



**Indoor Environmental Quality + Workplace Environment  
Hennepin County Sheriff's Office 911 Emergency Communications Facility  
(HCSO-911)**

**March 2016, Minneapolis, MN  
Sustainable Post-Occupancy Evaluation Survey (SPOES)  
B3 Guidelines**

**Denise A. Guerin, PhD (contact: [dguerin@umn.edu](mailto:dguerin@umn.edu))**  
**Caren S. Martin, PhD**  
*Martin & Guerin Design Research, LLC*

**Abimbola Asojo, PhD ([aasojo@umn.edu](mailto:aasojo@umn.edu))**  
**Suyeon Bae, MS**  
*College of Design  
University of Minnesota*

## 1.0 Overview

The purpose of this report is to examine the connection between sustainable design criteria used in the design of the Hennepin County Sheriff's Office 911 Emergency Communications (HCSO-911) facility and occupants' satisfaction with their work environments located in the facility. The HCSO-911 facility was designed using the B3 Guidelines (formerly known as the Minnesota Sustainable Building Guidelines or MSBG) and completed for occupancy in October 2014. The B3 Guidelines track specific state-funded, B3 buildings as a means of demonstrating real outcomes aimed at the conservation of energy resources, creation and maintenance of healthy environments, and occupants' satisfaction with their work environments. The Sustainable Post-Occupancy Evaluation Survey (SPOES) was developed to assess human outcomes in workplace, classroom, and residence hall settings in compliance with the B3 Guidelines project tracking requirements. This is a report of occupants' (hereafter called employees) responses from the survey conducted in February 2016.

This SPOES report focuses on employees' satisfaction with the physical environment as related to 26 indoor environmental quality (IEQ) criteria such as lighting, thermal, and acoustic conditions in their primary workspaces, i.e., offices. Employees' satisfaction with the facility (site, building, and interior) and the effect of the facility's physical environment on their perceptions of their work performance and health also are included. Finally, a brief look at employees' commuting and physical activities within the building are reported. The report provides descriptive information about employees' perceptions of the IEQ of their work environments. In addition, this information serves the broader development of knowledge regarding the influence of IEQ on employees.

## 2.0 Method

SPOES consists of a self-administered, Internet-based, questionnaire submitted to and completed by employees. The SPOES questionnaire has been tested for **validity** (measures what it is intended to measure) and **reliability** (repeatability or replicability of findings). Employees rate their level of satisfaction on a **Likert-type scale** (measurement scale) from 1 (very dissatisfied) to 7 (very satisfied) with IEQ of the facility and their primary workspaces. They also rate the influence of their physical environment on their perception of their work performance and health on a scale from 1 (hinders) to 7 (enhances).

The report provides a descriptive summary of the results stated as a **mean** (average of all responses), **standard deviations** (SD) (how different scores are from each other and the mean), and **number of responses** (N) for each question analyzed. The mean for a 7-point scale is 4.00. Lower or higher means reflect stronger tendencies towards dissatisfaction/satisfaction and hinders/enhances. Means that are close to the center of the scale (4) are considered to be neither dissatisfied/hinders or satisfied/enhances.

When interpreting **mean** responses, the following labels were used:

- 1.00 - 3.50 dissatisfied (or hinders)
- 3.51 - 4.50 neither dissatisfied (or hinders) nor satisfied ( or enhances)
- 4.51 - 7.00 satisfied (or enhances)

An IEQ Score is also calculated for employees' satisfaction with IEQ criteria in their primary workspaces. This is a statistical combination of all category-level (explained below) IEQ scores, which results in a single IEQ score for all respondents and is reported in an IEQ Scorecard.

## 2.1 Description of the Questionnaire

Employees first rate their level of satisfaction with the facility (site, building, and interior) and the influence of their physical environment on their perception of their work performance and health. Then they respond to questions about their satisfaction with their primary workspaces in relation to IEQ criteria from the B3 Guidelines. Additionally, employees' demographic, physical activity, and commuting practice data are collected to provide context for the study.

In the SPOES questionnaire, the 26 IEQ criteria listed below are evaluated. There are two levels of criteria, categories and attributes. As shown in the list, the 'overall' criteria are boldfaced and called 'categories' or 'category level' criteria. A category is broader or more general such as Overall View Conditions or Overall Indoor Air Quality. Some categories have 'attributes' or 'attribute level' criteria and provide greater detail about the category. For example, Overall Thermal Conditions is a category level question, and there are four attribute level questions related to thermal conditions such as adjustability, air velocity (draft), humidity, and temperature. Overall Acoustic Conditions is a category with attributes of employees' ability to hear desired sounds and their ability to limit undesired sounds. There are 12 category-level and 14 attribute level questions. Means are calculated and reported for all category and attribute-level criteria.

An IEQ Satisfaction Score is also calculated for employees' satisfaction with IEQ in their primary workspaces. This is a statistical combination of the 12 category-level criteria only and results in a single, mean IEQ Satisfaction Score for all employees' satisfaction with the physical conditions of their primary workspaces. Attribute-level criteria are not included in the IEQ Score because unequal weight would be given to criteria that have both category and attribute-level questions.

In the following list, **category (boldface)** criteria are listed in alphabetical order. If a category has attributes, they are listed with the category.

### **Overall Acoustic Quality**

- Ability to hear desired sounds
- Ability to limit undesired sounds

### **Overall Appearance (aesthetics)**

### **Overall Cleaning and Maintenance**

### **Overall Daylighting Conditions**

- Amount of daylighting
- Adjustability of daylighting

### **Overall Electric Lighting Conditions**

- Amount of electric lighting
- Adjustability of electric lighting
- Adjustability of task lighting

### **Overall Furnishings**

- Function of furnishings
- Adjustability of furnishings

### **Overall Indoor Air Quality**

### **Overall Privacy**

### **Overall Technology**

- Access to electric outlets

### **Overall Thermal Conditions**

- Adjustability of thermal conditions
- Air velocity (drafty/stagnant)
- Humidity (dry or moist)
- Temperature (hot or cold)

### **Overall Vibration and Movement**

### **Overall View Conditions**

## 2.2 Limitations

Employees' participation is voluntary, and responses are self-reported. As is true with all survey research, the responses indicate employees' perceptions. There were no physical measurements, e.g., temperature, humidity, or lighting levels of the environment taken. This study is limited to employees' perceptions.

## 3.0 Sample Description

### 3.1 Description of Building

The HCSO-911 facility is located at 1245 Shenandoah Lane, Plymouth, MN. The building (see Figure 1) is a three-story 59,000 square foot building that includes private offices, workstations, and open desk areas for employees. There are also employee support areas and technology maintenance areas. Only the overall facility and primary workspaces were included in this study. The building serves as the public safety emergency call center for approximately 450,000 residents of Hennepin County.



Figure 1. HCSO-911 (Photo courtesy of HCSO-911)

### 3.2 Description of Respondents

This survey was administered to 86 employees with workspace in the facility during February 2016. The response rate to the questionnaire was approximately 62%. Of those responding, 47% were male and 53% were female. The mean age of respondents was 45 years, with a range from 27-65 years of age.

The HCSO-911 was completed and ready for operation in October, 2014. Since that time, 81% of the respondents reported that they worked at the HCSO-911 facility since the building opened, 17% have worked at the facility for 1-2 years, and only 2% of the respondents spent less than one year at this site. Relating to hours worked during a typical week at HCSO-911, 49% of the employees reported they spend 40+ hours a week in the facility; 49% spend 30-40 hours a week at HCSO-911; 2% spend 20-29 hours at HCSO-911.

Relating to the time employees spend per week in their primary workspace, 60% of the employees reported they spend more than 75% of their weekly time in their primary workspace; 21% spend 51-75% of their time in their primary workspace; 17% spend 25-50% of their time in their primary workspace; and 2% spend less than 25% of their time in their primary workspace. These responses indicate the amount of time employees are exposed to IEQ conditions in their workplace environment.

HCSO-911 is a workplace with private offices, workstations (cubicles) with both low and high partitions, and desks in open office areas serving as primary workspaces. Employees indicated that 64% of their primary workspaces were located within 15 feet of an exterior window and 34% of the employees were not within 15 feet of an exterior window; 2% did not know the distance.

## 4.0 Findings and Discussion

### 4.1 HCSO-911 Facility (Site, Building, and Interior): Overall Satisfaction, Work Performance, and Health

Employees responded to questions concerning the HCSO-911 facility (site, building, and interior) and their overall satisfaction with the facility, overall perceptions of their work performance in relation to the facility, and their overall perception of their health in relation to the facility. Table 1 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 2 is a graph that shows the mean for each question, which is identified with a blue mark. The standard deviation is shown by the green/red, vertical bar with green representing satisfied (or enhanced) and red representing dissatisfaction (or hindered). Gray represents the 'neither/nor' range of responses. In cases where there were no dissatisfied responses, the bar may be all green or gray and green. This graph is simply a visual image of the findings from Table 1.

Table 1. HCSO-911 facility - overall satisfaction, work performance, and health

Overall	Mean	SD	N	Interpretation
Satisfaction	5.12	1.38	50	Satisfied
Work Performance	4.92	1.10	49	Enhanced
Health	4.68	1.07	50	Enhanced

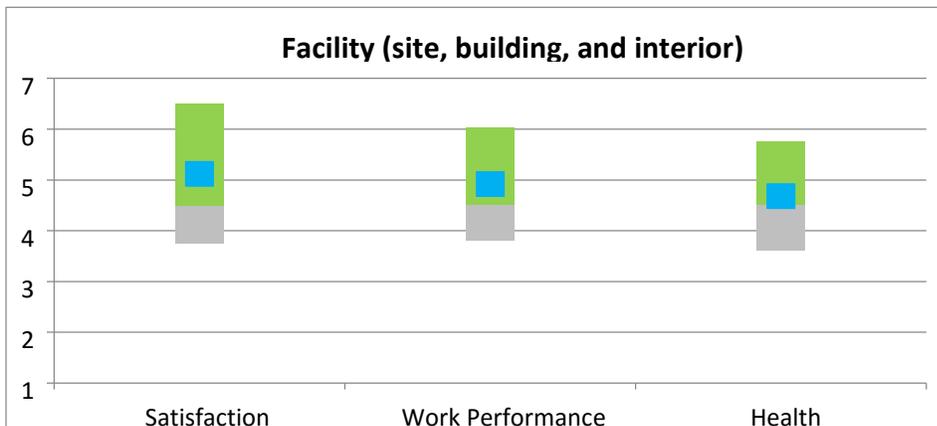


Figure 2. HCSO-911 facility - overall satisfaction, work performance, and health

Results indicate that employees were **satisfied (M = 5.12)** with the HCSO-911 physical environment of the facility (building, site, and interior) and reported that their overall work performance was **enhanced (M = 4.92)** by the facility. Employees reported that their overall health was **enhanced (M = 4.68)** by the facility.

#### 4.2 Primary Workspace: Overall Satisfaction, Work Performance, and Health

Employees responded to questions concerning their overall satisfaction and overall perceptions of their work performance and health as related to their primary workspace (e.g., private office, workstation, or other primary workspace). Table 2 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 3 is a visual image of the findings from Table 2; an explanation of the graph was given for Figure 2.

Table 2. HCSO-911 primary workspace – overall satisfaction, work performance and health

Overall	Mean	SD	N	Interpretation
Satisfaction	5.12	1.26	50	Satisfied
Work Performance	4.76	1.19	50	Enhanced
Health	4.56	1.13	50	Enhanced

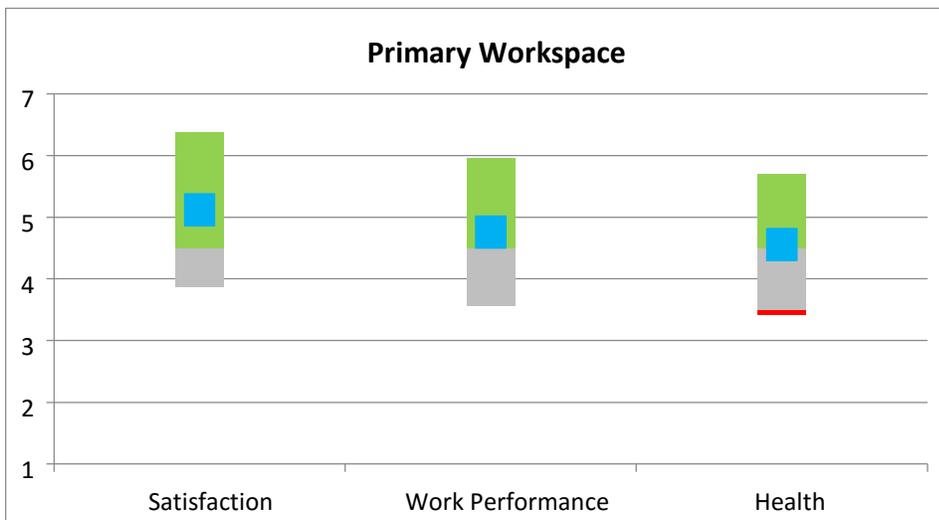


Figure 3. HCSO-911 primary workspace - overall satisfaction, work performance, and health

Results indicate that employees were **satisfied (M = 5.12)** with their primary workspace, their overall work performance was **enhanced (M = 4.76)** by their primary workspace, and their overall health was **enhanced (M = 4.56)** by their primary workspace.

#### 4.3 Primary Workspace: Satisfaction with Indoor Environmental Quality (IEQ)

Employees responded to questions concerning their satisfaction with IEQ categories (thermal conditions, indoor air quality, acoustic conditions, etc.) related to their primary workspace (e.g., private office, workstation, or other primary workspace). Table 3 shows the means and standard deviations of their responses from highest to lowest mean, as well as how the responses are interpreted. Figure 4 is a visual image of the findings from Table 3; an explanation of the graph was given for Figure 2.

Table 3. HCSO-911 primary workspace - satisfaction with IEQ criteria

#	IEQ Criteria (1-26) (Category level criteria are bold face)	Mean	SD	N	Interpretation (S = Satisfied) (D = Dissatisfied)
1	<b>Overall vibration and movement</b>	<b>5.13</b>	<b>1.28</b>	<b>48</b>	<b>Satisfied</b>
2	<b>Overall appearance (aesthetics)</b>	<b>5.10</b>	<b>1.43</b>	<b>48</b>	<b>Satisfied</b>
3	Adjustability of task lighting	5.04	1.56	49	Satisfied
4	Function of furnishings	4.94	1.48	48	Satisfied
5	Adjustability of furnishings	4.94	1.59	48	Satisfied
6	Access to electric outlets	4.88	1.75	49	Satisfied
7	<b>Overall technology</b>	<b>4.88</b>	<b>1.63</b>	<b>48</b>	<b>Satisfied</b>
8	<b>Overall furnishings</b>	<b>4.86</b>	<b>1.59</b>	<b>49</b>	<b>Satisfied</b>
9	<b>Overall cleaning and maintenance</b>	<b>4.83</b>	<b>1.95</b>	<b>48</b>	<b>Satisfied</b>
10	Amount of daylighting	4.76	1.82	49	Satisfied
11	Amount of electric light	4.73	1.69	49	Satisfied
12	<b>Overall daylighting conditions</b>	<b>4.58</b>	<b>1.90</b>	<b>48</b>	<b>Satisfied</b>
13	<b>Overall indoor air quality</b>	<b>4.49</b>	<b>1.77</b>	<b>47</b>	<b>Neither S or D</b>
14	<b>Overall electric lighting conditions</b>	<b>4.43</b>	<b>1.83</b>	<b>49</b>	<b>Neither S or D</b>
15	<b>Overall view conditions</b>	<b>4.43</b>	<b>1.78</b>	<b>49</b>	<b>Neither S or D</b>
16	Adjustability of daylighting	4.38	1.88	48	Neither S or D
17	Air velocity (drafty or stagnant)	4.37	1.80	49	Neither S or D
18	Humidity (dry or moist)	4.33	1.61	49	Neither S or D
19	Ability to hear desired sounds	4.21	1.87	48	Neither S or D
20	<b>Overall thermal conditions</b>	<b>4.00</b>	<b>1.78</b>	<b>49</b>	<b>Neither S or D</b>
21	Adjustability of task lighting	3.98	1.94	48	Neither S or D
22	Temperature (hot or cold)	3.86	1.90	49	Neither S or D
23	<b>Overall acoustic quality</b>	<b>3.71</b>	<b>1.88</b>	<b>49</b>	<b>Neither S or D</b>
24	<b>Overall privacy (sound and visual privacy)</b>	<b>3.40</b>	<b>1.68</b>	<b>48</b>	<b>Dissatisfied</b>
25	Ability to limit undesired sounds	3.31	1.70	49	Dissatisfied
26	Adjustability of thermal conditions	3.14	1.91	49	Dissatisfied

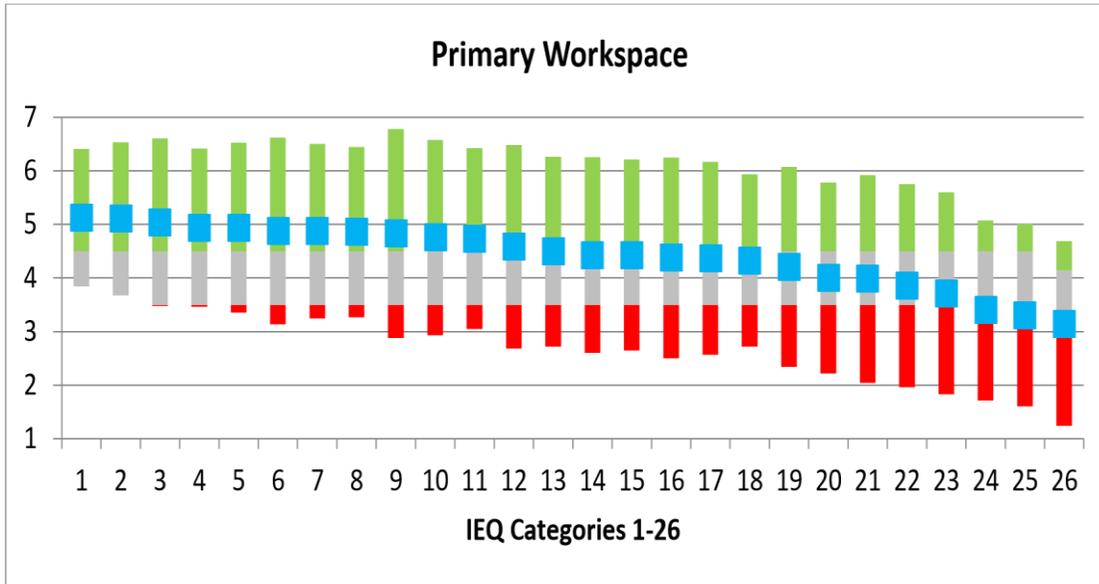


Figure 4. HCSO-911 primary workspace - satisfaction with IEQ criteria (IEQ 1-26 refer to Table 3)

Results indicate that employees were **satisfied** with 12 of the IEQ criteria in their primary workspaces, i.e., means at or above 4.50. Employees were **neither satisfied nor dissatisfied** with 11 of the IEQ criteria, ranging from a mean of 3.71 (overall acoustic quality) to 4.49 (overall indoor air quality). Employees indicate that they were **dissatisfied** with three IEQ criteria, e.g., overall privacy (sound and visual privacy) (3.40), ability to limit desired sounds (3.31), and adjustability of thermal conditions (3.14). The three criteria that employees were dissatisfied with are ripe for change to improve employees’ satisfaction with their primary workspaces. However, those criteria in the ‘neutral’ satisfaction range can also be reviewed and considered for change. Potential for change will be addressed in Section 6.2 Recommendations. Further explanation of these scores also can be found in Appendix A. Open-Ended Responses.

#### 4.4 IEQ Satisfaction Scorecard

The IEQ Satisfaction Score is determined by calculating a mean of the 12 ‘Overall’ category level IEQ criteria. At this time, criteria are weighted equally in this calculation as little evidence exists that provides rationale for weighting some criteria heavier than others. The IEQ mean is representative of a fair overall IEQ score and can serve as a benchmark of employees’ satisfaction with the physical environment of their primary workspace. As shown in Figure 5, the **IEQ Satisfaction Score** for HCSO-911 is **4.49**, which falls at the high end of the neither satisfied nor dissatisfied range. The large number of criteria with scores near or below the mean contribute to this low IEQ Score.



Figure 5. HCSO-911 primary workspace - IEQ Satisfaction Score

As shown in Table 3, satisfaction with the Overall vibrations and movement and Overall appearance were the criteria with the highest satisfaction means (5.04 or higher) and pulled the IEQ Satisfaction Score in a positive direction. However, six mean scores below 4.5 out of 12 category-level criteria pulled the IEQ Score down. Please note that the IEQ Satisfaction Score only uses the category level criteria (those labeled 'Overall'; see section 2.1, paragraph 3 for explanation).

### 5.0 Physical Activity Engagement and Commuting Practices

In the final section of the survey, employees responded to questions regarding their overall physical activity while at HCSO-911 (site, building, and interior) and their commuting practices.

#### 5.1 Physical Activity Engagement

Providing employees with opportunities for alternative paths of travel around the workplace, e.g., taking stairs as opposed to the elevator, provides opportunities to engage in additional types of physical activities. Engaging in physical travel throughout the work environment can be associated with healthier lifestyles.

Table 4. Overall physical activity (walking, stair use, etc.) affected by the HCSO-911 facility

HCSO-911 facility (site, building, and interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.13	1.55	47	Enhanced

Results indicate that employees felt that HCSO-911 **enhanced (M = 5.13)** their physical activities (walking, stair use, etc.).

#### 5.2 Commuting Practices

HCSO-911 is located on the western side of Minneapolis in a suburban area and sits just north of I-394 and west of I-494. The building has parking available for employees.

Table 5 provides results on employees' primary mode of transportation; Table 6 summarizes commuting distances between home and the HCSO-911 facility; and Table 7 summarizes employees' ability to commute using alternative choices (walk, public transit, bike, van, or carpool, etc.). These results, although not related to IEQ, do offer insight into employees' commuting behaviors and opinions. These data can provide important information about commuting practices that can reduce transportation energy consumption.

Table 5. Commuting Practices – HCSO-911 Primary mode of transportation

Primary Mode of Transportation (N=47)	Drive Alone (or w/children <16)	Van or Carpool
Commuting to HCSO-911	96%	4%

Related to primary modes of transportation, 96% of employees drive alone (or with children under 16) and 4% carpool or vanpool with others.

Table 6. Commuting Practices – HCSO-911 Commuting distance traveled

Miles Traveled (N=47)	0-5 miles	6-15 miles	16-30 miles	31+ miles
Home-to-HCSO-911 (One-way)	6%	21%	40%	33%

Results indicate that 6% of employees commuted 0-5 miles one-way between home and the HCSO-911, followed by 21% who commute 6-15 miles, 40% commute between 16-30 miles, and 33% commute over 31+- miles to the HCSO-911 facility. All of these are one-way miles.

Table 7. Commuting practices – HCSO-911 location and alternative commuting behaviors

Alternative Commuting	Mean	SD	N
Ability to commute in alternative ways	2.62	1.82	47

Results indicate that location of the HCSO-911 **hinders** (M = 2.62) employees' ability to commute to work in alternative ways, e.g., walk, bicycle, public transit, van or carpool, etc.

## 6.0 Conclusions

### 6.1 Summary

A post-occupancy evaluation was conducted of employees of HCSO-911 at approximately 24 months after it was first occupied. This HCSO-911 facility is used as the 911 call center. This survey reports the responses from employees and their satisfaction with the physical environment of the facility and their primary workspace. Results indicate that 98% of employees spend more than 30 hours per week in the HCSO-911 facility, and 81% of employees spend more than 50% of their time at HCSO-911 in their primary work space.

The survey included questions related to employees' satisfaction with the facility (site, building, and interior) and influence of the facility on their work performance and health. Employees were **satisfied** with the facility (M = 5.12); they found the facility **enhanced** their work performance (M = 4.92) and **enhanced** their health (M = 4.68). In addition, similar results were reported when employees were asked these same questions about their primary workspaces (private office, shared office, cubicles,

etc.). They reported **satisfaction (M = 5.12)** with their primary workspaces, that their work performance was **enhanced (M = 4.76)**, and their health was **enhanced (M = 4.56)** by their primary workspace. As the range of scores was from 1-7, scores showed a low level of satisfaction and enhancement.

Most of the survey questions related to employees' satisfaction with the IEQ criteria in their primary workspaces (private office, cubicles, etc.). Employees' responses showed they were **satisfied** with the 12 of the 26 IEQ criteria. The mean satisfaction scores ranged from **4.58** (Overall daylighting conditions) to **5.13** (Overall vibration and movement). Again, this shows a moderately positive level of **satisfaction**. Employees responded **neither dissatisfied nor satisfied** to 11 IEQ criteria and were **dissatisfied** with three IEQ criteria: Overall privacy (sound and visual privacy) (3.40), ability to limit desired sounds (3.31), and adjustability of thermal conditions (3.14).

From employees' responses, an IEQ Score was developed and shows respondents' satisfaction with the IEQ of all category level criteria. For HCSO-911, the IEQ Satisfaction Score was **4.49**. This score reflects the influence of the low satisfaction level with the other categories. Finally, employees reported that HCSO-911 **enhances (5.13)** their physical activity, which is one of the sustainable design criteria that influences occupant behavior.

It seems obvious that employees' satisfaction can be improved by addressing the categories that had 'neither dissatisfied nor satisfied' scores. However, the rest of the criteria would benefit from some attention as well. The following recommendations can help address change in these criteria to further improve employees' satisfaction. Exploring these areas in more detail and making adjustments may increase overall satisfaction at the primary workspace. It must be noted that the expense of building and operating a facility is second only to employee-related expenses over the life of the building. Therefore, maintaining or improving employees' satisfaction is a sound investment, which, in turn affects their performance and their health.

This study investigated employees' satisfaction with the facility and primary workspaces. IEQ satisfaction is individual, but the results of the survey show a central tendency of moderate satisfaction with the facility and most of the IEQ categories. The results can be used as a diagnostic tool to aid in improving IEQ conditions for employees and to set the benchmarks from which improvement can be measured in the future.

## **6.2 Recommendations**

Several IEQ criteria satisfaction scores are in the positive direction, however, improvement on the 'neutral' and dissatisfied criteria may be possible. For IEQ categories that can be physically measured (e.g., thermal, acoustic, and lighting), it is recommended that these measurements be taken in the primary workspaces. Specific recommendations for the most common areas of occupants' concern follow:

### **Acoustic Conditions**

- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from their original spatial layout/use (i.e., collaborative work spaces now located adjacent to focused work areas, individual workstations).

- Develop specialized acoustical performance requirements to support functional programming employees' tasks (e.g., sources of recurrent noise that need to be controlled, special user populations that may have distinct auditory performance limitations, or multiple uses of building spaces that may have different acoustic criteria). Identify and apply appropriate acoustics modeling software for the project.
- Measure acoustic performance onsite with full building systems (heating, ventilation, and air conditioning) running.
- Identify employees' privacy concerns via focus groups and/or log complaints relative to acoustical conditions for further evaluation.
- Consider employees' tasks within shared spaces to determine if spatial layout changes can be made for increased acoustic control.

### **Lighting Conditions**

- Identify employees' lighting performance criteria that are to be met to achieve goals by conducting onsite measurements of existing illumination and compare them to standards for employees' tasks as identified by the Illuminating Engineering Society (IES).
- Determine if any task areas differ now from original intent to be sure illumination quantity and quality are not impeded by physical changes to the space (i.e., walls, ceilings, furnishings, fixtures, or equipment).
- Develop additional quality lighting criteria as needed for special facility (e.g., influence of daylight quality or quantity) or employee (e.g., age, task duration) issues.
- Log complaints related to lighting conditions for further evaluation.
- Identify poor lighting conditions in the workspace caused by a lack of control over daylighting, which can cause glare and eyestrain.

### **Personal Adjustability**

- Determine what adjustability issues arise with temperature, lighting, or furnishings via a focus group.
- Identify personal, individual problem areas and relate them to other IEQ issues via a log of complaints relative to adjustability.
- Provide education to employees about any existing/achievable adjustment options, e.g., furnishings, air diffusers, lighting, temperature control, etc.

### **Privacy Conditions**

- Identify employees' privacy concerns via focus groups or log complaints relative to privacy to determine if visual or audio privacy is most affected.
- Determine if any task areas or responsibilities differ from original intent and develop alternatives or modifications.
- Consider adding noise masking equipment and/or visual screening depending on the nature of the complaints.
- Document and compare acoustic privacy problem areas with acoustic measurements to pinpoint specific problem areas.

### **Thermal Conditions**

- Measure thermal performance conditions on site.
- Log complaints related to thermal conditions for further evaluation.

- Determine special thermal comfort requirements or problems that may be encountered in the building due to physicality of work activities, duration of sitting, or design/layout considerations. Focus groups can be useful in identifying problem locations.
- Determine if any employees' task areas differ now from original layout to determine if air flow is meeting systems design intent.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or *Human Factors Design Handbook* (see B3 Guidelines).

## **Appendix A. Open-Ended Responses**

Employees had the opportunity to raise specific concerns on the overall facility and their primary workspaces. Important information can be gleaned from the open-ended survey responses. HCSO-911 employees raised specific concerns about the following themes: cleaning and maintenance, ventilation, furnishings, control of lighting, and thermal/ indoor air quality (IAQ). Though these qualitative responses overall appear as if the employees are dissatisfied; it does not mean they represent the overall sentiment from employees. However, the comments do give insight into specific issues that should be addressed by building management. Generally, the comments are summarized below.

### **Overall Negative**

- Superficially a beautiful building but was not designed for 24/7, 365 days/year use.
- Slippery and dangerous painted floor in garage area; several falls; must be addressed for safety.

### **Ventilation**

- There were many comments about the bad odors in the bathrooms (and adjacent halls) due to poor ventilation; air in the locker room is stale.

### **Cleaning and Maintenance**

- Limited dusting in dispatch room; limited vacuuming of entire floor, which causes dust build up.
- Poor cleaning on week-ends, but employees still there.
- Make disinfectant wipes available to clean shared work spaces.

### **Furniture**

- Toilet dispensers too low.
- No tilting keyboards to assist employees with carpal tunnel.
- Desk top surface is too narrow, no room to put 8x11 piece of paper without moving something out of the way.
- Laptop computer station takes up too much desktop space.

### **Lighting**

- Several employees reported a problem with the automatic lighting system. Power could be shut off during use of power tools.
- Motion sensors in bathrooms do not focus on areas 'where people are,' therefore lights shut off when people are still in the stalls.
- Shades in dispatch room and change of lighting in kitchen were helpful. However, it'd be nice if all shades were not on same system so some could be open and some closed.

### **Space / Layout**

- Long walk between areas such as kitchen, bathroom, locker room; employees not allowed to be away from desks for more than 5 minutes at a time – difficult with travel time to other needed areas and perform a task in that short amount of time.

### **Technology**

- Cell phone reception is poor.
- Only one set of outlets with a total of three plug-ins – one occupied by the task lighting and the other light. To use another electrical object, one of those has to be unplugged.

### **Thermal**

- There is 24/7 use of the facility however, the temperatures fluctuate when few employees are in the building, either too hot or too cold.
- Those who do not work M-F dayshift hours are subjected to cold temperatures. We were told we'd have more access to heating/cooling controls at new facility.
- No adjustability of thermal conditions; controlled by facility services; no autonomy.
- Extremely cold and drafty despite closing the little vents.

## Appendix B. Glossary

### **Descriptive statistics**

Statistics used to summarize large sets of data (i.e., means, frequencies, medians). Descriptive statistics describe only the sample under consideration and are not intended to infer results to the larger population.

### **Frequency**

A descriptive statistic that provides information about how many of a particular response or measurement is observed.

### **Likert-type scale**

A measurement technique, employed in questionnaires and interviews, that utilizes a range of standardized response categories such as strongly agree, agree, etc.

### **Mean**

The average score of a set of data calculated by adding all scores together, then dividing by the number of scores.

### **N**

The number of subjects or participants responding to the questions, or a single question, in the study.

### **Reliability**

The repeatability or replicability of findings; the same results are produced each time. Instruments and procedures should produce the same results when applied to similar people in similar situations, or on a second occasion.

### **Standard deviation**

A statistic used to measure the variability of a group of scores (how different scores are from each other and the mean). For example, if the range of scores is 1-7 and the mean (average) is 5.0 with a standard deviation of 1.0, then the scores are closely clustered around the mean, i.e., there is one unit of variation among all scores. If the mean was 5.0 and the SD was 3.0, there is a broader range of variation among the scores...a smaller SD means the scores are similar and the mean score is likely to be more accurate and more useful (this is better!).

### **Validity**

The extent to which an instrument or procedure measures what it is intended to measure (internal validity). The generalizability of results to another population (external validity).