INDOOR AIR QUALITY ASSESSMENT OF BUILDING ST
PALOMAR COMMUNITY COLLEGE
ADMINISTRATION ANNEX - GROUND FLOOR
1140 WEST MISSION ROAD
SAN MARCOS, CALIFORNIA

PREPARED FOR:
Palomar Community College
1140 West Mission Road
San Marcos, California

PREPARED BY:
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April 26, 2017
Project No. 108182004

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Mr. Derrick Johnson
Supervisor, Environmental Health and Safety
Palomar Community College
1140 West Mission Road
San Marcos, California

Subject: Indoor Air Quality Assessment of Building ST
Palomar Community College Administration Annex - Ground Floor
1140 West Mission Road
San Marcos, California

Dear Mr. Johnson:

In accordance with your request and authorization to proceed, Ninyo & Moore has performed a visual inspection and limited indoor air quality assessment of the ground floor interior of Building ST (Administration Annex) at the Palomar Community College (PCC) located at 1140 West Mission Road in San Marcos, California. The assessment was conducted in response to indoor air quality complaints from several individuals working within the building, and general concern over indoor air quality within the interior spaces. Remodeling activities are taking place in an adjacent space.

Ninyo & Moore's scope of services included visual inspection of the affected areas, and air sampling of the interior spaces including total and respirable dust via NIOSH Methods 0500 and 0600, total airborne particulate via spore-trap, ultrafine particulate via condensation particle counter, total volatile organic gases and vapors via real-time instrumentation, and the general indoor air quality parameters of carbon monoxide, carbon dioxide, temperature and relative humidity in selected indoor and outdoor areas. The attached report presents our methodology, observations, results, conclusions and recommendations. We appreciate the opportunity to be of service to you on this project.

Sincerely,
NINYO & MOORE

Nicolas Carpenter
Project Environmental Scientist

Stephen J. Wade, CIH, CSP, CIEC, CMC
Principal Environmental Scientist

NJC/SJW/gg

Distribution: (1) Addressee

TABLE OF CONTENTS

Page

1. VISUAL INSPECTION 1
2. GENERAL MEASUREMENT OF INDOOR AIR QUALITY 1
3. AIR MONITORING FOR VOLATILE ORGANIC COMPOUNDS 2
4. PARTICULATE AIR SAMPLING METHODOLOGY 2
5. TOTAL AND RESPIRABLE DUST AIR SAMPLING METHODOLOGY 3
6. EXPOSURE GUIDELINES AND INTERPRETATION OF RESULTS 4
   - 6.1. Temperature and Relative Humidity 4
   - 6.2. Carbon Monoxide 4
   - 6.3. Carbon Dioxide 5
   - 6.4. Mold Spore and Total Particulate Air Sampling Results 5
   - 6.5. Total and Respirable Air Sampling Results 7
7. CONCLUSIONS AND RECOMMENDATIONS 8
8. LIMITATIONS 9

Tables

Table 1 – Ranges of Typical Outdoor and Indoor Particle Concentrations 6
Table 2 – Building-ST Dust Sampling Summary Results 7

Appendices

Appendix A – Instrument Calibration Record
Appendix B – Laboratory Reports and Chain-of-Custody Record
Appendix C – Photographic Documentation

1. VISUAL INSPECTION

A Ninyo & Moore Certified Industrial Hygienist (CIH) and the Palomar Community College Environmental Health and Safety Supervisor performed an initial visual inspection within the affected spaces on April 7, 2017 in order to discuss the complaint areas and develop a sampling strategy. Further inspection and field sampling was performed by the CIH on April 14, 2017, which included comprehensive sampling within the building's interior spaces. The heating, ventilation and air conditioning (HVAC) system was temporarily shut down at the time of our assessment due to construction activities in an adjacent space.

Interior surfaces of the surveyed building appeared to be dusty due to the construction activities although no noticeable odor was present. Ninyo & Moore personnel began the initial assessment at approximately 0830 and performed air sampling activities throughout the day with short-duration monitoring and sampling. Employees were present in the occupied spaces during all activities.

2. GENERAL MEASUREMENT OF INDOOR AIR QUALITY

Air monitoring for general indoor air quality parameters is typically performed by indoor air quality professionals as a general indicator of whether air handling systems are properly balanced and appropriate indoor and fresh outdoor air mixing is occurring. Ninyo & Moore performed this monitoring using a calibrated Q-TRAK® Indoor Air Quality Meter (TSI Instruments, Model No. 7575) during air sampling activities on April 14, 2017. The parameters measured included temperature (Temp), relative humidity (rH), carbon monoxide (CO), and carbon dioxide (CO2). The following is a summary of the measurements obtained:

- **Temp –** The temperature within Building ST and the adjacent Pride Center ranged from approximately 68.0 to 73.7 degrees Fahrenheit (º F). The outside temperature was approximately 59 to 69 º F throughout the day.
- **rH –** The relative humidity within Building ST and the adjacent Pride Center ranged from approximately 47.1 to 56.3 percent. The outside relative humidity ranged from approximately 30 to 59 percent.

- **CO –** The CO readings within Building ST and the adjacent Pride Center and immediately outdoors were consistently less than 1 part per million (ppm).
- **CO_2 –** CO_2 readings within Building ST ranged between 760 and nearly 1,600 ppm during sampling activities throughout the day. The adjacent Pride Center ranged between approximately 580 to 680 ppm CO_2. The outside CO_2 readings maintained approximately 420 ppm.

A copy of the calibration certificates for the instruments used is provided in Appendix A.

3. AIR MONITORING FOR VOLATILE ORGANIC COMPOUNDS

A calibrated photoionization detector (PID), with a detection limit in the parts per billion (ppb) range was used on-site to detect any ambient volatile organic compounds within Building ST and the adjacent Pride Center in real time. The intent was to use this qualitative instrument to locate areas of high organic vapor (or "hot-spots") for possible further sampling. Indications of organic vapor ranged from approximately 300 to 500 ppb with no reproducible "hot-spots" identified.

4. PARTICULATE AIR SAMPLING METHODOLOGY

A condensation particle counter was used to assess any unusual condition associated with the presence of ultra-fine particles (UFPs) that were present, resulting from sources of combustion, chemical reaction or malfunctioning office equipment. Respiration of UFPs can challenge the body's natural defense mechanisms and overexposure may strain these mechanisms, causing an adverse reaction. Measurements of UFPs within Building ST and the adjacent Pride Center during this assessment were consistently between approximately 3.000 to 8,000 particles per cubic centimeter of air (pcc) with outdoor readings measured between 3,500 and 10,800 pcc with no unusual conditions noted.

Air samples were also collected within Building ST for the evaluation of total airborne spores and other particulates using Zefon™ Air-O-Cell sampling cassettes and a high-volume, rotating vane Gast™ sampling pump (calibrated to 15 liters of air per minute). The Air-O-Cell sampler is a particulate sampling cassette designed for the rapid collection and analysis of a wide range of airborne aerosols, including mold spores (to the genus level). This sampling device is useful in

providing rapid analysis of airborne contaminants in indoor air quality testing. Samplers were calibrated on site immediately before use and samples drawn for a period of five minutes each, one just outside Room ST-63, one just outside of Room ST-64 and two just outside the building (in the outdoor environment). Each collected air sample was labeled with a unique identification number corresponding to the sample location.

Collected samples were documented on a chain-of-custody form and submitted to the laboratory for analysis. Samples were submitted to Environmental Microbiology Laboratory (EMLab) of Irvine, California. EMLab is an American Industrial Hygiene Association Environmental Microbiology Accredited Laboratory. The laboratory reports and Chain-of-Custody (COC) forms are included in Appendix B.

5. TOTAL AND RESPIRABLE DUST AIR SAMPLING METHODOLOGY

Because different exposure limits exist for respirable and total dust, two sets of samplers were prepared for use to assess dust exposure during routine daily activities in Offices ST-62 and ST-67 during the late morning. Two personal samplers were set up in each office near the employee's desks at approximate breathing zone height for a seated person and run from approximately 0930 to 1030 to capture a representative hour's dust exposure.

Air samples were collected using suction pumps (Buck Libra Personal Air Sampling Pumps, Orlando, FL) with one set connected to a Zefon respirable dust aluminum cyclone to measure the respirable fraction of dust, and another set connected directly to the sample media to measure the inhalable dust fraction. Each sampling train was calibrated in the field using a field rotometer which was itself calibrated to a primary standard at the laboratory. The sampling medium was a 37 millimeter (mm), 5.0 micrometer pore size PVC filter with a cellulose support pad housed in a three-stage filter cassette. The 10 mm aluminum cyclone with its attachments is a light weight, size-selective particulate collector widely recommended by the National Institute for Occupational Safety and health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) for sampling airborne respirable dust. Each sample was collected for the approximate maximum sampling time recommended by the written NIOSH method.

At the end of the day the post-sampling flow rate of each sampler was recorded. The post-calibration reading of each was then checked to ensure that the average value was within 10% of the pre-sampling flow rate value, otherwise the sample would have been considered invalid.

Each sample was then labeled with an identification number, documented on a chain-of-custody form, and returned to the laboratory for analysis by NIOSH Method 0500 and 0600. All samples were submitted to EMSL of Huntington Beach, California. EMSL is an American Industrial Hygiene Association (AIHA) Accredited Laboratory.

6. EXPOSURE GUIDELINES AND INTERPRETATION OF RESULTS

6.1. Temperature and Relative Humidity

Temperature and relative humidity were measured at various times and locations inside Building ST and the adjacent Pride Center and immediately outdoors to determine if these air quality parameters fall outside the ASHRAE recommended ranges. Measurements outside of the recommended ranges can be indicative of problems with building design or maintenance. On April 14, 2017 the temperature inside the building ranged from approximately 68 to 74 º F and the indoor relative humidity ranged from approximately 47 to 56 percent. These conditions were found to be similar to the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) comfort parameters of 68 to 74 degrees Fahrenheit (wintertime) and 30 to 65 percent relative humidity.

6.2. Carbon Monoxide

Direct instrument readings indicated that CO concentrations in the surveyed areas were consistently less than 1 ppm. Although there are no federal regulations governing CO exposure limits in non-industrial indoor environments, the USEPA has set National Primary Ambient Air Quality Standards for Outdoor Air to be used in locating ventilation sources for buildings. Exposure limits for CO have been established at a maximum of 35 ppm for one hour, not more than one time per year, or 9 ppm over any eight-hour period. The American Conference of Governmental Industrial Hygienists (ACGIH) and the Occupational Safety and

Health Administration (OSHA) have established similar maximum exposure limits in the Industrial Workplace Standard. In view of these guidelines, the CO concentrations measured in the surveyed areas are not considered significant.

6.3. Carbon Dioxide

CO_2 is a good indicator of proper ventilation within a building environment and the ASHRAE's Standard 62 recommends an indoor level not to exceed 650 ppm above outdoor ambient air. Direct-reading instruments employed during the study showed CO_2 levels inside Building ST during sampling activity to be generally between 760 and 1,600 ppm, with measured outdoor levels at approximately 420 to 460 ppm. This was expected since the HVAC system is not currently functioning. Carbon dioxide concentrations above 1,000 ppm can cause occupants to feel sluggish and is generally considered to be indicative of substandard ventilation rates. The Pride Center maintained a much lower CO_2 concentration of 580 to 680 ppm. The Pride Center reading is considered to be well within the recommended balance of outdoor to re-circulated indoor air and indicates a building that is efficiently removing indoor air and properly mixing fresh, outdoor air.

6.4. Mold Spore and Total Particulate Air Sampling Results

Since there are no regulated exposure threshold levels for molds, the American Conference of Governmental Industrial Hygienists and the United States Environmental Protection Agency guidelines suggest that interpretation of air sampling results should be generally based on comparison of indoor and outdoor spore contents. In addition, it is common industry practice to compare outside bioaerosol concentrations and genera to inside bioaerosol concentrations and genera. If the indoor concentration is significantly higher than the outdoor concentration, or if different spore types are present indoors and outdoors, then indoor fungus sources (amplifiers) are presumed to exist. These observations are guidelines only. Variation is an inherent part of airborne spore sampling and the presence of a few different genera in small numbers should not be considered abnormal.

Results of the spore trap samples collected from the interior of Building ST were compared to the exterior (background) sample results. With the exception of two Penicillium/Aspergillus spores and one Ulocladium spore found indoors, all spore types identified indoors were detected in the background samples collected on the same day within minutes of the interior samples. In addition, the total average spore counts detected in the background samples showed similar spore types and higher average concentrations than those found in the interior samples. The results of sampling were considered to be representative of a "normal indoor fungal ecology" and the slight variation in spore types is considered consistent with variation seen in common practice. A copy of the laboratory results associated with spore trap air sampling at the site is provided in Appendix B.

Other biological and non-biological particles were also detected in indoor air during our assessment as indicated in the laboratory report in Appendix B. Pollens, epithelial (skin) cells, insect parts, fungal hyphal fragments, starch particles and miscellaneous fibers was detected in indoor air. There are no exposure limits for these particulates commonly detected in indoor air but these concentrations are typically noted and compared to local laboratory databases to determine whether any contaminant is present in an abnormal or elevated concentration. For comparison, a table is provided below which summarizes typical indoor levels of some of these commonly detected contaminants. The table is provided by EMLab P&K, a TestAmerica Company, in the IAQ Pocket Reference Guide 7th Edition, copyrighted in 2012 and published in January 2013. A copy of the laboratory results associated with particulate air sampling in the ST Building and outdoors is provided in Appendix B.

Table 1 – Ranges of Typical Outdoor and Indoor Particle Concentrations

Particle Type	Outdoor Environment (counts/m^3)	Indoor Environment (counts/m^3)			Building ST Results
		Low	***Moderate***	***High***	
Pollen	ND-5000	ND-50	50-100	>100	13-53
Glass fibers	ND-80	ND-80	80-200	>200	13
Epithelial cells	ND-1500	ND-10,000	10,000-15,000	>15,000	290-6,200

Note:
ND – None detected

6.5. Total and Respirable Air Sampling Results

Results of samples collected in the individual employee's offices (ST-62 and ST-67) during routine operations indicated levels of respirable dust at less than the laboratory limit of detection of 0.351 to 0.357 milligrams per cubic meter (mg/m^3) of air, well below the ACGIH TLV of 3 mg/m^3 of air. In addition, collection and analysis of *total* dust samples running in the same locations and during the same time frame also resulted in levels of total particulate measured at less than the laboratory limit of detection of 0.375 mg/m^3, well below the ACGIH TLV of 10 mg/m^3 of air. Laboratory reports and chain-of-custody documentation are presented in Attachment C with a summary in Table 1 below.

While not directly applicable, the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) are provided in the following table for comparison to these laboratory results. The TLVs refer to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. As is shown in the table, all results from sampling within the two offices represent conditions that are orders of magnitude below recommended guidelines established by the ACGIH.

Table 2 – Building-ST Dust Sampling Summary Results

Area Monitored	Calculated (TWA[1])	Cal-OSHA PEL[2] (TWA)	ACGIH TLV[3] (TWA)
Office ST-62 (respirable)	<0.351 mg/m^3	5 mg/m^3	3 mg/m^3
Office ST-62 (total dust)	<0.375 mg/m^3	15 mg/m^3	10 mg/m^3
Office ST-67 (respirable)	<0.357 mg/m^3	5 mg/m^3	3 mg/m^3
Office ST-67 (total dust)	<0.375 mg/m^3	15 mg/m^3	10 mg/m^3

Notes:
TWA[1] – 8-hour time weighted average concentration
PEL[2] – Permissible Exposure Limit (legal exposure limit)
TLV[3] – Threshold Limit Value (recommended exposure limit)

7. CONCLUSIONS AND RECOMMENDATIONS

Indoor air quality parameters investigated during this assessment included temperature, humidity, CO levels, CO_2 levels, airborne gases and vapors, ultrafine particles and total spore and particulate concentrations. Air quality measurements were performed throughout the day within Building ST, and from within several different areas including the adjacent Pride Center. Real-time readings throughout the day indicated that the complaint area suffers from a lack of fresh-air mixing and high CO_2 levels which is significantly affecting air quality in these offices. The adjacent Pride Center has no such problem, with monitoring results indicating that this part of the structure is efficiently removing indoor air and properly mixing fresh, outdoor air.

Spore and particulate concentrations were measured in two areas within Building ST and indicated what should be considered a "normal indoor fungal ecology" with normal levels of particulate contaminants such as epithelial (skin) cells and cellulose fibers. Total and respirable dust sampling indicated levels of airborne dust in concentrations less than the laboratory limits of detection during our sampling event. It should be noted however, that construction activities were *not* occurring in the adjacent space during our sampling event and *settled* dust was present on many observed surfaces in the occupied complaint areas.

In summary, during on-site investigation, two air quality issues were discovered in the complaint areas that should be addressed. The most significant was the lack of fresh air mixing and elevated carbon dioxide levels in these occupied spaces. This condition should be remedied once the HVAC system in the immediate area is back online however, until that time it is highly recommended that fresh air be provided by open doors and fan units when employees are working in the space. The second issue is that while no significant airborne issue was uncovered, visible settled dust is present in many of the occupied complaint areas. This dust should be removed once construction activities have been completed, preferably with vacuums fitted with high efficiency particulate air (HEPA) filters as part of the exhaust systems. Attention to both of these remedial measures will greatly improve air quality within the occupied spaces.

8. LIMITATIONS

Air sampling results are limited in that they represent airborne concentrations at the time of sample collection only. Changes in weather, operating procedures, ventilation, temperature, humidity, occupant practices and other conditions including further construction activities in adjacent areas, may cause variations in anticipated indoor airborne concentrations.

Ninyo & Moore has performed the tasks set forth above in a thorough and professional manner consistent with industry guidelines and under supervision of a certified professional. Ninyo & Moore cannot guarantee and does not warrant that this limited assessment has revealed all adverse environmental conditions affecting the site. Nor can Ninyo & Moore warrant that the assessment requested would satisfy the dictates of, or provide a legal defense in connection with, environmental laws or regulations.

The results reported and any opinions reached by Ninyo & Moore are for the benefit of the client. Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. It should be understood that changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge.