

WESTPORT PUBLIC SCHOOLS

Board of Education

Mark Mathias, Chair
Jeannie Smith, Vice Chair
Elaine Whitney, Secretary
Karen Kleine
Vik Muktavaram
Candice Savin
Neil Phillips

110 MYRTLE AVENUE
WESTPORT, CONNECTICUT 06880
TELEPHONE: (203) 341-1025
FAX: (203) 341-1029

November 11, 2019

In late September 2018, Coleytown Middle School (CMS) received reports of mold in the building, raising indoor air quality concerns. In an abundance of caution, the Westport Board of Education (Board) closed CMS on September 20, 2018. A major cause of the mold was water incursion due to the failure of the window system. Other deficiencies that led to the problem were the poor exterior envelope, grading issues around the perimeter of the building that were pitched toward the building, air handling units that were not functioning due to energy conservation programs and other conditions insufficient to prevent further water-related issues.

The mold reports set in place an immediate response to the situation, most visibly closing CMS, and moving the students and staff in grades six and seven to Bedford Middle School (BMS) while splitting CMS students and staff in grade eight between BMS and Staples High School.

Over the following months, numerous experts were engaged by the Board to assess the situation and to determine how best to address the needs of the school. Each of these experts, including architects, engineers and industrial hygienists, looked at specific aspects of the situation. The existence of multiple technical reports made it difficult to have a comprehensive and cohesive view of the results. In order to provide clarity, the Board engaged its legal counsel, Shipman & Goodwin (S&G), to work with their experts to aggregate the results of the reports into a single document. Toward that end, S&G engaged the services of Langan CT, Inc. (Langan), an Environmental and Engineering Consulting firm who performed an "Indoor Air Quality Desktop Study and Site Walk." The result of the work from S&G and Langan is attached.

In order to ameliorate the problems which led to CMS closing, the Town established the Coleytown Middle School Building Committee (Building Committee), comprised of a talented group of residents, including an architect, engineers, an HVAC expert and town planner, who developed a plan to fully refurbish CMS. The timetable developed by the Building Committee projects that CMS will re-open in August, 2020. On Tuesday, July 16, 2019, the Town, through the Representative Town Meeting (RTM), voted to fully fund the repair of CMS by appropriating \$32,000,000.

In order to address the educational issues associated with CMS being closed during construction, for the duration of the 2019-2020 school year all sixth, seventh and eighth grade students attend BMS.

In an effort to mitigate some of the educational issues associated with the combined middle school, the Board took several measures. They include:

1. Purchasing and installing portable classrooms, creating six additional classrooms at BMS;
2. Constructing four additional office spaces for speech and language pathologists, counseling services and two conference rooms in the library media area of BMS; and

3. Reconfiguring interior classrooms and the guidance suite to add classroom space for special education services and office space for school psychologists.

Financially, the Board and Town are actively seeking approximately \$150,000 in funding from the State of Connecticut to help offset the costs of the portables.

In addition to obtaining the results from expert reports, since 2018 the Board, in concert with the Town of Westport, has engaged the architectural firm Antinozzi and Associates to provide a facilities study for all of the Westport Public Schools buildings.

In a heightened effort to implement a proactive approach to preventive maintenance and specifically, to monitor and prevent circumstances that could potentially result in mold issues, the following actions have been implemented:

- HVAC cooling systems operated continuously during the course of warm weather and high humidity months – in particular, during the summer.
- Custodians conduct a visual inspection of every room at least twice per week. A log of inspection dates is being kept by the school head custodian.
- During custodian visual inspections any signs of mold growth, water incursion or high indoor humidity levels are being recorded and immediately reported to the school's Head Custodian. In turn, the Coordinator of Custodians will be notified of the conditions and will inspect the impacted area.
- Immediate steps will be taken to identify all water or mold sources to prevent further incursion or spread of growth.
- The Coordinator of Custodians meets with the Head Custodian of each school biweekly throughout the school year to review log reports and overall building conditions.
- The district has purchased and is using handheld humidity level testers for all schools.
- The Coordinator of Custodians consults with the Director of Facilities on repairs required to ensure acceptable Indoor Air Quality (IAQ) standards.
- The Director of Facilities apprises the Chief Financial Officer of all planned repairs and any need for additional funds.
- Since their implementation in 2013, all Tools for Schools protocols have been adhered to.

Altogether, these actions continue to provide Westport students with exceptional learning environments in facilities that enable high quality education for our students.

Sincerely,

Mark Mathias, Chair
Jeannie Smith, Vice Chair
Elaine Whitney, Secretary
Karen Kleine
Vik Muktavaram
Candice Savin
Neil Phillips

INDOOR AIR QUALITY DESKTOP STUDY AND SITE WALK

for

**Westport Public Schools
Coleytown Middle School
255 North Avenue
Westport, CT 06880**

Prepared for:

**Westport Board of Education (BOE)
110 Myrtle Avenue
Westport, CT 06880**

Prepared By:

**Langan CT, Inc.
555 Long Wharf Drive
New Haven, CT 06511**



**Matthew A. Myers
Senior Project Manager**



**Jamie P. Barr, L.E.P.
Senior Associate/Vice President**

**24 September 2019
140197201**

LANGAN

TABLE OF CONTENTS

	<u>Page No.</u>
1.0 INTRODUCTION AND BACKGROUND	1
2.0 SUMMARY OF DOCUMENT REVIEW	4
3.0 SUMMARY OF LANGAN SITE WALK AND INTERVIEW	14
4.0 CONCLUSIONS.....	16
5.0 LIMITATIONS.....	18

1.0 INTRODUCTION AND BACKGROUND

Westport Public Schools (WPS) engaged Langan CT, Inc. (Langan) to conduct a historical document review, a site walkthrough and interviews of WPS personnel associated with the recent indoor air quality (IAQ) assessments conducted at Coleytown Middle School (CMS). The objective of Langan's evaluation was to develop a single IAQ report summarizing the information provided in various prior commissioned IAQ reports (and other related architectural/engineering reports and assessments) for the BOE's reference with respect to the IAQ issues at CMS. Please note that although this report addresses related architectural and engineering-focused reports as helpful and necessary context, this report is primarily focused on Langan's review and evaluation of the information provided in the prior commissioned IAQ reports and Langan's site walk and interviews.

Executive Summary

Langan performed a review of available documents including: several IAQ reports (written by Hygenix Inc.); Superintendent information releases; architectural, engineering and peer review reports, studies and memos (KG+D Architects, P.C., Turner Building Science & Design, LLC., Kohler Ronan, LLC, Wiss, Janney, Elstner Associates, Inc.); as well as a site walkthrough and interview of CMS personnel.¹ Detailed summaries of each report review, site walkthrough and interview findings are found in sections 2.0 and 3.0 of this report.

Superintendent Releases, Architectural, Engineering and Peer Review Reports, Studies and Memo Reviews, Site Walkthrough and Interviews

Despite an award-winning "Tools for Schools" IAQ program,² the building's history of water intrusion appears to be the likeliest root cause of the IAQ issues at CMS. Mold growth in the building was exacerbated in the 2018 summer with heavy rains, high humidity and HVAC systems designed to conserve energy by reducing airflow in unoccupied areas. The following items have been identified by several of the documents reviewed by Langan and were confirmed by the site walkthrough and CMS personnel interviews. As informed by the reports, site walkthrough and interviews, the below issues should be addressed to prevent future water intrusion, possible mold growth and ultimately the mold-related IAQ issues for building occupants:

¹ Langan reviewed IAQ-related documents commissioned by the Westport Board of Education and/or the Town of Westport and available at the project website at the time of our site walk (<http://cms.westportps.org/general/cms-facility-updates>).

² https://www.westportps.org/uploaded/site_files/www/Tools_for_Schools_-_post-award_release_2.pdf.

- In conjunction with abatement of mold-impacted building materials, window wall systems and masonry walls should be removed and replaced with new/repared walls (or covered with a water-tight boundary (e.g., over-cladding the wall surface)) where appropriate to prevent water intrusion;
- The sun shades should be removed throughout or, at a minimum, attached and sealed properly to prevent water intrusion;
- The unit ventilators and overall HVAC systems should be upgraded or replaced. HVAC upgrades, according to reports, could be an entirely new system or involve reworking the existing system. Consider incorporating positive pressure and dehumidification features if possible. Do not allow HVAC systems to turn off indefinitely if rooms/areas are not occupied;
- Complete new site grading, adjusting the hardscapes and drainage away from the building;
- Change of the roof drain pipes to drain away from building;
- Install damp-proofing materials on foundation walls below grade in areas that have a history of water intrusion;
- Fix the rotunda window/wall leakage; and
- Additional mold sampling and inspections should be performed to evaluate the IAQ and identify and abate/remove any structures, fixtures or materials that may harbor mold.
- Please also note the reports indicate that the roof is currently acceptable but will reportedly need replacement in the near future.

IAQ Report Review

The majority of the Hygenix reports state that the airborne mold tests satisfied the criteria for a "Clean" building (using the Daniel Baxter table referenced in section 2.0) and visual inspections were satisfactory for several rounds of sampling. In our opinion, this was not the case for several rooms where the indoor airborne concentrations of *Aspergillus/Penicillium* were higher than the exterior concentrations.

Although there are no federal or state regulatory standards or regulations regarding permissible exposures to mold spores, reference sources agree that concentrations of certain pathogenic

mold species should be as low as possible. Airborne mold concentrations can vary depending upon the space, temperature and humidity levels at the time of sampling.

Absent standards and regulations, the interpretation of microbial air sample results relies on the comparison of indoor versus outdoor concentration results. In general, indoor airborne microbial counts should be lower than those found in the outdoor air. The genus/species of the fungi found indoors should be similar to those identified in the outdoor air. However, this may not always be consistent. A situation may be considered unusual when the airborne microbial concentrations in an indoor/complaint area are significantly higher than those found in an outside/non-complaint area. Interpretation of these results requires considerable professional judgment.

Some areas at CMS have never had a “clean” air confirmation result after a “dirty” air sample result was reported (e.g., tunnels, room 119, room 204,). Prior to reoccupying the building (if it is to be reoccupied), airborne mold sampling should be performed throughout the interior and exterior of the building. Langan also recommends sampling from multiple exterior locations on different sides of the building and near the HVAC air intakes for additional reference data to compare against indoor results (not just one outdoor reference sample). Based on available data, the tunnels may require abatement and it should be confirmed that air cannot enter CMS from the affected tunnels before the building is reoccupied.

WPS should monitor building for potential new water intrusion sources and/or mold growth periodically to address issues while manageable. As appropriate, WPS should conduct additional air and tape lift or bulk samples (e.g., if a new leak is reported or occupants report respiratory issues).

PROJECT INFORMATION

Client Name:	Westport Board of Education 110 Myrtle Avenue Westport, CT 06880	Property Visit Date:	25 January 2019
Langan project #:	140197201	Construction Dates:	Original – 1963 Renovations/ Additions – 1994 - 2000
Consultant’s Project Manager:	Matthew A. Myers	No. Buildings:	One
Phone No.:	203-562-5771	No. of Stories:	Two (Approximately 125,000 Square Feet)
Email:	mmyers@langan.com		
Property Address:	255 North Avenue	Property Use:	Public Middle School
Property Town, State:	Westport, Connecticut		

2.0 SUMMARY OF DOCUMENT REVIEW

Below are chronological summaries of the various project documents provided to Langan by WPS³ (comments by Langan are shown as bold and italicized):

- **17 September 2018 – Superintendents Verbal Report, BOE Meeting**
 - CMS experienced moisture and mold issues over the summer leading to varying levels of mold abatement in more than half of the CMS building.
 - Factors believed to be contributing to IAQ issues:
 - Lower level of CMS is below grade;
 - A new energy-efficient HVAC system turned off unit ventilator fans when rooms were not occupied. Combined with unusually high humidity over the summer, the HVAC system was not able to manage the moisture indoors, prompting mold growth in numerous areas of CMS.

³ Langan reviewed IAQ-related documents commissioned by the Westport Board of Education and/or the Town of Westport and available at the project website at the time of our site walk (<http://cms.westportps.org/general/cms-facility-updates>).

- Affected spaces were professionally cleaned, affected ceiling tiles/sheetrock were removed, indoor air was “scrubbed” (filtered outdoors with negative air units), dehumidifiers were installed and run around the clock and air sampling was performed. To mitigate water intrusion, exterior soil excavation occurred in select locations to check for sealed foundations and to promote water drainage away from the building. In addition, the exterior sunshades on the entrance rotunda were removed and exterior wall penetrations were caulked.
 - High humidity, warm weather and rain continued into the first two weeks of the 2018-2019 school year and new mold growth occurred within the CMS building thereafter.
- **18 September 2018 – Superintendents Update**
 - In light of higher than normal student absenteeism, CMS was closed September 20 & 21 for Hygenix, Inc. to perform a visual inspection of building, follow-up air testing, review of student illness complaints and consultation with medical professionals.
- **Hygenix, Inc. Reports dated 2 & 17 August and 4, 10, 21 & 29 September 2018**
 - Multiple rounds of airborne mold sampling occurred from July to September 2018 with varied results (i.e., some results showing satisfactory indoor air (mold) conditions and others showing possibly mold-impacted areas). Air sampling was reported to have been performed in areas where mold abatement work had previously been completed. Hygenix’s airborne mold sampling reports reference a “guide to evaluating the relative degree of indoor airborne mold spore amplification” by Daniel Baxter with a table showing spore counts and a description of the building assessment according to the reported spore concentrations. The descriptions are as follows:
 - “Clean building” – less than 2,000 (spore count) total for all spores or less than 700 *Penicillium/Aspergillus* (predominant types)
 - Possible Indoor Amplification – 1,000 – 5,000 *Penicillium, Aspergillus, Cladosporium* (predominant types)
 - Indoor Amplification likely present – 5,000 – 10,000 *Penicillium, Aspergillus, Cladosporium* (predominant types)

- Chronic Indoor Amplification – 10,000 – 500,000 *Penicillium*, *Aspergillus*, *Cladosporium* (predominant types)
- Inadequate flood cleanup or active indoor demolition of contaminated surfaces – 50,000 – 10,000,000 *Penicillium*, *Aspergillus*, *Stachybotrys*, *Cladosporium*, *Chaetomium*, *Basidiomycetes*, *Trichoderma*, *Ulocladium*, etc. (predominant types)

Langan comment: Although the Daniel Baxter table can be a reference table (albeit of limited utility), it should be noted that buildings can experience mold amplification even when spore concentrations are below the “Clean Building” levels listed in the table. In general, indoor airborne microbial counts should be lower than those found in the outdoor air. In addition, the genus/species of the fungi found indoors should be relatively similar to those identified in the outdoor air. However, this may not always be completely consistent. Test data may indicate an issue when the airborne microbial concentrations in an indoor/complaint area are significantly higher than those found in an outside/non-complaint area and/or a specific mold genus/species is identified indoors in elevated concentrations but not identified outdoors.

- The Hygenix report dated 2 August 2018 states the airborne mold test satisfied the criteria for “Clean” building and visual inspections were satisfactory.

Langan comment: It should be noted that the nurse’s room had Aspergillus/Penicillium detected (low concentration) when compared to the outdoor air sample (none detected).

- The Hygenix report dated 17 August 2018 states the volatile organic chemicals (VOCs) testing performed in the offices found no elevated levels of VOCs.

Langan comment: VOCs are chemical compounds in solid or liquid form that emit vapors and can accumulate inside and under buildings. It should be emphasized that all results were well below the CT DEEP Target Indoor Air Concentrations for residential settings.

- The Hygenix report dated 4 September 2018 (for air sampling performed on 6, 9, 13, 14, 16, 21 & 26 of August) states the airborne mold tests satisfied the criteria for a “Clean” building and visual inspections were satisfactory.

Langan comment: However, although the overall and individual spore counts were generally higher in the outdoor air when compared to the indoor air, the following facts were noted:

- ***6 August 2018 Sampling - Room 119 (custodial office) showed elevated concentrations of Aspergillus/Penicillium when compared to the outdoor air sample.***
 - ***8 August 2018 Sampling - Room 131 showed elevated concentrations of Aspergillus/Penicillium when compared to the outdoor air sample (none detected). Rooms 130, 128, 125, 123 & 120 showed low concentrations of Aspergillus/Penicillium when compared to the outdoor air sample (none detected).***
 - ***9 August 2018 Sampling - Rooms 127, 115, 119 & 205 showed elevated concentrations of Aspergillus/Penicillium when compared to the outdoor air sample.***
 - ***13 August 2018 Sampling – Rooms 226, 126 Prep, 207, Corridor by Cafeteria and 127 showed elevated concentrations of Aspergillus/Penicillium when compared to the outdoor air sample.***
 - ***14 August 2018 Sampling – Rooms 127, 119, 205 & 204 showed elevated concentrations of Aspergillus/Penicillium when compared to the outdoor air sample.***
- The Hygenix report dated 10 September 2018 states the airborne mold tests satisfied the criteria for a “Clean” building and visual inspections were satisfactory.

Langan comment: we concur with the findings in this report (for the limited areas sampled).

- The Hygenix report dated 21 September 2018 states several testing locations satisfied the criteria for “Clean” building while rooms 203, 208, 113 and tunnels have remaining issues (did not satisfy the clean building criteria).

Langan comment: We noted that a few of the “satisfactory” testing locations showed higher concentrations of Aspergillus/Penicillium when compared to the outdoor air sample (concentrations were low, however).

- The Hygenix report dated 29 September 2018 states the airborne mold test satisfied the criteria for “Clean” building and visual inspections were satisfactory.

Langan comment: However, it should be noted that Room 113 showed a low concentration of Aspergillus/Penicillium and none was detected in the outdoor air sample.

- **5 October 2018 – KG+D Architects, P.C. Memo – Water Infiltration – Preliminary Envelope Observations from 26 September and 3 October 2018 site visits**

- The architects’ memo focused on building exterior envelope, the majority of which is ground faced concrete masonry units (CMUs), featuring a permeable layer that purportedly provides weather-tight construction that wraps interior wall construction. The envelope construction was designed to capture water and use gravity to take water out of assembly. According to the report, the wall system is not functioning properly.
 - CMU wall construction is inconsistent (flashings and weeps are not uniform and not present in some locations), existing weeps do not evidence active water flow (weeps may be blocked or water is not reaching them) and weeps and flashings may not be properly coordinated with grading;
 - Exterior sunscreens are poorly attached to building, cuts and penetrations affect the walls, there are no sealants/flashings in some locations, creating a potential avenue of water intrusion;
 - There is significant and widespread evidence of water saturating the exterior walls (discoloration, surface film), including leaking at mortar joints and fastener penetrations (indicating algae and moss growth), contributing to interior humidity problems;

- Regarding window and wall construction, evidence of envelope leaks include missing sill flashings, failing glass seals and sealants at panel and mullion junction points;
 - Other site concerns include the grading and hardscapes abutting the building are at same elevation as interior floor and the slabs are sloped toward the building. The unit ventilators are at ground level and the wall base and louvers are vulnerable to leaking. Remedial drainage has been added in problem locations but does not address causal problems.
 - The architects recommend destructive testing of the wall and roofing to learn more about the building.
- **1 November 2018 – Superintendent’s Update**
 - Fourteen days into the new school year, students and staff were relocated to another school for the entire school year.
- **5 November 2018 - KG+D Architects, P.C. Exterior Enclosure & Mechanical System Study, Board of Education Presentation**
 - The architects presented observations (including water intrusion vulnerabilities) on roofing, window glazing compounds, various wall constructions, weeps, sunshade support, grading and HVAC expanding on the 5 October 2018 memo.
 - The architects’ recommendations included:
 - New roofing installation;
 - Removal and replacement of exterior wall systems, window systems and curtain walls;
 - Sunshade removal;
 - Exterior grading with proper pitch away from building;
 - Waterproofing and wall insulation;
 - Storm water drainage from roofs connected to piping system going away from building;
 - Mechanical system HVAC upgrades versus complete replacement; and
 - Interior renovations associated with HVAC work.

The architects presented several budget estimates for renovation versus demolition and build new with timelines.

- **12 November 2018 – Turner Building Science & Design, LLC (TBSD) Summary Report**

- October 2018 site visit recommendations:
 - Regrade the site to move rain water away from building;
 - Provide dehumidification (summarized pros and cons of new installation versus upgrades and alterations to existing HVAC systems);
 - Evaluate wall structures and possibly perform additional investigation and mitigation within wall systems;
 - Complete dew point calculations of repaired/replaced wall assemblies; and
 - If re-occupancy of building is to occur, (i) adjust HVAC system(s); (ii) improve dehumidification; (iii) alter water dams and/or drainage trenches to divert water away from the building; (iv) improve dehumidification; (v) clean unit ventilators (and install intake extensions) and roof top units; (vi) adjust pressurization of existing spaces; and (vii) repair roof/flashing where necessary.

- **16 November 2018 – TBSD Field Observation Report No. BECx 1 from 26 September 2018 site visit**

- TBSD lists background issues of mold, high humidity, mechanical systems maintenance, building envelope design/build, ground level air intakes, pooling water at rooftop air handler air intakes, boilers and chillers sharing one set of piping, improper drainage of condensate from cooling equipment and exterior grading issues around perimeter of building that pitch towards the building.
- TBSD discusses unit ventilators (with intakes at ground level), site drainage (pitch and water intrusion, water seepage into foundations/wall assemblies), wall assemblies (damp and mossy, water staining, evidence of water inside walls), flooring, roof assembly (older but not yet in need of replacement, flashing failure at front tower), override of HVAC system (temporary dehumidification system in place).

- TBSD's recommendations included re-grading site/engineering, installing dehumidification HVAC systems throughout building, installing new HVAC upgrades to roof top units, possibly unit ventilators (including raising air intakes off ground), evaluating wall structures (including invasive investigation), and completing dew point calculations of replaced/repared wall assemblies.
 - TBSD's recommendations, in a temporary re-occupation scenario, include HVAC repairs/ modifications/cleaning, installing water dams/drainage trenches to divert water away from building, improving dehumidification, raising air intake louvers off ground, coordinating positive pressure in existing spaces and repairing roof leaks and flashing failures.
- **12 December 2018 - KG+D Architects, P.C. Building Envelope & HVAC Systems Evaluation and Recommendations**
 - The architects further discussed the building's wall construction (presenting findings from destructive opening/testing), sunscreen attachments, grading and slope, canopies and downspouts dumping water at base of building, window assemblies, roofing deficiencies similar to previous documents;
 - The architects discussed the HVAC system. Unit ventilators issues are attributable to exterior louvers at ground level, excessive moisture and water intrusion, the cooling coil not designed to dehumidify excessive amounts of moisture and the energy-efficiency upgrades (which can cause the cooling and dehumidification cycle to turn off with no occupancy – increasing moisture levels). Condensate drainage was improper in some locations and lead to condensate not being able to be discharged. Condensate drainage may be piped directly to ground (not sanitary system as needed), which can lead to water and pest intrusion. Rooftop units only have dry bulb and no dehumidification cycle.
 - Recommendations include regrading grounds to slope away from building, improving waterproofing, new wall and roof installation, draining rain water from roofs to piping system going away from building, removing and replacing of exterior wall systems, window systems and curtain walls, removing the sun shade removal, mechanical system HVAC upgrades versus complete replacement, interior renovations associated with HVAC work, cooling tower

replacement. The architects presented several budget estimates for renovation versus demolition and build new with timelines.

- The architects presented several budget and timeline estimates for renovation versus demolition and build new.

- **14 January 2019 – Kohler Ronan, LLC – Coleytown Middle School HVAC Peer Review Draft**

- This report reviewed the KG&D and TBSD reports and Encon's proposal. According to the report, the quickest and easiest option to adapt the HVAC system for reoccupation is to reuse all existing HVAC equipment and modify it with dedicated outdoor air delivery systems (DOAS) for a short term fix (as units are over 18 years old). Installing a Variable Air Volume system may not be feasible due to physical building constraints. Encon's design build approach with new Variable Refrigerant Flow System and DOAS is also an option, as it is a new state of the art installation that does not rely on existing systems.
- The review of Hygenix, Inc. reports show the tunnels do not have an adequate ventilation system and abatement of tunnels is not completed.
- The review of KG&D report – discusses issue with sunshades, exterior envelope effects on HVAC equipment, improper installation or non-functioning air handling unit, cooling tower, unit ventilators, with comments similar to above summaries.
- The review of TBSD report – discusses different improvement options and recommendations to temporarily re-occupy building with comments similar to above summaries.
- Kohler Ronan lists fourteen items in the general observations section at end of review that are not identified in any of the reports they reviewed. These include many HVAC observations and recommendations for throughout the building and roof debris removal in a library ceiling area.

- **15 January 2019 – Wiss, Janney, Elstner Associates, Inc. - Coleytown Middle School Peer Review of Indoor Air Quality Evaluation - Draft Report**

- The Peer Review group determined that indoor humidity levels are largely attributed to current HVAC systems as well as leaking and permeability of the building envelope. Existing systems cannot sufficiently dehumidify and are further compromised by the current energy conservation control strategies – outdoor air is reduced and negative pressurization of the building brings air inside through the compromised envelope.
- Different solutions by KG&D, TBSD and Encon documents are discussed. The conclusion is that installation of new DOAS equipment to provide controlled/dehumidification ventilation would be necessary if WPS is to re-occupy the building.
- Facilities staff report making improvements that include: new below grade waterproofing and site drainage at the northeast corner stairwell; clear sealer applied to ground face CMU above grade of this area of wall; site grading at various locations; flashing installation (classroom 130); sunshades removed from upper atrium (poorly attached before removal).
- The report provides a review and discussion of KG&D findings of façade, wall cavity issues, sidewalks/hardscapes sloped toward building, unit ventilator louvers, regrading, window system and curtain wall issues, interior wall penetrations, sunshades, cavities wet and some mold. Roofing and mechanical systems were reviewed and discussed with comments similar to those above.
- Noted observations of site walk include window water leakage in classrooms and entrance rotunda, stained ceiling tiles and/or active roof leaks in five locations, window glazing failure/fogging of windows, among others.
- Exterior observations include: mortar joints on 1998 CMU walls are in good condition; mortar joints on 1960s CMU walls are in variable condition (west façade deterioration); there are cracks at sunshade anchors; there is erosion of 1960s base CMU walls at grade/ground level; the control joints are variable; sealants installed (due to multiple failures at control joints and window perimeters); and the lack of sill flashings.
- Discussion and conclusions/recommendations include: lowering sidewalks and hard surfaces; regrading and waterproofing CMU walls that go below grade; moving storm water drainage by connecting to a system that flows away from

building; finding 1960s wall failures and possibly remove entire system but mass repairs may also work (repointing, "over-cladding the wall surface," and other options); removal or study/repair of 1988 walls, possibly removing or remediating the sunshades and windows system failures throughout; and removing, repairing or replacing roof, as needed (roof is 18-20 years old).

3.0 SUMMARY OF LANGAN SITE WALK AND INTERVIEW

On 25 January 2019, Langan senior project manager, Matthew A. Myers (M.Sc. in Occupational Safety and Health with a concentration in Industrial Hygiene) met several representatives from the WPS to discuss the following:

- The history of the building;
- Building construction;
- Events from the summer and September 2018;
- Mold abatement and air sampling;
- Water intrusion corrective action; and
- HVAC systems.

Below is a summary of the discussion and limited site walk:

- The unit ventilators/cabinetry areas are a main source of water intrusion (some intakes are at ground level, where water can easily enter) and the building materials inside/adjacent to such materials have experienced mold growth and abatement (pipe insulation, sheetrock, etc.). The unit ventilator controls had been changed before the summer of 2018 for energy conservation reasons so that if no one occupied the rooms (as detected by carbon dioxide and occupancy sensors), the units did not run, which allowed temperatures and humidity to remain elevated and increased the mold growth. Additionally, a wall AC unit in the nurse's office and storeroom malfunctioned at the end of July/early August and those areas were described by CMS staff as "raining inside." The heating and cooling is a two pipe system. CMS uses AC throughout the whole building (except the gym, which only uses a ventilation system). The auditorium has a separate air handler and the library and cafeteria have separate rooftop units, respectively. Corridors have coil units above ceiling tiles and exhaust fans and were running until a dehumidification system was temporarily installed. Our site walk

confirmed that some of the unit ventilators are at ground level, making water intrusion likely. Some visible water damage was noted inside the units on wall materials and pipe insulation. Langan also noted that some damaged wall and pipe insulation materials have been removed and replaced.

- Drainage was reported to have been installed in front of some of the unit ventilators and the drainage pipe extends away from the building. Maintenance staff stated this seems to have helped with water intrusion. Drainage systems were visible in some exterior locations adjacent to the unit ventilator intakes.
- The office space previously had carpeting that would get wet (a roof drain would empty below this space and water would come up through floor). Maintenance staff stated extending the roof drainage pipe took care of this issue. This issue was not verifiable on the date of the site walk.
- The maintenance staff reported the main entrance rotunda window/angles/block walls have moisture issues (water comes down inside walls) because of design issues and leaks. This issue was not verifiable on the date of the site walk.
- According to the maintenance staff, a stairwell/corridor previously flooded on a regular basis but some re-grading/waterproofing/drainage seems to have helped. This issue was not verifiable on the date of the site walk, however the exterior wall materials show water marks consistent with water collecting in this area. New/replaced interior building materials indicate previous water intrusion and building material replacement.
- The maintenance staff reportedly found a wall below grade that had a large hole through the foundation and the hole was recently sealed off. This issue was not verifiable on the date of the site walk.
- The maintenance staff reported that the Summer and Fall 2018 mold abatement and sampling typically was completed a few rooms at a time. Types of abatement included: cleaning all the unit ventilators and duct work; removing suspect mold growth on fiberglass pipe insulation, cellulose ceiling tiles, sheetrock/ wallboard, etc. and replacing the impacted materials. The maintenance staff reported that sometimes the mold would return to areas already abated. The site walk confirmed that ceiling tiles, pipe insulation, sheetrock walls, etc. appear to have been replaced recently in areas of reported abatement.

- The building was put under positive pressure and a dehumidification system was installed from 2 August through 1 November 2018.
- The maintenance staff reported the sunshade installation created penetrations throughout the building and were not properly connected in some areas. They also reported that sealant compounds and/or damp-proofing were not applied to several areas where the shades entered into the exterior walls. The site walk and previous photographic evidence confirmed that there are several wall penetration areas that had visible mold/moss growth and sealant compounds and/or damp-proofing was never applied to some of the openings around exterior wall penetrations.
- The maintenance staff reported the window walls are prone to leaking issues throughout and that the roofing has had a few isolated issues that have been repaired. The exterior wall systems throughout are reported to have on-going moisture issues throughout (cracks, water intrusion, improper construction, water retention, etc.) and the site walk and previous photographic evidence confirm that there is water intrusion issues involving the window walls.
- Notwithstanding the documented water intrusion, IAQ and mold history of CMS, the facility staff was very knowledgeable of the building and attentive to the building's conditions.

4.0 CONCLUSIONS

As noted above, the building's history of water intrusion appears to be the likeliest root cause of the IAQ issues at CMS. The mold growth was exacerbated last summer with heavy rains, high humidity and an HVAC system designed to conserve energy in unoccupied areas. Should the decision be made to reoccupy the building, it is Langan's opinion that the following items should be addressed to prevent future water intrusion, possible mold growth and ultimately the mold-related IAQ issues for occupants (based on our review of multiple reports and findings, site interviews summarized above):

- In conjunction with abatement of mold-impacted building materials, window wall systems and masonry walls should be removed and replaced with new/repared walls (or covered with a water-tight boundary (e.g., over-cladding the wall surface)) where appropriate to prevent water intrusion.

- As part of the wall/window wall replacement, the unit ventilators/HVAC upgrades or replacements should be performed. The sun shades should be removed throughout or at least attached and sealed properly to prevent water intrusion.
- Create new site grading, adjust the hardscapes and change the roof drain pipes to drain away from building. Install damp-proof on foundation walls below grade.
- Fix the rotunda window/wall leakage.
- HVAC upgrades which, according to reports, could be an entirely new system or reworking the existing system. Consider incorporating positive pressure and dehumidification features if possible. Do not allow systems to turn off indefinitely if rooms/areas are not occupied.
- The roofing is reported and appears to be acceptable currently but will need replacement in the near future.
- Perform mold sampling and inspections to evaluate the IAQ and identify and abate/remove any structures, fixtures or materials that may harbor mold. After occupancy, monitor building for potential *new* water intrusion sources and/or mold growth periodically to address issues while manageable. As appropriate, conduct additional air and tape lift or bulk samples (e.g., if a new leak is reported or occupants report respiratory issues).

IAQ and Air Sampling Results

Although there are no federal or state regulatory standards or regulations regarding permissible exposures to mold spores, reference sources agree that concentrations of certain pathogenic mold species should be as low as possible. Airborne mold concentrations can vary depending upon the space, temperature and humidity levels at the time of sampling.

Absent standards and regulations, the interpretation of microbial air sample results relies on the comparison of indoor versus outdoor concentration results. In general, indoor airborne microbial counts should be lower than those found in the outdoor air. The genus/species of the fungi found indoors should be similar to those identified in the outdoor air. However, this may not always be consistent. A situation may be considered unusual when the airborne microbial concentrations in an indoor/complaint area are significantly higher than those found in an

outside/non-complaint area. Interpretation of these results requires considerable professional judgment.

Based on our review of the Hygenix IAQ reports, we provide the following considerations:

- Hygenix reports that the airborne mold tests satisfied the criteria for a “Clean” building (using the Daniel Baxter table referenced above) and visual inspections were satisfactory for several rounds of sampling. In our opinion, this was not the case for several rooms where the indoor concentration of *Aspergillus/Penicillium* were higher than the exterior concentrations.
- Some areas have never had a “clean” air confirmation result after a “dirty” air sample result was reported (e.g., tunnels, room 119, 204). Prior to reoccupying the building (if it is to be reoccupied), airborne mold sampling should be performed throughout the interior and exterior of the building. Langan also recommends sampling from multiple exterior locations on different sides of the building and near the HVAC air intakes for additional reference data to compare against indoor results (not just one sample).
- Based on available data, the tunnels may require abatement and it should be confirmed that air cannot enter CMS from the affected tunnels before the building is reoccupied.

5.0 LIMITATIONS

The conclusions presented in this report are professional opinions based solely upon Langan’s visual observations, document review and current regulatory requirements. These conclusions are intended exclusively for the purpose stated herein, at the site indicated, and for the project indicated.

Langan cannot act as insurers and cannot “certify” that all mold/indoor air quality concerns associated with the property have been identified, and no expressed or implied representation or warranty is included or intended in our report, except that our services were performed, within the limits prescribed by our client, with the customary thoroughness and competence of our profession.