AMERESCO

Airflow Testing Report

Prepared for

Portland Public Schools

November 2021

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

PROJECT OVERVIEW

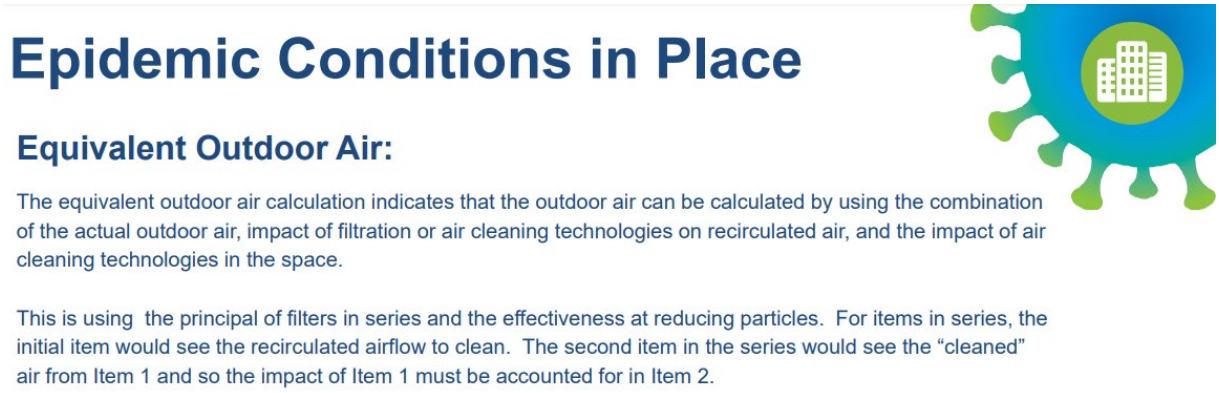
As part of the continuing process to ensure a safe return to in-person learning, Portland Public Schools has contracted with Ameresco to test the airflow and ventilation of all educational and office spaces in each school. The data is reviewed by both Ameresco and PPS personnel to identify any potential 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 CO_2 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:



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:

$$\mathrm{ACH_e} = \left(ACH_{oa} + ACH_f\right) * E_Z + ACH\_ir$$

where:

- $\mathrm{ACH_{oa}}$ = air changes per hour of outside air = outside airflow in cubic feet per minute * 60 minutes per hour / room volume in cubic feet
- $\mathrm{ACH_f}$ = 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.

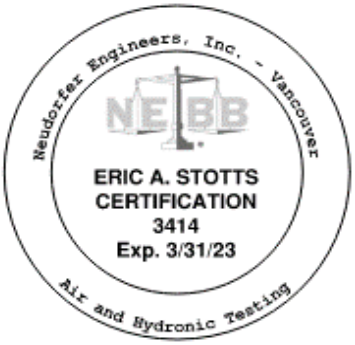
TEST REPORT TYPE:
SURVEY REPORT

Portland Public Schools Airflow Testing
Jackson MS

Job Number: 2021-0297

Project Completion Date: November 2021
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

Portland Public Schools Airflow Testing
Jackson MS
TABLE OF CONTENTS

Title Sheet	3
Report Certification	4
Terms	5
Instrument Calibration	6
Report Summary	7
Airflow Survey Report	8
TAB Notes	15
Floor Layout	16

REPORT TITLE

CERTIFIED TEST: SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Jackson MS

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**





TERMS AND ABBREVIATIONS

Project: **Portland Public Schools Airflow Testing**

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

INSTRUMENT CALIBRATIONS

Portland Public Schools Airflow Testing

Jackson MS

Instrument Type	Air Data Meter with Flowhood	Instrument Serial #	**M97410**
Instrument Manufacturer	**Shortridge**	Calibration Date	**10/4/2021**
Instrument Model Number	**ADM 860**	Calibration Due	**10/4/2022**

Instrument Type	Differential Pressure Water Meter	Instrument Serial #	**W12178**
Instrument Manufacturer	**Shortridge**	Calibration Date	**10/4/2021**
Instrument Model Number	**HDM-250**	Calibration Due	**10/4/2022**

Instrument Type	Psychrometer	Instrument Serial #	**181128924**
Instrument Manufacturer	**Extech**	Calibration Date	**10/1/2021**
Instrument Model Number	**RH390**	Calibration Due	**10/1/2022**

Instrument Type	Tachometer	Instrument Serial #	**B185B5022P**
Instrument Manufacturer	**Nidec**	Calibration Date	**10/1/2021**
Instrument Model Number	**MT-200**	Calibration Due	**10/1/2022**

Instrument Type	Amp Probe	Instrument Serial #	**33380179WS**
Instrument Manufacturer	**Fluke**	Calibration Date	**10/1/2021**
Instrument Model Number	**323 Clamp Meter**	Calibration Due	**10/1/2022**

Instrument Type	Digital Thermometer	Instrument Serial #	**45400509WS**
Instrument Manufacturer	**Fluke**	Calibration Date	**10/1/2021**
Instrument Model Number	**52 II**	Calibration Due	**10/1/2022**

Instrument Type	Manometer	Instrument Serial #	**M97410**
Instrument Manufacturer	**Shortridge**	Calibration Date	**10/4/2021**
Instrument Model Number	**ADM 860**	Calibration Due	**10/4/2022**

Instrument Type	Thermal Anemometer	Instrument Serial #	**AVM440808002**
Instrument Manufacturer	**Alnor Instruments**	Calibration Date	**9/22/2021**
Instrument Model Number	**AVM 440**	Calibration Due	**9/22/2022**

Instrument Type	Ultrasonic Flow Meter	Instrument Serial #	**N1F1823T**
Instrument Manufacturer	**Fuji**	Calibration Date	**9/20/2021**
Instrument Model Number	**Portaflow-C**	Calibration Due	**9/20/2022**

PROJECT Portland Public Schools Airflow Testing
LOCATION Jackson MS; 10625 SW 35th Ave, Portland, OR 97219

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: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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																
A01	H&V #12	AHU	41.9	63.4	3,114	11.6	36,122	3,640	0	0%	6.0	0.0	1	4.8	4.4	**Note #2.** Non-rectangular room.
A02	-	-	16.0	27.5	440	13.4	5,896	-	-	-	0.0	0.0	1	2.6	0.0	Ventilation provided by adjacent spaces.
A03	H&V #12	AHU	12.1	16.2	3,114	12.3	38,302	80	0	0%	0.1	0.0	1	0.5	0.1	**Note #2**
A04	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This a water closet.
A06	-	-	11.7	19.6	229	8.5	1,949	-	-	-	0.0	0.0	0	N/A	0.0	This is a shower.
A07	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	A33 and A07 are one hot tub room.
A08	-	-	11.9	19.9	237	8.5	2,013	-	-	-	0.0	0.0	0	N/A	0.0	This is a shower.
A11	H&V #12	AHU	15.9	43.6	693	13.4	9,289	905	0	0%	5.8	0.0	1	5.9	4.2	**Note #2**
A13	H&V #12	AHU	19.7	24.9	491	10.0	4,905	295	0	0%	3.6	0.0	1	5.8	2.6	**Note #2**
A14	H&V #12	AHU	8.0	19.5	156	10.1	1,576	170	0	0%	6.5	0.0	1	14.6	4.7	**Note #2**
A15	H&V #12	AHU	18.1	40.0	724	13.5	9,774	875	0	0%	5.4	0.0	1	5.5	3.9	**Note #2**
A16	A16 FCU	FCU	10.9	57.1	622	13.5	8,402	-	-	-	0.0	0.0	1	1.9	0.0	Storage--unit for freeze protection only.
A17	H&V #12	AHU	18.1	40.0	724	13.5	9,774	705	0	0%	4.3	0.0	1	4.7	3.1	**Note #2**
A18	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	A16, A18, A20 are one room.
A19	H&V #12	AHU	19.5	39.9	778	12.4	9,648	735	0	0%	4.6	0.0	1	4.9	3.3	**Note #2**
A20	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	A16, A18, A20 are one room.
A21	H&V #12	AHU	18.8	36.2	681	13.5	9,188	855	0	0%	5.6	0.0	1	5.7	4.0	**Note #2**
A22	A22 FCU	FCU	9.1	18.8	171	13.7	2,344	-	-	-	0.0	0.0	1	6.7	0.0	Storage--unit for freeze protection only.
A23	-	-	12.1	18.7	226	13.5	3,055	-	-	-	0.0	0.0	0	N/A	0.0	This is storage.
A24	H&V #6	AHU	43.0	64.1	2,756	15.2	41,896	924	65	7%	1.3	0.1	1	1.3	1.0	Split level ceiling.
A25	H&V #9	AHU	19.4	22.6	438	19.5	8,550	60	0	0%	0.4	0.0	1	2.1	0.3	**Note #3**
A26	H&V #9	AHU	43.5	50.3	2,490	11.6	28,884	400	0	0%	0.8	0.0	1	1.1	0.6	**Note #3.** Non-rectangular room.
A27	-	-	10.7	11.7	125	12.3	1,540	-	-	-	0.0	0.0	1	10.1	0.0	Ventilation provided by adjacent spaces.
A28	H&V #9	AHU	10.0	28.3	283	9.0	2,547	300	0	0%	7.1	0.0	1	11.2	5.1	**Note #3**

Date: 11/5/2021 Readings By: Mayer

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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																
A30	H&V #9	AHU	15.8	40.6	641	13.4	8,596	110	0	0%	0.8	0.0	1	2.4	0.6	**Note #3**
A32	-	-	11.9	20.0	238	8.5	2,023	-	-	-	0.0	0.0	0	N/A	0.0	This is a shower.
A33	-	-	14.0	17.4	244	8.5	2,071	-	-	-	0.0	0.0	1	7.5	0.0	A33 and A06 are one hot tub room.
A34	-	-	11.8	19.8	234	8.5	1,986	-	-	-	0.0	0.0	0	N/A	0.0	This is a shower.
A35	-	-	7.5	7.7	58	13.4	774	-	-	-	0.0	0.0	1	20.2	0.0	Ventilation provided by adjacent spaces.
A40	A40 FCU	FCU	18.7	33.4	625	13.4	8,369	-	-	-	0.0	0.0	1	1.9	0.0	Storage--unit for freeze protection only.
B03	SF-70	AHU	14.6	19.4	283	8.0	2,266	490	490	100%	13.0	13.0	1	17.3	10.4	**Note #4**
B04	SF-70	AHU	14.1	19.4	274	8.0	2,188	265	265	100%	7.3	7.3	1	12.9	5.8	**Note #4**
B05	SF-70	AHU	14.5	14.0	203	8.5	1,726	320	320	100%	11.1	11.1	1	17.9	8.9	**Note #4**
First Floor - North																
Main Office D101	SF-123	AHU	46.7	50.0	1,875	10.0	18,750	1,785	571	32%	5.7	1.8	2	5.9	4.3	
D102	SF-123	AHU	15.4	16.2	249	10.0	2,495	490	157	32%	11.8	3.8	1	15.0	8.8	
D103	SF-123	AHU	16.0	17.7	283	9.0	2,549	300	96	32%	7.1	2.3	1	11.4	5.3	
Conf. Room D104	SF-123	AHU	6.5	11.0	72	10.0	715	45	14	32%	3.8	1.2	1	24.6	2.8	
Conf. Room D104A	SF-123	AHU	6.5	11.0	72	10.0	715	50	16	32%	4.2	1.3	1	24.9	3.1	
D123	SF-123	AHU	8.2	11.6	95	9.0	856	95	30	32%	6.7	2.1	1	23.2	5.0	
D108	SF-123	AHU	10.3	14.1	85	9.0	767	60	19	32%	4.7	1.5	1	23.8	3.5	
D124	SF-123	AHU	36.7	29.7	901	10.0	9,010	775	248	32%	5.2	1.7	1	5.6	3.8	
Rm D121	SF-123	AHU	20.0	29.0	580	10.0	5,800	865	277	32%	8.9	2.9	2	12.0	6.7	
D125	SF-123	AHU	19.0	19.8	376	10.0	3,762	445	142	32%	7.1	2.3	1	9.4	5.3	
D119	SF-123	AHU	21.0	29.4	372	10.0	3,724	1,830	586	32%	29.5	9.4	1	26.2	22.0	
D105	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This is storage.
Rm D126	SF-123	AHU	27.7	39.8	1,102	10.0	11,025	2,250	720	32%	12.2	3.9	1	10.5	9.1	
Rm D127	SF-123	AHU	28.2	39.8	1,122	10.0	11,224	1,605	514	32%	8.6	2.7	1	7.8	6.4	

Date: 11/5/2021 Readings By: Mayer

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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- North																
D129	SF-120	AHU	34.0	38.0	830	10.0	8,300	440	440	100%	3.2	3.2	1	4.4	2.5	**Note #6.** Non-rectangular room.
D130	SF-120	AHU	17.4	18.6	324	10.0	3,236	170	170	100%	3.2	3.2	1	7.3	2.5	**Note #6**
Rm D136	SF-120	AHU	41.0	46.2	1,696	10.0	16,962	1,055	1,055	100%	3.7	3.7	1	3.9	3.0	**Note #6.** Non-rectangular room.
Conf. Room D137	SF-120	AHU	8.0	14.3	114	9.0	1,030	110	110	100%	6.4	6.4	1	20.3	5.1	**Note #6**
Conf. Room D138	SF-120	AHU	8.0	14.3	114	9.0	1,030	105	105	100%	6.1	6.1	1	20.0	4.9	**Note #6**
D139	SF-120	AHU	11.0	14.7	162	9.0	1,455	95	95	100%	3.9	3.9	1	13.9	3.1	**Note #6**
D140	SF-120	AHU	11.0	14.2	156	9.0	1,406	80	80	100%	3.4	3.4	1	13.8	2.7	**Note #6**
D147	SF-120	AHU	29.2	33.6	981	9.9	9,713	575	575	100%	3.6	3.6	1	4.4	2.8	**Note #6**
D151	SF-120	AHU	28.7	30.4	872	10.0	8,725	600	600	100%	4.1	4.1	1	5.1	3.3	**Note #6**
D153	SF-120	AHU	28.7	30.4	872	10.0	8,725	495	495	100%	3.4	3.4	1	4.5	2.7	**Note #6**
D157	SF-120	AHU	28.7	27.6	792	10.0	7,921	650	650	100%	4.9	4.9	2	7.9	3.9	**Note #6**
Library D165	SF-120	AHU	58.4	56.4	3,294	13.0	60,805	3,025	3,025	100%	3.0	3.0	2	2.9	2.4	**Note #6.** Non-rectangular room.
Rm D164	SF-120	AHU	29.3	33.2	973	9.0	8,755	655	655	100%	4.5	4.5	1	5.4	3.6	**Note #6**
G100	SF-160	AHU	10.5	15.0	158	10.0	1,575	100	87	87%	3.8	3.3	1	12.9	3.0	
Conf. Room G101	SF-160	AHU	11.9	14.9	177	10.0	1,773	150	131	87%	5.1	4.4	1	12.8	4.0	
Conf. Room G102	SF-160	AHU	6.7	9.8	66	10.0	657	105	91	87%	9.6	8.3	1	31.3	7.6	
Conf. Room G103	SF-160	AHU	6.7	9.8	66	10.0	657	140	122	87%	12.8	11.1	1	33.9	10.1	
G104	SF-160	AHU	28.5	41.8	681	10.0	6,813	160	139	87%	1.4	1.2	1	3.4	1.1	Non-rectangular room.
G105	SF-160	AHU	28.3	41.0	854	9.0	7,689	210	183	87%	1.6	1.4	1	3.3	1.3	Non-rectangular room.
HG2	SF-160	AHU	60.5	60.5	3,680	10.0	36,803	1,930	1,679	87%	3.1	2.7	1	2.9	2.5	
G113	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	G113 and G115 are one room.
Rm G115	SF-160	AHU	28.3	45.0	1,274	9.9	12,608	805	700	87%	3.8	3.3	1	4.3	3.0	
Rm G116	SF-160	AHU	28.1	36.2	1,017	9.8	9,969	485	422	87%	2.9	2.5	1	3.9	2.3	
G118	SF-160	AHU	11.6	17.6	204	9.9	2,021	130	113	87%	3.9	3.4	1	10.8	3.0	

Date: 11/5/2021 Readings By: Mayer

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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- North																
Rm G117	SF-160	AHU	28.8	36.7	1,057	9.8	10,358	520	452	87%	3.0	2.6	1	3.9	2.4	
G110	SF-160	AHU	28.2	34.5	973	10.0	9,729	510	444	87%	3.1	2.7	1	4.1	2.5	
G109	SF-160	AHU	28.2	18.9	533	10.0	5,330	550	479	87%	6.2	5.4	1	7.8	4.9	
G108	SF-160	AHU	28.2	26.8	756	10.0	7,558	550	479	87%	4.4	3.8	1	5.5	3.4	
G123	-	-	13.3	40.6	540	14.9	8,046	-	-	-	0.0	0.0	1	1.9	0.0	This is a greenhouse.
G125	G125 FCU	FCU	14.8	40.6	601	10.9	6,550	-	-	-	0.0	0.0	1	2.4	0.0	Greenhouse storage
G129	SF-172	AHU	11.7	17.7	207	10.0	2,071	150	0	0%	4.3	0.0	1	10.7	3.1	**Note #7**
Rm G130	SF-172	AHU	28.3	36.6	1,036	9.8	10,151	565	0	0%	3.3	0.0	1	3.9	2.4	**Note #7**
Rm G131	SF-172	AHU	28.3	36.6	1,036	9.8	10,151	725	0	0%	4.3	0.0	1	4.6	3.1	**Note #7**
Rm G132	SF-172	AHU	28.3	44.8	1,268	10.0	12,678	805	0	0%	3.8	0.0	1	4.0	2.7	**Note #7**
G134	-	-	-	-	-	-	-	-	-	-	0.0	0.0	1	-	0.0	G132 and G134 are one room.
HG1	SF-172	AHU	60.5	60.5	3,680	10.0	36,803	1,710	0	0%	2.8	0.0	1	2.4	2.0	**Note #7.** Non-rectangular room.
Rm G137	SF-172	AHU	26.7	28.2	753	10.0	7,529	430	0	0%	3.4	0.0	1	4.5	2.5	**Note #7**
Rm G138	SF-172	AHU	27.0	28.3	764	10.0	7,641	360	0	0%	2.8	0.0	1	4.1	2.0	**Note #7**
Rm G139	SF-172	AHU	27.9	34.4	960	10.0	9,598	460	0	0%	2.9	0.0	1	3.7	2.1	**Note #7**
G141	SF-172	AHU	28.2	41.3	875	9.9	8,659	215	0	0%	1.5	0.0	1	2.9	1.1	**Note #7**
Conf. Room G142	SF-172	AHU	9.8	14.0	137	10.0	1,372	115	0	0%	5.0	0.0	1	15.0	3.6	**Note #7**
Conf. Room G143	SF-172	AHU	9.8	14.0	137	10.0	1,372	155	0	0%	6.8	0.0	1	16.2	4.9	**Note #7**
Conf. Room G144	SF-172	AHU	11.9	14.7	175	10.0	1,749	80	0	0%	2.7	0.0	1	10.9	2.0	**Note #7**
G145	SF-172	AHU	10.6	14.7	156	10.0	1,558	65	0	0%	2.5	0.0	1	11.8	1.8	**Note #7**
G146	SF-172	AHU	15.1	16.5	249	9.2	2,292	185	0	0%	4.8	0.0	1	10.3	3.5	**Note #7**
G147	SF-172	AHU	10.5	22.5	236	9.0	2,126	125	0	0%	3.5	0.0	1	9.9	2.5	**Note #7**
G147B	-	-	7.6	19.2	146	9.1	1,328	-	-	-	0.0	0.0	1	11.7	0.0	Ventilation provided by adjacent spaces.
G154	SF-160, 172	AHU	26.3	48.9	1,286	9.9	12,732	745	408	55%	3.5	1.9	1	3.9	2.7	**Note #7**

Date: 11/5/2021 Readings By: Mayer

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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- South																
C115	SF-103	AHU	32.3	75.0	2,423	16.0	38,760	5,025	5,025	100%	7.8	7.8	1	6.6	6.2	**Note #8**
Rm C138	SF-103	AHU	25.7	49.0	1,259	12.1	15,238	1,620	1,620	100%	6.4	6.4	1	6.1	5.1	**Note #8**
C139	SF-103	AHU	9.1	10.5	96	11.0	1,051	380	380	100%	21.7	21.7	1	32.2	17.4	**Note #8.** Open to adjacent room Rm C138.
C140	SF-103	AHU	8.2	16.8	138	12.0	1,653	485	485	100%	17.6	17.6	1	23.5	14.1	**Note #8.** Open to adjacent room Rm C138.
Rm C135	SF-103	AHU	27.9	51.0	1,423	10.0	14,229	1,935	1,935	100%	8.2	8.2	1	7.6	6.5	**Note #8**
C127	SF-103	AHU	21.6	26.0	616	10.0	6,156	345	345	100%	3.4	3.4	1	5.2	2.7	**Note #8.** Non-rectangular room.
Perf. C121	SF-100	AHU	36.0	40.5	1,458	16.5	24,057	2,815	0	0%	7.0	0.0	2	6.3	5.1	**Note #9**
Perf. C125	SF-100	AHU	37.6	49.0	1,842	17.1	31,505	3,360	0	0%	6.4	0.0	2	5.6	4.6	**Note #9.** Non-rectangular room.
C128	SF-100	AHU	10.9	23.3	254	10.0	2,540	310	0	0%	7.3	0.0	1	11.4	5.3	**Note #9**
Stage	SF-100	AHU	74.8	35.3	2,640	21.4	56,505	950	0	0%	1.0	0.0	1	1.0	0.7	**Note #9**
Auditorium 161	SF-106	AHU	83.0	82.0	6,806	20.4	138,842	28,512	1,996	7%	12.3	0.9	1	9.0	8.9	
Kitchen	SF-68	AHU	32.1	68.7	3,349	10.9	36,507	4,695	4,695	100%	7.7	7.7	1	6.6	6.2	**Note #10**
Cool 107D	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This is the walk-in cooler.
Rm 107H	SF-70	AHU	9.1	10.0	91	9.0	819	260	260	100%	19.0	19.0	1	34.3	15.2	**Note #4**
Dish M108	SF-70	AHU	20.3	21.8	443	10.0	4,425	970	970	100%	13.2	13.2	1	14.0	10.5	**Note #4.** Ventilation provided by adjacent spaces.
Cafeteria	SF-27, 63, 65	AHU	77.5	118.0	9,145	16.1	147,235	13,290	3,452	26%	5.4	1.4	2	4.2	4.0	
Gym	H&V #1,2,3	AHU	99.6	206.7	20,587	31.5	648,501	27,780	13,057	47%	2.6	1.2	1	2.0	1.9	
A101	H&V #9	AHU	10.5	10.7	112	8.5	955	115	0	0%	7.2	0.0	1	21.5	5.2	**Note #3**
A103	H&V #6	AHU	12.3	10.7	132	8.5	1,119	463	167	36%	24.8	8.9	1	32.5	18.6	
A106	H&V #12	AHU	9.6	10.7	103	8.5	873	120	0	0%	8.2	0.0	1	23.8	5.9	**Note #2**
Second Floor																
Rm G200	SF-160	AHU	28.2	28.3	798	10.0	7,981	485	422	87%	3.6	3.2	1	4.8	2.9	
Rm G201	SF-160	AHU	28.1	20.6	579	10.0	5,789	265	231	87%	2.7	2.4	1	4.9	2.2	
Rm G204	SF-160	AHU	28.2	39.5	1,114	10.0	11,139	285	248	87%	1.5	1.3	1	2.6	1.2	

Date: 11/5/2021 Readings By: Mayer

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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	
Second floor																
Rm G206	SF-160	AHU	28.3	39.4	1,115	10.0	11,150	300	261	87%	1.6	1.4	1	2.7	1.3	
Rm G207	SF-160	AHU	28.3	28.5	807	10.0	8,066	470	409	87%	3.5	3.0	1	4.7	2.8	
G208	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	G210 and G208 are one room.
Rm G210	SF-160	AHU	28.1	44.9	1,262	10.0	12,617	620	539	87%	2.9	2.6	1	3.6	2.3	
Rm G211	SF-160	AHU	28.2	33.6	948	10.0	9,475	410	357	87%	2.6	2.3	1	3.7	2.0	
Rm G212	SF-160	AHU	28.1	27.6	776	10.0	7,756	400	348	87%	3.1	2.7	1	4.5	2.4	
Rm G213	SF-160	AHU	28.2	23.3	657	10.0	6,571	195	170	87%	1.8	1.5	1	3.8	1.4	
HG4	SF-160	AHU	60.5	60.5	3,680	10.0	36,803	1,590	1,383	87%	2.6	2.3	1	2.5	2.0	
Rm G228	SF-172	AHU	28.2	23.3	657	10.0	6,571	320	0	0%	2.9	0.0	1	4.5	2.1	**Note #7**
Rm G229	SF-172	AHU	28.2	27.6	778	10.1	7,861	415	0	0%	3.2	0.0	1	4.3	2.3	**Note #7**
Rm G230	SF-172	AHU	28.2	33.5	945	10.1	9,541	375	0	0%	2.4	0.0	1	3.3	1.7	**Note #7**
Rm G231	SF-172	AHU	28.2	44.8	1,263	10.0	12,634	1,075	0	0%	5.1	0.0	2	6.1	3.7	**Note #7**
G232	-	-	-	-	-	-	-	-	-	-	0.0	0.0	1	-	0.0	G232 and G231 are one room.
G234	SF-172	AHU	28.2	28.0	790	10.1	7,975	305	0	0%	2.3	0.0	1	3.6	1.7	**Note #7.** This is a classroom.
Rm G235	SF-172	AHU	28.2	39.5	1,114	10.1	11,250	365	0	0%	1.9	0.0	1	2.8	1.4	**Note #7**
Rm G236	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	G235 and G236 are one room.
Rm G237	SF-172	AHU	28.2	20.4	575	10.1	5,810	345	0	0%	3.6	0.0	1	5.2	2.6	**Note #7**
Rm G238	SF-172	AHU	28.2	28.2	795	10.1	8,032	415	0	0%	3.1	0.0	1	4.2	2.2	**Note #7**
240	SF-172	AHU	28.3	29.6	1,039	10.0	10,387	190	0	0%	1.1	0.0	1	2.3	0.8	**Note #7.** Non-rectangular room.
G241	SF-172	AHU	14.1	18.8	193	10.1	1,950	105	0	0%	3.2	0.0	1	10.3	2.3	**Note #7.** Non-rectangular room.
Library G239	SF-172	AHU	60.5	60.5	3,680	10.0	36,803	2,110	0	0%	3.4	0.0	1	2.9	2.5	**Note #7.** Non-rectangular room.
Industrial Arts																
02	-	-	8.1	8.0	65	15.0	972	-	-	-	0.0	0.0	1	16.0	0.0	Ventilation provided by adjacent spaces.
Rm 03	03 FCU	FCU	81.1	59.1	4,821	15.2	73,279	1,215	600	49%	1.0	0.5	1	1.0	0.8	Non-rectangular room.

Date: 11/5/2021 Readings By: Mayer

Neudorfer Engineers. Inc.
Consulting Engineers Seattle Portland
www.NeudorferEngineers.com

AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219
Filter Status: Upgraded

Room	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	
Industrial Arts																
07	-	-	13.6	9.9	135	15.2	2,047	-	-	-	0.0	0.0	1	7.6	0.0	Ventilation provided by adjacent spaces.
08	-	-	12.2	16.5	201	15.2	3,060	-	-	-	0.0	0.0	1	5.1	0.0	Ventilation provided by adjacent spaces.
09	-	-	8.0	10.0	80	15.5	1,240	-	-	-	0.0	0.0	1	12.6	0.0	Ventilation provided by adjacent spaces.
10	UV	UV	18.1	20.2	366	10.7	3,912	195	195	100%	3.0	3.0	1	6.4	2.4	

Date: 11/5/2021 Readings By: Mayer

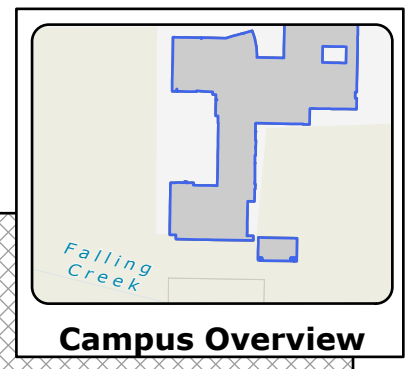
Project: Portland Public Schools Airflow Testing
Location: Jackson MS; 10625 SW 35th Ave, Portland, OR 97219

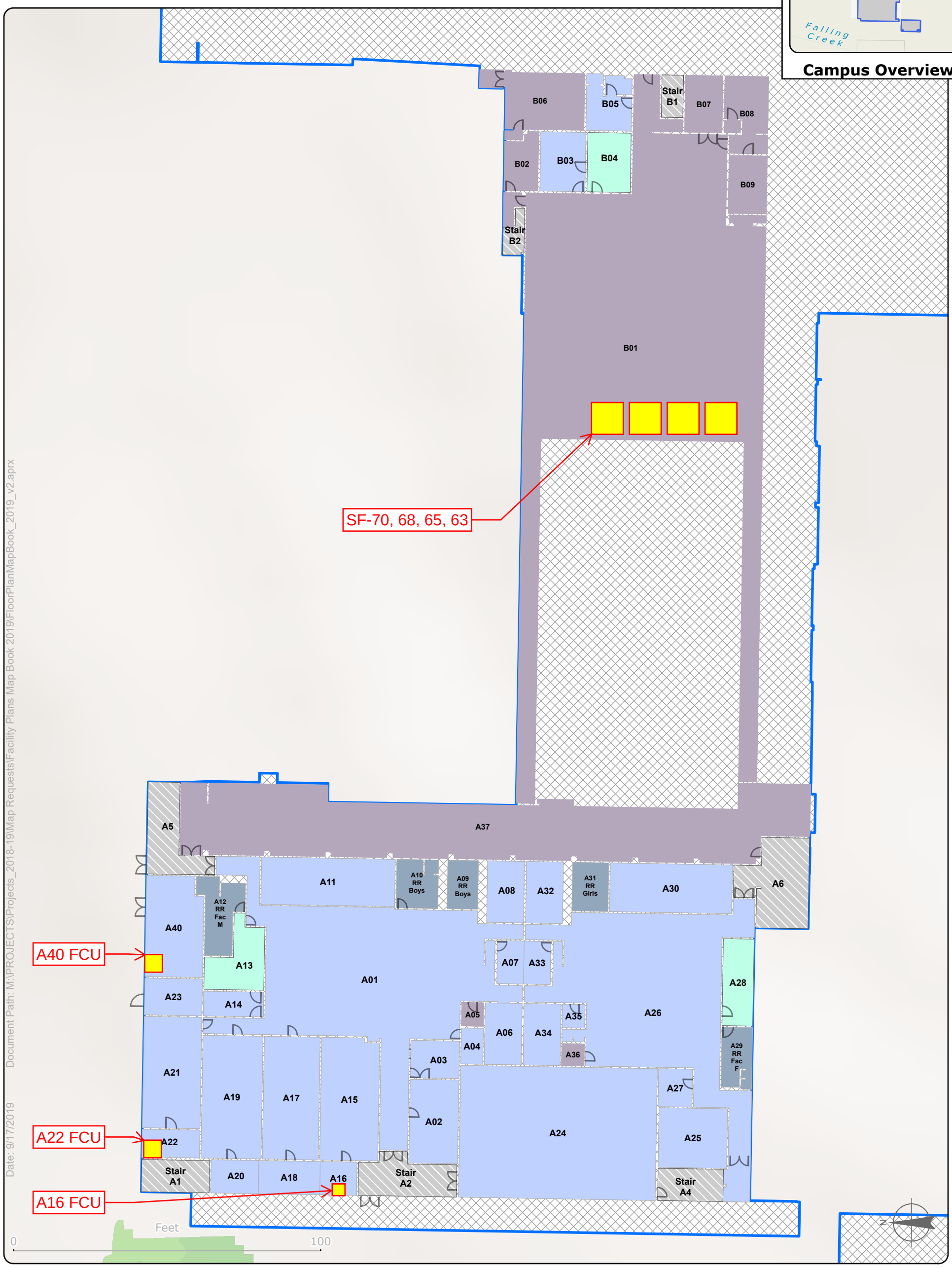
NOTE #	NOTE DESCRIPTION
1	H&V #6 is not running.
2	H&V #12 OSA damper closed.
3	H&V #9 OSA damper closed.
4	SF-70 100% OSA. Not ducted for return.
5	N/A
6	SF-120 100% OSA. Return damper closed.
7	SF-172 100% Return. OSA damper closed.
8	SF-103 100% OSA. Return damper closed.
9	SF-100 100% Return. OSA damper closed.
10	SF-68 100% OSA, Return damper closed.

FOR INTERNAL USE ONLY

DO NOT DISTRIBUTE

JACKSON: 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

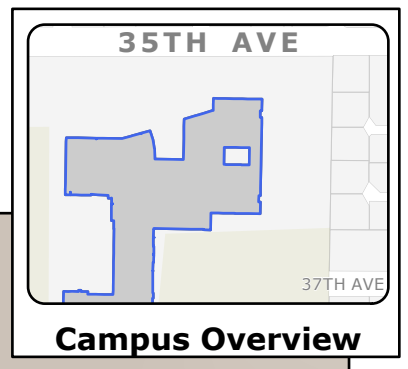
Total Number Of Rooms By Classification

Classrooms: 0	Special Purpose: 30
Office Spaces: 3	Storage: 4

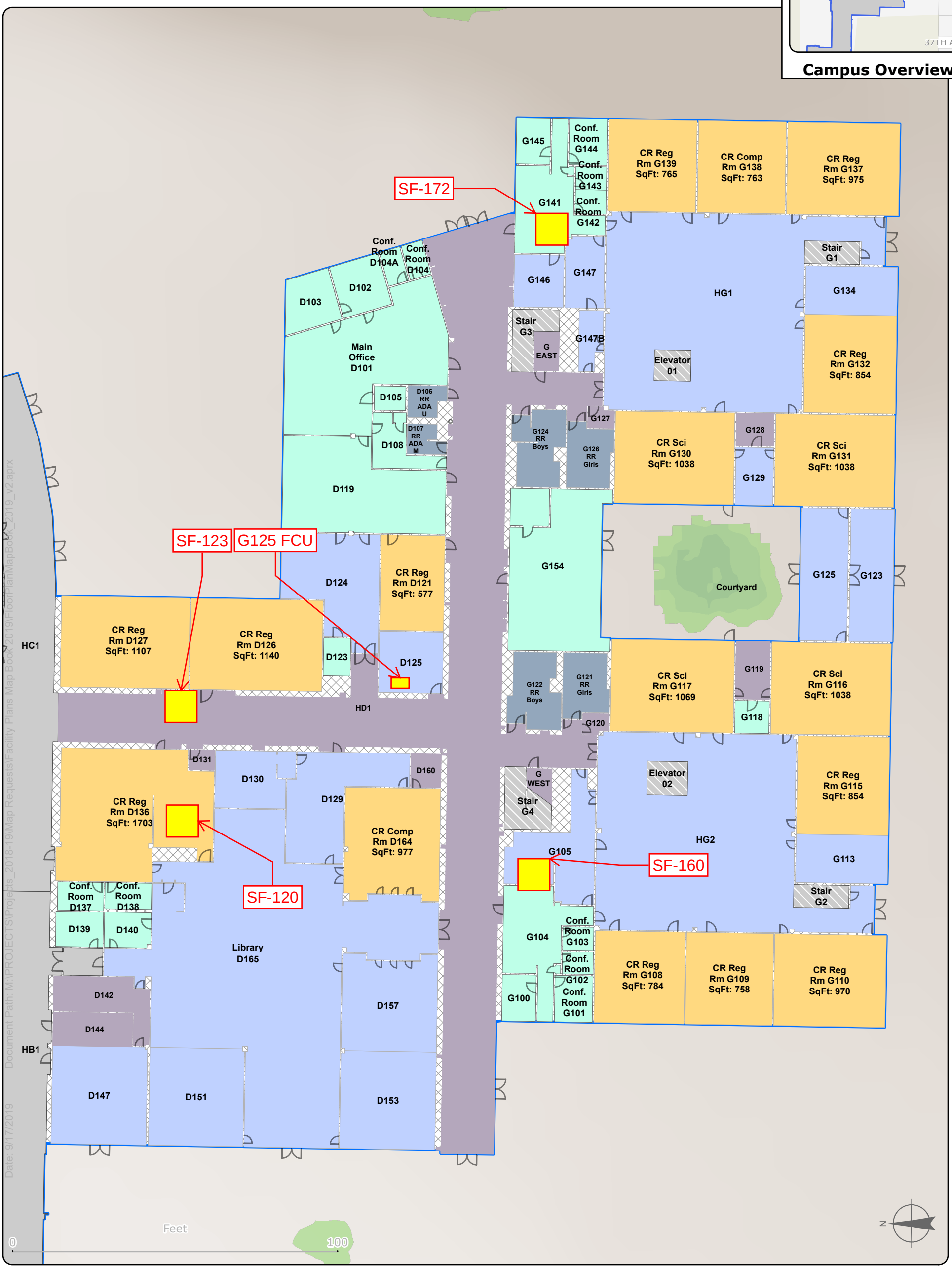
FOR INTERNAL USE ONLY

DO NOT DISTRIBUTE

JACKSON: First Floor - North



Campus Overview



Space Use

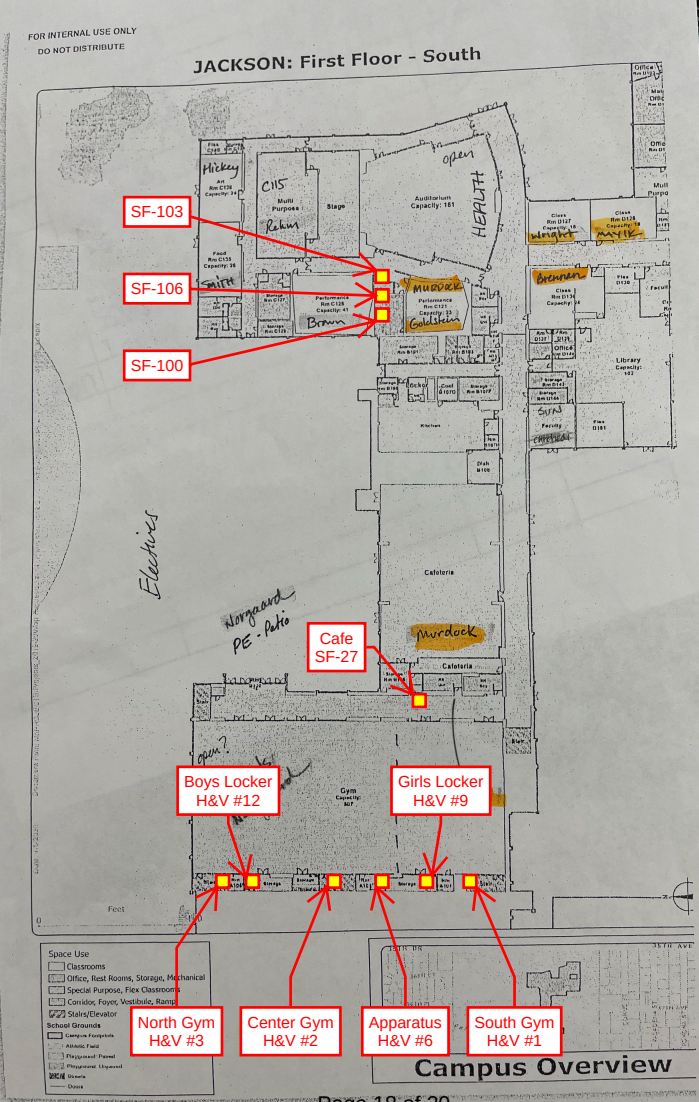
- Classroom
- Office
- Rest Room
- Special Purpose
- Corridor
- Other
- Stairs/Elevator

School Grounds

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

Total Number Of Rooms By Classification

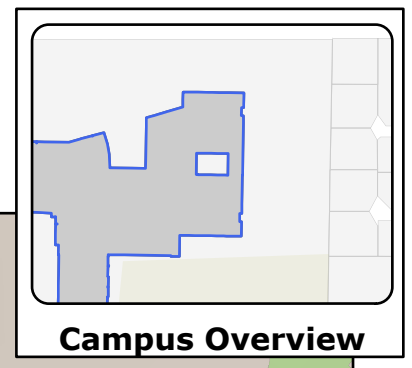
Classrooms: 17	Special Purpose: 20
Office Spaces: 25	Storage: 7

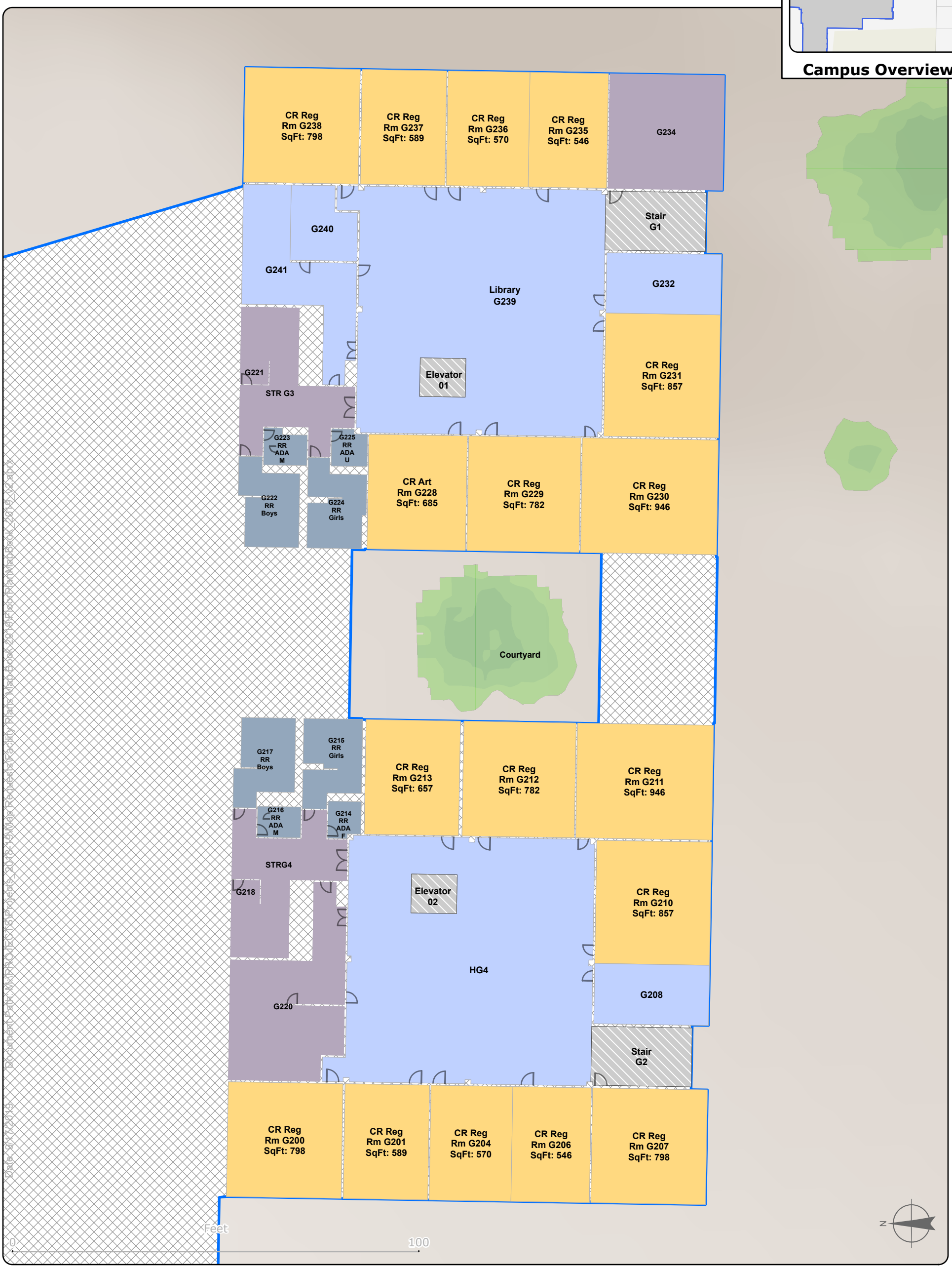

FOR INTERNAL USE ONLY
DO NOT DISTRIBUTE
JACKSON: First Floor - South
SF-103
SF-106
SF-100
Cafe
SF-27
Boys Locker
H&V #12
Girls Locker
H&V #9
North Gym
H&V #3
Center Gym
H&V #2
Apparatus
H&V #6
South Gym
H&V #1
Auditorium
Capacity: 181
Stage
Cafeteria
Gym
Capacity: 80
Library
Capacity: 102
Kitchen
Electives
Space Use
Classrooms
Office, Rest Rooms, Storage, Mechanical
Special Purpose, Flex Classrooms
Corridor, Foyer, Vestibule, Ramp
Stairs/Elevator
School Grounds
Campus Footpaths
Athletic Field
Playground Paved
Playground Unpaved
Doors
Campus Overview

FOR INTERNAL USE ONLY

DO NOT DISTRIBUTE

JACKSON: Second Floor





\\PROJECTS\Projects_2018\19\Map Requests\Facility Plans\Map Book_2019\FloorPlanMapBook_2019_v2.aprx
Date: 9/17/2019
Document Path: M:\PRO

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: 17

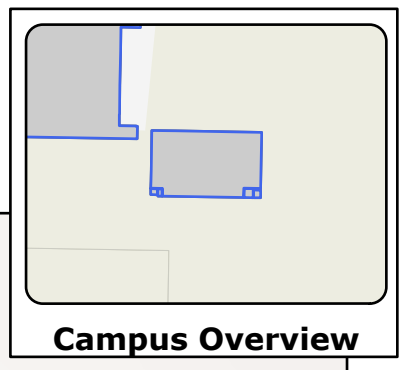
Special Purpose: 6

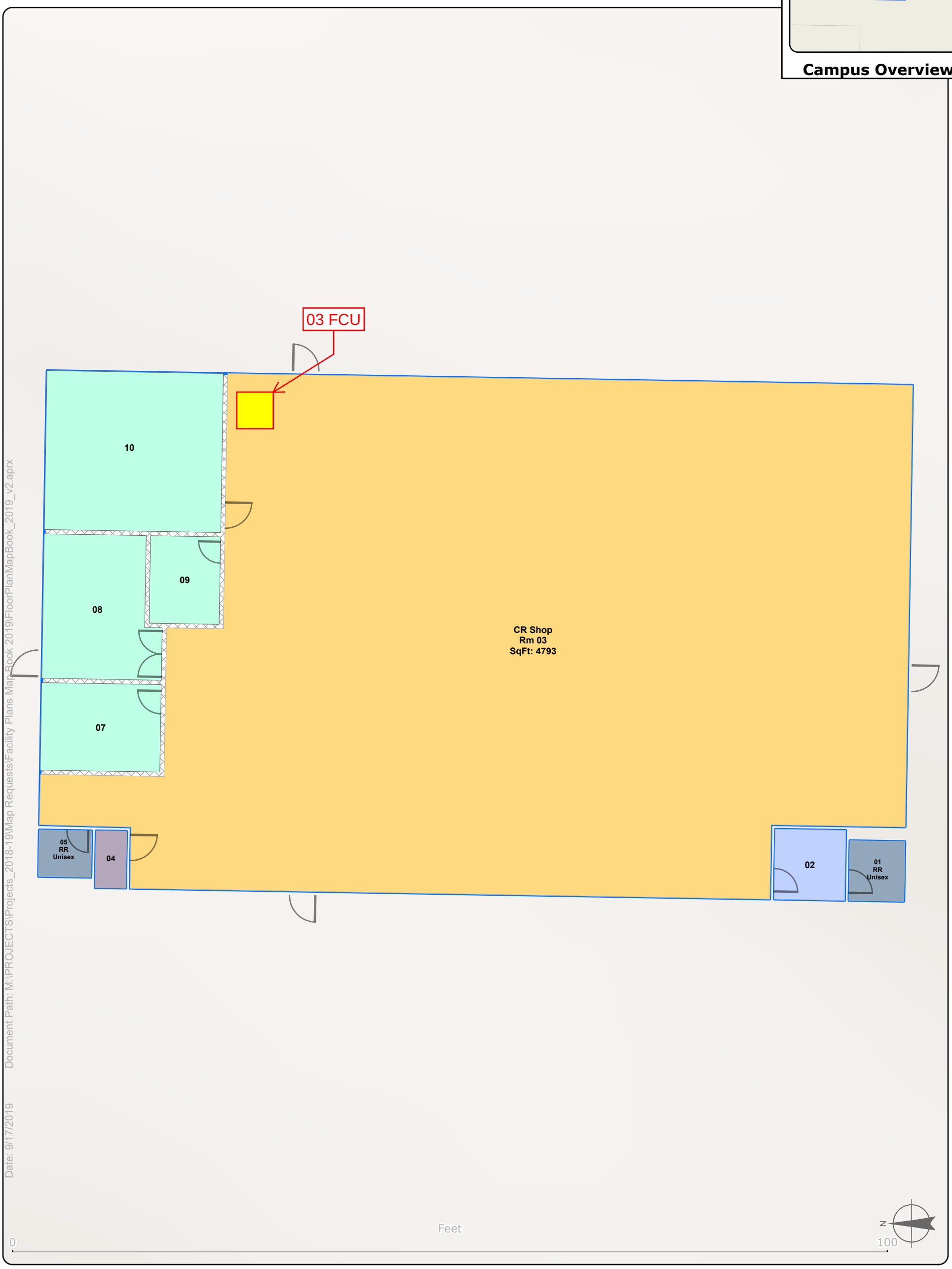
Office Spaces: 0

Storage: 5

FOR INTERNAL USE ONLY
DO NOT DISTRIBUTE

JACKSON: Industrial Arts





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: 1	Special Purpose: 1
Office Spaces: 4	Storage: 1