



Airflow Testing Report

Prepared for

Portland Public Schools

August 2021





9700 SW Capitol Hwy, Suite 110
Portland, OR 97219
ameresco.com

PROJECT OVERVIEW

As part of the continuing process to ensure a safe return to in-person learning, Portland Public Schools has contracted with Ameresco to test the airflow and ventilation of all educational and office spaces in each school. The data is reviewed by both Ameresco and PPS personnel to identify any potential shortcomings in the airflow from the HVAC systems. To accomplish this task, Ameresco has partnered with a local NEBB certified Test-Adjust-Balance (TAB) firm, Neudorfer Engineers, who will measure the airflow to each zone with calibrated measurement equipment in accordance with current testing standards and procedures. As part of this effort, HVAC professionals will review the operation of the HVAC equipment serving every educational and office space in each school.

Ameresco is pleased to have partnered with PPS over the last decade as the district's Energy Services Company (ESCO) on six energy efficiency construction projects, four service projects, and numerous energy audits. Our partnership has resulted in reducing over 3,000 tons of CO₂ and other GHG emissions and over \$1,000,000 in utility cost savings per year. Ameresco appreciates this opportunity to play a small role in the safe reopening of schools.

About Ameresco, Inc.

Founded in 2000, Ameresco, Inc. (NYSE:AMRC) is a leading cleantech integrator and renewable energy asset developer, owner and operator. Our comprehensive portfolio includes energy efficiency, infrastructure upgrades, asset sustainability and renewable energy solutions delivered to clients throughout North America and the United Kingdom. Ameresco's sustainability services in support of clients' pursuit of Net Zero include upgrades to a facility's energy infrastructure and the development, construction, and operation of distributed energy resources. Ameresco has successfully completed energy saving, environmentally responsible projects with Federal, state and local governments, healthcare and educational institutions, housing authorities, and commercial and industrial customers. With its corporate headquarters in Framingham, MA, Ameresco has more than 1,000 employees providing local expertise in the United States, Canada, and the United Kingdom. For more information, visit www.ameresco.com.

Explanation of ASHRAE Total Effective Air Changes per Hour (ACH_e) Calculation

ASHRAE has been updating their Building Readiness document to reflect the most current understanding in the engineering community for how to operate and maintain buildings during the pandemic. Their update on 4/27/2021 provided an explanation of the impact air filters and air cleaning devices have on the air in buildings. They provided the methodology, formulas, and an Excel-based tool for determining the equivalent outside air a space is receiving by having a mix of outside air, filtered recirculated air, and additional air filtration or cleaning devices in the room. Here is the explanation from ASHRAE:

Epidemic Conditions in Place



Equivalent Outdoor Air:

The equivalent outdoor air calculation indicates that the outdoor air can be calculated by using the combination of the actual outdoor air, impact of filtration or air cleaning technologies on recirculated air, and the impact of air cleaning technologies in the space.

This is using the principal of filters in series and the effectiveness at reducing particles. For items in series, the initial item would see the recirculated airflow to clean. The second item in the series would see the “cleaned” air from Item 1 and so the impact of Item 1 must be accounted for in Item 2.

As part of the airflow testing project that Portland Public Schools has partnered with Ameresco to complete, we are including the calculation of the Total Effective Air Changes per Hour (ACH_e) to show the impact of the air filtration that is active in nearly all spaces in the PPS schools. The formula for doing so is:

$$ACH_e = (ACH_{oa} + ACH_f) * E_z + ACH_{ir}$$

where:

- ACH_{oa} = air changes per hour of outside air = outside airflow in cubic feet per minute * 60 minutes per hour / room volume in cubic feet
- ACH_f = air changes per hour of clean air from filtered recirculated air with filters of the specified MERV rating as determined by ASHRAE
- E_z = Zone Air Distribution Effectiveness = how effective the HVAC system is at circulating and mixing the air to distribute the clean air throughout the room
- ACH_{ir} = the air changes per hour of clean air from portable air filters in the room = number of filters * CADR * 60 minutes per hour / room volume in cubic feet
 - CADR = Clear Air Delivery Rate = the CFM of clean air as specified by the manufacturer of the air filter

In order to include these calculations in the airflow testing reports, Ameresco and PPS have made the following assumptions as not all the variables are known:

1. PPS is in process of upgrading the air filters in their HVAC systems to MERV 13 and plans to be complete with that project for the start of the '21-'22 school year. In this report and for the sake of the ACH_e calculation, we are using the filters that are in place at the time of the measurements, so some of them are still MERV 8.
2. ASHRAE has guidelines for what should be used for the Zone Air Distribution Effectiveness (E_z) based on the HVAC system configuration, but they do not provide a value for every HVAC system and room configuration. For the majority of PPS rooms, an E_z of 0.8 – 1.0 would be most appropriate, so we have made the conservative assumption of using 0.8 for every space as that yields the lower ACH_e.
3. The CADR for a given air filter is from manufacturer ratings and is based on certain conditions (fan speed, particulate size, filter cleanliness, etc.) that change with operating conditions.



NEUDORFER ENGINEERS INC.

TEST REPORT TYPE: SURVEY REPORT

**Portland Public Schools Airflow Testing
Cesar Chavez ES
5103 N Willis Blvd, Portland, OR 97203**

Job Number: 2021-0297

Project Completion Date: 08/25/21

Revision Date:

-

Revision Number:

-



SEATTLE

5516 1st Avenue South
Seattle, Washington 98108
Phone (206) 621-1810
Fax (206) 343-9820

PORTLAND

2501 SE Columbia Way, Suite 230
Vancouver, Washington 98661
Phone (503) 235-8924
Fax (503) 235-8925



Neudorfer Engineers, Inc.

Consulting Engineers Seattle, Washington - Portland, Oregon



www.NeudorferEngineers.com

**Portland Public Schools Airflow Testing
Cesar Chavez ES**

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REPORT TITLE

CERTIFIED TEST: SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Cesar Chavez ES

NEI Job#: 2021-0297

Mechanical Engineer: NA

Architect: NA

HVAC Contractor: NA

TAB Firm: Neudorfer Engineers Inc
Test Engineer: Zach Mayer



5516 1st Ave South
Seattle, Washington 98108
Phone (206) 621-1810
Fax (206) 343-9820



2501 SE Columbia Way, Suite 230
Vancouver, Washington 98661
Phone (503) 235-8924
Fax (503) 235-8925

CERTIFICATION

Portland Public Schools Airflow Testing

The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. Any variances from design quantities, which exceed NEBB tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

Significant / Noteworthy Remarks are noted on the General Remarks and General Field Notes pages. Other remarks are noted on individual test sheets.

Noted deficiencies are not the TAB firms responsibility to repair. Prior to issuance of this report, Deficiency Reports are forwarded to our contracted agent.

Warranty is limited to one year from date of this report. Within that time, any discrepancies, ambiguities, or omissions found in this report will be retested, adjusted, or balanced as needed. A written notification will be required.

Submitted and Certified by:

NEBB TAB Firm: **Neudorfer Engineers Inc**

Certification No: **3414**

Expiration Date: **March 31, 2023**

Certification Date: **March 31, 2021**

(Date completed) **Signed and Sealed by:**

NEBB Supervisor: **Mike Vawter P.E.**

NEBB Supervisor: **Eric Stotts**





Neudorfer Engineers, Inc.

Consulting Engineers Seattle, Washington - Portland, Oregon



www.NeudorferEngineers.com

TERMS AND ABBREVIATIONS

Project: **Portland Public Schools Airflow Testing**

AC or ACU Air Conditioner or Air Conditioning Unit	HEPA High Efficiency Particulate Arrestance
AH or AHU Air Handler or Air Handling Unit	HP Horsepower
AVG Average	HVAC Heating Ventilation and Air Conditioning
BHP Brake Horsepower	HWS Heating Water Supply
CAV Constant Air Volume	HWR Heating Water Return
CBV Calibrated Balancing Valve (Circuit Setter)	HX Heat Exchanger
CC Cooling Coil	HZ Hertz, cycle per second
CD Ceiling Diffuser	in. inches
CFM Cubic Feet per Minute	in.w.g. inches of water gauge
CH Chiller	Kfactor Correction factor to the free area need to calculate CFM.
CHWS Chilled Water Supply	KW Kilowatts
CHWR Chilled Water Return	LAT Leaving Air Temperature
CP Circulating Pump	LWG Low Wall Grille
CR Ceiling Register	LWR Low Wall Register
CRAC Computer Room Air Conditioner	LWT Leaving Water Temperature
CRU Computer Room Unit	MAU Make-up Air Hanging Unit
CT Cooling Tower	MBH 1,000 BTUH
CU Condenser Unit	N/A Not Applicable
CUH Cabinet Unit Heater	OSA Outside Air
CWS Condenser Water Supply	OBD Opposed Blade Damper
CWR Condenser Water Return	ΔP Pressure Drop.
DAT Discharge Air Temperature	PH Phase
DB Dyr Bulb	PSI Pounds per Square Inch
DD Direct Drive	RA Return Air
DDC Direct Digital Controls: EMS Control System for the HVAC	RAD Radiator
Des. Design	RAT Return Air Temperature
Dia. Diameter	RF Return Fan
Disch. Discharge	RH Relative Humidity
EA Exhaust Air	RHC Reheat Coil
EAT Entering Air Temperature	RPM Revolutions per Minute
Economizer Controls and components that allow an air handler to logically utilize outdoor air for cooling as opposed to the use of mechanical cooling.	RTU Roof Top Unit
EF Exhaust Fan	SA Supply Air
EG Exhaust Grille	SAT Supply Air Temperature
EMCS Energy Management Control System	S.F. Service Factor
ERU Energy Recovery Unit	SF Supply Fan
E.S.P. External Static Pressure	SFD Smoke/Fire Damper
HRC Heat Recovery Coil	SP Static Pressure
EWT Entering Water Temperature	sq.ft. square feet
FCU Fan Coil Unit	Suct. Suction
FD Fire Damper	SWG Sidewall Grille
FLA Full Load Amperage: Maximum amperage a motor can draw.	SWR Sidewall Register
Flow Hood Instrument that captures air and converts the reading to CFM.	TAB Test; Adjust; and Balance
FHT Fume Hood Test	TSP Total Static Pressure: Difference between the entering and leaving static pressure of a fan.
FPB Fan Powered Box	UH Unit Heater
FPM Feet per Minute	VAV Variable Air Volume; box that contains a motorized damper that modulates airflow.
FR Field Report	VD Volume Damper
FT Foot, Feet	VFD Variable Frequency Drive
FTU Fan Terminal Unit	Velgrid Instrument that reads used to read velocity in feet per minute.
GPM Gallons per Minute	VVT Variable Volume Terminal
HC Heating Coil	WC Water Column
TDH Pressure Difference across the entering and leaving side of a pump.	W.G. Water Gauge
	WB Wet Bulb

INSTRUMENT CALIBRATIONS

Portland Public Schools Airflow Testing

Instrument Type	Air Data Meter with Flowhood	Instrument Serial #	M00475
Instrument Manufacturer	Shortridge	Calibration Date	11/4/2020
Instrument Model Number	ADM 870	Calibration Due	11/4/2021
Instrument Type	Differential Pressure Water Meter	Instrument Serial #	W14090
Instrument Manufacturer	Shortridge	Calibration Date	10/16/2020
Instrument Model Number	HDM-250	Calibration Due	10/16/2021
Instrument Type	Psychrometer	Instrument Serial #	8084305
Instrument Manufacturer	Extech	Calibration Date	10/13/2020
Instrument Model Number	RH390	Calibration Due	10/13/2021
Instrument Type	Tachometer	Instrument Serial #	B185B5022P
Instrument Manufacturer	Nidec	Calibration Date	10/11/2020
Instrument Model Number	MT-200	Calibration Due	10/11/2021
Instrument Type	Amp Probe	Instrument Serial #	33380179WS
Instrument Manufacturer	Fluke	Calibration Date	10/9/2020
Instrument Model Number	323 Clamp Meter	Calibration Due	10/9/2021
Instrument Type	Digital Thermometer	Instrument Serial #	45400509WS
Instrument Manufacturer	Fluke	Calibration Date	10/9/2020
Instrument Model Number	52 II	Calibration Due	10/9/2021
Instrument Type	Manometer	Instrument Serial #	M00475
Instrument Manufacturer	Shortridge	Calibration Date	11/4/2020
Instrument Model Number	ADM 870	Calibration Due	11/4/2021
Instrument Type	Thermal Anemometer	Instrument Serial #	AVM440742003
Instrument Manufacturer	Alnor Instruments	Calibration Date	11/9/2020
Instrument Model Number	AVM 440	Calibration Due	11/9/2021
Instrument Type	Ultrasonic Flow Meter	Instrument Serial #	N5K1435T
Instrument Manufacturer	Fuji	Calibration Date	10/14/2020
Instrument Model Number	Portaflow-C	Calibration Due	10/14/2021



PROJECT	Portland Public Schools Airflow Testing
LOCATION	Cesar Chavez ES; 5103 N Willis Blvd, Portland, OR 97203

REPORT SUMMARY

This project has been surveyed per plans and specifications using the National Environmental Balancing Bureau (NEBB) standards and procedures.

The scope of work for this project was to assess the current airflows for each classroom, office, and special purpose space. Air changes per hour were calculated along with the % of OSA for the spaces and any deficiencies found for each piece of equipment has been noted in the following report.

All ventilation equipment was commanded to run by the BMS system. Ventilation units were measured with a flowhood on the supply outlets. Outside air was recorded with a flowhood on the OSA louvre where accessible. AK factors were calculated from flowhood readings. The remaining OSA values were recorded with a velgrid. AHU supply air was recorded by a summation of the outlets as recorded by flowhood or velgrid when appropriate. Outside air was recorded with a velgrid or airfoil and calculated by the free area method.

The measured airflows in this report represent the performance of the equipment at the time of measurement, which vary over time based on operating conditions. There are factors outside the control of Neudorfer that impact airflow, and variance in those factors is expected and normal. One significant factor is the MERV rating and condition of the air filters on the equipment. During the summer of 2021, PPS began upgrading the filters on all their fan systems to MERV 13. Those upgraded filters are more effective at capturing particles but also impact the amount of airflow from the equipment. These filter changes were occurring while the airflow measurement project was happening, so some schools had the new filters, and some had the old filters at the time of measurement. On the data page included this report, there is a line stating whether or not the upgraded filters were in place at the time of measurement.

AIRFLOW SURVEY REPORT

Project:	Portland Public Schools Airflow Testing
Location:	Cesar Chavez ES; 5103 N Willis Blvd, Portland, OR 97203
Filter Status:	Not Upgraded

Room Floor Plan # (Actual #)	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH						Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter		
Lower Level 1																	
Rm 11	UV	UV	39.9	14.5	579	8.4	4,860	845	355	42%	10.4	4.4	1	9.4	6.2		
Rm 19	HV-02	FCU	33.0	35.1	1,158	8.0	9,266	1,435	150	10%	9.3	1.0	1	6.2	4.5		
Rm 19B	-	-	16.0	22.1	354	10.8	3,819	-	-	-	0	0	0	N/A	0.0	Storage rm, ventilation supplied from adjacent space	
Rm 19A	HV-01	FCU	29.8	39.1	1,165	8.5	9,904	1,250	180	14%	7.6	1.1	1	5.3	3.8		
Rm 23	FC-1-1	FCU	21.0	18.0	378	12.0	4,536	535	37	7%	7.1	0.5	1	10.9	7.5	Note #13	
Conf Rm 006	GYM unit	AHU	32.0	15.0	480	9.0	4,320	840	840	100%	11.7	11.7	1	12.9	9.3		
First Floor																	
Rm 101	UV	UV	30.6	22.3	683	12.2	8,333	735	60	8%	5.3	0.4	1	4.4	2.5		
Rm 101A	UV	UV	30.0	21.9	657	12.2	14,204	870	100	11%	3.7	0.4	1	2.9	1.8		
Rm 101B	-	-	17.2	10.9	187	12.2	6,356	-	-	-	0	0	1	2.5	0.0	Ventilation supplied from the adjacent space	
Rm 104	UV	UV	39.6	29.4	1,164	12.2	6,356	645	50	8%	6.1	0.5	1	5.3	2.9		
Rm 108	MZU-87-3	FCU	23.9	21.8	521	8.9	4,637	420	Unknown	Unknown	5.4	0	1	5.8	2.4	Note #1, Note #2, Note #3	
Rm 115	UV	UV	37.1	21.8	809	12.2	9,867	250	50	20%	1.5	0.3	1	2.4	0.8	Note #4	
Rm 165	UV	UV	29.1	22.0	640	12.0	7,682	390	0	0%	3.0	0.0	1	3.4	1.4	OSA damper may be closed	
Rm 169	UV	UV	29.1	22.0	640	12.0	7,682	320	0	0%	2.5	0.0	1	3.1	1.1	OSA damper may be closed	
Rm 170	UV	UV	37.0	22.0	814	12.0	9,768	445	0	0%	2.7	0.0	1	2.8	1.2	OSA damper may be closed	
Rm 171	MZU-87-2	FCU	34.5	24.5	845	9.5	8,030	290	78	27%	2.2	0.6	1	3.1	1.2	Note #7	
Rm 173	UV	UV	29.1	22.0	640	12.0	7,682	730	50	7%	5.7	0.4	1	4.7	2.7		
Rm 174	UV	UV	29.8	27.0	805	12.3	9,897	670	125	19%	4.1	0.8	1	3.7	2.1		
Office 116	MZU-87-4	FCU	16.8	14.0	235	10.4	2,446	265	24	9%	6.5	0.6	1	9.5	3.1	Note #6	
Conf Rm 117	MZU-87-4	FCU	14.4	9.7	140	10.2	1,425	170	15	9%	7.2	0.6	1	14.4	3.4	Note #6	
Office 118	MZU-87-4	FCU	12.2	10.3	126	9.0	1,131	135	12	9%	7.2	0.6	1	17.2	3.4	Note #6	
Conf Rm 119	MZU-87-4	FCU	14.3	11.7	167	10.2	1,707	190	17	9%	6.7	0.6	1	12.3	3.2	Note #6	
Office 122	MZU-87-4	FCU	8.3	7.4	61	9.0	553	65	6	9%	7.1	0.6	1	31.6	3.4	Note #6	

Date: 5/10/2021

Readings By: Davis / Mayer

AIRFLOW SURVEY REPORT

Project:	Portland Public Schools Airflow Testing
Location:	Cesar Chavez ES; 5103 N Willis Blvd, Portland, OR 97203
Filter Status:	Not Upgraded

Room Floor Plan # (Actual #)	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Office 123	MZU-87-4	FCU	14.7	9.9	146	10.1	1,470	175	16	9%	7.1	0.6	1	14.0	3.4	Note #6
Rm 124B	-	-	-	-	-	-	-	-	-	-	0	0	1	-	0.0	Room open to office so area added to RM 124
Conf Rm 124	VU&MZU-87-4	FCU&VU	30.6	28.6	875	10.0	8,752	800	72	9%	5.5	0.5	1	7.7	5.9	Note #6, room also served by UV
Rm 134A	MZU-87-3	FCU	8.3	10.3	85	10.3	881	70	Unknown	Unknown	4.8	0	1	18.3	0.6	Note #4
Rm 132	MZU-87-3	FCU	14.4	8.6	124	9.0	1,115	130	Unknown	Unknown	7.0	0	1	17.1	3.1	Note #4
Office 125	-	-	-	-	-	-	-	-	-	-	0	0	1	-	0.0	Office restroom
Conf Rm 128	-	-	-	-	-	-	-	-	-	-	0	0	1	-	0.0	Room open to office so area added to RM 124
Office 128A	-	-	-	-	-	-	-	-	-	-	0	0	1	-	0.0	Room open to office so area added to RM 124
Office 132	MZU-87-3	FCU	14.4	8.6	124	9.0	1,115	130	Unknown	Unknown	7.0	0	1	17.1	3.1	Note #4
Office 136	MZU-87-8	FCU	21.7	19.3	418	9.9	4,143	440	34	8%	6.4	0.5	1	6.8	3.0	
Office 152	MZU-87-5	FCU	12.0	10.0	120	9.0	1,080	70	14	20%	3.9	0.8	1	16.4	2.0	
Office 153	MZU-87-5	FCU	22.6	10.2	231	9.7	2,236	215	43	20%	5.8	1.2	1	10.0	3.0	
Conf Rm 163	MZU-87-2	FCU	15.9	14.1	224	10.4	2,332	115	31	27%	3.0	0.8	1	8.3	1.6	Note #7
Conf Rm 164	MZU-87-2	FCU	14.9	9.9	148	10.4	1,534	65	18	27%	2.5	0.7	1	11.5	1.4	Note #7
Office 192A	MZU-87-1	FCU	21.4	8.3	178	7.6	1,350	90	14	15%	4.0	0.6	1	13.5	2.0	Note #10
134	MZU-87-3	FCU	29.6	15.3	251	10.3	2,511	195	Unknown	Unknown	4.7	0	1	8.3	2.1	Note #4 & Note #5
135	MZU-87-8	FCU	27.8	10.7	297	9.8	2,915	125	10	8%	2.6	0.2	0	N/A	1.2	
135A	MZU-87-8	FCU	11.8	8.3	98	9.8	960	135	11	8%	8.4	0.7	0	N/A	4.0	
135B	MZU-87-8	FCU	12.1	9.1	110	9.8	1,079	135	11	8%	7.5	0.6	0	N/A	3.5	
Gym 137	Gym AHU	AHU	91.0	64.1	5,833	24.9	145,244	9,740	2,922	30%	4.0	1.2	1	2.3	2.2	
138	Locker Room	AHU	17.0	8.7	148	10.5	1,553	360	360	100%	13.9	13.9	1	21.2	11.1	
139	Locker Room	AHU	29.1	24.5	713	8.9	6,345	415	415	100%	3.9	3.9	1	5.6	3.1	
140	Locker Room	AHU	29.1	24.5	713	8.9	6,345	520	520	100%	4.9	4.9	1	11.3	8.9	

Date: 5/10/2021

Readings By: Davis / Mayer

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First Floor																
141	Locker Room	AHU	17.0	8.7	148	10.5	1,553	160	160	100%	6.2	6.2	1	15.0	4.9	
146	-	-	13.3	6.4	85	9.0	766	-	-	-	0	0	1	20.4	0.0	Ventilation is supplied from adjacent space
148	MZU-87-5	FCU	43.2	17.6	760	9.0	6,843	340	68	20%	3.0	0.6	1	3.8	1.5	
Library 151	MZU-87-5	FCU	46.2	49.8	2,298	25.4	58,381	1,960	392	20%	2.0	0.4	1	1.3	1.0	
158	-	-	14.4	9.1	131	10.4	1,363	-	-	-	0	0	1	11.4	0.0	Ventilation supplied from adjacent space
167	MZU-87-2	FCU	15.0	13.2	198	10.0	1,980	65	18	27%	2.0	0.5	1	8.9	1.1	Note #7
177A	-	-	10.1	10.9	110	9.0	991	-	-	-	0	0	0	N/A	0.0	Kitchen cooler
183	FC-87-1 & 2	FCU	41.6	20.4	848	9.0	7,634	10	Unknown	Unknown	0.1	0	1	2.1	0.0	Note #11
185	MZU-87-1	FCU	28.0	11.0	308	16.0	4,928	250	38	15%	3.0	0.5	0	N/A	1.5	Note #10
Cafeteria 186	MZU-87-1	FCU	57.0	53.8	3,067	25.0	76,665	3,575	536	15%	2.8	0.4	1	1.6	1.4	Note #10
189	-	-	7.2	8.3	60	7.7	460	-	-	-	0	0	1	33.9	0.0	Ventilation supplied from adjacent space
Second Floor																
Rm 200	UV	UV	27.9	21.8	608	12.3	7,481	920	65	7%	7.4	0.5	1	5.6	3.5	
Rm 203	UV	UV	27.6	21.8	602	12.3	7,401	355	0	0%	2.9	0.0	1	3.4	1.3	
Rm 206	UV	UV	29.9	21.9	655	12.4	8,120	440	45	10%	3.3	0.3	1	3.5	1.6	
Rm 214	UV	UV	22.3	21.9	488	12.3	6,007	555	50	9%	5.5	0.5	1	5.2	2.6	
Rm 215	UV	UV	30.0	21.8	654	12.3	8,044	525	465	89%	3.9	3.5	1	4.9	3.0	
Rm 218	UV	UV	45.3	21.8	988	12.4	12,245	550	155	28%	2.7	0.8	1	2.7	1.5	
Rm 221	UV&MZU-87-7	UV&FCU	37.3	22.5	839	12.3	10,323	490	125	26%	2.8	0.7	1	3.0	1.5	Note #8
Rm 236	MZU-87-6&UV	UV&FCU	37.7	22.0	829	12.3	10,202	915	Unknown	Unknown	5.4	0	1	3.9	2.4	Note #9, Rm is served from UV and MZU-87-6
Rm 237	UV	UV	29.9	22.3	667	12.3	8,201	260	0	0%	1.9	0.0	1	2.7	0.8	
Rm 238	UV	UV	29.9	22.0	658	12.3	8,091	295	115	39%	2.2	0.9	1	4.8	2.9	
Rm 242	UV	UV	29.9	22.0	658	12.3	8,091	710	85	12%	5.3	0.6	1	4.5	2.6	
Rm 248	UV	UV	29.3	22.3	653	12.3	8,037	175	0	0%	1.3	0.0	1	2.5	0.6	OSA damper may be closed

Date: 5/10/2021

Readings By: Davis / Mayer



Project:	Portland Public Schools Airflow Testing
Location:	Cesar Chavez ES; 5103 N Willis Blvd, Portland, OR 97203
Filter Status:	Not Upgraded

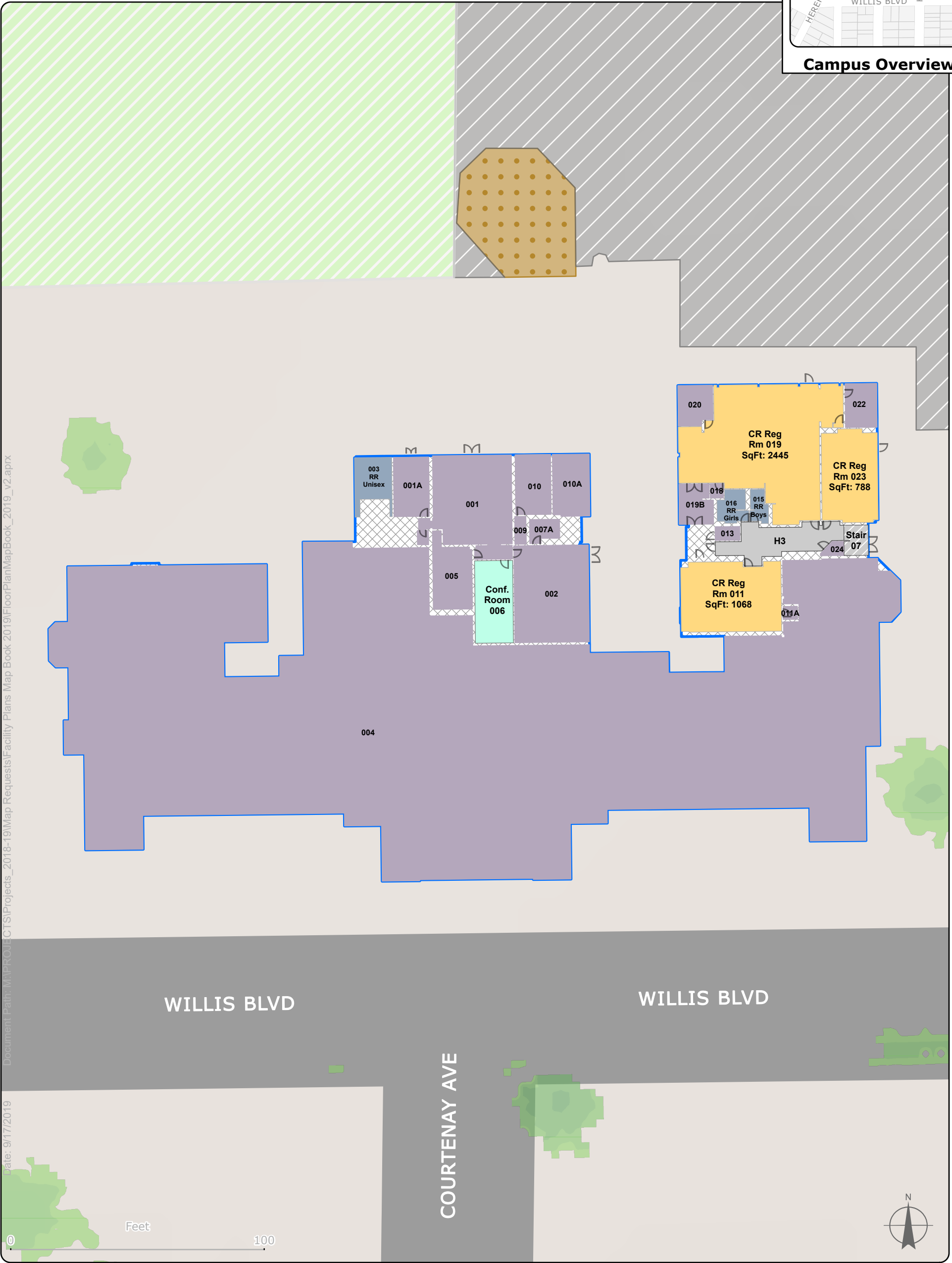
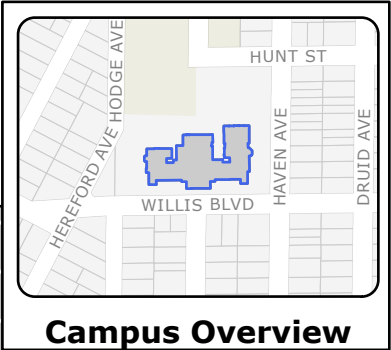
Date: 5/10/2021 Readings By: Davis / Mayer

Project: Portland Public Schools Airflow Testing

Location: Cesar Chavez ES; 5103 N Willis Blvd, Portland, OR 97203

NOTE #	NOTE DESCRIPTION
1	RM 104 : drop down in ceiling subtracts 884 ft3
2	RM 104 : UV runs uneven, ramping up then down
3	RM 104 : also has MZU-87-9 in the ceiling drop down. Unit was turned off at the disconnect and didn't turn on when commanded.
4	RM 108 : MZU-87-3 serves RM108, 3 hall GRDs, 3 hall restrooms, RM-132, RM-134 and RM-134A. total airflow 1265 CFM. OSA inlet is above hard lid and could not have a reliable reading taken.
5	Room 134 Measurements 10x14x10.3 & 19.6x5.3x10.3 = room volume 2511 ft
6	MZU-87-4 OSA measured 90 CFM
7	MZU-87-2 OSA measured 145 CFM
8	MZU-87-7 serves Rm 204, Rm 219, Rm 221A and the restroom adjacent. The total air flow is 440 CFM and the OSA measured 95 CFM
9	MZU-87-6 serves Rm 231, Rm 236, Rm 250, SW hall grille in the new addition and the restrooms adjacent. The total airflow for the unit is 1915 CFM and the OSA could not be measured due to the ductwork continuing over the hard lid in the restrooms.
10	MZU-87-1 serves the cafeteria, Rm 185, Rm 188, Rm 191, Rm 192A and Rm 194. Total airflow for the unit is 4,320 CFM and the OSA measured 665 CFM.
11	Rm 183 is the Kitchen. There are two Fan Coils that serve the space (FC-87-1 & FC-87-2) 87-2 not running at the time of the survey. FC-87-1 is supposed to be linked to the large kitchen hood as make-up and FC-87-2 to the dishwasher.
12	MZU-87-5 serves the library and rooms attached. The total supply air is 2585 CFM, OSA for the unit is 520 CFM.
13	FCU-1-1 serves RM 023, elevator vestibule and the hall adjacent. The total airflow for the unit is 7985 CFM and the OSA measured 570 CFM.

CHAVEZ: Lower Level 1



Space Use

- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

School Grounds

- Campus Footprints
- Athletic Field
- Playground: Paved
- Playground: Unpaved
- Streets
- Doors

Total Number Of Rooms By Classification

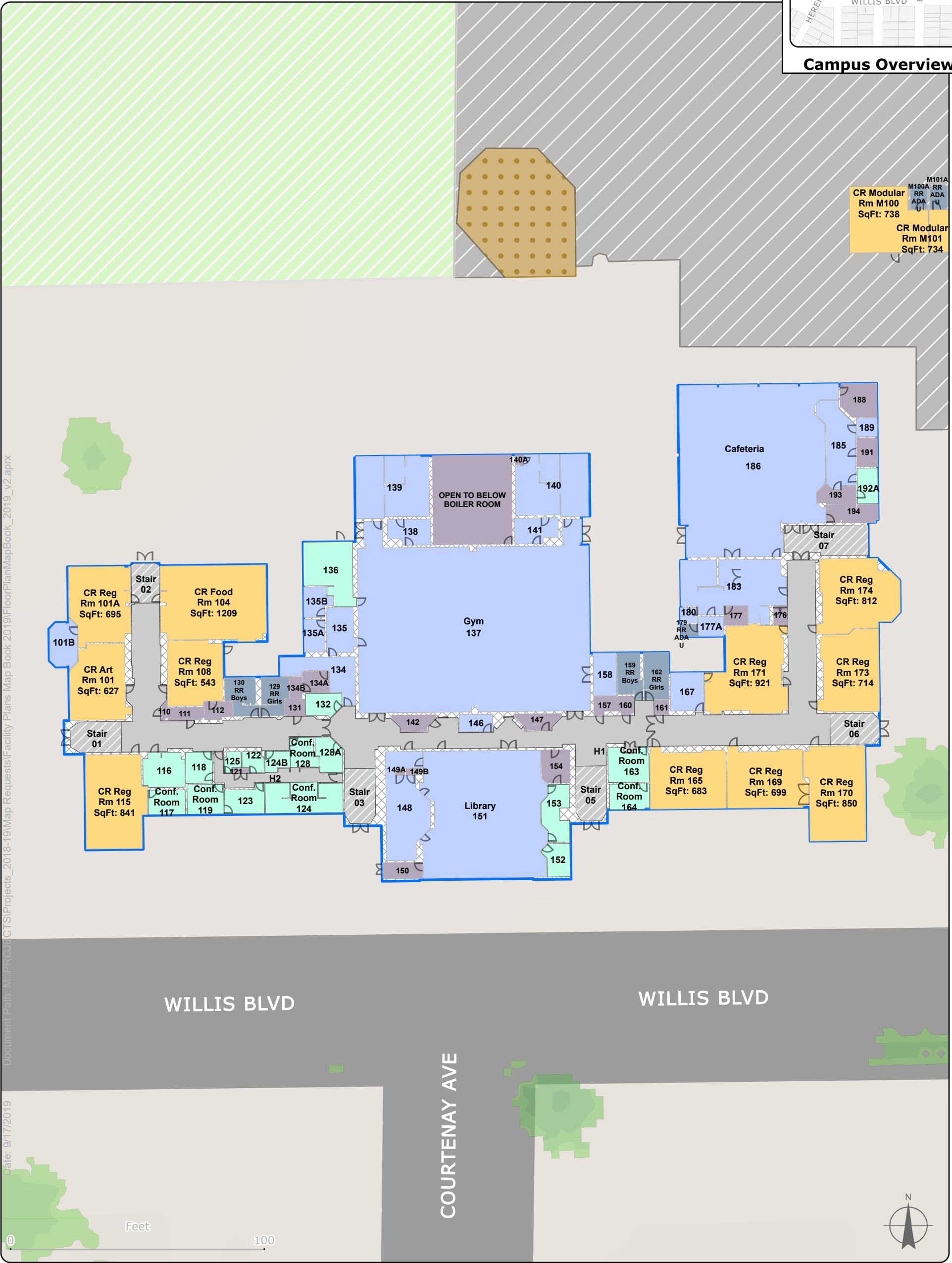
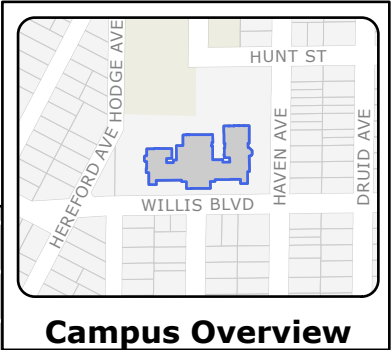
Classrooms: 3

Office Spaces: 1

Special Purpose: 0

Storage: 11

CHAVEZ: First Floor



Space Use

- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

School Grounds

- Campus Footprints
- Athletic Field
- Playground: Paved
- Playground: Unpaved
- Streets
- Doors

Total Number Of Rooms By Classification

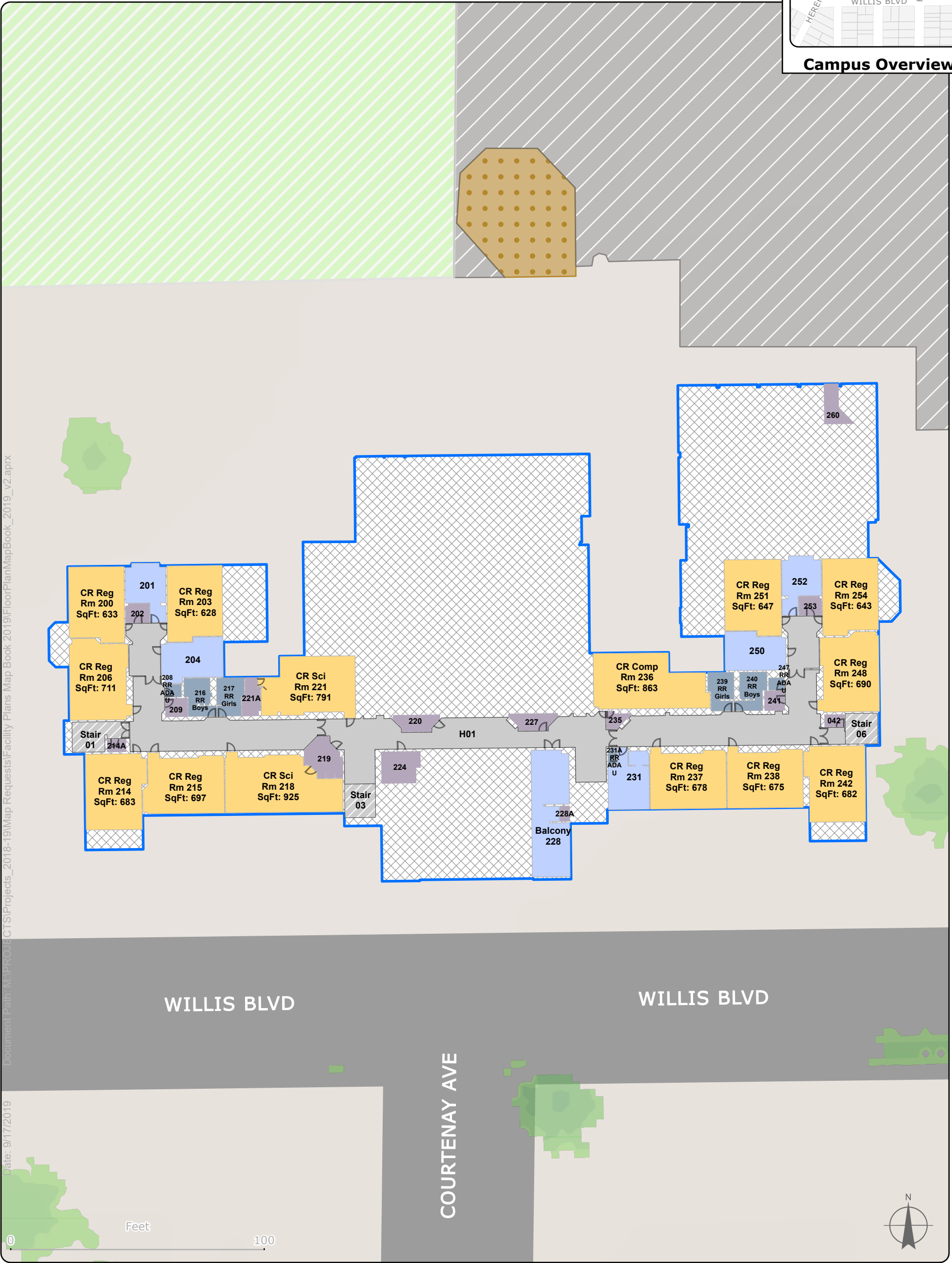
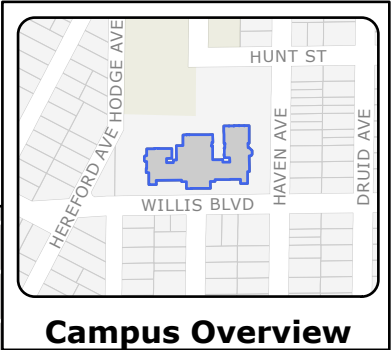
Classrooms: 11

Special Purpose: 21

Office Spaces: 18

Storage: 21

CHAVEZ: Second Floor



Space Use		School Grounds	
	Classroom		Campus Footprints
	Office		Athletic Field
	Rest Room		Playground: Paved
	Special Purpose		Playground: Unpaved
	Corridor		Streets
	Other		Doors
	Stairs/Elevator		

Total Number Of Rooms By Classification			
Classrooms: 14		Special Purpose: 6	
Office Spaces: 0		Storage: 11	