Illinois Department of
Public Health

John R. Lumpkin, M.D., M.P.H., Director

525-535 West Jefferson Street • Springfield, Illinois 62761-0001

#908219501

September 11, 1995

Mr. Michael Sartore
Principal
Macomb Jr./Sr. High School
1525 South Johnson Road
Macomb, IL 61455

Dear Mr. Sartore:

The Illinois Department of Public Health (IDPH) has conducted a follow-up evaluation of indoor air quality (IAQ) at Macomb Junior-Senior High School, Macomb, Illinois from August 25 through September 1, 1995. Continuous air monitoring was conducted using instruments which measured temperature (F), relative humidity (%RH), and carbon dioxide (CO_2). The graphs generated from the continuous sampling are attached. The uppermost line marked with a diamond symbol represents the temperature over the sampling period. The middle line marked with a triangle symbol represents relative humidity. The lower line marked with a square symbol represents the level of carbon dioxide. The maximum, minimum, and average values over the sample period are shown in the lower left corner of the graph.

The purpose of the sampling was to determine if the heating, ventilation, and air conditioning (HVAC) system was operating properly and to evaluate the air quality in different parts of the building. An HVAC system includes all heating, cooling, and ventilation equipment serving a building. A properly designed HVAC system provides thermal comfort; distributes adequate amounts of outdoor air to meet ventilation needs of all building occupants; and isolates and removes odors and contaminants through pressure control, filtration, and exhaust fans. HVAC systems have been identified as a major contributing cause of occupant complaints in the indoor air quality investigations conducted by IDPH.

A walk-through IAQ survey conducted by IDPH on August 21 verified reports of high humidity and subsequent mold growth in the building. Because air conditions that can change from day to day inside a building, longer term sampling was recommended. The longer term sampling is much more indicative of the typical indoor environment.

Relative humidity can be an important factor for occupant comfort. High relative humidity reduces the body's ability to lose heat and can increase levels of body odors. Sensitivity to odors increases with increased humidity, as does release of gases from some building materials. High relative humidity (above 60%) can support microbial growth inside buildings. Relative

humidities that are too low can dehydrate skin and mucous membranes. Recent studies have found higher rates of nasal, eye, skin, and mucous membrane symptoms; lethargy; and headaches in low relative humidity environments. Occupants who wear contact lenses often have problems with low relative humidities, due to lenses irritating the eyes from lack of moisture. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) *Ventilation for Acceptable Indoor Air Quality* (62-1989) recommends that relative humidity be maintained between 30% and 60%.

Classrooms I-6, S-10, and E-22 had relative humidities greater than 60% throughout the sampling. Room E-22 peaked at 88.6% on Tuesday afternoon, August 25. Relative humidities in the Honor's Lab and Room W-4 were in the upper 50% range throughout most of the sampling, with occasional excursions above 60%.

Since CO_2 is a normal constituent of exhaled breath, measurements can be used to determine if the quantity of outdoor air that is being delivered to occupants is adequate. High concentrations of CO_2 indicate that outside air is not being adequately supplied to the building to mix with recirculated air. If indoor CO_2 concentrations are more than 1000 parts per million (ppm), complaints such as headaches; fatigue; and eye, nose and throat irritations may be anticipated. The elevated CO_2 concentration itself is not responsible for the complaints; however, high CO_2 concentrations are indicative of stale, stagnant air, which does contribute to occupant complaints. Each of the sampled classrooms had elevated CO_2 concentrations.

Currently, there are no regulations for the amount of outdoor air that is supplied to buildings. The ASHRAE 62-1989 Ventilation Standard recommends the amount of outdoor air that should be supplied to buildings. These guidelines are recognized throughout the country and some states have adopted these guidelines into legislation. These guidelines recommend that school classrooms be supplied with 15 cubic feet per minute (CFM) of outside air per person. This volume of make-up air roughly corresponds with a CO_2 concentration of 1000 ppm. The classrooms sampled were being supplied with from 8 to 10 CFM of outside air per person at peak occupancy during our continuous sampling.

In general, classroom temperatures were maintained within the comfort zone recommended by ASHRAE (*Thermal Environmental Conditions for Human Occupancy* 55-1992). At a relative humidity of 60%, the ASHRAE thermal comfort range is from about 72 to 79 degrees. The only occurrence of a temperature outside this range during occupancy was in the Honor's Lab on Tuesday afternoon, August 25.

IDPH also conducted bioaerosol sampling in several areas of the building on August 25. At the time of sampling the visible mold growth had been cleaned from the surfaces in much of the school, and no mold-like odors were present. Bioaerosol sampling was conducted in rooms S-10, W-4, I-4, E-21, E-22, the Honor's Lab, the Principal's office, and outside using an Anderson sampler and agar plates. The samples were collected, maintained at room temperature, and incubated at IDPH labs in Springfield, where they were read by a staff microbiologist. Total colony forming units were reported and air concentrations were calculated using this data and the sampling air flow rate. The results of the sampling are shown on Table One.

The concentration of microbials in indoor air is affected by the outdoor concentration, the relative humidity, the number and density of occupants, the type of activity, and air circulation. The sampling indicates that the microbial levels in the classrooms are lower than those found outside and in a non-complaint area (the principal's office). Outdoor microbial concentrations routinely exceed 1,000 colony forming units per cubic meter of air (cfu/m3). In general, indoor concentrations should be less than 50% of the outdoor levels. Some of the classrooms were slightly higher than this 50% figure.

Based on our sampling, our observations, and the concerns of district employees, IDPH recommends the following:

1. Have a contractor inspect and repair the HVAC system to lower relative humidity levels to less than 60% during the humid summer months.
2. Make sure make-up air is adequate to meet the ASHRAE guidelines of 15 CFM per occupant.
3. Continue to deter the growth of microbials on surfaces through routine cleaning with a disinfectant solution.
4. Porous building components (ceiling tiles, bulletin boards, carpeting) with visible mold growth should be discarded. These materials cannot be adequately cleaned and disinfected.

If you have any questions or require additional information, feel free to contact us at (217) 782-5830.

Sincerely,

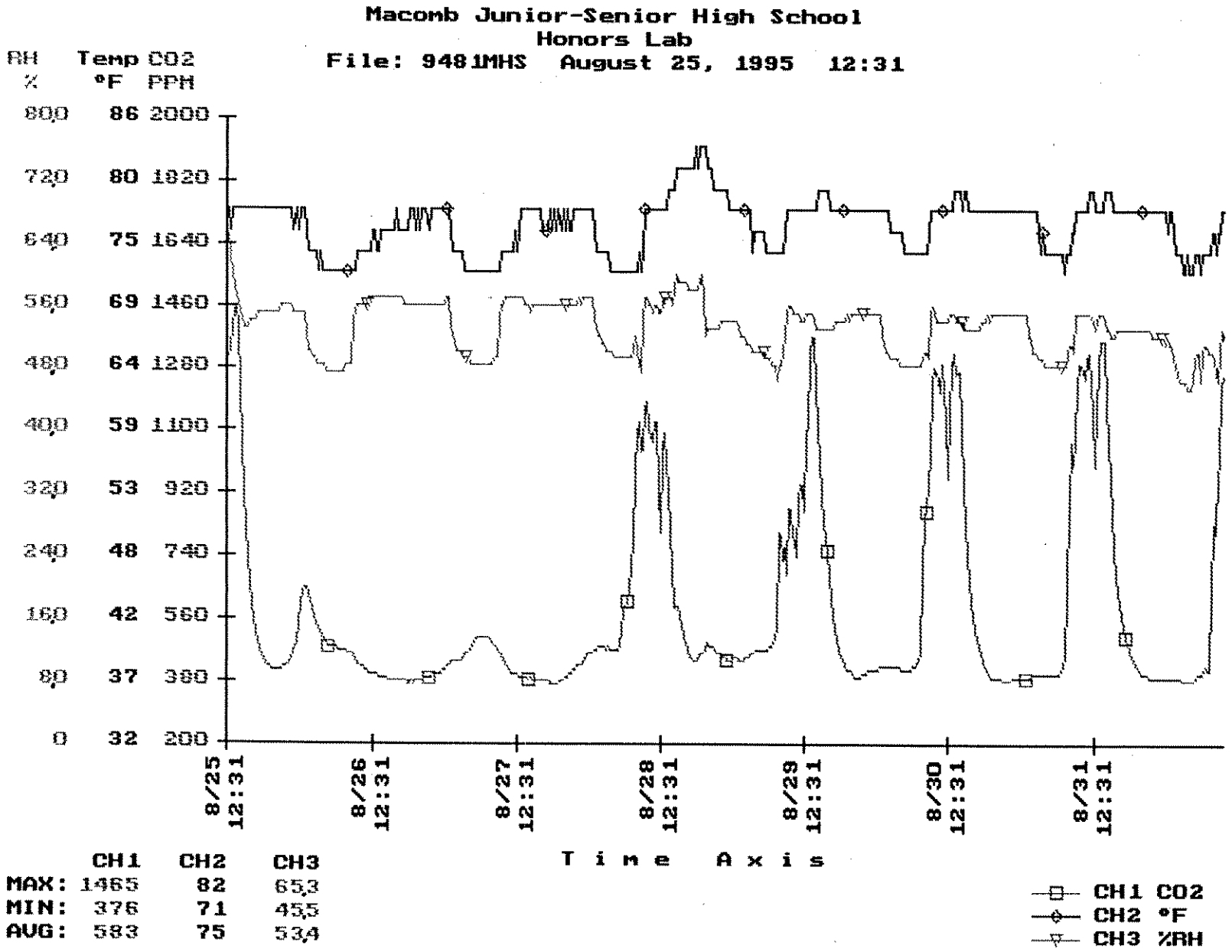
K. D. Runkle
Toxicology Section

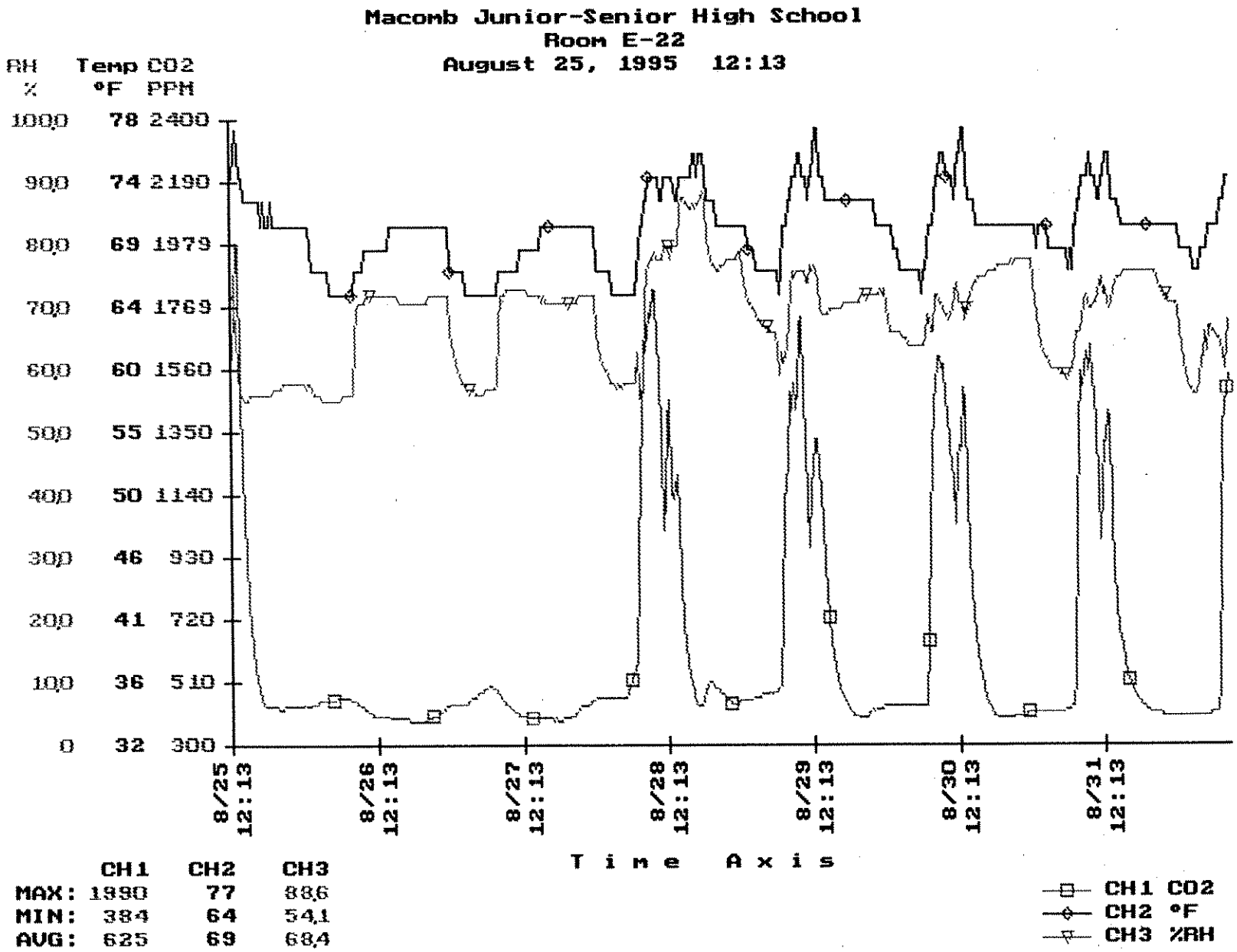
cc: McDonnough Co. Health Dept.
IDPH Peoria Regional Office

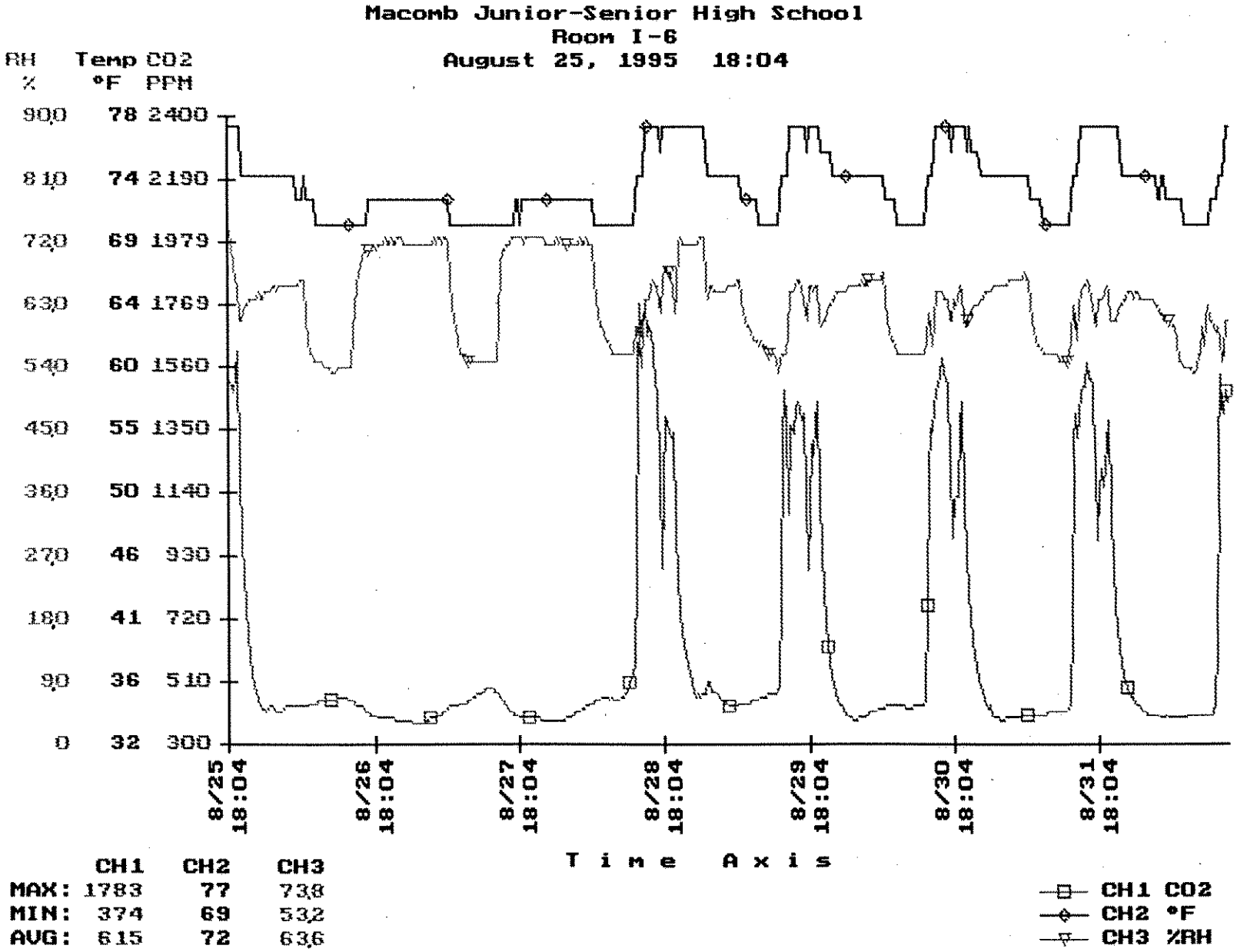
TABLE ONE -- M.H.S. BIOAEROSOL SAMPLING
August 25, 1995

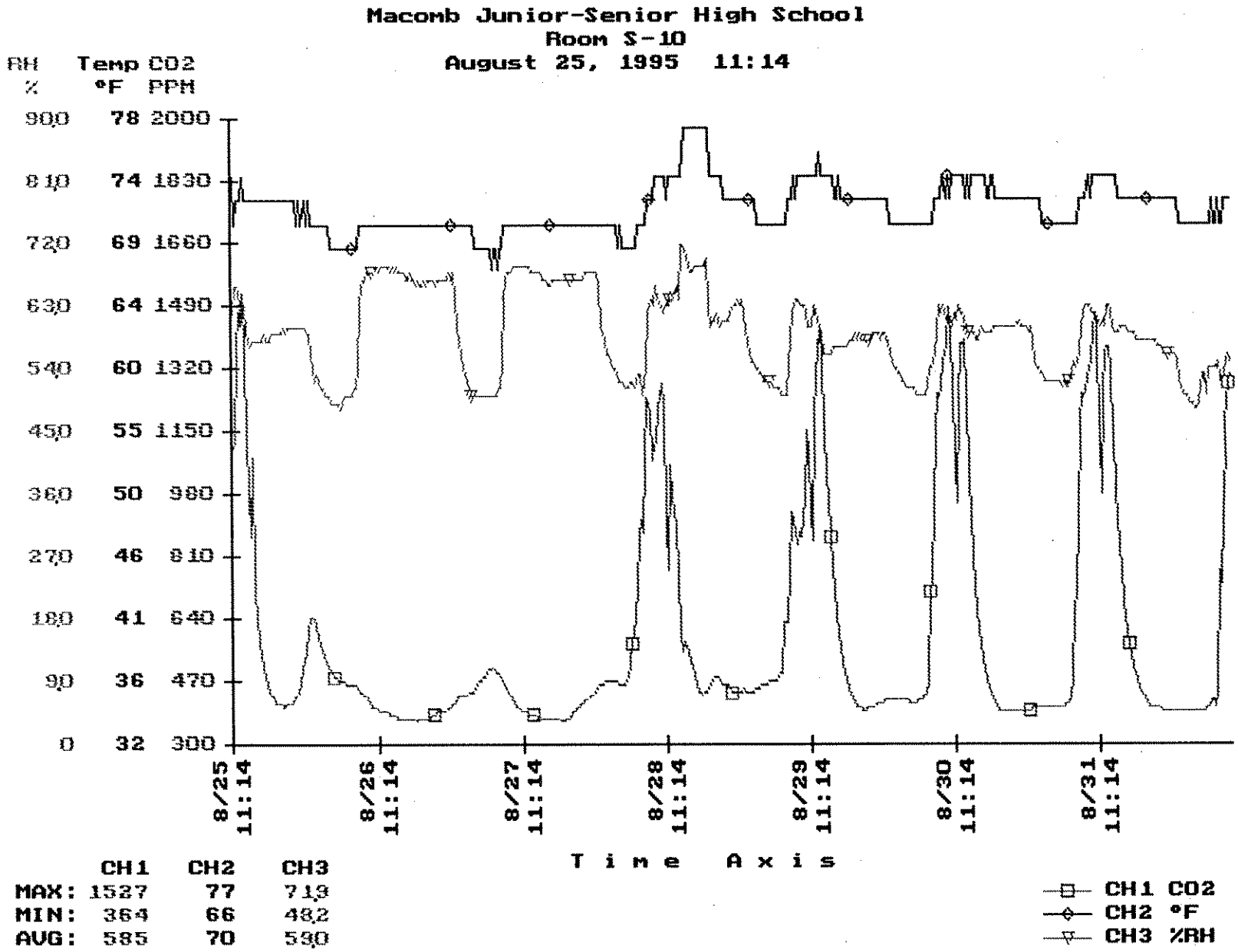
AREA SAMPLED	MICROBIAL LEVEL (cfu/m3)
OUTDOORS	1,049
Principal's Office	962
S-10	629
Honors Lab	542
W-4	542
I-6	472
E-21	664
E-22	717

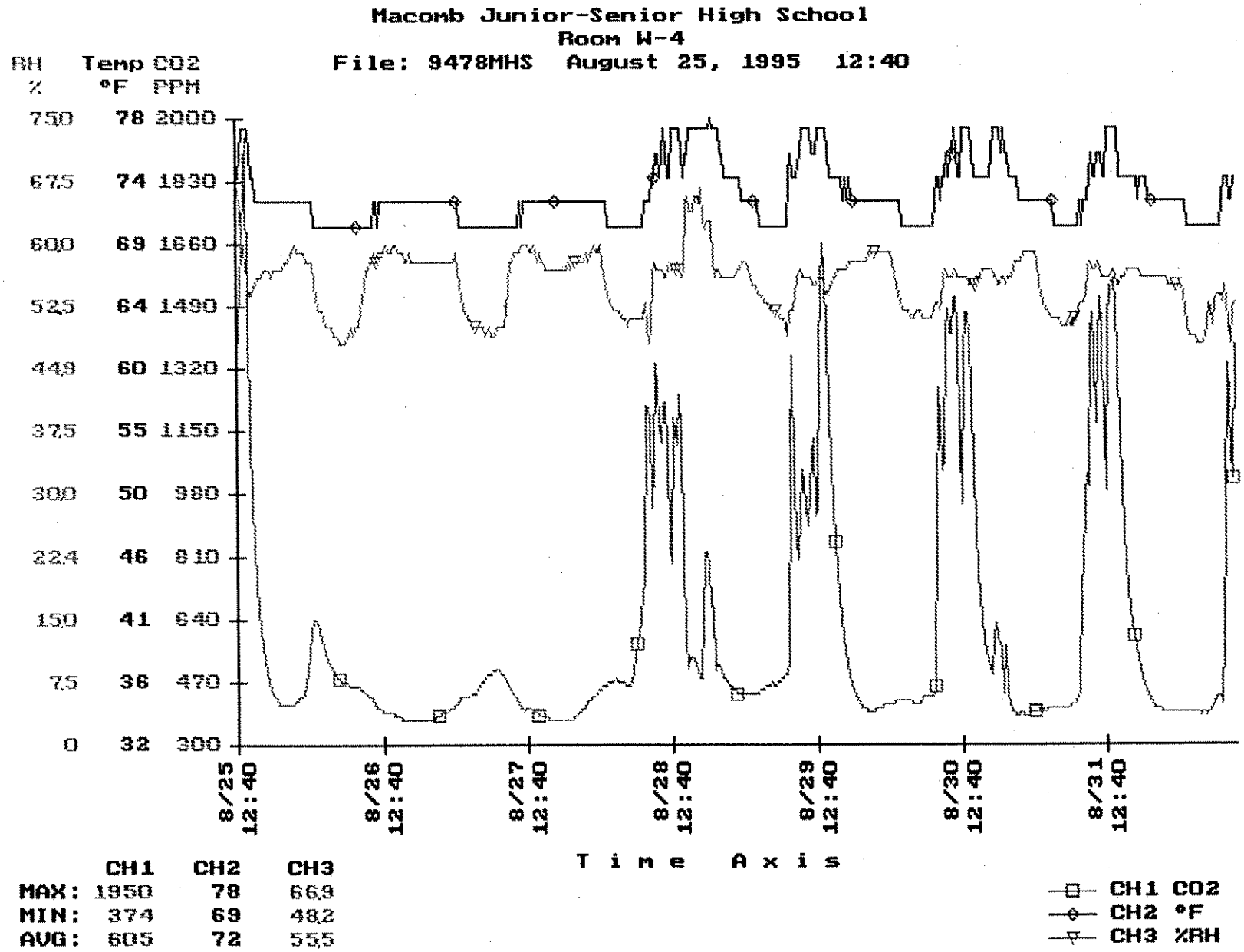
cfu/m3 = colony forming units per cubic meter


Macomb Junior-Senior High School
Honors Lab
File: 9481MHS August 25, 1995 12:31
RH % Temp °F CO2 PPM
80,0 86 2000
72,0 80 1820
64,0 75 1640
56,0 69 1460
48,0 64 1280
40,0 59 1100
32,0 53 920
24,0 48 740
16,0 42 560
8,0 37 380
0 32 200
8/25 12:31
8/26 12:31
8/27 12:31
8/28 12:31
8/29 12:31
8/30 12:31
8/31 12:31
Time Axis
CH1 CH2 CH3
MAX: 1465 82 65,3
MIN: 376 71 45,5
AVG: 583 75 53,4
CH1 CO2
CH2 °F
CH3 %RH


Macomb Junior-Senior High School
Room E-22
August 25, 1995 12:13
RH % Temp °F CO2 PPM
100.0 78 2400
90.0 74 2190
80.0 69 1979
70.0 64 1769
60.0 60 1560
50.0 55 1350
40.0 46 1140
30.0 41 930
20.0 36 720
10.0 510
0 32 300
8/25 12:13
8/26 12:13
8/27 12:13
8/28 12:13
8/29 12:13
8/30 12:13
8/31 12:13
Time Axis
CH1 CH2 CH3
MAX: 1990 77 88.6
MIN: 384 64 54.1
AVG: 625 69 68.4
CH1 CO2
CH2 °F
CH3 %RH


Macomb Junior-Senior High School
Room I-6
August 25, 1995 18:04
RH % Temp °F CO2 PPM
90.0 78 2400
81.0 74 2190
72.0 69 1979
63.0 64 1769
54.0 60 1560
45.0 55 1350
36.0 50 1140
27.0 46 930
18.0 41 720
9.0 36 510
0 32 300
8/25 18:04
8/26 18:04
8/27 18:04
8/28 18:04
8/29 18:04
8/30 18:04
8/31 18:04
Time Axis
CH1 CH2 CH3
MAX: 1783 77 73.8
MIN: 374 69 53.2
AVG: 615 72 63.6
CH1 CO2
CH2 °F
CH3 %RH


Macomb Junior-Senior High School
Room S-10
August 25, 1995 11:14
RH % Temp °F CO2 PPM
90,0 78 2000
81,0 74 1830
72,0 69 1660
63,0 64 1490
54,0 60 1320
45,0 55 1150
36,0 50 980
27,0 46 810
18,0 41 640
9,0 36 470
0 32 300
8/25 11:14
8/26 11:14
8/27 11:14
8/28 11:14
8/29 11:14
8/30 11:14
8/31 11:14
Time Axis
CH1 CH2 CH3
MAX: 1527 77 71,9
MIN: 364 66 48,2
AVG: 585 70 59,0
CH1 CO2
CH2 °F
CH3 %RH


Macomb Junior-Senior High School
Room W-4
File: 9478MHS August 25, 1995 12:40
RH % Temp °F CO2 PPM
75.0 78 2000
67.5 74 1830
60.0 69 1660
52.5 64 1490
44.9 60 1320
37.5 55 1150
30.0 50 980
22.4 46 810
15.0 41 640
7.5 36 470
0 32 300
8/25 12:40
8/26 12:40
8/27 12:40
8/28 12:40
8/29 12:40
8/30 12:40
8/31 12:40
Time Axis
CH1 CH2 CH3
MAX: 1950 78 66.9
MIN: 374 69 48.2
AVG: 605 72 55.5
CH1 CO2
CH2 °F
CH3 %RH