall} \\ (z_{1}ull=Ztouch) \\ & me Eqns (state of a state of a stat$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm
Solve for Height of CASC critical vertical Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> fable of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 260.0 280.0 300.0 320.0 330.0 320.0 330.0 340.0 360.0 380.0 400.0 End Merging (full/mp) = 414.1	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 61.53 67.63 73.72 79.82 85.91 92.01 98.11 102.40	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Uning Height Vert. Vel(m/s) 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.54 3.54 4.14	feet feet	$\begin{array}{l} V=\!$	lume values OUCHING + {[π(V <sup>3</sup> a) <sub>1</sub> ul] (2[ul]=Ztouch) (2[ul]=Ztouch) *40.12F <sub>0</sub> [(2-z z <sub>v</sub> ) (4 <sub>0</sub> /θ <sub>8</sub> ))*(V <sub>e</sub> d Layer Eqn V <sub>m</sub> -V <sub>touch</sub> )*( ume Eqns	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm ) 20 ft Interval
Solve for Height of CASC critical vertical Find Height above Stack z <sub>erti</sub> Height above Ground z <sub>erti</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 280.0 280.0 380.0 330.0 340.0 340.0 350.0 380.0 400.0 End Merging (full/mp) = 414.1 450.0	velocity V <sub>erit</sub> JET JET /elocities sta (meters) above stack 55.43 67.63 67.63 67.63 77.72 79.82 85.91 92.01 98.11 102.40 113.35	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.54 3.76 3.98 4.14 4.09	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tall})_{tall}$ ( $(z_{tall}z_{touch})$ me Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ d Layer Eqn $V_m V_{touch})^*($ mme Eqns $_{M}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm ) 20 ft Interval
Solve for Height of CASC critical vertical Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>s</sub> fable of MERGED Plume-Averaged Vertical V Height (feet) above ground Begin Merging (touch) = 246.9 280.0 380.0 300.0 340.0 340.0 340.0 340.0 500.0	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 85.91 92.01 98.11 <b>102.40</b> 113.35 128.59	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET uching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.76 3.98 4.14 4.09 4.02	feet feet	$\begin{array}{l} V=\!$	lume values OUCHING + {[ $(I(V^3a)_{tall})_{tall}$ ( $(z_{tall}z_{touch})$ me Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ d Layer Eqn $V_m V_{touch})^*($ mme Eqns $_{M}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it->Vm ) 20 ft Interval
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Solve for Height of CASC critical vertical           Find Height above Stack z <sub>crit</sub> Height above Ground z <sub>crit</sub> +h <sub>a</sub> 'able of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           260.0           280.0           320.0           340.0           360.0           380.0           400.0           End Merging (full/mp) = 414.1           450.0           500.0           550.0           660.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 55.873	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 4.2.86 3.09 3.31 3.54 4.14 4.28 3.88 4.14 4.09 4.02 3.95 3.89 3.89 3.89	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V           Beight (feet)           above ground           Begin Merging (touch) = 246.9           260.0           280.0           300.0           322.0           340.0           380.0           450.0           550.0           60.0           550.0           600.0           550.0           660.0           660.0           660.0           660.0           700.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 55.873	JET JET Uning Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.78 3.78 4.14 4.09 4.02 3.95 3.89 3.83 3.89 3.83 3.85 4.12 4.02 3.95 3.89 3.83 3.83 3.83 3.83 3.84 3.85 3.89 3.83 3.83 3.83 3.84 3.85 3.85 3.85 3.85 3.85 3.85 3.85 3.85	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>e</sub> 'able of MERGED Plume-Averaged Vertical V           Begin Merging (touch) = 246.9           280.0           280.0           280.0           380.0           380.0           400.0           End Merging (full/mp) = 414.1           450.0           5500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           600.0           6500.0           700.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.89 3.83 3.87 3.87 3.87 3.87	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V           Beight (feet)           above ground           Begin Merging (touch) = 246.9           260.0           280.0           300.0           322.0           340.0           60.0           End Merging (full/mp) = 414.1           450.0           550.0           660.0           650.0           660.0           700.0           800.0           900.0           100.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 260.51 280.99	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 56.873 61.750 66.626 66.626 67.1.503	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.83 3.83 3.85 3.89 3.83 3.85 3.85 3.85 3.85 3.87 3.56	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>8</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           560.0           560.0           600.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 220.51 280.99 311.47	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 4.09 4.02 3.95 3.89 3.85 3.89 3.85 3.89 3.83 3.87 3.67 3.58 3.89 3.83 3.87 3.54 3.89 3.83 3.87 3.54 3.89 3.85 3.89 3.85 3.89 3.85 3.89 3.85 3.85 3.85 3.85 3.85 3.85 3.85 3.85	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>erti</sub> Height above Ground z <sub>erti</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           260.0           280.0           3300.0           340.0           380.0           400.0           End Merging (tull/mp) = 411.1           450.0           550.0           600.0 <t< td=""><td>velocity V<sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 77.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 220.93 311.47 341.95</td><td>5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A</td><td>JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.87 3.87 3.88 3.83 3.50 3.89 3.83 3.55 3.58 3.58 3.58 3.58 3.58 3.58</td><td>feet feet</td><td><math display="block">\begin{array}{l} V\!=\!</math></td><td>lume values OUCHING + {[<math>(I(V^3a)_{tull})_{tull}</math> <i>(</i><math>(z_{tull}:z_{touch})_{tull}</math> <i>ne</i> Eqns (st <sup>34</sup>-0.12F<sub>4</sub>(<math>(z-z, z_v)</math> (<math>(\theta_0/\theta_s))^*(V_e</math> <i>d</i> Layer Eqn <math>V_m^*V_{touch})^*(</math> <i>me</i> Eqns <i>u</i>/a)<sup>1/3</sup></td><td><math display="block">\label{eq:critical} Critical \$\$ (V_{crit})^3]-a_m / 0.16 if V_{crit} &lt; V_m \$\$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}\$\$ es Single Plume spreadsheet, \$\$ a^2(s.25D-z_s)^2)^{1/2} / a \$\$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ </math></td><td>20 ft Interva</td></t<>	velocity V <sub>crit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 77.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 220.93 311.47 341.95	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Iching Height Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.87 3.87 3.88 3.83 3.50 3.89 3.83 3.55 3.58 3.58 3.58 3.58 3.58 3.58	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           260.0           280.0           300.0           322.0           340.0           60.0           End Merging (full/mp) = 414.1           450.0           550.0           660.0           550.0           660.0           700.0           800.0           900.0           1000.0           1100.0           1200.0           1300.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 220.51 280.99 311.47 341.95 372.43	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 47.119 66.626 54.434 55.873 61.750 66.626 71.503 76.380 81.257 86.134	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.76 3.98 4.14 4.02 3.95 3.89 3.83 3.83 3.83 3.85 4.12 3.95 3.89 3.83 3.85 3.85 3.85 3.85 3.50 3.50 3.50 3.50 3.50 3.50 3.50 3.5	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>d</i> Layer Eqn $V_m^*V_{touch})^*($ <i>me</i> Eqns <i>u</i> /a) <sup>1/3</sup>	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           580.0           580.0           550.0           660.0           550.0           660.0           660.0           700.0           1000.0           1100.0           1200.0           1100.0           1200.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 67.63 73.72 85.91 92.01 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 2250.51 280.99 311.47 341.95 372.43 402.91	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 4.09 4.02 3.95 3.89 3.85 3.89 3.85 3.89 3.85 3.89 3.85 3.89 3.85 3.89 3.85 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.89 3.35 3.54 3.55 3.89 3.35 3.89 3.35 3.54 3.54 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.55 3.89 3.35 3.35 3.35 3.35 3.35 3.35 3.35 3.3	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interva
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           280.0           380.0           340.0           380.0           380.0           380.0           380.0           380.0           400.0           End Merging (full/mp) = 414.1           450.0           550.0           6600.0           600.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 55.43 67.63 67.63 77.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 2260.51 2280.99 311.47 341.95 372.43 402.91 433.39	5.30 meters meters Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.77 3.67 3.88 3.89 3.83 3.77 3.67 3.88 3.35 3.28 3.35 3.28 3.32 3.35 3.28 3.32 3.35 3.28 3.32 3.35 3.28 3.35 3.28 3.35 3.32 3.35 3.35 3.35 3.35 3.35 3.35	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           300.0           320.0           340.0           60.0           550.0           60.0           60.0           60.0           550.0           60.0           650.0           650.0           600.0           650.0           600.0           650.0           600.0           650.0           600.0           650.0           600.0           600.0           650.0           600.0           650.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0 </td <td>velocity V<sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 70.82 717.43 71 74.31 73.41 74.41.71 74.4</td> <td>5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 45.6.873 61.750 66.626 71.503 76.380 81.257 86.134 91.010 95.8871 120.271</td> <td>JET JET Vert. Vel(m/s) 2.27 2.42 2.86 3.09 3.31 3.54 4.22 3.35 4.14 4.09 4.02 3.95 3.89 3.83 3.83 3.83 3.85 3.89 3.83 3.85 3.85 3.85 3.85 3.85 3.85 3.50 3.42 3.55 3.50 3.42 3.55 3.50 3.42 3.55 3.50 3.50 3.52 3.50 3.52 3.55 3.55 3.55 3.55 3.55 3.55 3.55</td> <td>feet feet</td> <td><math display="block">\begin{array}{l} V\!=\!</math></td> <td>lume values OUCHING + {[<math>(I(V^3a)_{tull})_{tull}</math> <i>(</i><math>(z_{tull}:z_{touch})_{tull}</math> <i>ne</i> Eqns (st <sup>34</sup>-0.12F<sub>4</sub>(<math>(z-z, z_v)</math> (<math>(\theta_0/\theta_s))^*(V_e</math> <i>I Layer Eqn</i> <math>V_m^-V_{touch})^*(</math> <i>ime</i> Eqns <math>_{ull}/a)^{1/3}</math></td> <td><math display="block">\label{eq:critical} Critical \$\$ (V_{crit})^3]-a_m / 0.16 if V_{crit} &lt; V_m \$\$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}\$\$ es Single Plume spreadsheet, \$\$ a^2(s.25D-z_s)^2)^{1/2} / a \$\$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ </math></td> <td>20 ft Interval</td>	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 70.82 717.43 71 74.31 73.41 74.41.71 74.4	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 45.6.873 61.750 66.626 71.503 76.380 81.257 86.134 91.010 95.8871 120.271	JET JET Vert. Vel(m/s) 2.27 2.42 2.86 3.09 3.31 3.54 4.22 3.35 4.14 4.09 4.02 3.95 3.89 3.83 3.83 3.83 3.85 3.89 3.83 3.85 3.85 3.85 3.85 3.85 3.85 3.50 3.42 3.55 3.50 3.42 3.55 3.50 3.42 3.55 3.50 3.50 3.52 3.50 3.52 3.55 3.55 3.55 3.55 3.55 3.55 3.55	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           3300.0           340.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           380.0           490.0           End Merging (full/mp) = 414.1           450.0           550.0           600.0           650.0           700.0           800.0           900.0           1000.0           1000.0           1100.0           1200.0           1300.0           1400.0           1550.0  <	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 67.63 73.72 85.91 92.01 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 226.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.86 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.85 3.89 3.87 3.85 3.89 3.85 3.89 3.85 3.89 3.87 3.85 3.89 3.89 3.85 3.89 3.85 3.89 3.89 3.85 3.89 3.82 3.82 3.82 3.82 3.82 3.82 3.82 3.82	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           380.0           3300.0           340.0           360.0           360.0           360.0           600.0           2850.0           380.0           340.0           360.0           360.0           360.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           600.0           1000.0           1000.0           1000.0           1000.0           1200.0           1200.0           1200.0           1200.0           1200.0           1300.0           1400.0           1500.0 <t< td=""><td>velocity V<sub>erit</sub> JET JET (elocities sta (meters) above stack 55.43 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 2260.51 2280.99 311.47 341.95 372.43 402.91 433.39 565.79 78.819 89.59</td><td>5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A</td><td>JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.66 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.77 3.67 3.88 3.89 3.83 3.77 3.67 3.88 3.355 3.28 3.355 3.22 3.355 3.255 3.255 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.25777 3.25777 3.25777777777777777777777777777777777777</td><td>feet feet</td><td><math display="block">\begin{array}{l} V\!=\!</math></td><td>lume values OUCHING + {[<math>(I(V^3a)_{tull})_{tull}</math> <i>(</i><math>(z_{tull}:z_{touch})_{tull}</math> <i>ne</i> Eqns (st <sup>34</sup>-0.12F<sub>4</sub>(<math>(z-z, z_v)</math> (<math>(\theta_0/\theta_s))^*(V_e</math> <i>I Layer Eqn</i> <math>V_m^-V_{touch})^*(</math> <i>ime</i> Eqns <math>_{ull}/a)^{1/3}</math></td><td><math display="block">\label{eq:critical} Critical \$\$ (V_{crit})^3]-a_m / 0.16 if V_{crit} &lt; V_m \$\$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}\$\$ es Single Plume spreadsheet, \$\$ a^2(s.25D-z_s)^2)^{1/2} / a \$\$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ \$\$ </math></td><td>20 ft Interval</td></t<>	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 55.43 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 2260.51 2280.99 311.47 341.95 372.43 402.91 433.39 565.79 78.819 89.59	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.66 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.77 3.67 3.88 3.89 3.83 3.77 3.67 3.88 3.355 3.28 3.355 3.22 3.355 3.255 3.255 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.25777 3.25777 3.25777777777777777777777777777777777777	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
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Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>a</sub> Table of MERGED Plume-Averaged Vertical V           Height (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           280.0           380.0           340.0           360.0           380.0           360.0           600.0           2850.0           380.0           340.0           360.0           360.0           360.0           600.0           700.0           800.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 67.63 67.63 73.72 79.82 85.91 92.01 98.11 102.40 113.35 128.59 143.83 159.07 174.31 189.55 220.03 2260.51 2280.99 311.47 341.95 372.43 402.91 433.39 565.79 78.819 89.59	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 45.6.873 61.750 66.626 71.503 76.380 81.257 86.134 91.010 95.887 120.271 1144.655 169.039	JET JET Vert. Vel(m/s) 2.27 2.42 2.64 2.66 3.09 3.31 3.54 3.76 3.98 4.14 4.09 4.02 3.95 3.89 3.83 3.77 3.67 3.88 3.89 3.83 3.77 3.67 3.88 3.355 3.28 3.355 3.22 3.355 3.255 3.255 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.355 3.22 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.2577 3.25777 3.25777 3.25777777777777777777777777777777777777	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	20 ft Interval
Solve for Height of CASC critical vertical           Find Height above Stack z <sub>eff</sub> Height above Ground z <sub>eff</sub> +h <sub>s</sub> Fable of MERGED Plume-Averaged Vertical V           Beight (feet)           above ground           Begin Merging (touch) = 246.9           280.0           280.0           280.0           300.0           320.0           340.0           60.0           500.0           500.0           660.0           650.0           660.0           660.0           660.0           1000.0           1100.0           1200.0           1300.0           1400.0           1200.0           2500.0           300.0           2500.0           300.0           200.1           200.2           200.1           200.2           200.1           200.2           200.0           200.0           200.0           200.0           200.0           200.0           200.0           200.0	velocity V <sub>erit</sub> JET JET (elocities sta (meters) above stack 51.44 55.43 61.53 67.63 73.72 79.82 70.82	5.30 meters meters rting at Tou Plume Radius(m) 8.155 #N/A #N/A #N/A #N/A #N/A #N/A #N/A 42.930 44.681 47.119 49.558 51.434 47.119 49.558 51.434 56.873 61.750 66.626 71.503 76.380 81.257 86.134 91.010 95.887 120.271 144.655 169.039 193.423	JET JET Vert. Vel(m/s) 2.27 2.42 2.86 3.09 3.31 3.54 4.14 4.09 4.02 3.95 3.89 3.83 3.83 3.83 3.85 4.14 4.02 3.95 3.89 3.83 3.83 3.83 3.85 3.85 3.85 3.85 3.85	feet feet	$\begin{array}{l} V\!=\!$	lume values OUCHING + {[ $(I(V^3a)_{tull})_{tull}$ <i>(</i> $(z_{tull}:z_{touch})_{tull}$ <i>ne</i> Eqns (st <sup>34</sup> -0.12F <sub>4</sub> ( $(z-z, z_v)$ ( $(\theta_0/\theta_s))^*(V_e$ <i>I Layer Eqn</i> $V_m^-V_{touch})^*($ <i>ime</i> Eqns $_{ull}/a)^{1/3}$	$\label{eq:critical} Critical $$ (V_{crit})^3]-a_m / 0.16 if V_{crit} < V_m $$ (V_{crit}-V_{touch})/(V_m-V_{touch}) if V_{cr}$$ es Single Plume spreadsheet, $$ a^2(s.25D-z_s)^2)^{1/2} / a $$ (a_D^2/(4V_{plume}*a^2*\lambda^2))) $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $$ $	it>Vm



MERGED (along width) Plume Average				ioyant Plumes					
							ditions at 1	/arious Heights in the Merg	ed
		.ne Evalual						/arious Heights in the Merg r, Queensland, Australia ," [	
mbient Conditions:			Fiume					eutral conditions (dθ/dz=0 or	
Ambient Potential Ter	mp θ <sub>a</sub>	278.15	Kelvins	41.0				meters/feet	-a -e/
Plume Exit Conditions:						Gravity g		m/s <sup>2</sup>	
Stack Heig	aht h <sub>s</sub>	23.81	meters	78 2/12	feet-inches	λ	1.11		
Individual Stack Diame		3.86213661			inches	λο	~1.0		
Stack Velocity	/ V <sub>exit</sub>	8.06	m/s	26.45	ft/sec	4Vol/(60πD	<sup>2</sup> )		
Individual Volumetric	Flow	94.44	cu.m/sec	200,110	ACFM	$\pi V_{exit} D^2/4$			Sect.2/¶1
Stack Potential Ter	mp θ <sub>s</sub>	289.26	Kelvins	61.0	°F				
Initial Stack Buoyancy Fl	ux Fo	11.33	m <sup>4</sup> /s <sup>3</sup>	20.0	ΔT(°F)	gV <sub>exit</sub> D <sup>2</sup> (1-6	$\theta_a/\theta_s)/4 = V$	ol.Flow(g/π)(1-θ <sub>a</sub> /θ <sub>s</sub> )	Sect.2/¶1
Plume Buoyancy F	lux F	N/A	m <sup>4</sup> /s <sup>3</sup>			$\lambda^2 g V a^2 (1 - \theta_1)$	<sub>a</sub> /θ <sub>p</sub> ) for a,V	,θ <sub>p</sub> at plume height (see belo	w)
Total Number of Sta	cks n	48							
Average Adjacent Stack Separat	tion d	7.50	meters	24.6	feet	Calcs base	d on multipl	e plume treatment in Peter Be	st Paper:
Number of Stacks along Orientat	ion N	16				plume veloo	cities increa	used by N <sup>0.25</sup> at the height when	e plumes
						fully merge	d (interp. be	low ht, single merged stack a	bove ht)
Conditions at End (Top) of Jet Phase:									
Height above Stac	ck z <sub>jet</sub>	24.138	meters*	79.2	feet*	$z_{jet} = 6.25D$	0, meters*=	meters above stack top	Sect.3/¶1
Height above Ground z	<sub>jet</sub> +hs	47.952	meters	157.3	feet				
Vertical Velocit	y V <sub>jet</sub>	4.031	m/s	13.22	ft/sec	$V_{jet} = 0.5V_{e}$	$e_{xit} = V_{exit}/2$		
Plume Top-Hat Diameter	r 2a <sub>jet</sub>	7.724	meters	25.3	feet	$2a_{jet} = 2D$		Conservation of momentum	
Spillane Methodology - Analytical Solut	tions fo	or Calm Con	ditions for	Plume Height	s above Je	t and Merg	ing Phase	S	
Single Plume-averaged Vertical Ve		V given by	Analytical S	Solution in Pa	per where	Product Va	a given by	equations below:	
Single Plume Values: Plume Top-Hat Rac	dius a	Use	d in Plume	Merging On	У			r increase with height	Sect.2/Eq.6
Virtual Source Heig	ght z <sub>v</sub>		meters*		feet*	$z_v = 6.25D$	$[1-(\theta_{e}/\theta_{s})^{1/2}]$	, meters*=meters above stack top	
Height above Ground a	z <sub>v</sub> +hs		meters	79.7				where $\left(\theta_a/\theta_s\right)^{1/2}$ = $\left(\theta_e/\theta_s\right)^{1/2}$ =	0.9806
Single Plume Values: Vertical Veloc	city V	Use	d in Plume	e Merging On	У	${(Va)_{o}^{3} + 0}$	12F <sub>o</sub> [ (z-z	/) <sup>2</sup> - (6.25D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>(1/3)</sup> / a	Sect.2.1(6)
Product	(Va)₀	15.265	m²/s			Vexit(D/2)(0			
Plume Merging - Based on Single Plum	e Calc	ulations wh	ere:						Sect.3/¶3
Begin Merging Plume Top-Hat Diameter 2	a <sub>touch</sub>	7.500	meters	24.6	feet	2a <sub>touch</sub> =d, (	or a <sub>touch</sub> =d/	2)	
Height above Stack	ztouch	23.906	meters*	78.4	feet*			meters*=meters above stack	top
Height above Ground ztou		47.720	meters	156.6	feet				
Vertical Velocity		4.065	m/s	13.3	ft/sec			$F_o [ (z-z_v)^2 - (6.25D-z_v)^2 ]$	
Total Merging Plume Top-Hat Diameter	2a <sub>full</sub>	112.500		369.1		2a <sub>full</sub> =2d(N-	-1)/2, (or a <sub>f</sub>	all=d(N-1)/2) FOR 2 STACKS,	2a <sub>full</sub> =2d
Height above Stac	k z <sub>full</sub>	352.031	meters*	1155.0	feet*			meters*=meters above stack	
Height above Ground z <sub>f</sub>		375.845	meters	1233.1	feet				
Vertical Velocity	y V <sub>full</sub>	0.986	m/s	3.2	ft/sec	$V_{full} = \{(Va)$	) <sub>o</sub> <sup>3</sup> + 0.12F,	$[(z_{full}-z_v)^2 - (6.25D-z_v)^2]^{(1/3)}$	/ a <sub>full</sub>
Product (V	′ <sup>3</sup> a) <sub>full</sub>	54	m <sup>4</sup> /s <sup>3</sup>						
Conditions at End (Top) of Merging Phas	se - De	fine new valu	es for V <sub>full</sub> a	ind a <sub>full</sub> in Merg	ed Plume c	alculations (	(based on T	OTAL number of stacks):	
Merged Plume Values: Plume Diamet	ter 2a	S	olutions in	Table Below		$2a = 2 \times (a)$	m + 0.16(z-	z <sub>full</sub> )), or linear increase with h	neight
Revised Merged Plume Radio	us a <sub>m</sub>	148.058	meters	485.8	feet			here Total Merging Occurs	
Revised Merged Plume Velocit	ty V <sub>m</sub>	2.596	m/s	8.52	ft/sec	and V <sub>m</sub> =	n <sup>0.25</sup> V <sub>full</sub> w	here Total Merging Occurs	
Revised Virtual Source Heigh	nt z <sub>full</sub>	352.031	meters*	1155.0	feet*	Height abov	ve stack wh	ere Total Merging Occurs (sh	iown above)
Revised Vertical Veloc	city V	Se	olutions in	Tables Below		V={n(V <sup>3</sup> a) <sub>f</sub>	₄⊮/a} <sup>1/3</sup> for h	eights above total merging ele	evation
								z-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> )	
Multiple Plume Calculations								for heights below total mergi	ng elevation
Solve for plume-averaged vertical	veloci	ty at height	940.0	feet	286.512	meters abo			
Gives the following Height above Sta	ack z	262.698	meters*	861.9	feet*	LESS THA	N TOP OF	MERGING PHASE-INTERPC	LATE
Plume Top-Hat Rac	dius a	#N/A	meters	#N/A	feet	a=a <sub>m</sub> +0.16			
Vertical Veloc	city V	2.996	m/s	9.83	ft/sec	V={n(V <sup>3</sup> a) <sub>f</sub>			
						V'=V <sub>touch</sub> +(	V <sub>m</sub> -V <sub>touch</sub> )*	z'-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> ) if z <sub>touch</sub> <	Z <z<sub>full</z<sub>
						V'=single p	lume values	if z <ztouch< td=""><td></td></ztouch<>	
Solve for Height of CASC critical ver		elocity V <sub>crit</sub>	5.30			BEFORE T	OUCHING	Critical	VV < Top of
Find Height above Stac	k z <sub>crit</sub>	JET	meters	JET	feet	$z_{crit} = z_{full} +$	⊦ {[n(V <sup>3</sup> a) <sub>ful</sub>	/(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> }/0.16 if V <sub>crit</sub> <v<sub>m</v<sub>	
Height above Ground z	<sub>crit</sub> +h <sub>s</sub>	JET	meters	JET	feet	z <sub>crit</sub> =z <sub>touch</sub> +	(Zfull=Ztouch)	*(V <sub>crit</sub> -V <sub>touch</sub> )/(V <sub>m</sub> -V <sub>touch</sub> ) if V <sub>cr</sub>	rit>Vm
Table of MERGED Plume-Averaged Vert			-					ee Single Plume spreadsheet	)
Height	(feet)	(meters)	Plume	Vert.		V <sub>plume</sub> ={(Va) <sub>o</sub>	<sup>3</sup> +0.12F <sub>o</sub> [(z-z	<sub>v</sub> ) <sup>2</sup> -(6.25D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>1/3</sup> / a	
above gr	ounda	above stack	Radius(m)	Vel(m/s)		a = 0.16(z-	z <sub>v</sub> )		
Begin Merging (touch) = 1		23.92	3.750	4.06		$\theta_p = \theta_s(1+(1-\theta_s))$	$-(\theta_e/\theta_s))^*(V_e)$	$_{xit}D^2/(4V_{plume}*a^{2*}\lambda^2)))$	
	160.0	24.95	#N/A	4.06		Interpolated			20 ft Interval
	180.0	31.05		4.03		V'=V <sub>touch</sub> +(	V <sub>m</sub> -V <sub>touch</sub> )*	z'-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> )	
·	200.0	37.15		4.01					
	220.0	43.24		3.98					
:	240.0	49.34		3.95					
		55.43		3.92					
	260.0			3.87					50 ft Interva
	300.0	67.63							
	300.0 350.0	67.63 82.87	#N/A	3.80					
	300.0 350.0 400.0	67.63 82.87 98.11	#N/A #N/A	3.80 3.73					
	300.0 350.0 400.0 450.0	67.63 82.87 98.11 113.35	#N/A #N/A #N/A	3.80 3.73 3.66					
	300.0 350.0 400.0 450.0 500.0	67.63 82.87 98.11 113.35 128.59	#N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60					
	300.0 350.0 400.0 450.0 500.0 550.0	67.63 82.87 98.11 113.35 128.59 143.83	#N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53					
	300.0 350.0 400.0 450.0 500.0 550.0 600.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07	#N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46					
	300.0 350.0 400.0 450.0 500.0 550.0 600.0 650.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31	#N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39					
	300.0 350.0 400.0 450.0 500.0 550.0 600.0 650.0 700.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55	#N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32					
	300.0         350.0         400.0         450.0         500.0         550.0         600.0         650.0         700.0         800.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03	#N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19					100 ft Interv
	300.0     350.0       350.0     400.0       450.0     500.0       550.0     6600.0       650.0     700.0       800.0     900.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05					100 ft Interva
	300.0     350.0       350.0     400.0       450.0     500.0       550.0     600.0       650.0     700.0       800.0     900.0       900.0     000.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.53 3.46 3.39 3.32 3.19 3.05 2.91					100 ft Interv
	300.0     350.0       350.0     400.0       450.0     500.0       550.0     600.0       650.0     700.0       800.0     900.0       900.0     100.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05 2.91 2.78					100 ft Interv
	300.0       350.0       400.0       450.0       550.0       600.0       650.0       700.0       800.0       900.0       100.0       200.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05 2.91 2.78 2.64					100 ft Interv
11 11 11 12 12 14 14 15 14 14 14 14 14 14 14 14 14 14 14 14 14	300.0     350.0       350.0     400.0       450.0     500.0       550.0     600.0       650.0     700.0       800.0     900.0       100.0     200.0       230.1     233.1	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b>	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.39 3.32 3.19 3.05 2.91 2.78 2.64 2.60		Merged Plu			100 ft Interv
11 11 11 12 12 14 14 15 14 14 14 14 14 14 14 14 14 14 14 14 14	300.0       350.0       400.0       450.0       550.0       600.0       650.0       700.0       800.0       900.0       100.0       200.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05 2.91 2.78 2.64		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		100 ft Interv
11 End Merging (full/mp) = 11	300.0     350.0       350.0     400.0       450.0     500.0       550.0     600.0       650.0     700.0       800.0     900.0       100.0     200.0       230.1     233.1	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b>	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.39 3.32 3.19 3.05 2.91 2.78 2.64 2.60			"II/a} <sup>1/3</sup>		100 ft Interv
1 End Merging (full/mp) = 1 1 1 1 1 1 1 1 1 1 1 1 1 1	300.0       350.0       400.0       450.0       550.0       600.0       650.0       700.0       800.0       000.0       100.0       200.0       233.1       300.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>552.03</b> 352.03	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.53 3.39 3.32 3.19 3.05 2.91 2.78 2.64 <b>2.60</b> 2.58		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		100 ft Interv
	300.0       350.0       400.0       450.0       500.0       550.0       660.0       680.0       700.0       800.0       900.0       100.0       200.0       233.1       300.0       400.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b> 372.43	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.80 3.73 3.66 3.60 3.34 3.39 3.32 2.31 9 3.05 2.91 2.78 2.78 2.64 2.66 2.68 2.55		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		100 ft Intervi
End Merging (full/mp) = 1 1 1 1 1 1 2 2	300.0       350.0       400.0       4450.0       500.0       550.0       660.0       700.0       800.0       900.0       100.0       200.0       233.1       300.0       400.0       500.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b> 372.43 372.43 402.91 433.39	#NVA #NVA #NVA #NVA #NVA #NVA #NVA #NVA	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05 2.91 2.78 2.64 2.60 2.58 2.55 2.55		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		
11 12 13 14 14 14 15 14 14 15 14 14 14 14 14 14 14 14 14 14 14 14 14	300.0       350.0       400.0       4450.0       550.0       600.0       700.0       800.0       900.0       100.0       200.0       233.1       300.0       400.0       500.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b> 372.43 402.91 433.39 585.79	#NVA #NVA #NVA #NVA #NVA #NVA #NVA #NVA	3.80 3.73 3.66 3.60 3.53 3.39 3.32 2.91 2.78 2.64 2.25 2.55 2.55 2.55 2.52 2.52 2.52		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		
End Merging (full/mp) = 12 11 12 13 14 14 14 14 14 14 14 14 14 14	300.0           350.0           400.0           440.0           400.0           450.0           500.0           600.0           650.0           700.0           800.0           900.0           100.0           200.0           233.1           300.0           400.0           500.0           500.0           500.0           500.0           500.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b> 372.43 402.91 433.39 9585.79 738.19	#NVA #NVA #NVA #NVA #NVA #NVA #NVA #NVA	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.32 3.19 3.05 2.91 2.78 2.64 2.66 2.65 2.55 2.55 2.55 2.25 2.25 2.241		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		
End Merging (full/mp) = 12 1 1 1 2 2 2 2 3 3 3	300.0         350.0           350.0         400.0           445.00         450.0           550.0         550.0           600.0         650.0           700.0         900.0           900.0         100.0           200.0         200.0           300.0         400.0           500.0         500.0           600.0         500.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>352.03</b> 372.43 372.43 372.43 402.91 433.39 585.79 938.19 890.59	#NVA #NVA #NVA #NVA #NVA #NVA #NVA #NVA	3.80 3.73 3.66 3.60 3.53 3.46 3.39 3.05 2.91 2.78 2.64 2.65 2.55 2.55 2.55 2.52 2.51 2.41 2.41 2.41 2.41 2.41 2.41 2.41 2.4		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		
11 11 11 11 11 11 11 11 11 11	300.0       350.0       350.0       400.0       445.0       550.0       600.0       650.0       700.0       800.0       900.0       100.0       200.0       233.1       300.0       400.0       500.0       500.0       500.0       500.0       500.0       500.0       500.0	67.63 82.87 98.11 113.35 128.59 143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 <b>52.03</b> 372.43 402.91 433.39 585.79 738.19 980.59	#NVA #NVA #NVA #NVA #NVA #NVA #NVA #NVA	3.80 3.73 3.66 3.60 3.53 3.32 3.32 3.32 2.91 2.78 2.66 2.55 2.55 2.55 2.52 2.52 2.41 2.31 2.23 2.41		V={n(V <sup>3</sup> a) <sub>f</sub>	"II/a} <sup>1/3</sup>		100 ft Interva



"Aviation Sa		e Chillers usi <i>yant Plume</i> s					
					ditions at V	arious Heights in the Plume	9
	from a Gas-	Turbine Pow	er Station a	at Oakey, Q	ueensland	Australia," Dr. K.T. Spilla	ne
				Constants:	Assume n	eutral conditions (dθ/dz=0 or	θ <sub>a</sub> =θ <sub>e</sub> )
302.21	Kelvins	84.3	°F		0.3048	meters/feet	
				Gravity g	9.81	m/s <sup>2</sup>	
23.81	meters	78 2/12	feet-inches	λ	1.11		
3.8621	meters	152.1	inches	λο	~1.0		
8.06	m/s	26.45	ft/sec	4Vol/(60πE	<sup>2</sup> )		
94.44	cu.m/sec	200,110	ACFM	$\pi V_{exit} D^2/4$			Sect.2/¶1
313.32	Kelvins	104.3	°F				
10.4540	m <sup>4</sup> /s <sup>3</sup>	20.0	ΔT(°F)	gV <sub>exit</sub> D <sup>2</sup> (1-6	$\theta_a/\theta_s)/4 = V$	ol.Flow(g/π)(1-θ <sub>a</sub> /θ <sub>s</sub> )	Sect.2/¶1
N/A	m <sup>4</sup> /s <sup>3</sup>			λ <sup>2</sup> gVa <sup>2</sup> (1-θ	<sub>a</sub> /θ <sub>p</sub> ) for a,V	,θ <sub>p</sub> at plume height (see belo	w)
48			2.632				
24.138	meters*	79.2	feet*	z <sub>jet</sub> = 6.250	), meters*=	meters above stack top	Sect.3/¶1
47.952	meters	157.3	feet				
4.031	m/s	13.22	ft/sec	V <sub>jet</sub> = 0.5V	$e_{xit} = V_{exit}/2$		
7.724	meters	25.3	feet	$2a_{iet} = 2D$		Conservation of momentum	
				,=-			
for Calm Con	ditions for P	ume Heights	above Jet	t Phase			
		-			given by e	quations below:	
	-	-				•	Sect.2/Eq.6
			feet*			-	Sect.2/Eq.6
					, ,,	where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	
				$\{(Va)_{0}^{3} + 0\}$	12F。[ (z-7.		Sect.2.1(6)
						.,	
. 5.255							
city at height	1.000.0	feet	304.8	meters abo	ve ground (	z'+h。)	
					- ground (	.0/	
				2a'= 2*0 10	(7'-7.)		Sect.2/Eq.6
						) <sup>2</sup> -(6.25D-z) <sup>2</sup> ]) <sup>(1/3)</sup> /(2a'/2)	Sect.2/Eq.6
1.040	11/3	3.41	10 300	v = 1( v a)o +	0. 121 o[(2-Z	// -(0.200-2v/ j) · ·/(2d/2)	5661.2/EQ.0
Velocity V	E 00	m/e plume	woraced	ortion	city.	O-1/11	VV < Top of
#IVA	meters	#IN/A	ieel	IOI V=V <sub>crit</sub>	-		
-114-1 1-4	DI						
				and d	=[0.12F <sub>o</sub> (6.		
40.332	meters	132.4	leet		give	or z(m/above stack) = z(ft/above ground) =	17.47 17.9 13
Nume-Averag	ed Vertical	Velocities sta	arting at en	d of jet ph	ase:		
-			Plume	, p			
	Radius(m)	_	Temp(K)				
0.00	1.931	8.06					
0.57	1.977	7.97				Jet Phase Eqs:	20 ft Interva
6.67	2.464	6.95				Linearly interpolated from Stack R	el.Ht to Top of Je
12.76	2.952					Spillane Equations:	
16.54							
						V <sub>plume</sub> ={(Va) <sub>o</sub> <sup>3</sup> +0.12F <sub>o</sub> [(z-z <sub>v</sub> ) <sup>2</sup> -(6.2	5D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>1/3</sup> / a
						$a = 0.16(z-z_v)$	
			306.56			,	4V <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> )
			306.55			CEC Staff Equation:	
						V <sub>mp</sub> =n <sup>0.25</sup> V <sub>sp</sub>	
							u <sup>(-1/2)</sup> x 7 <sup>(-1/2)</sup>
							50 ft Interva
						Max<5.3 m/s	
98.11 113.35	15.628 18.066		303.09 302.89			wax<0.3 m/s	
113.35							
400 50							
128.59							
143.83	22.943	1.33	302.66				
143.83 159.07	22.943 25.381	1.33 1.28	302.66 302.58				
143.83 159.07 174.31	22.943 25.381 27.820	1.33 1.28 1.24	302.66 302.58 302.53				
143.83 159.07 174.31 189.55	22.943 25.381 27.820 30.258	1.33 1.28 1.24 1.20	302.66 302.58 302.53 302.48				
143.83 159.07 174.31 189.55 220.03	22.943 25.381 27.820 30.258 35.135	1.33 1.28 1.24 1.20 1.13	302.66 302.58 302.53 302.48 302.45				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51	22.943 25.381 27.820 30.258 35.135 40.012	1.33 1.28 1.24 1.20 1.13 1.08	302.66 302.58 302.53 302.48 302.45 302.45				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99	22.943 25.381 27.820 30.258 35.135 40.012 44.889	1.33 1.28 1.24 1.20 1.13 1.08 1.04	302.66 302.58 302.53 302.48 302.45 302.40 302.36				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33 302.32				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33 302.32 302.30				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33 302.32 302.30				100 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33 302.32 302.30				100 ft Interv
143.83 159.07 174.31 188.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92	302.66 302.58 302.53 302.48 302.45 302.40 302.36 302.33 302.32 302.30 302.29				
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 93.657	1.33 1.28 1.24 1.20 1.13 1.08 1.04 0.97 0.94 0.92 0.89	302.66 302.58 302.48 302.45 302.40 302.30 302.32 302.32 302.30 302.22 302.29				
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 33.657 118.041	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92 0.89 0.89	302.66 302.58 302.48 302.45 302.40 302.36 302.33 302.32 302.30 302.29 302.28 302.28				
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 93.657 118.041 142.425	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92 0.89 0.81 0.75	302.66 302.58 302.53 302.45 302.40 302.30 302.30 302.32 302.32 302.32 302.29 302.28 302.27				
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19 890.59	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 93.657 118.041 142.425 166.809	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92 0.89 0.81 0.75 0.70	302.66 302.58 302.48 302.45 302.40 302.30 302.30 302.30 302.29 302.29 302.27 302.25 302.25				100 ft Interv 500 ft Interv
143.83 159.07 174.31 189.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19 890.59 1042.99	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 93.657 118.041 142.425 166.809 191.193	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92 0.89 0.81 0.75 0.70 0.70	302.66 302.53 302.48 302.45 302.44 302.45 302.30 302.32 302.30 302.22 302.25 302.25 302.24 302.22 302.24 302.22				
143.83 159.07 174.31 188.55 220.03 250.51 280.99 311.47 341.95 372.43 402.91 433.39 585.79 738.19 890.59 1042.99 1042.99	22.943 25.381 27.820 30.258 35.135 40.012 44.889 49.765 54.642 59.519 64.396 69.273 33.657 118.041 142.425 166.809 191.193 215.577	1.33 1.28 1.24 1.20 1.13 1.08 1.04 1.00 0.97 0.94 0.92 0.89 0.81 0.75 0.70 0.67	302.66 302.53 302.48 302.45 302.44 302.36 302.30 302.30 302.29 302.29 302.27 302.25 302.24 302.22 302.24 302.22				
	3.8621 8.66 94.44 313.32 10.4540 N/A 48 24.138 47.952 4.031 7.724 for Calm Con V given by Ar 5 0.432 24.246 8 0.432 24.246 8 9.777 1.040 1 velocity V <sub>crit</sub> #N/A #N/A elocity in Jet 16.537 40.352 Plume-Averag ((meters) above stack 0.00 0.57 6.67 12.76 16.54 18.86 24.14 18.86 24.14 18.86 24.14 18.86 24.14 18.86 24.14 18.85 23.105 37.15 18.32 24.24	3.8621       meters         8.06       m/s         94.44       cu.m/sc         94.44       cu.m/sc         94.44       cu.m/sc         94.44       cu.m/sc         94.44       cu.m/sc         91.44       cu.m/sc         10.4540       m <sup>4</sup> /s <sup>3</sup> N/A       m <sup>4</sup> /s <sup>3</sup> 48	3.8621       meters       152.1         8.06       n/s       26.45         94.44       cum/sec       200,110         313.25       Kelvins       104.3         10.4540       m <sup>4</sup> /s <sup>3</sup> 20.0         N/A       m <sup>4</sup> /s <sup>3</sup> 20.0         N/A       m <sup>4</sup> /s <sup>3</sup> 20.0         N/A       m <sup>4</sup> /s <sup>3</sup> 20.0         A8	3.8621       meters       152.1       inches         8.06       m/s       26.45       f/sec         94.44       cu.m/sec       200,110       ACFM         313.32       Kelvins       10.4.3       "F         10.4540       m <sup>4</sup> /s <sup>3</sup> 20.0       AT(*F)         N/A       meters*       79.2       feet         24.138       meters*       79.2       feet         40.031       m/s       13.22       f/sec         7.724       meters       25.3       feet         Solutions in Table Below       0.432       meters       79.5         0.432       meters*       921.9       feet*         Solutions in Table Below       3.04.8       280.986       meters*         280.986       meters*       921.9       feet*         1.940       m/s       3.41       f/sec	23.81       meters       78       2/12       feet-inches $\lambda_{o}$ 3.8621       meters       26.45       ft/sec       4Vol/(60mt)         94.44       cu.m/sec       200.10       ACFM $TV_{exit}D^2/4$ 313.32       Kelvins       104.3       °F       gVexit D^2/4         10.4540       m <sup>4</sup> /s <sup>3</sup> 20.0 $\Delta T(F)$ gVexit D^2/4         10.4540       m <sup>4</sup> /s <sup>3</sup> 20.0 $\Delta T(F)$ gVexit D^2/4         110.4540       m <sup>4</sup> /s <sup>3</sup> 20.0 $\Delta T(F)$ gVexit D^2/4         110.4540       m <sup>4</sup> /s <sup>3</sup> 20.0 $\Delta T(F)$ gVexit D^2/4         48       2.632       Multiple St       2.632       Multiple St         24.138       meters       79.2       feet       2.632       Multiple St         4031       m/s       13.22       ft/sec       V <sub>jet</sub> = 0.5V,       7.724       meters       2.632       feet       2.632       4.633       4.64       2.632       4.633       4.64       2.642       4.633       4.644       6.25D[1-(6, 2.7), 0.16(2.7),	23.81       meters       78       2/12       feet-inches       A       1.11         3.8621       meters       152.1       inches       A <sub>0</sub> -1.0         8.06       m/s       26.45       ft/sec       4Vol/(60mD <sup>2</sup> )         94.44       cu.m/sec       200.110       ACFM       TV <sub>sa0</sub> D <sup>2</sup> /4       =         313.32       Kelvins       104.3       °F       gt/sec       4Vol/(60mD <sup>2</sup> )       =         10.4540       m <sup>4</sup> /s <sup>3</sup> 20.0       AT(*F)       gt/sec/14-gt/9c) for a.U       =	23.81 meters       78       2/12 feat-inches       1       1         3.8621 meters       152.1 inches $\lambda_0$ -1.0         8.06 m/s       26.45 (ivse 4 Vol/(Gbr)D <sup>5</sup> )       -1.0         94.44 cu.m/sec       200.10 ACFM $W_{eac}D^{5/4}$ -1.0         10.4540 m/s <sup>3</sup> 20.0 $\Delta T(F)$ $y_{eac}D^{5/4}$ -1.0         10.4540 m/s <sup>3</sup> 20.0 $\Delta T(F)$ $y_{eac}D^{5/4}$ -0.1 Flow(g/m)(1-0/6),         A/2 v132 feat $z_{gel} = 6.250$ , meters interces above stack top       4.0         4.031 m/s       13.22 (i/sec $V_{gel} = 0.5V_{ext} = V_{ual}/2$ 7.724 meters       13.22 (i/sec $V_{gel} = 0.5V_{ext} = V_{ual}/2$ 7.724 meters       13.22 (i/sec $V_{gel} = 0.5V_{ext} = V_{ual}/2$ 7.724 meters       14.1 feet*       6.25D (1-60/6) <sup>1/2</sup> , meters-meters above stack top         6/2 4.246 meters       1.4 feet*       6.25D (1-60/6) <sup>1/2</sup> , meters-meters above stack top         0.432 meters*       1.4 feet*       6.25D (1-60/6) <sup>1/2</sup> , meters-meters above stack top         15.289 m²/s       V_sexD/2(0/6/4) <sup>1/2</sup> (i/60/2) <sup>1/2</sup> (i/6/6) <sup>1/2</sup> 280.986 meters*       921.91 feet*       294.5 feet       29-2 <sup>1</sup> /2 (-6.25D-2, r) <sup>2</sup> ) (1/3/(2/2)         14040 m/s       1,040 m/s

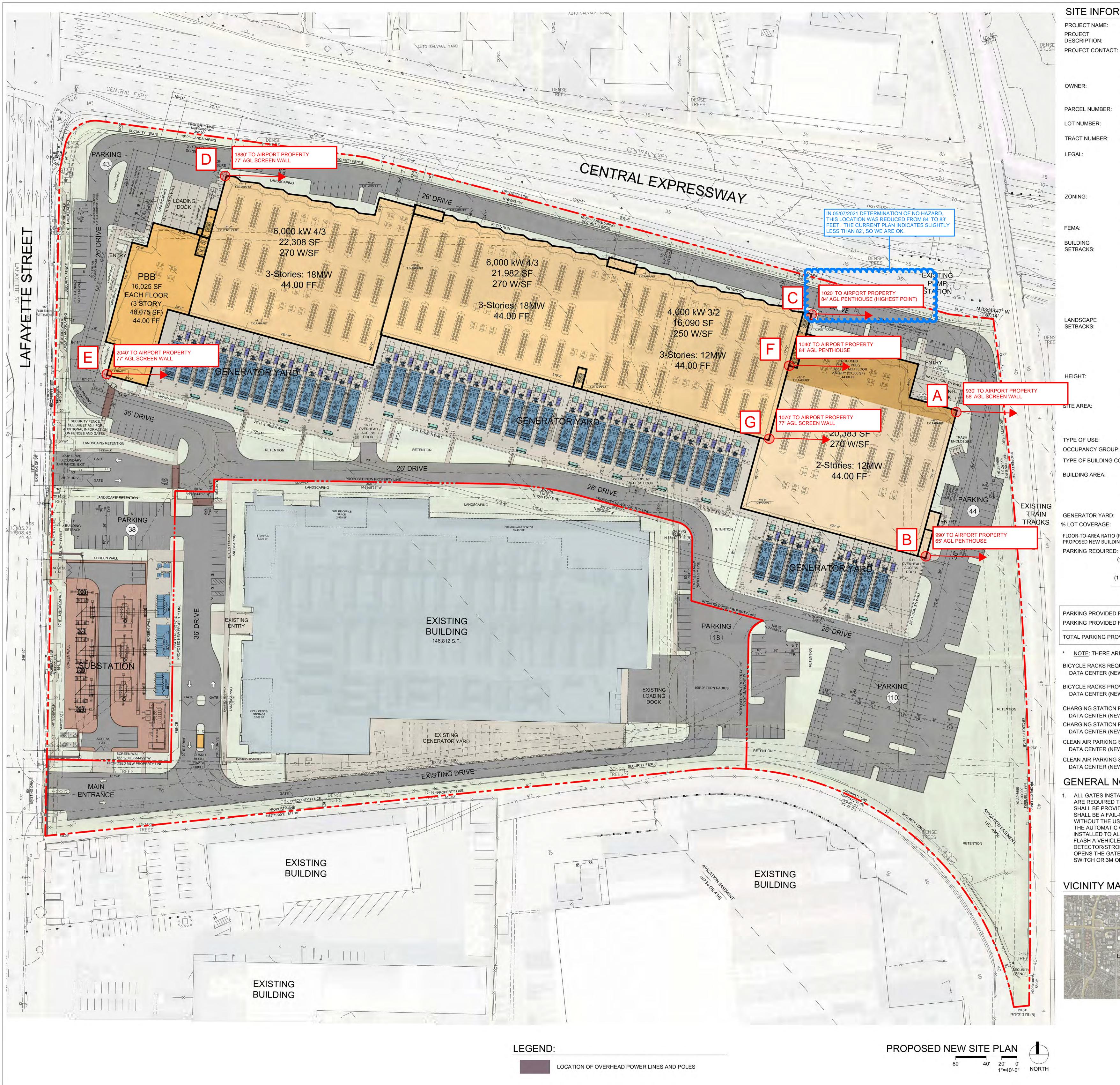


Image: and intermined with a property of the pr	MERGED (along length) Plume Average Vert			oyant Plumes						
Anticle Conditions         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)         Out of Protect strong conditions (difference or p. n.i.)							ditions at	Various Heights in the Merg	ed	
Arouge it possible from a matrix of part of p			Plume	from Two Gas						
Items Bit KonditionsOnly of the set of t						Constants:			$\theta_a = \theta_e$ )	
Bits Bits Bits Bits Bits Bits Bits Bits		302.21	Kelvins	84.3	°F	0				
Individual Back Longence 0       0.8128   index       1628   index       ind       -1.0       Individual Back Longence 104		00.01		70 0/40	6					
Bios         Bios <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>										
inductioninductionSec. 2P1Sec.										
Bake Network         Bake Network         Biolog							, ,		Soot 2/¶1	
Initial Stack Buygeney Trice T         10.40 m/s <sup>1/2</sup> 20.0 (ATC)         9/m_m <sup>2</sup> (1-4,0,0,1) = 1.40 minut hanged counts counts for the section frame of the sec						IIV <sub>exit</sub> D /4			Sect.2/11	
Plane Boymery FlarNA $(m)^{1/2}$ NA $(m)^{1/2}$ N						$aV = D^2(1-b)$	(A)/4 = V	$(a = E \log(\alpha/\pi)(1-\theta_1/\theta_2)$	Sect 2/¶1	
Too humber of blocks and power of blocks of the set of				20.0	Δ1(1)					
Average Adsport Stack Support         10.31         Description         Calce Stack and Description Stack Support         Description Stack Support           scationas et for (Top) of set Phase:         Image Address Addres Address Address Address Address Address Addres						x gva (1-0	<sub>a</sub> /o <sub>p</sub> /ioi a, v	, op at plaine height (see beid	,	
Number of basiss stars (Contraction IN)         S         Just (Contraction IN)         S         Just (Contraction IN)         Number of basis stars (Contraction IN)         Just (Contractin IN)         Just (Contraction IN) <thj< td=""><td></td><td></td><td></td><td>53.5</td><td>feet</td><td>Calcs base</td><td>d on multip</td><td>e plume treatment in Peter Be</td><td>st Paper:</td></thj<>				53.5	feet	Calcs base	d on multip	e plume treatment in Peter Be	st Paper:	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$										
Seatilized Ein (Pap) of at Phase: Height above foround s, n, n, and 2000										
Height above Octowed $y_{m}$ is $47:92$ mean1772 is set $1772$ is set <t< td=""><td>Conditions at End (Top) of Jet Phase:</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></t<>	Conditions at End (Top) of Jet Phase:									
Preprint	Height above Stack ziel	24.138	meters*	79.2	feet*	$z_{iet} = 6.250$	, meters*=	meters above stack top	Sect.3/¶1	
United Vectory Van         4.031 mix         52.2 Process         Van = 0.50 mix         Van = 0.5			meters	157.3	feet					
			m/s	13.22	ft/sec	$V_{jet} = 0.5V$	$e_{xit} = V_{exit}/2$			
Spitlane Methodology - Analytical Solutions for Catm. Conditions for Plume Heights above Jet and Merging Phase         Spitlane Methodology - Analytical Solutions in Plane Vhace Product Vs given by exations blow.         Spitlane Methodology - Values V agiven by exations blow.           Single Plume Varies         Vertical Varies         Spitlane Methodology - Analytical Solution in Plane Varies         Spitlane Methodology - Values Val			meters	25.3	feet					
Single Plume averaged Varital Velocity V given by Analytal Solution in Pager When Product Va given by equations below:         Sector (Validation of Pager Veraing) (Validation of Validation of Validatio Validation of Validation of Validation of Validation	· · · · · · · · · · · · · · · · · · ·									
Single Plane Values Plane Top-141 Radius a         Used in Plane Merging Ohly         a. a. 0.15(z), or theore merges when height         Single Plane Values (Plane Merges)         Single Plane Values (Plane Values (Pla	Spillane Methodology - Analytical Solutions	for Calm Con	ditions for	Plume Height	s above Je	t and Merg	ing Phase	s		
Single Plane Values Plane Top-Leit Ratius a         Used in Plane Merging Orbit         a. a. 0.15(z - ), or floar inforce or which height active and the plane of the plane decomposition of the p										
Virtual Source Height abors0.432 (meters Packet for meters Packet Source									Sect.2/Eq.6	
Height above Ground 2, -h, 1         Used in Planew Firty OU-V         Vertual (Va), 1         Used in Planew Firty OU-V         Vertual (Va), 1         Set 100           Intem Marging Plane Action Single Plane Vertual Vert	Virtual Source Height zv	0.432	meters*	1.4	feet*				Sect.2/Eq.6	
Disple Priume Values         Vanical Velocity Values         Used in Plane Merging One 2000 (1900)         (Value) 228 (0000)         (Value) 228 (000	Height above Ground zv+h			79.5	feet					
Product (Va)         10.20 $n^2 \omega$ Variable (Variable)         Variable (Variable)         Variable (Variable)         Sect. 37.3           Plume Merging - Based on Single Plume Calcutations Planet				e Merging On	У					
Nume Marging - Based on Single Plume Colutions where:         Image: Single Plume Top-Hall Dameter 2 along 2000         Sect. 3/12           Sect. 3/12		15.289	m²/s							
Begin Merging Plume Tap-Hat Dameter 280,00         16.310         meters         30.5 freet         Research (or Research2)         Height above Group Zamath (or Research2)           Height above Group Zamath (or Research2)         100.0 freet         Ramath (C)										
Begin Merging Plume Top-Net Dameter 28,000         16.310         meters         103.5         feet         Resume Act (27 allow 72/m)         Act (27 allow	Plume Merging - Based on Single Plume Ca	culations wh	ere:						Sect.3/¶3	
Height above Stack $z_{out}$ 51-400 meters <sup>2</sup> 128.6 fleet <sup>1</sup> $z_{outh} = 2, +al(2^{\circ}0.16), meters2 meters above stack top           Total Mergin PL more that Banker Zaug         22.244 miss         7.4 ft/acc         z_{outh} = 2, +al(2^{\circ}0.16), meters2, ft(2, 2D, 2, 1)^{10.01} / a           Height above Stack Zaug         102.360 meters2         102.06 meters2         z_{outh} = 2, +al(2^{\circ}0.16), meters2, ft(2, 2D, 2, 1)^{10.01} / a           Height above Stack Zaug         102.360 meters2         0.1 ft(2D, 2) meters2, ft(2, 2D, 2, 1)^{10.01} / a         z_{out} = 10.000, a^{-1} $				53.5	feet	2a <sub>touch</sub> =d, (	or atouch=d/	2)		
Height above Ground Zamashki         75.214 meters         74.4 fters         Varial Values         ( $-2, -2, -2, -2, -2, -2, -2, -2, -2, -2, $			meters*						top	
Ventral Velocity Vacan         2.244 m/s         7.4 m/see $(V_m_h)^2 = (V_m_h)^2 = (2 \times m)^2 + (2 \times m)$				246.8	feet					
Cotal Marging         Plume Top-Hat Diameter 2 <sub>ma</sub> 32.620 meters         107.0 [set         22ma/242(h1/2) (2014).         23ma/24(h1/2)						$V_{touch} = \{(V$	a) <sub>o</sub> <sup>3</sup> + 0.12	$F_0 [(z-z_v)^2 - (6.25D-z_v)^2]^{(1/3)}$	/ a	
Height above Stack $_{10}$ 102.389 meters         335.9 levt $_{210}$ = $z_+ z^2(2^{+}(2).15)$ , meters**meters above stack top           Writeal Velocity $V_{10}$ 15.183 meter         335.9 levt $v_{10} = z_+ z^2(2^{+}(2).15)$ , meters**meters above stack top           Broded Vertical Velocity $V_{10}$ 60 m/ $z^2$ 5.1 fif sec $v_{10} = (10.5)^3 + 0.12 r_0 + (12.5) dec) top         v_{10} = 10000 top           Broded Merged Plume Radus a         42.730 meters         140.8 lext         whore a_{10} = n^{-2} v_{10} whore Total Merging Occurs         v_{10} = 10000 top           Revised Merged Plume Radus a         42.730 meters         140.8 lext         whore a_{10} = n^{-2} v_{10} whore Total Merging Occurs         meters           Revised Vertical Velocity v_{10}         70.000 feet         30.48 lext         v_{10} (v_{10} v_{10} v_{10$				107.0	feet					
Height above Ground $Z_{u,vh_1}$ 125.153 metrs         414.0 feet         Note of the second seco			meters*	335.9	feet*					
Vertical Velocity $V_{m_{1}}$ 1.5 Ltrace $V_{m_{2}} = (Va)_{n}^{3} + 0.12F_{m} [2 c_{m}c_{n}^{2} + 0.6250 - z)^{2} [1^{100}] / a_{m}}$ Conditions at End (Top) of Merging Phase - Define new values for $V_{m_{1}}$ and $u_{m_{1}}$ in Marged Plune calculations (based on TOTAL number of stacks):         Number of the stacks in the stack in the sta				414.0	feet	Tun V			1	
						V <sub>full</sub> = {(Va	$a^{3} + 0.12F_{2}$	$(z_{\text{full}} - z_v)^2 - (6.25D - z_v)^2 ]^{(1/3)}$	/ a	
Conditions at End (Top) of Marging Phase : Define new values is for Y <sub>10</sub> and a <sub>10</sub> in Margind Plume catculations (based on TOTAL number of stacks):         Image: Stack S						run (( )				
Meteored Plume Values     Plume Readus and Revised Merged Plume Readus and Revised Merged Plume Velocity values Revised Merged Plume Velocity values Revised Merged Plume Velocity values Revised Values Plume Velocity values Revised Values Plume Velocity values Revised Values Plume Velocity values Revised Values Velocity values Plume Top Analysis Solve for Height abox Stack zam Values Velocity values Revised Values Velocity values Revis				and acut in Merc	ed Plume c	alculations	based on T	OTAL number of stacks):		
Revised Margad Plume Radius, and 22.900 meters         14.0.8 feet         where a.s. m <sup>23</sup> b. and where Total Marging Occurs           Revised Varial Valocity Va									height	
Revised Merged Plume Velocity V., Revised Vertual Source Heipht 2, and Solutions in Tables Below         and V., = n <sup>22</sup> / <sub>V.,uk</sub> where Total Merging Occurs (shown above) Velo(V.24), and Velocity V           Revised Vertual Velocity V         Solutions in Tables Below         Velo(V.24), and Velocity V         Velo(V.24), and Velocity V         Velo(V.24), and Velocity V           Multipo Plume-averaged vertual velocity at height 1,0000 feet         308         Retained Velocity V         342         m/V         Nelocity Velocity V         Velo(V.24), and Velocity V         Velo(V.24), and Velocity V         Velo(V.24), and Velocity V         342         m/V         Nelocity Velocity V         342         m/V         Nelocity Velocity V         Nelocity Velocity V         Nelocity Velocity V         342         m/V         Nelocity Velocity Vel					feet				- <b>3</b> -	
Revised Virtual Source Height z., ul         12.39 (meters'         Vertique Value stack where Total Marging Occurs (shrown above)           Revised Varial Velocity         Vertigue Source Marging Vertigue Source Vertigue Sou										
Revised Vertical Velocity V     Solve for humber back pack and an entry solve for hubbrs above for an entry solve for an entry solve for hubbrs above for an entry solve for an entry solve for an entry solve for hubbrs above for an entry solve for an entry sol									nown above)	
Number of the second			olutions in	Tables Below						
Multiple Plume Calculationsmetersnoteformal presentationsSolve or plume-averaged vertical u=0:110,00.0 err822.0 lert*Reters above ground (z+h)Gives the following Height above Stack z20.08 meters822.0 lert*ama-0.16(z-z)(1 z-zm)Plume Top-Patt Radius a71.50 meters122.4 leftama-0.16(z-z)(1 z-zm)Vertical VelocityX.32Nr11.2 leftMetersVertical Velocity5.30 meters5.30 metersUVertical Velocity(2 meters)USolve for Height above Stack zen Height above Ground zen/s5.30 metersJETMetersBEFORE TOUCHINSOricital VV < Top of										
Solve for plume-averaged vertical velocity         1,000. [set         304.8         meters above ground (<+h_a)         ()         ()	Multiple Plume Calculations					toden (	in todeny (		ing elevation	
Glues the following Height above Stack z         20.086 meters         224.6 [net:work]         REQUARE EQNS           Pump Top-Hat Radius a         71.500 meters         234.6 [net:work]         a=au-016(c;zus) if 32-sus)         a=au-016(c;zus) if 32-sus)           Vertical Velocity V         3.424 m/s         11.23 ft/sec         V=Voust) (V:zus) if 32-sus)         Testes           Solve for Height of CASC critical vertical velocity V <sub>ars</sub> JET         meters         JET         V=single plume values if s2-suss)         Critical VV < Top of the second velocity V = Voust) (V:zus) (V:zus) velocity velocity (V:zus) velocity velocity velocity (V:zus) velocity (V:zu		city at height	1,000.0	feet	304.8	meters abo	ve ground (			
Vertical Velocity V Balance Market N Balance Ma	Gives the following Height above Stack z	280.986	meters*	921.9	feet*	REGULAR	EQNS			
Vertical Velocity V Balance Market N Balance Ma	Plume Top-Hat Radius a	71.509	meters	234.6	feet	a=am+0.16	(z-z <sub>full</sub> ) if z:	>Z <sub>full</sub>		
Solve for high of CAS critical variableImage: A second of the	Vertical Velocity V	3.424	m/s	11.23	ft/sec					
Solve for high of CAS critical variableImage: A second of the						V'=Vtouch+(	V <sub>m</sub> -V <sub>touch</sub> )*	(z'-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> ) if z <sub>touch</sub> .	<z<z<sub>full</z<z<sub>	
Solve for Height of CASC critical vertices in electron of the set of t										
Height above Ground z_ent he         JET         feet $z_{ent} z_{couch} + (z_{tur - Z_{couch}})^* (V_{ent} - V_{souch}) if V_{ent} > V_{souch}) if V_{ent} > V_{souch} if$	Solve for Height of CASC critical vertical	velocity V <sub>crit</sub>	5.30	m/s					VV < Top of	
Table of MERGED Plume-Averaged Vertices acting at trucking Hight (bet) Height (bet) above stack Radius(m)       Vert.       V $_{uum}^{+}(Va)_{a}^{+}0.12F_{a}((z-z_{a})^{-}(6.25D-z_{a})^{+}))^{(2)}/a$ Begin Merging (bach) = 24.8       51.41       8.155       C2       Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"         Begin Merging (bach) = 24.8       S1.41       8.155       C2       Colspan="2"         20.6       S5.43       #WA       Colspan="2"       Colspan="2"         Colspan="2"        Colspan="2"       Colspan="2"         Colspan="2"        Colspan="2"         Colspan="2"        Colspan="2"      Colspan="2"         Colspan="2"        Colspan="2"         Colspan="2"          Colspan="2"         Colspan="2" <td cols<="" td=""><td>Find Height above Stack z<sub>crit</sub></td><td>JET</td><td>meters</td><td>JET</td><td>feet</td><td>Z<sub>crit</sub> = Z<sub>full</sub> -</td><td>⊦ {[n(V<sup>3</sup>a)<sub>ful</sub></td><td>/(V<sub>crit</sub>)<sup>3</sup>]-a<sub>m</sub>}/0.16 if V<sub>crit</sub><v<sub>m</v<sub></td><td></td></td>	<td>Find Height above Stack z<sub>crit</sub></td> <td>JET</td> <td>meters</td> <td>JET</td> <td>feet</td> <td>Z<sub>crit</sub> = Z<sub>full</sub> -</td> <td>⊦ {[n(V<sup>3</sup>a)<sub>ful</sub></td> <td>/(V<sub>crit</sub>)<sup>3</sup>]-a<sub>m</sub>}/0.16 if V<sub>crit</sub><v<sub>m</v<sub></td> <td></td>	Find Height above Stack z <sub>crit</sub>	JET	meters	JET	feet	Z <sub>crit</sub> = Z <sub>full</sub> -	⊦ {[n(V <sup>3</sup> a) <sub>ful</sub>	/(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> }/0.16 if V <sub>crit</sub> <v<sub>m</v<sub>	
Table of MERGED Plume-Averaged Vertices acting at trucking Hight (bet) Height (bet) above stack Radius(m)       Vert.       V $_{uum}^{+}(Va)_{a}^{+}0.12F_{a}((z-z_{a})^{-}(6.25D-z_{a})^{+}))^{(2)}/a$ Begin Merging (bach) = 24.8       51.41       8.155       C2       Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2"         Begin Merging (bach) = 24.8       S1.41       8.155       C2       Colspan="2"         20.6       S5.43       #WA       Colspan="2"       Colspan="2"         Colspan="2"        Colspan="2"       Colspan="2"         Colspan="2"        Colspan="2"         Colspan="2"        Colspan="2"      Colspan="2"         Colspan="2"        Colspan="2"         Colspan="2"          Colspan="2"         Colspan="2" <td cols<="" td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>rit&gt;Vm</td></td>	<td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>rit&gt;Vm</td>									rit>Vm
Height (feet) above ground above stack Radius(m)Plume Vort. $V_{prime} = ((Va)_{*}^{*} + 0.12F_{4}(2x-2_{*})^{2} (6.25D - 2_{*})^{1})^{1/2} / 8$ Begin Merging (touch) = 246.8S1.418.1552.24 $\Theta_{p} = \Theta_{4}(t + (1 - (a)_{d})_{0}) (V_{min} D^{2} (4V_{plume} \pi^{2} + \lambda^{2})))$ 260.055.43#NVA2.39Interpolated Layer Eqns20 ft Interva280.067.63#NVA2.80 $V = V_{buch} + (V_m - V_{buch})^* (2 \cdot z_{buch}) (2 \cdot um - 2 \cdot um - 1)^{1/2} / 2 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um - 1 \cdot um - 1 \cdot um - 1)^{1/2} / 2 \cdot um - 1 \cdot um$	u de la companya de						,			
above ground         above stack         Return         Vet(m/s)         a = 0.16( $z \cdot z_n$ )         (model)         (	Table of MERGED Plume-Averaged Vertical	Velocities sta	rting at Tou	uching Height	:	Single Plur	ne Eqns (s	ee Single Plume spreadshee	t)	
above ground         above stack         Return         Vet(m/s)         a = 0.16( $z \cdot z_n$ )         (model)         (	Height (feet)	(meters)	Plume	Vert.						
Begin Merging (touch) = 246.8         51.41         8.15         2.24 $\theta_{=}0_{1}(1+(1-(\theta_{e}0_{0}))^{V}(u_{ext}}C^{2}(X_{plum}^{*}a^{2}h^{3})))$ Verture (the polated Layer Eqns = 200)         201 Interval           280.0         61.53         #NA         2.60 $V=V_{ubouch}^{*}(V_m-V_{ubouch}^{*}(Z^{*}ztouch)/(Z^{*}utouch)^{*}(Z^{*}ztouch)/(Z^{*}utouch)/(Z^{*}touch)/(Z^{*$										
1       1								$x_{it}D^2/(4V_{plume}*a^{2*}\lambda^2)))$		
1       1									20 ft Interva	
Second										
320.073.72#N/A3.04Image: second se										
340.0 $79.82$ $#NA$ $3.26$ $M$										
360.0 $85.91$ $#NA$ $3.47$ $M$										
380.0 400.092.01 98.11 $\#NA$ 3.69 $\#NV$ $mean (Marged Plume Eqns)$ End Merging (hull/mp) = 414.00102.37 42.9344.967 44.687 $Marged Plume Eqns$ $mean (Marged Plume Eqns)$ 450.0113.3544.687 44.6874.00 $V=(n(V^3a)_{tull}a)^{1/3}$ 50 ft Interval450.0113.3544.687 44.6874.00 $V=(n(V^3a)_{tull}a)^{1/3}$ 50 ft Interval500.0114.3349.65 3.6873.87 $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.01159.0752.0023.81 3.49 $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.01159.0752.0023.81 3.49 $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.01159.0752.0023.81 3.49 $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.01159.0752.0023.81 3.49 $maa (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.01159.0752.0023.81 3.82 $maa (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.0128.9971.5033.44 3.49 $maa (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ 600.0128.9971.5033.44 3.49 $maa (Marged Plume Eqns)$ $mean (Marged Plume Eqns)$ $maa (Marged Plume Eqns)$ 600.0220.0361.7553.60 $maa$										
400.0       98.11       #N/A       3.91       Merged Plume Eqns       Merged Plume Eqns         End Merging (full/mp) = 414.0       102.37       42.930       4.06       Merged Plume Eqns       500       500       500       500       500 $V=(n(V^3a)_{1/3})^{1/3}$ 500       500       500       500       113.35       44.687       4.00 $V=(n(V^3a)_{1/3})^{1/3}$ 500       500       500       500       1143.33       49.683       3.87 $V=(n(V^3a)_{1/3})^{1/3}$ 500       500       500       500       3.87 $V=(n(V^3a)_{1/3})^{1/3}$ $V=(n(V^3a)_{1/3})^{1/3}$ 500       500       100 ft Interval         1000000000000000000000000000000000000										
End Merging (full/mp) = 414.0102.3742.9304.06Merged Plume EqnsImage: Plane EqnsSo ft Interval450.0113.3544.6874.00 $\vee = (n(\sqrt{3}a)_{ndl})^{1/3}$ 50 ft Interval50 ft Interval500.0128.5947.1253.93 $a=a_m + 0.16(z \cdot z_{1ul})$ 50 ft Interval500.0143.8349.5633.87 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval600.0174.3154.4403.75 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval600.0174.3154.4403.75 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval700.0189.5556.8793.70 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval900.0220.0361.7553.60 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval100.0280.9971.5093.42 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval100.0280.9971.5093.42 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval1100.0311.4776.3863.35 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval120.0341.9581.2633.28 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval120.0341.9581.2633.28 $a=a_m + 0.16(z \cdot z_{1ul})$ 100 ft Interval120.0341.9591.0163.16 $a=a_m + 0.16(z \cdot z_{1ul})$ 500 ft Interval120.0343.3995.8933.10 $a=a_m + 0.16(z \cdot z_{1ul})$ 500 ft Interval120.0585.7910.2772.88 $a=a_m + 0.16(z \cdot z_$										
450.0113.3544.6874.00 $V=(n(V^3a)_{tull}/a)^{1/3}$ 50 ft Interval500.0128.5947.1253.93 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0143.8349.6533.87 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0159.0752.0023.81 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0159.0752.0023.81 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0159.0752.0023.81 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0159.0752.0023.81 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0174.3154.4403.75 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 600.0189.5556.6793.70 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 900.0220.0361.7553.60 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 900.0220.0361.7553.60 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 900.0280.9971.5093.42 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 1000.0311.4776.3863.28 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 1100.0311.4776.3863.28 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 1200.0372.4386.1393.22 $a=a_m+0.16(2-2_{tull})$ $a=a_m+0.16(2-2_{tull})$ 1400.0402.9191.0163.16 <td></td> <td></td> <td></td> <td></td> <td></td> <td>Merged Plu</td> <td>ıme Eqns</td> <td></td> <td></td>						Merged Plu	ıme Eqns			
128.59       47.125       3.93 $a=a_m+0.16(z-z_{tul})$ 150.0       143.83       49.63       3.87         60.0       159.07       52.02       3.81       1         660.0       174.31       54.440       3.75       1       1         660.0       174.31       54.440       3.75       1       1       100 ft Interv         700.0       189.55       56.879       3.70       1       100 ft Interv       100 ft Interv         800.0       220.03       61.755       3.60       1       1       100 ft Interv         900.0       220.03       61.755       3.61       1       1       100 ft Interv         900.0       220.03       61.755       3.62       3.61       1       1       100 ft Interv         1000.0       280.99       71.509       3.42       1									50 ft Interva	
143.83       49.563       3.87 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></td<>										
600.0       159.07       52.002       3.81										
650.0       174.31       54.440       3.75       0       100 ft Interv         700.0       189.55       56.879       3.70       0       100 ft Interv         800.0       220.03       61.755       3.60       0       0       100 ft Interv         900.0       250.51       66.632       3.51       0										
189.55       56.879       3.70       100 ft interv         800.0       220.03       61.755       3.60       66.87       6.67       <										
800.0       220.03       61.755       3.60									100 ft Interv	
900.0       250.51       66.632       3.51										
1000.0       280.99       71.509       3.42         1100.0       311.47       76.386       3.25         1200.0       314.95       81.263       3.26         1300.0       372.43       86.139       3.22         1400.0       402.91       91.016       3.16         1500.0       433.39       95.893       3.10         1500.0       585.79       120.277       2.88         1500.0       738.19       144.661       2.71         3000.0       890.59       169.045       2.57         3000.0       1042.99       193.429       2.46         4000.0       1195.39       217.813       2.36										
1100.0       311.47       76.386       3.35										
1200.0       341.95       81.263       3.28	1000.0									
1300.0       372.43       86.139       3.22         1400.0       402.91       91.016       3.16       500 ft Interv         1500.0       433.39       95.893       3.10       500 ft Interv         2000.0       585.79       120.277       2.88       500 ft Interv         3000.0       895.99       144.661       2.71       500 ft Interv         3000.0       1895.99       193.429       2.46       500 ft Interv         4000.0       1195.39       217.813       2.36       500 ft Interv										
1400.0     402.91     91.016     3.16     6     6     600 ft Interv       1500.0     433.39     95.893     3.10     500 ft Interv     500 ft Interv       2000.0     585.79     120.277     2.88     6     6       2500.0     738.19     144.661     2.71     6     6       3000.0     890.59     169.045     2.57     6     6       3500.0     1042.99     193.42     2.46     6     6       4000.0     1195.39     217.813     2.36     6     6	1100.0	341.95								
1500.0       433.39       95.893       3.10       500 ft Interv         2000.0       555.79       120.277       2.88       2.88       2.000         2500.0       738.19       144.661       2.71       2.88       2.000       2.000         3000.0       890.59       169.045       2.57       2.57       2.46       2.50       2.56         3000.0       1042.99       193.429       2.46       2.36       2.36       2.36       2.36	1100.0 1200.0	070	86.139							
2000.0     585.79     120.277     2.88       2500.0     738.19     144.661     2.71       3000.0     890.59     169.045     2.57       3500.0     1042.99     193.429     2.46       4000.0     1195.39     217.813     2.36	1100.0 1200.0 1300.0			3.16						
2500.0     738.19     144.661     2.71       3000.0     890.59     169.045     2.57       3500.0     1042.99     193.429     2.46       4000.0     1195.39     217.813     2.36	1100.0 1200.0 1300.0 1400.0	402.91							500 ft Interv	
3000.0         890.59         169.045         2.57           3500.0         1042.99         193.429         2.46           4000.0         1195.39         217.813         2.36	1100.0 1200.0 1300.0 1400.0 1400.0 1500.0	402.91 433.39	95.893	3.10					000 11 11101 1	
3500.0         1042.99         193.429         2.46           4000.0         1195.39         217.813         2.36	1100.0 1200.0 1300.0 1400.0 1500.0 2000.0	402.91 433.39 585.79	95.893 120.277	3.10 2.88						
4000.0 1195.39 217.813 2.36	1100.0 1200.0 1300.0 1400.0 1500.0 2000.0 2500.0 2500.0	402.91 433.39 585.79 738.19	95.893 120.277 144.661	3.10 2.88 2.71						
	1100.0 1200.0 1300.0 1400.0 2500.0 2500.0 3000.0 3000.0	402.91 433.39 585.79 738.19 890.59	95.893 120.277 144.661 169.045	3.10 2.88 2.71 2.57						
4500.0 1347.79 242.197 2.28	1100.0 1200.0 1300.0 1400.0 2000.0 2500.0 3000.0 3000.0	402.91 433.39 585.79 738.19 890.59 1042.99	95.893 120.277 144.661 169.045 193.429	3.10 2.88 2.71 2.57 2.46						
	1100.0 1200.0 1300.0 1400.0 2000.0 2500.0 3500.0 3500.0	402.91 433.39 585.79 738.19 890.59 1042.99	95.893 120.277 144.661 169.045 193.429	3.10 2.88 2.71 2.57 2.46						



MERGED (along width) Plume Average Vertic			ioyant Plumes					
	"The Evalua						/arious Heights in the Merg	
		Plume	from Two Gas				, Queensland, Australia ," [	
Ambient Conditions:					Constants:		eutral conditions (dθ/dz=0 or	$\theta_a = \theta_e$ )
Ambient Potential Temp $\theta_a$ Plume Exit Conditions:	302.21	Kelvins	84.3	*F	Gravity g		meters/feet m/s <sup>2</sup>	
Stack Height hs	23.81	meters	78 2/12	feet-inches	διανιτγ φ	1.11	m/s	
Individual Stack Diameter D	3.86213661			inches	λο	~1.0		
Stack Velocity Vexit	8.06			ft/sec	4Vol/(60πD			
Individual Volumetric Flow	94.44	cu.m/sec	200,110		$\pi V_{exit} D^2/4$	,		Sect.2/¶1
Stack Potential Temp θ <sub>s</sub>		Kelvins	104.3					
Initial Stack Buoyancy Flux Fo	10.45	m <sup>4</sup> /s <sup>3</sup>	20.0	ΔT(°F)	gV <sub>exit</sub> D <sup>2</sup> (1-6	$_{\rm a}/\Theta_{\rm s})/4 = V$	ol.Flow(g/π)(1-θ <sub>a</sub> /θ <sub>s</sub> )	Sect.2/¶1
Plume Buoyancy Flux F	N/A	m <sup>4</sup> /s <sup>3</sup>			$\lambda^2 g V a^2 (1 - \theta_a)$	/θ <sub>p</sub> ) for a,V	,θ <sub>p</sub> at plume height (see belo	w)
Total Number of Stacks n	48							
Average Adjacent Stack Separation d	7.50	meters	24.6	feet			e plume treatment in Peter Be	
Number of Stacks along Orientation N	16						used by N <sup>0.25</sup> at the height whe	
					fully merged	d (interp. be	low ht, single merged stack a	bove ht)
Conditions at End (Top) of Jet Phase:								
Height above Stack z <sub>jet</sub>		meters*	79.2		$z_{jet} = 6.25D$	, meters*=	meters above stack top	Sect.3/¶1
Height above Ground zjet+hs	47.952		157.3					
Vertical Velocity V <sub>jet</sub>	4.031	m/s meters	13.22 25.3	ft/sec	$V_{jet} = 0.5V_e$ $2a_{jet} = 2D$	$x_{it} = v_{exit}/2$	Conservation of momentum	
Plume Top-Hat Diameter 2a <sub>jet</sub>	7.724	meters	25.3	reet	$2a_{jet} = 2D$		Conservation of momentum	
nillene Methodelene Anelutical Colutioned			Diverse Listentet				_	
Spillane Methodology - Analytical Solutions								
Single Plume-averaged Vertical Velocity								Sect 2/Ea 6
Single Plume Values: Plume Top-Hat Radius a			e Merging Onl				r increase with height	Sect.2/Eq.6
Virtual Source Height zv		meters*		feet*	$z_v = 6.25D[$	1-(θ <sub>e</sub> /θ <sub>s</sub> ) <sup>1/2</sup>	, meters*=meters above stack top	
Height above Ground z <sub>v</sub> +h <sub>s</sub>		meters	79.5 Morging Opl		(0.(-) 3		where $(\theta_a/\theta_s)^{1/2} = (\theta_e/\theta_s)^{1/2} =$	
Single Plume Values: Vertical Velocity V		-	e Merging Onl	y			,) <sup>2</sup> - (6.25D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>(1/3)</sup> / a	Sect.2.1(6)
Product (Va) <sub>o</sub>	15.289	m*/s			V <sub>exit</sub> (D/2)(θ <sub>e</sub>	s/⊎s)``*		
Rumo Morging Develop Club Divert	oulot'							Sect 2/52
Plume Merging - Based on Single Plume Cal				6	0-		2)	Sect.3/¶3
Begin Merging Plume Top-Hat Diameter 2atouch		meters	24.6		2a <sub>touch</sub> =d, (			
Height above Stack z <sub>touch</sub>		meters*	78.3		$Z_{touch} = Z_v +$	u/(∠*0.16),	meters*=meters above stack	стор
Height above Ground z <sub>touch</sub> +h <sub>s</sub>		meters	156.4		V	-) 3	F <sub>o</sub> [ (z-z <sub>v</sub> ) <sup>2</sup> - (6.25D-z <sub>v</sub> ) <sup>2</sup> ]} <sup>(1/3)</sup>	12
Vertical Velocity V <sub>touch</sub>	4.071		13.4 369.1	ft/sec				
Total Merging Plume Top-Hat Diameter 2afull							all=d(N-1)/2) FOR 2 STACKS,	
Height above Stack z <sub>full</sub> Height above Ground z <sub>full</sub> +h <sub>s</sub>	351.994 375.808		1154.8 1233.0		$z_{full} = z_v + 2e$	ur(∠ 0.16),	meters*=meters above stack	юр
						3 0 105	$[(z_{full}-z_y)^2 - (6.25D-z_y)^2]^{(1/3)}$	
Vertical Velocity V <sub>full</sub>	0.961	m/s m <sup>4</sup> /s <sup>3</sup>	3.2	ft/sec	$v_{full} = \{(va)$	o + 0.12⊢c	[ (Z <sub>full</sub> -Z <sub>v</sub> ) - (6.25D-Z <sub>v</sub> ) ]}	/ a <sub>full</sub>
Product (V <sup>3</sup> a) <sub>full</sub>			ada in Maan	ad Diverse a	alaulatiana (			
Conditions at End (Top) of Merging Phase - D				ea Plume c			z <sub>full</sub> )), or linear increase with	h = : = h 4
Merged Plume Values: Plume Diameter 2a	148.058		Table Below 485.8	64			here Total Merging Occurs	neigni
Revised Merged Plume Radius am Revised Merged Plume Velocity Vm	148.058 2.529			feet ft/sec			here Total Merging Occurs	
Revised Virtual Source Height z <sub>full</sub>	351.994		1154.8				ere Total Merging Occurs (sh	
Revised Vertical Velocity V			Tables Below	leet			eights above total merging el	
Revised Venical Velocity V	3	Juuons m	Tables Below				z-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> )	evalion
Multiple Plume Calculations					v = v <sub>touch</sub> +(v	m <sup>v</sup> touch) (	for heights below total mergi	ing algorition
Solve for plume-averaged vertical veloc	ity at beight	1,000.0	feet	304.8	meters abo	e around (		ing elevation
Gives the following Height above Stack z	280.986		921.9				MERGING PHASE-INTERPO	
Plume Top-Hat Radius a		meters	921.9 #N/A		a=a <sub>m</sub> +0.16(			
Vertical Velocity V	#IN/A 2.863			ft/sec	$V = \{n(V^3 a)_{fu}\}$			
venical velocity v	2.003	m/s	9.39	il/sec				
							Z'-Ztouch)/(Zfull=Ztouch) if Ztouch	<z<zfull< td=""></z<zfull<>
Solve for Height of CASC critical vertical	velocity V	5.30	m/c		BEFORE T		if z <z<sub>touch</z<sub>	VV < Top of Jet
Find Height above Stack z <sub>crit</sub>		meters	JET	feet			/(V <sub>crit</sub> ) <sup>3</sup> ]-a <sub>m</sub> }/0.16 if V <sub>crit</sub> <v<sub>m</v<sub>	vv < rop or set
-				feet				- V
Height above Ground z <sub>crit</sub> +h <sub>s</sub>	JEI	meters	JEI		-crit=∠touch+	v←tull=∠touch)	*(V <sub>crit</sub> -V <sub>touch</sub> )/(V <sub>m</sub> -V <sub>touch</sub> ) if V <sub>c</sub>	rit-•m
Table of MERGED Plume-Averaged Vertical V	elocities etc	rting at To-	uching Height		Sinale Dlum	ne Fans (o	ee Single Plume spreadsheel	t)
Height (feet)	(meters)	Plume	Vert.		-		v) <sup>2</sup> -(6.25D-z <sub>v</sub> ) <sup>2</sup> ] <sup>1/3</sup> / a	~
above ground					$v_{plume} = {(va)_{o}}$ a = 0.16(z-z		, (	
above ground Begin Merging (touch) = 156.4	above stack 23.86	Radius(m) 3.750	Vei(m/s) 4.07				<sub>xit</sub> D²/(4V <sub>plume</sub> *a <sup>2</sup> *λ <sup>2</sup> )))	
160.0	23.00	3.750 #N/A	4.07					20 ft Intervals
180.0	24.95	#N/A #N/A	4.07		Interpolated		z'-z <sub>touch</sub> )/(z <sub>full</sub> -z <sub>touch</sub> )	Lo it intervals
200.0	37.15	#N/A #N/A			• - • touch+(	• m <sup>-</sup> • touch) (	touch// (-tulitouch/	
200.0	43.24	#N/A #N/A						
240.0	49.34	#N/A						
240.0	55.43	#N/A						
300.0	67.63	#N/A						50 ft Intervals
350.0	82.87	#N/A						
400.0	98.11	#N/A						
450.0	113.35	#N/A						
	128.59	#N/A						
		#N/A						
500.0	143.83							
550.0	143.83 159.07	#N/A						
550.0 600.0	159.07	#N/A #N/A						
550.0 600.0 650.0	159.07 174.31	#N/A	3.36					
550.0 600.0 650.0 700.0	159.07 174.31 189.55	#N/A #N/A	3.36 3.29					
550.0 600.0 650.0 700.0 750.0	159.07 174.31 189.55 204.79	#N/A #N/A #N/A	3.36 3.29 3.22					100 ft Intervale
550.0 600.0 650.0 700.0 755.0 800.0	159.07 174.31 189.55 204.79 220.03	#N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15					100 ft Intervals
550.0 600.0 700.0 700.0 750.0 800.0 850.0	159.07 174.31 189.55 204.79 220.03 235.27	#N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08					100 ft Intervals
550.0 600.0 650.0 700.0 750.0 800.0 800.0 800.0 900.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51	#N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01					100 ft Intervals
550.0 600.0 650.0 700.0 750.0 8800.0 850.0 9900.0 955.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75	#N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93					100 ft Intervals
550.0 600.0 700.0 750.0 800.0 850.0 900.0 990.0 950.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99	#N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86					100 ft Intervals
550.0 600.0 650.0 700.0 750.0 800.0 850.0 900.0 990.0 990.0 1000.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47	#N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72					100 ft Intervals
550.0 600.0 600.0 700.0 750.0 880.0 880.0 900.0 990.0 990.0 1000.0 1100.0 1200.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58					100 ft Intervals
550.0 600.0 700.0 750.0 850.0 900.0 900.0 900.0 1000.0 1100.0 1100.0 1200.0 End Merging (full/mp) = 1233.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b>	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53		Merged Plu			100 ft Intervals
550.0 600.0 650.0 700.0 750.0 800.0 850.0 900.0 950.0 1000.0 1100.0 1200.0 <b>End Merging (full/mp) = 1233.0</b> 1300.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 <b>2.53</b>		V={n(V <sup>3</sup> a) <sub>fu</sub>	∥/a} <sup>1/3</sup>		100 ft Intervals
550.0 600.0 700.0 750.0 880.0 880.0 990.0 995.0 1000.0 1100.0 1200.0 <b>End Merging (full/mp) = 1233.0</b> 1300.0 1500.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43 433.39	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53 2.53 2.51 2.46			∥/a} <sup>1/3</sup>		
550.0 600.0 700.0 780.0 880.0 880.0 900.0 900.0 1000.0 1100.0 End Merging (full/mp) = 1233.0 1300.0 1300.0 2000.0	159.07 174.31 189.55 204.79 220.03 235.27 260.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43 433.39 585.79	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53 2.51 2.51 2.46 6 2.35		V={n(V <sup>3</sup> a) <sub>fu</sub>	∥/a} <sup>1/3</sup>		100 ft Intervals
550.0 600.0 700.0 7700.0 780.0 880.0 9900.0 9900.0 950.0 11000.0 1100.0 1200.0 End Merging (full/mp) = 1233.0 1300.0 1500.0 2000.0 2500.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43 433.39 585.79 738.19	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53 2.51 2.46 2.35 2.25		V={n(V <sup>3</sup> a) <sub>fu</sub>	∥/a} <sup>1/3</sup>		
550.0 600.0 700.0 750.0 850.0 850.0 900.0 950.0 1000.0 1100.0 1200.0 End Merging (full/mp) = 1233.0 1300.0 1500.0 2000.0 2500.0 3300.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43 433.39 585.79 788.19	#N/A #N/A #N/A #N/A #N/A #N/A #N/A 148.058 151.327 161.081 185.465 209.849 234.233	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53 2.51 2.46 2.35 2.25 2.25 2.25 2.25		V={n(V <sup>3</sup> a) <sub>fu</sub>	∥/a} <sup>1/3</sup>		
550.0 600.0 700.0 7700.0 780.0 880.0 9900.0 9900.0 950.0 11000.0 1100.0 1200.0 End Merging (full/mp) = 123.0 1300.0 1500.0 2000.0 2500.0	159.07 174.31 189.55 204.79 220.03 235.27 250.51 265.75 280.99 311.47 341.95 <b>352.00</b> 372.43 433.39 585.79 738.19	#N/A #N/A #N/A #N/A #N/A #N/A #N/A #N/A	3.36 3.29 3.22 3.15 3.08 3.01 2.93 2.86 2.72 2.58 2.53 2.51 2.46 2.35 2.25		V={n(V <sup>3</sup> a) <sub>fu</sub>	∥/a} <sup>1/3</sup>		





RMATION:					
2825 LAFAYETTE STREET NEW DATA CENTER					
T: CHAD MENDELL ENVIRONMENTAL SYSTEMS DES 233 SOUTH WACKER DRIVE, SUIT CHICAGO, ILLINOIS 60606	-				
312-372-1200 DIGITAL LAFAYETTE, LLC		DIC	GITAL	REA	LTY
2825 LAFAYETTE STREET SANTA CLARA, CA 95050-2627 NORTH PARCEL: 224-04-093			Data Cente		
NORTH PARCEL: 224-04-093 SOUTH PARCEL: 224-04-094 NORTH PARCEL: LOT 2					
SOUTH PARCEL: LOT 1 NORTH PARCEL: 93 SOUTH PARCEL: 94					
BOUNDED BY CENTRAL EXPRES		282	25 LAFAY	ETTE S	TREET
STREET (SITE) AND RAILROAD T 2805 LAFAYETTE STREET (DLR) SANTA CLARA: 1.78M POPULATIO TAX ASSESSOR'S PARCEL NUME	RACKS TO THE EAST, AND TO THE SOUTH COUNTY OF ON (2010 CENSUS)		SANTA C	김 아이지 않는 것	
MH - HEAVY INDUSTRIAL PROCESSING AND STORAGE USI	ES PERMITTED	MEP EN	IGINEER		
(MH - ZONING ORD 18.50.030) COMMERCIAL STORAGE AND WH	IOLESALE DISTRIBUTION				1
NORTH PARCEL: FLOOD ZONE X SOUTH PARCEL: FLOOD ZONE AF FRONT YARD 15'-0"	ł		E.		<b>ノ</b>
EACH LOT SHALL HAVE A ST OF NOT LESS THAN FIFTEEN		Er	nvironmental S	ystems Desi	ign, Inc.
SIDE YARD 15'-0" THE STREET SIDE YARD OF EXCLUSIVE OF THE FRONT Y		2		llinois 60606	
THAN FIFTEEN (15) FEET IN E REAR YARD 0'-0"				72.1200 Iglobal.com Io. 184-0008	92 IL
SETBACK ADJACENT TO NOI YARD FRONT, SIDE YARDS 10'-0"	N-RESIDEN HAL O' RÉAR	_			
A MINIMUM OF TEN FEET OF AND STREET SIDE YARDS, E	XCLUSIVE OF	ARCHIT	ECT		
CITY-PERMITTED DRIVEWAY DEVELOPED INTO AND PERM OPEN LANDSCAPED AREAS APPROVAL OF THE DIRECTO INSPECTION.	MANENTLY MAINTAINED AS SUBJECT TO THE			15	5
70 FT MAX HEIGHT (ZONING ORE MECH AND PARAPETS CAN BE F (ZONING ORD. 18.64.010). VARIAN ON FAA REGULATIONS.	PLACED ABOVE THIS BLE MAX. HEIGHT BASED		TURAL ENGINEER		
NORTH PARCEL: SOUTH PARCEL: TOTAL:	691,526.384 S.F. 299,683.550 S.F. 991,209.934 S.F. (22.755 ACRES)	STR	OPLES A		
P: BUSINESS GROUP B (CHA CONSTRUCTION: TYPE 2B (	OFFICE/ DATA CENTER PTER 3, SECTION 304) FULLY SPRINKLERED) HAPTER 6, TABLE 601)		imley	»He	orn
EXISTING BUILDING - 2805: DATA CENTER:	148,812 S.F.				
NEW BUILDING - 2825: DATA CENTER:	575,401 S.F.				
TOTAL:	724,213 S.F. 108,631 S.F.				
(209 869/	30 % 691,526.384 = 0.3034)				
(1 SPACE PER 4,000 S.F.) (575,401 S.F TOTAL PARKING REQUIRED: DATA CENTER (NEW): (14 D FOR BUILDING 2805: D FOR BUILDING 2825:	182 SPACES 44 + 38 = 182 SPACES) 76 SPACES 177 SPACES				
OVIDED:	253 SPACES				
RE <b>0</b> COMPACT PARKING STALLS ON QUIRED:	I THIS SITE.				
EW): (CLASS 1 - 5% OF 182 PARKING (CLASS 2 - 5% OF 182 PARKING					
OVIDED: EW):	CLASS 1 = 10 RACKS CLASS 2 = 10 RACKS				
N PARKING SPACES REQUIRED: EW): (6% OF 182 PARKING S N PARKING SPACES PROVIDED: EW):	STALLS) = 11 SPACES 11 SPACES				
S SPACES REQUIRED: EW): (8% OF 182 PARKING S	STALLS) = 15 SPACES				
B SPACES PROVIDED: EW):	15 SPACES				
NOTES:					
TALLED ON DESIGNATED FIRE DEPAR TO ELECTRICALLY AUTOMATIC POW /IDED WITH AN EMERGENCY BATTER L-SAFE DESIGN, ALLOWING THE GAT JSE OF SPECIAL KNOWLEDGE OR EG C GATES A DETECTOR/STROBE SWIT ALLOW EMERGENCY VEHICLES (E.G., LE MOUNTED STROBE LIGHT TOWAR ROBE SWITCH, WHICH IN TURN OVER TE. THE GATES SHALL BE EQUIPPED OPTICOM DETECTOR TO FACILITATE	VERED GATES. GATES AY POWER SUPPLY, OR E TO BE PUSHED OPEN OUIPMENT. TO CONTROL TCH SHALL BE , FIRE, POLICE, EMS) TO DS THE RIDES THE SYSTEM AND WITH A TOMAR STROBE				
AP					
		2	PCC ISSI		06.19.20
et i	Answers Noted S To 2 service to 2 service	NO.	RECO		DATE
SITE	Di Pa Lamana Aligo me u Li ra chi Sa construint Manazza Le vi andreazza Le vi		MASTE	R PLAN	
			PROPOS		w
	N.T.S.		SITE	PLAN	
	NORTH	PRINCI MC	PAL IN CHARGE	PROJECT 1 C190280	NUMBER
			CT MANAGER	DATE 06/19/2020	
		1	CT ENGINEER	SHEET NU	MBER
		SCALE AS NOT			1.1
			Copyright © 2019	by Environmental	Systems Design, I



Mail Processing Center Federal Aviation Administration Southwest Regional Office Obstruction Evaluation Group 10101 Hillwood Parkway Fort Worth, TX 76177

Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
58 feet above ground level (AGL) 99 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-45.50W	37-22-22.84N NAD 83	Santa Clara, CA	Building 2825 Lafayette A

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

# See attachment for additional condition(s) or information.

lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M. Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

noise from aircraft operating to and from the airport. The structure considered under this study lies in proximity to an airport and occupants may be subjected to

This determination expires on 11/07/2022 unless:

- (a) Construction or Alteration, is received by this office. the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual
- (b) extended, revised, or terminated by the issuing office.

(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12505-OE.

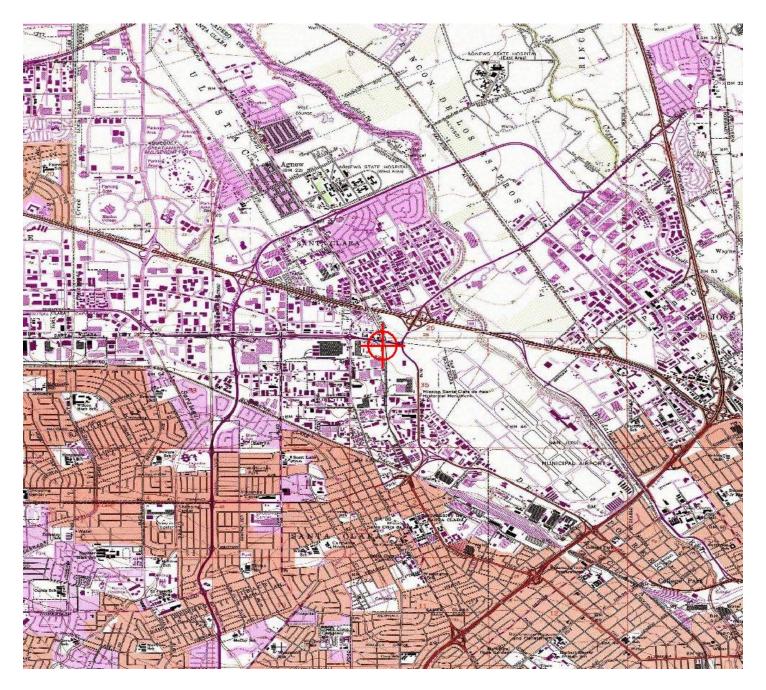
(DNE)

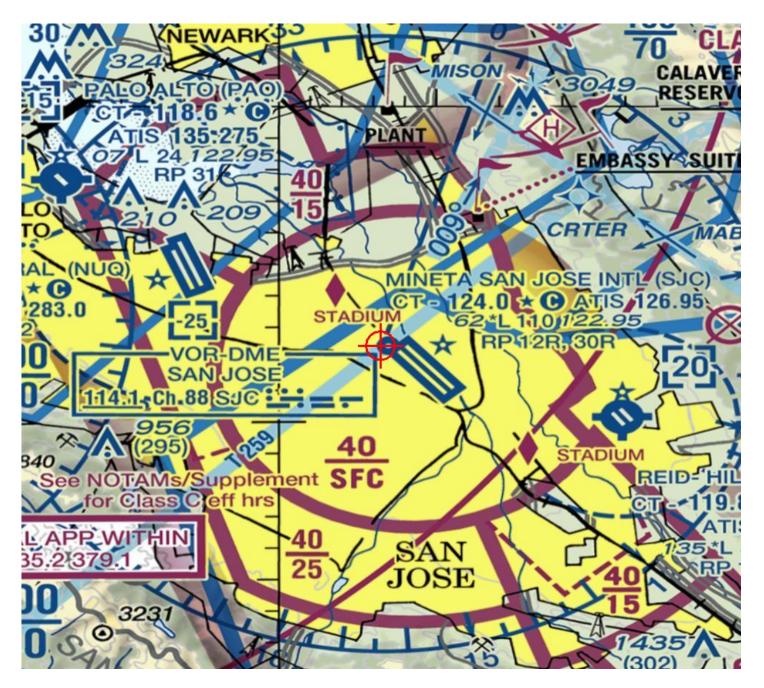
Signature Control No: 455757144-480154406 Daniel Shoemaker Specialist

Attachment(s) Additional Information Map(s)

### Additional information for ASN 2020-AWP-12505-OE

This building will be located in very close proximity to the threshold of the Norman Y. Mineta San Jose International Airport (SJC) Runway (RWY) 12R. Occupants and people outside the building will be exposed to frequent loud jet aircraft noise and the sight of large commercial aircraft operating at very low altitudes near the building.







Mail Processing Center Federal Aviation Administration Southwest Regional Office Obstruction Evaluation Group 10101 Hillwood Parkway Fort Worth, TX 76177

Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
65 feet above ground level (AGL) 106 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-45.99W	37-22-20.89N NAD 83	Santa Clara, CA	Building 2825 Lafayette B

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- (a) Construction or Alteration, is received by this office. the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual
- (b) extended, revised, or terminated by the issuing office.

(c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12506-OE.

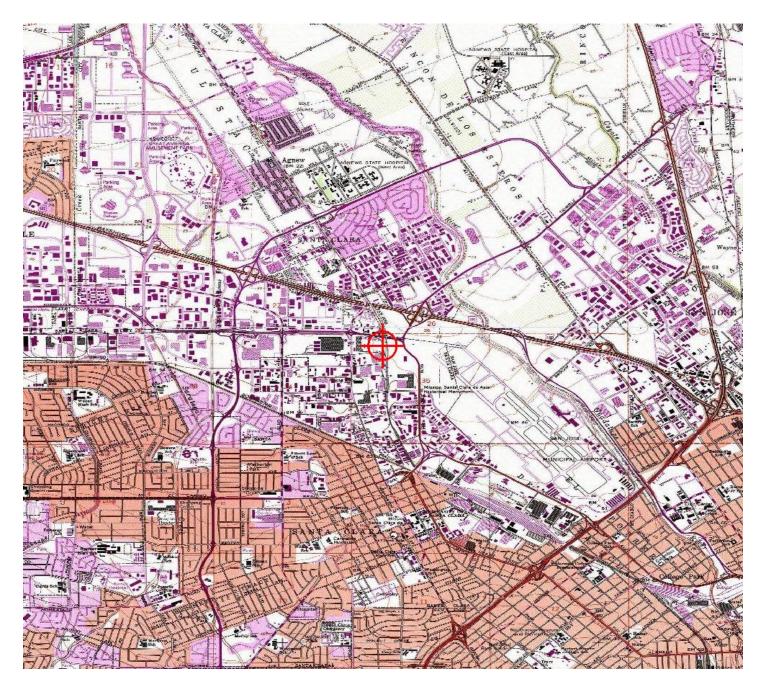
(DNE)

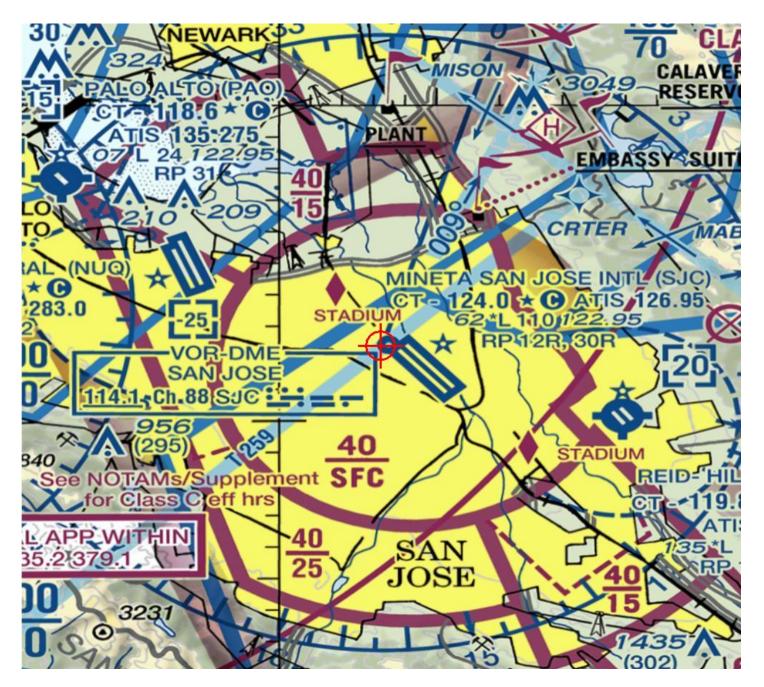
Signature Control No: 455757145-480154409 Daniel Shoemaker Specialist

Attachment(s) Additional Information Map(s)

### Additional information for ASN 2020-AWP-12506-OE

This building will be located in very close proximity to the threshold of the Norman Y. Mineta San Jose International Airport (SJC) Runway (RWY) 12R. Occupants and people outside the building will be exposed to frequent loud jet aircraft noise and the sight of large commercial aircraft operating at very low altitudes near the building.







Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
83 feet above ground level (AGL) 124 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-47.87W	37-22-24.05N NAD 83	Santa Clara, CA	Building 2825 Lafayette C

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

## See attachment for additional condition(s) or information.

circular 70/7460-1 M. lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

noise from aircraft operating to and from the airport. The structure considered under this study lies in proximity to an airport and occupants may be subjected to

adverse effect and would warrant a Determination of Hazard to Air Navigation. Any height exceeding 83 feet above ground level (124 feet above mean sea level), will result in a substantial

- (a) the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual Construction or Alteration, is received by this office.
- (b) extended, revised, or terminated by the issuing office.
- (c) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

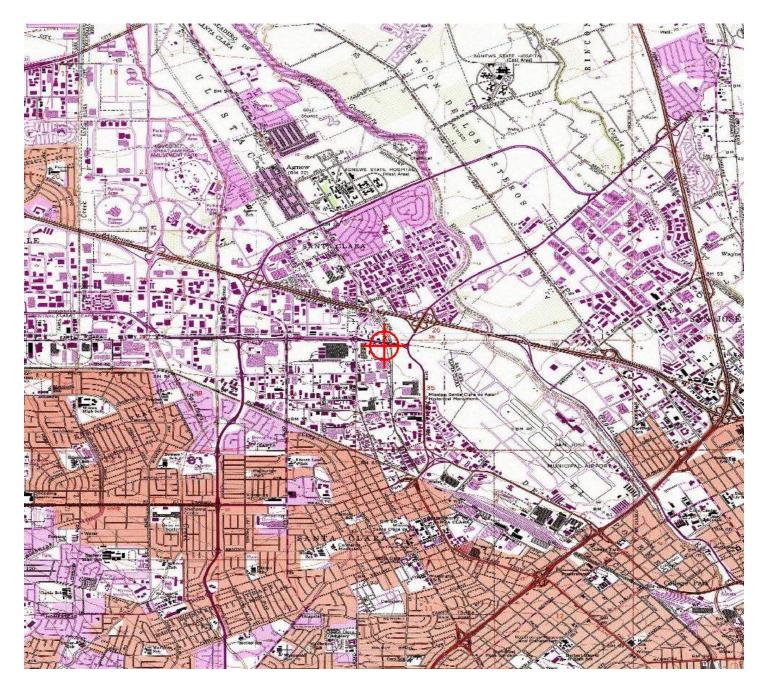
If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12507-OE.

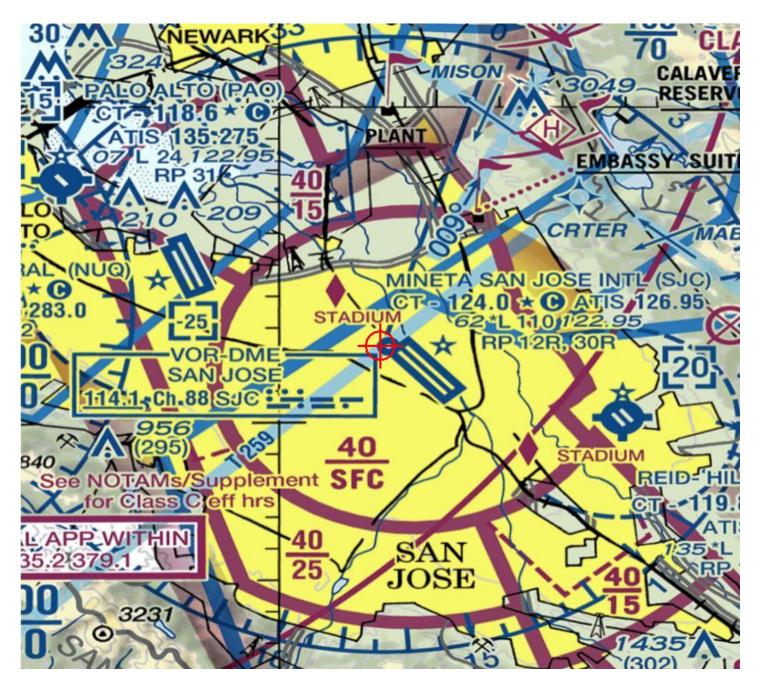
Signature Control No: 455757146-480154616 Daniel Shoemaker Specialist ( DNE )

### Additional information for ASN 2020-AWP-12507-OE

At the negotiated reduced height of 83 feet above ground level (AGL), 124 feet above mean sea level (AMSL), this corner of the building will be at the exact height of the Norman Y. Mineta San Jose International Airport (SJC) Runway (RWY) 12R/30L 14 CFR Part 77 transitional surface. At any height greater than 83 feet AGL/124 feet AMSL, this corner of the building would require circularization for public comment and red obstruction lighting.

### TOPO Map for ASN 2020-AWP-12507-OE







Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
77 feet above ground level (AGL) 118 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-57.39W	37-22-25.73N NAD 83	Santa Clara, CA	Building 2825 Lafayette D

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

## See attachment for additional condition(s) or information.

lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M. Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

noise from aircraft operating to and from the airport. The structure considered under this study lies in proximity to an airport and occupants may be subjected to

- (a) Construction or Alteration, is received by this office. the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual
- (b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

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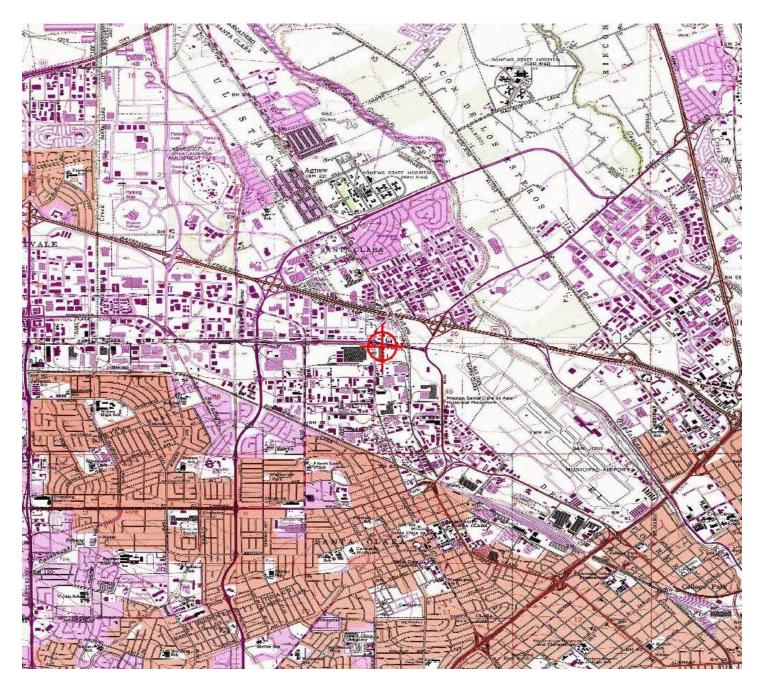
This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

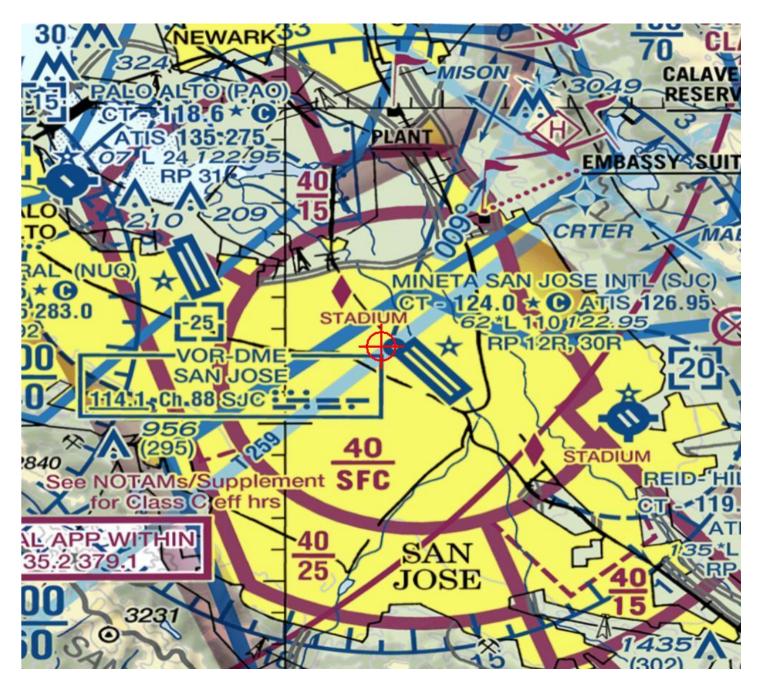
If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12508-OE.

(DNE)

Signature Control No: 455757147-480154408 Daniel Shoemaker Specialist

### Additional information for ASN 2020-AWP-12508-OE







Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
77 feet above ground level (AGL) 118 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-59.45W	37-22-23.12N NAD 83	Santa Clara, CA	Building 2825 Lafayette E

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

## See attachment for additional condition(s) or information.

lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M. Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

noise from aircraft operating to and from the airport. The structure considered under this study lies in proximity to an airport and occupants may be subjected to

- (a) Construction or Alteration, is received by this office. the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual
- (b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

If construction or alteration is dismantled or destroyed, you must submit notice to the FAA within 5 days after the construction or alteration is dismantled or destroyed.

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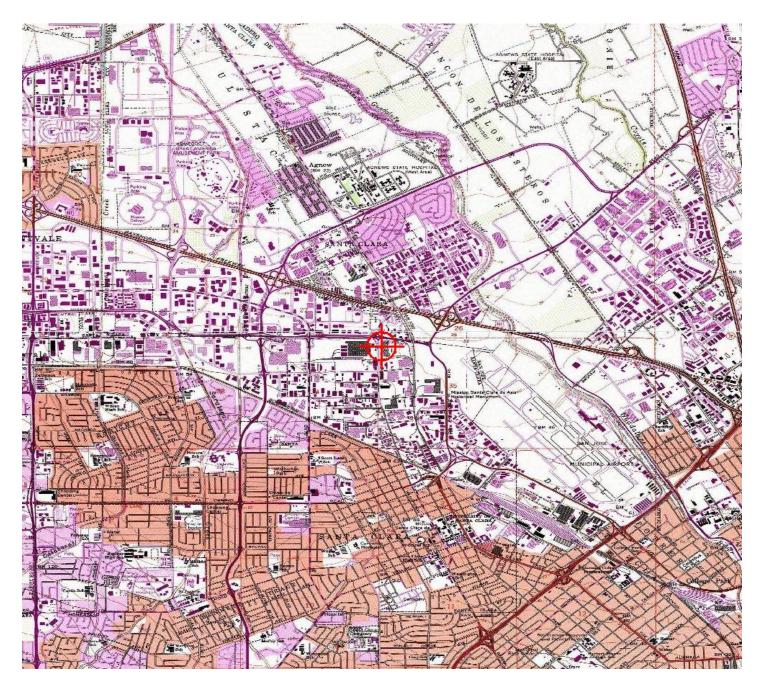
This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

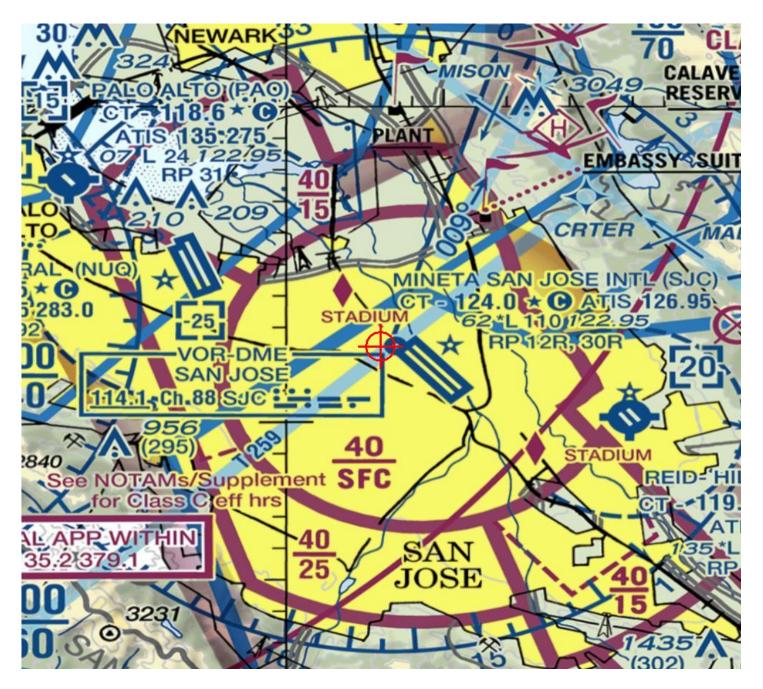
If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12509-OE.

(DNE)

Signature Control No: 455757148-480154410 Daniel Shoemaker Specialist

### Additional information for ASN 2020-AWP-12509-OE







Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
84 feet above ground level (AGL) 125 feet above mean sea level (AMSL)	41 feet site elevation (SE)	121-56-48.22W	37-22-23.40N NAD 83	Santa Clara, CA	Building 2825 Lafayette F

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

## See attachment for additional condition(s) or information.

lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M. Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

noise from aircraft operating to and from the airport. The structure considered under this study lies in proximity to an airport and occupants may be subjected to

- (a) Construction or Alteration, is received by this office. the construction is started (not necessarily completed) and FAA Form 7460-2, Notice of Actual
- (b) extended, revised, or terminated by the issuing office.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE E-FILED AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE. AFTER RE-EVALUATION OF CURRENT OPERATIONS IN THE AREA OF THE STRUCTURE TO DETERMINE THAT NO SIGNIFICANT AERONAUTICAL CHANGES HAVE OCCURRED, YOUR DETERMINATION MAY BE ELIGIBLE FOR ONE EXTENSION OF THE EFFECTIVE PERIOD.

This determination is based, in part, on the foregoing description which includes specific coordinates, heights, frequency(ies) and power. Any changes in coordinates, heights, and frequencies or use of greater power, except those frequencies specified in the Colo Void Clause Coalition; Antenna System Co-Location; Voluntary Best Practices, effective 21 Nov 2007, will void this determination. Any future construction or alteration, including increase to heights, power, or the addition of other transmitters, requires separate notice to the FAA.This determination includes all previously filed frequencies and power for this structure.

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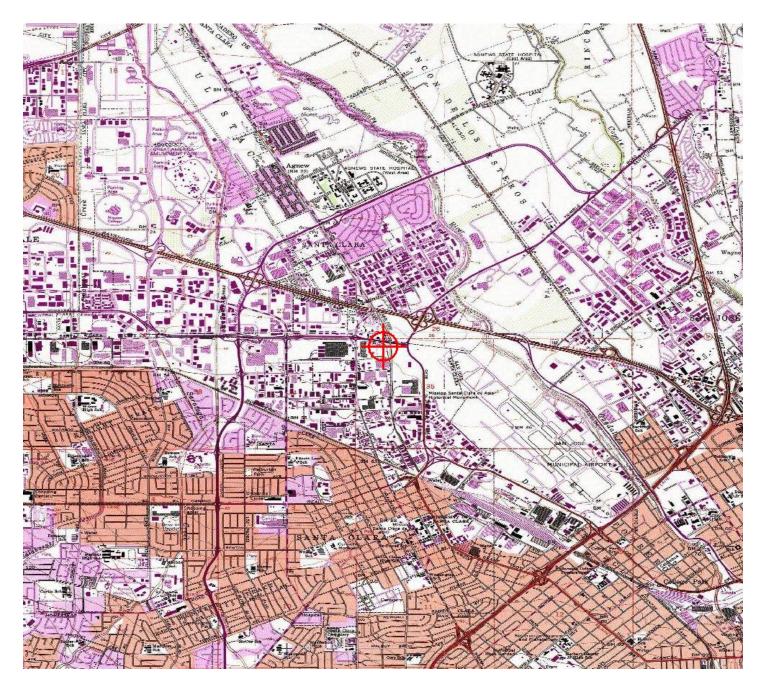
If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12510-OE.

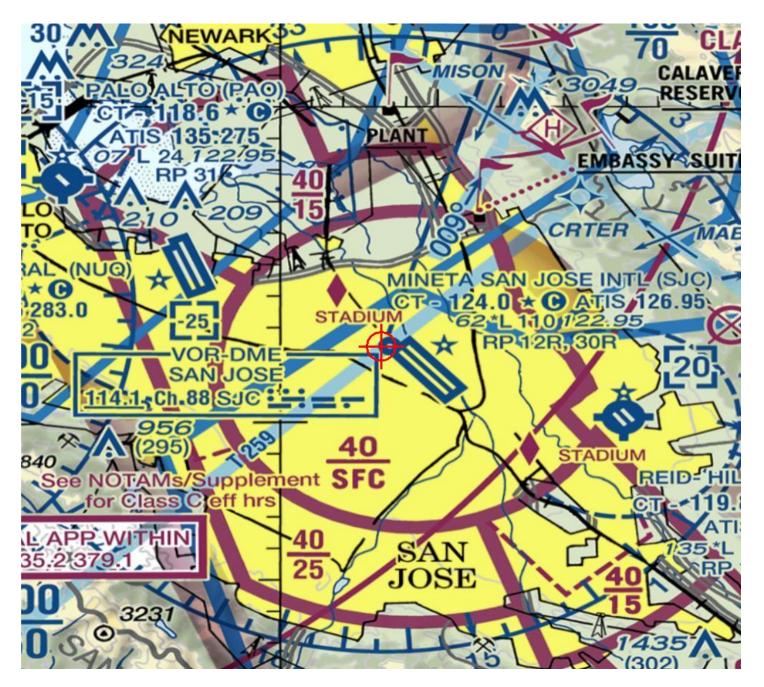
(DNE)

Signature Control No: 455757149-480154407 Daniel Shoemaker Specialist

### Additional information for ASN 2020-AWP-12510-OE

### TOPO Map for ASN 2020-AWP-12510-OE







Issued Date: 05/07/2021

Digital Realty Rafal Rak 9355 Grand Avenue Franklin Park, IL 60131

# **\*\* DETERMINATION OF NO HAZARD TO AIR NAVIGATION \*\***

Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning: The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C.,

	Heights:	Longitude:	Latitude:	Location:	Structure:
<ul><li>118 feet above ground level (AGL)</li><li>118 feet above mean sea level (AMSL)</li></ul>	41 feet site elevation (SE)	121-56-48.55W	37-22-22.38N NAD 83	Santa Clara, CA	Building 2825 Lafayette G

hazard to air navigation provided the following condition(s), if any, is(are) met: This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a

project is abandoned or: It is required that FAA Form 7460-2, Notice of Actual Construction or Alteration, be e-filed any time the

At least 10 days prior to start of construction (7460-2, Part 1)

× Within 5 days after the construction reaches its greatest height (7460-2, Part 2)

## See attachment for additional condition(s) or information.

lighting are accomplished on a voluntary basis, we recommend it be installed in accordance with FAA Advisory circular 70/7460-1 M. Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking/

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This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (206) 231-2989, or dan.shoemaker@faa.gov. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2020-AWP-12511-OE.

(DNE)

Signature Control No: 455757150-480154411 Daniel Shoemaker Specialist

### Additional information for ASN 2020-AWP-12511-OE

