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Library Impact Research Report
Facilitating Innovative Research, Creative Thinking, and Problem Solving

Valrie Minson, Project Coordinator; Laura I. Spears; Adrian Del Monte; Margaret Portillo; Jason Meneely; Sara Gonzalez; and Jean Bossart

University of Florida George A. Smathers Libraries

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Association of Research Libraries 21 Dupont Circle NW, Suite 800, Washington, DC 20036

(202) 296-2296 | ARL.org

Abstract

The Marston Science Library (MSL) of the University of Florida (UF) George A. Smathers Libraries partnered with the UF Department of Interior Design (IND) to explore how research libraries facilitate innovation, creativity and problem-solving competencies among their patrons. The MSL-IND team explored a three-tiered hypothesis that included: (1) students' use of library spaces can contribute to building knowledge and practical applications for library space renovations; (2) student perceptions of space desirability as measured by the Place-based Semantic Differential can be used to indicate gaps in the library space facilitation of creativity; and (3) the creative thought process requires spaces that are diverse, flexible, and under a certain amount of student control. The research team developed a mixed-method study that included a spatial analysis, a survey utilizing an adjective checklist, and several focus groups designed to validate the adjective checklist. The research team analysis of the resulting data identified recommendations related to creating a sense of place, solving for the group by addressing the individual, offering a palette of posture, increasing biophilia, and offering choice and control.

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Introduction

Over the course of four years (2014–2017), the Marston Science Library (MSL) of the University of Florida (UF) George A. Smathers Libraries renovated three of five floors. These were the first renovations since the library was built in 1987 and resulted in an increase in traffic by approximately 40 percent. Despite these excellent metrics, there were two additional floors to renovate and the MSL team was interested in understanding how renovations may support innovation, creative thinking and problem-solving in the student population. In order to approach this research question, the MSL team approached three researchers from the UF Department of Interior Design (IND) to assist in study design and implementation.

The MSL-IND team developed a mixed-method study that included a spatial analysis, a survey utilizing an adjective checklist, and several focus groups designed to validate the adjective checklist. This study identified the following questions:

- How do research libraries facilitate innovation, creativity, and problem-solving competencies among their patrons?
- What are students' ideal space needs for specific floors (1st–5th) and their unique study environments (silent, quiet, collaborative, etc.)?
- How do the current MSL floors compare to the students' ideal?
- How might MSL better support the different study dimensions (together vs. individual and public vs. private) to identify building capabilities?

Why It Matters to Research Libraries

As research libraries embark upon costly renovation projects, a better understanding of the usage of space is needed. To assess the impact of libraries on student success, we must look beyond usage statistics and transactional outputs. Instead, we focused on the students and asked them how they use the library, where do they feel most creative, and what motivates their creativity. Understanding how spaces are currently being used and the preferences of our patrons will drive plans for future space renovation.

The emergence of COVID-19 in early 2020 drove library patrons to use more on-line resources and to spend less in-person time within the physical library. For those patrons who still used the physical library space, their purpose was less for

collaboration and more for individual study. In response, academic libraries have needed to quickly reinvent their services and collection access to support the new blended learning environment.[1] Space flexibility is even more critical during these times when libraries have had to adapt to the changing needs of their patrons.

The emphasis for the future MSL renovation of the top two floors will be to provide ideal spaces for students to study and collaborate. Renovation plans were developed using evidence-based assessment conducted as a collaboration between MSL leadership and the IND researchers. This collaboration underscored the Smathers Libraries' strategic initiatives to partner library assessment efforts with campus academic resources and increase the libraries' impact on student success. The findings from the various data collection methods were analyzed to create a library floor re-design that identifies and illustrates ideal library space and furniture. We hope to maximize the potential of the library to offer a setting that facilitates innovation, creativity and problem-solving competencies. The methodology developed for this study and the results are being shared to aid other academic libraries in their renovation planning. The research methodology used at UF is scalable for use in all types of libraries.

Objectives

Libraries have long considered public/private and individual/group zones as one and the same. Recent research suggests that a campus library should support independent work within a public setting or collaborative work in a private setting.[2] The current study builds on Kim and colleagues' systematic research process of unobtrusive observation of student behavior in the space combined with a survey, conducted both online and face-to-face, within the MSL library branch. The study focused on functional, environmental, social, and psychological needs.

The MSL-IND team examined student use of existing spaces based on four categories: individual, group, private, and public. This mixed method approach had the following three key objectives:

1. To assess the current use of the library, a spatial analysis was conducted of all five floors during both heavy and light usage hours.
2. To understand users' perceptions of the library, a survey was conducted in which students selected terms from a validated instrument used in

construction design, Yarnell's Adjective Check List (ACL) Creativity Scale, which was adapted for library use.

3. To gather feedback on student perceptions of current library uses and desired future considerations, focus groups were split into graduate and undergraduate and asked to provide their perceptions of the current space and their vision of an ideal library space.

Through this study, a methodology of space use analysis, scalable for multiple library types and sizes was developed. The outcome was a preliminary design of the two floors of the science library that are older and have been identified for renovation when circumstances and budgets permit. As spaces shift to interactive areas, identifying the characteristics that power library spaces and what contributes to student success will inform new designs and provide measures for future assessment.

Hypothesis

This research project aims to prove or disprove:

1. Students' use of library spaces can contribute to building knowledge and practical applications for library space renovations.
2. Student perceptions of space desirability, as measured by the Place-based Semantic Differential, can be used to indicate gaps in how the library space facilitates creativity.
3. The creative thought process requires spaces that are diverse, flexible, and under a certain amount of student control.

Literature Review

Up until the 1990s, the motivation for library design focused on maximizing space to house ever growing physical collections; however, that changed with the introduction of digital collections. Digital formats freed librarians to rethink their physical spaces to focus more on optimizing student learning experiences. Consequently, the library paradigm shifted from book-centered library spaces that emphasized individual study to those that fostered a learning-centered environment with group study areas.[3]

Students primarily perceive the academic library as a place for learning and information, using the library for individual and group study, finding information,

computer use, reference services, and meeting and socializing. They perceive their academic library as a multi-purpose destination.[4] Studies of student library use showed two distinct user groups of academic libraries: those who come for individual study and those students who meet at the library for collaborative study, with both groups having specific requirements and using the library in different ways.[5] The same students may be part of these two distinct groups as students have different needs at different times.[6]

When undertaking costly library renovation projects, as part of the planning process, it is important to consult the students and conduct a needs assessment.[7] To learn about university library users and to design the spaces to serve student needs, observational studies and surveys are tools that can aid in producing a well-rounded understanding of library space use.[8] Researchers use surveys and focus groups to learn how students study and how they use library space. In preparation for a recent library renovation at an Ohio university, the library conducted sessions with two student focus groups and one faculty focus group. The results from both the focus groups and survey indicated that students frequently work in groups and that group study was an integral part of their learning. Sixty-two percent of the students indicated in the survey that they study in a group at least weekly and 15 percent indicated daily group-study.[9]

Because many students switch between individual study and group study throughout the day, the week, and the semester, libraries need to offer spaces for multiple uses. Students prefer learning spaces related to their learning activities.[10] To remain effective, academic libraries must evolve into a place that supports a range of activities by continuously refashioning spaces and services. Students need spaces to reflect, question, and experiment. For academic libraries to understand how their spaces are used by students, it is helpful for libraries to conduct a space audit for their library to determine how students use specific spaces.[11]

The ability for space to be highly adaptable to individual and institutional as well as normative and non-normative factors is critical to creating a system supporting problem solving, creativity, and satisfaction. A vibrant place-based ecology is diverse and adaptable. These environments accommodate ways of working individually and in groups.[12]

A recent spatial study of two academic libraries in the United Kingdom identified six key spatial design characteristics that influence student use of informal learning spaces: comfort, flexibility, functionality, spatial hierarchy, openness, and other

support facilities.[13] A mixed-methods study was used in the UK study, including questionnaires, observations, interviews, and focus groups.

Renovating an existing library space requires a large capital expense. Prior to making such an investment, it is important to consider the preferences and behavior of students. Libraries need floor plans with flexible zones that can accommodate multiple uses including individual study, group work, socializing and relaxing. Incorporation of a variety of furniture types in turn leverages the advantages of flexible floor plans, allowing students to decide where and how to study within each zone and floor.[14]

Methodology

Key Performance Indicators

1. Results from unobtrusive observations of student usage of space categorized as public, private, individual, and group uses recording the actual usage of these spaces

The unobtrusive observations are used to explore the anecdotal information and library literature that suggests that library users have basic needs and behaviors that result in space use that can be categorized as public use, private use, individual use, and group use.

2. Quantitative and qualitative results of the online survey, including statistical validation of the Creativity Index

Adapting an instrument used to analyze student use of space in educational environments, the study combined the quantitative measure of the adjective checklist to validate the results of the concepts being tested that relate to the public, private, individual, and group behavior patterns.

3. Mapping the Creativity Index to the open text comments, which provide tangible results to make design decisions in library spaces

By mapping the adjective checklist to the open text comments, the suggestions provided by student responses were validated as generalizable to the UF student

population and serve to illustrate the physical ways that students want their spaces to look, feel and change in order to support their academic success.

4. Design solutions developed by five teams of UF Interior Design students tasked with synthesizing findings from the first three phases of the study that include revised floor plans, digital renderings, perspective views, furniture, and finish selections

Methods

The first method employed was intensive conversations with the study team, and a review of the literature on both library space studies and research on interior design and user behaviors. To gain a common understanding of what the MSL needs were, what approaches different team members had used in various space studies, and to develop a consensus on the framework and analysis that could be done, the study team developed a codebook. The concepts included a **space typology** comprising individual/group/public/private space considerations; a **system-wide diversity** framework in which student views of how a library should feel would be categorized as Establishment (traditional, like Harry Potter), Anti-establishment (modern, like Helsinki's Central Library, Figure 1, and a combination of both (e.g., Harry Potter with nap pods and abundant and various power connections for devices); and functional characteristics such as noise, power (students can never have enough outlets), seating, and restroom visibility. The codebook was used to analyze the qualitative comments in the online survey and the focus group transcripts (Appendix A).

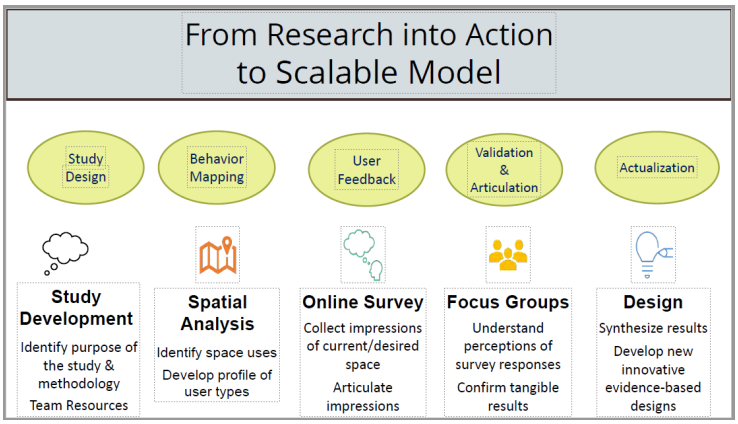
Figure 1.

Helsinki Central Library

An initial period of study design and development included a literature review and sharing of disciplinary perspectives among the study team. The data collection for the study comprised three phases that included a spatial analysis of the library's five floors; an online survey of UF students; and three separate focus groups with undergraduate students, graduate students, and library employees. A final phase of the study produced student-generated interior designs based on the findings from the first three phases (Figure 2).

Figure 2.

Study Design Model for Marston Science Library Space Study



1. Spatial Analysis: The study team conducted an unobtrusive observation of the students' use of the MSL spaces in January 2020. The spatial analysis of the existing work environment enabled the study team to document the (pre-pandemic) use of the current library space. Using the MSL user traffic counts, four time periods were identified as the lowest and highest traffic count periods for the libraries. Using this information, each floor was observed for two 15-minute periods, on both Wednesday and Saturday during January 2020. Existing spaces were categorized into one of the four categories labelled Individual/Public; Individual/Private; Group/Public; Group/Private.

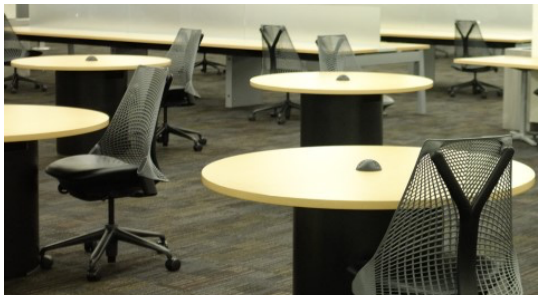
   Integral to the study was to examine how students utilize the space and how, given the realities of the pandemic, spatial attributes and how items are situated together might best support both the independent and collaborative work needs of the students and staff in these four types of zones. The **individual-public** zone (Figure 3A) is characterized as a flexible space for individual use that is located in a communal area designed for more collaborative work. Often, a partition is provided as a demarcation, yet it allows users to be seen, connect with their surroundings, and switch between individual and group user preferences.

   The **individual-private** zone (Figure 3B) is generally a quiet environment that visually isolates users from its surroundings. Examples are study carrels and quiet rooms for solitary use.

   Group-public zone (Figure 3C) is a communal workspace that could support diverse group sizes for social and collaborative activities. This zone includes lounges and other types of in-between spaces that fall outside traditional use of libraries (cafeterias, coffee shops, etc.). **Group-private** (Figure 3D) is an enclosed or partially enclosed space designed for group usage within a communal area, a makeshift partition like a mobile white board could quickly differentiate the space.

Figures 3A–D

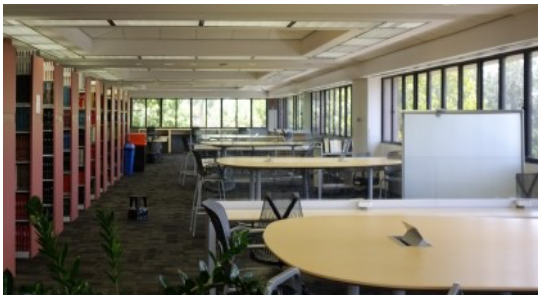
Spatial Analysis of Marston Science Library by Category



3A. Individual Public Zone

3B. Individual-Private Zone

3C. Group-Public Zone

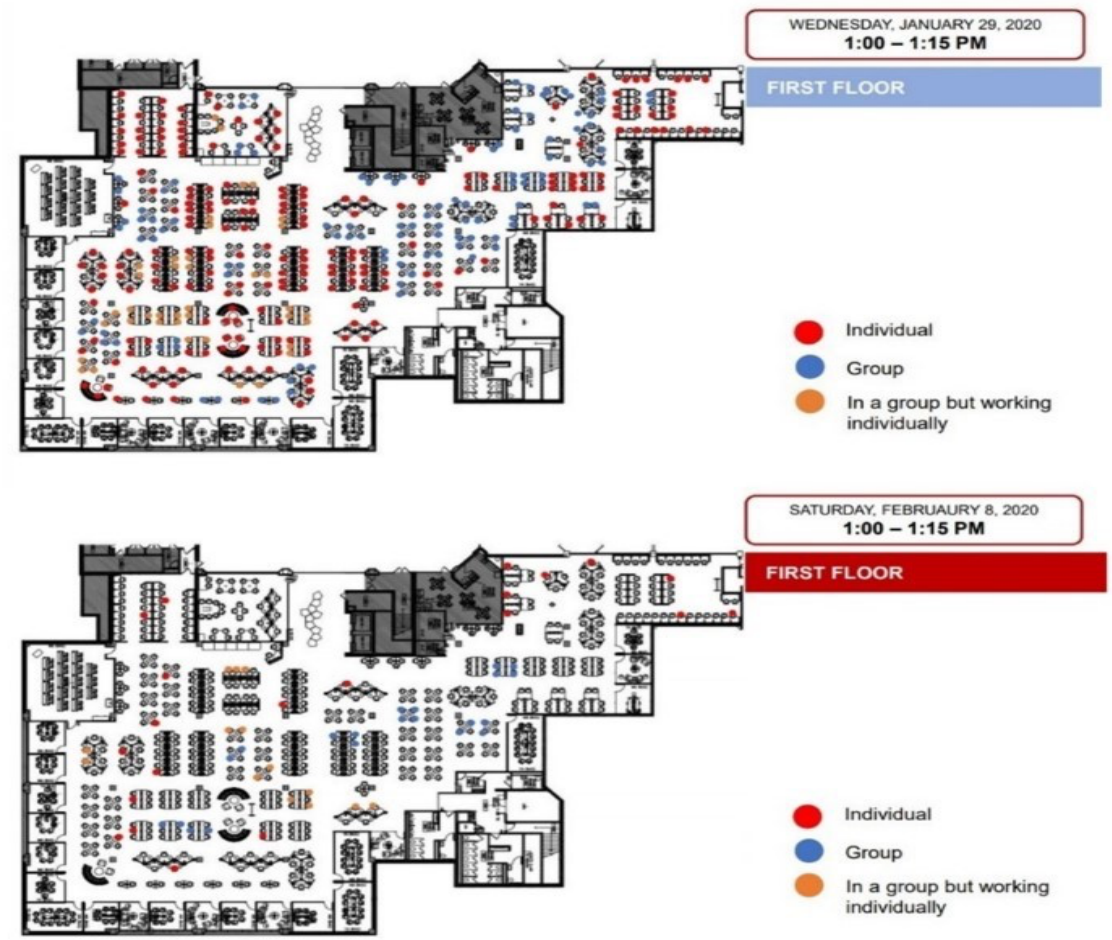


3D. Group-Private Zone

To assess the usage of the physical environment within the Marston Science Library, the data were collected using a cross-sectional observational study of users engaging in a specific type of activity over a focused time period (counts for each floor in Appendix B). The emphasis was to document how users utilized the library space based on the individual/group and public/private library zones framework. A visual sweep of the entire floor was conducted to record user's activity and furniture utilization (Figure 4).

Figure 4.

Layout Used in Spatial Analysis



1. The patron activity and furniture utilization illustrate MSL occupancy, groupings, and spaces for each floor. Although the library's open spaces provide its users with seating options for individual and group utilization, studying or working individually was preferred by its users regardless of furniture and seating type. Heavy traffic and crowding were observed on the first three floors, where communal and collaborative settings are accessible and have recently been renovated. Alternatively, the designated quiet spaces where most students utilize the space for studying alone are available on the uppermost floors that are subject to future renovation.

2. Survey: Initially, the study team intended to collect the survey data in person, as an "intercept" survey, in which visitors to the physical library are approached while they are using the spaces and interviewed with a semi-structured set of questions. However, with the closure during the 2020 onset of the COVID-19 pandemic, the MSL was closed until fall 2020 and afterward was only opened with 34% pre-pandemic capacity to meet the needs of social distancing. Therefore, the survey recruitment shifted to an online questionnaire distribution to the entire student population. To address the problem of recall bias, images of the MSL were inserted into the survey as memory aids; also, the survey controlled for those participants who had never visited the branch in person.

   The survey collected student preferences related to the four Use categories (Private, Public, Group, Individual), 14 Space categories and three System-wide Diversity factors, asking students to define existing spaces using a place-based semantic differential (PBSD) (Appendix C). The PBSD scale was offered twice, one focusing on the user's perception of the current MSL spaces; and the second exploring the type of spaces seen as ideal. Drawing on design methodologies, the two PBSD questions included visual prompts comprising images of the current library spaces as well as images of other academic libraries from around the world. Additional open-ended questions were used to solicit the user's perceptions of the space they "typically use" in their own words and their ideas for potential future renovations to the MSL.

3. Focus Groups: Five focus groups were conducted, one for library staff, and two each for undergraduates and graduates. A total of 15 students participated in the four student groups and nine individuals participated in the employee focus group. Students were recruited from the survey participants and employees were recruited via email sent from the study staff. All focus groups were conducted via Zoom due to COVID-19 social distancing constraints. The Zoom session transcripts and audio were recorded but no video was recorded.

   After a brief welcome and description of the full study purpose, the participants were provided with a set of images of libraries and asked to comment on how they felt about the spaces. Then prompts based on the spatial analysis and survey findings were presented to each group, including:

   a. When you're working independently, what should the space look like?
   b. When you're working in groups, what should the space look like?

c. When would you want a playful space versus a serious space and what would it look like in terms of furniture, lighting, and privacy?
d. How would you define social space and unsocial space and when do you want to use these kinds of spaces? What does it look like (i.e., furnishings)?
e. What can we do with the physical space of our building to better support your success, creativity, innovation, and problem solving?
f. What small changes could we make to the library?
g. What big changes could we make to the library?

Polling software was used to collect feedback and increase the interactive nature of the sessions. This was especially helpful with the library employees, whose focus group was conducted by non-library members of the research team—the anonymity of the polling software and the neutrality of the facilitators were designed to encourage the library workers to feel comfortable in offering authentic viewpoints.

All data collected from the transcripts and the polling software were analyzed using NVivo 11 software, using the codebook developed by the research team identifying System-wide diversity, Public/Private/Individual/Group, and Functional categories.

4. Design Solutions: A team of 23 interior design students led by study team member, Jason Meneely, Associate Professor of Interior Design, developed five different design solutions for renovating the interior spaces of the MSL. Students worked in five teams (four to five students each) to synthesize the findings from the ARL-RLIF MSL research into cohesive design solutions that included revised floor plans, digital renderings, perspective views, furniture, and finish selections. The design portion of the project lasted five weeks (October 25–December 8, 2021) and included 40 hours of in-class teamwork and 40 hours of outside work per team.

   The following tasks were completed as part of Meneely's studio class to coordinate and manage this phase of the study:

   - Created a summary of condensed research findings from ARL-RLIF MSL Project that became primary design drivers for the student design project
   - Developed design project materials and coordinated the "Project Kickoff Seminar" with student teams and MSL members of the study team
   - Conducted on-site student tour and field verification measurements of MSL

- Provided daily instructor led feedback and critique on evolving student design solutions
- Conducted a formal, mid-term Schematic Design Review
- Coordinated a formal review of final student design presentations with critique from outside experts
- Created a content analysis and documentation of final student solutions for project dissemination and submission to the Environmental Design Research Association's Certificate of Research Excellence award program

Additional supervision of the project was provided by the course's Teaching Assistants (one doctoral and one masters student).

Resources Required

The effectiveness of the project implementation required a wide variety of resources, expertise, and university administrative authority. After initial discussions, it became evident that our project required interior design expertise that included both a research framework and a practicing designer's ability to translate research data into tangible results that could be used for future renovations. The project also needed MSL librarians who could provide both anecdotal and user-based evidence to provide background and direction for the study; and develop, implement, and analyze the study data collection and results.

People

The study's principal investigator, Valrie Minson, is chair of the Marston Science Library and the Smathers Libraries' assistant dean of assessment and student engagement. Upon receipt of the award notification, Minson recruited a library study team to begin considering the overall RLIF project and to select the research question and team. After selecting the library space study topic, Minson contacted Dr. Jason Meneely (UF Interior Design), who recruited fellow departmental members: Dr. Sheila Bosch, Dr. Meg Portillo, and doctoral student Adrian Del Monte. Additional members of the library team included the associate chair of MSL, Dr. Sara Russell Gonzalez; engineering librarian (and certified licensed professional engineer) Jean Bossart; and the Smathers Libraries' director of assessment and user experience, Dr. Laura Spears.

The ARL-RLIF award from IMLS made funding available to the UF research team to support doctoral student Del Monte, who was able to work for two years with the team. Del Monte developed, conducted, and visualized the spatial analysis, presenting the study design and the spatial analysis findings at the Interior Design Educators Council (IDEC) 2021 Conference, for which he was awarded the Best Paper prize. Del Monte graduated from the University of Florida in fall 2021 with his PhD in interior design and holds a faculty appointment at the University of San Carlos in the Philippines.

The UF research team was also provided funds to support Meneely's work in the studio design course and to develop three workshops in which the research team presented all phases of the study in spring 2022 to interested ARL libraries.

Skills

This collaboration of academic and library faculty provided the necessary research skills including interior design theoretical expertise, design studio practitioner, research study design, survey design and implementation including human subject compliance, focus group facilitation, statistical analysis skills, MSL-specific knowledge and visualization expertise. This combination of skills and abilities allowed the team to identify a space study framework that resulted in use of the place-based semantic differential adjective checklist; conduct and visualize the spatial analysis that offers a view of space use over time; statistical analysis to validate the adjective checklist into a scalable model for examining library spaces; and the interior design expertise and studio availability that allowed students to further engage with the study results and create true user participatory designs for the MSL renovations that have been planned.

Technical Resources

The study team used multiple software packages to complete the study:

- Qualtrics Online Research Software, CoreXM™ (used to develop and deploy the online survey)
- Nvivo 11 Qualitative Data Analysis Software (used to analyze the focus group data)
- Microsoft PowerPoint software (for group/online presentations)

- Adobe Pro DC Software (for creating the floor layout visualizations)
- Adobe Creative Suite (used by students in the design studio to create design solutions)

All of these software packages were made available by the University of Florida and were supported in implementation by the Smathers Libraries Library Technology Services department.

Findings

Spatial Analysis

The analysis of the spatial usage dataset revealed:

- users preferred studying or working individually regardless of furniture or seating type;
- heavy traffic and crowding were observed on the three renovated floors, where communal and collaborative settings are accessible;
- patterns in occupancy by floor and in the types of furniture/seating that was preferred; and
- confirmed findings in a previous unobtrusive observation[15] in which students studying individually work in group spaces.
- Further quantitative analysis of the space use confirmed that seating intended for group work is often used for those working individually, especially when students visit the library in groups but are clearly engaged in individual activities.

Survey Findings

Descriptive Statistics and Patterns of Library Usage

The team decided to restrict the analysis to only the 337 respondents that had previously visited the MSL, out of 608 total respondents. The survey respondent demographics were 82.4% undergraduate students, 17.0% graduate students, and .6% other students. The campus demographic data reports that UF is comprised of 65.5% undergraduates and 34.5% graduate students, thus the sample overrepresents the undergraduate viewpoint.

Survey findings include:

- The primary floors used are the basement level and the third floor, with the entry level (2nd floor) used as a hybrid service and study commons.
- More than half of students (54.2%) indicated their duration of use of the MSL is between two and seven hours per week.
- Students primarily use the MSL for individual study (66% do so frequently), while only 17% use the space for team projects, and 31% use it for group study. Most students report using the MSL "rarely" for either socializing (53%) or for "taking a break" (41%).
- Students reported interruptions in their use of the MSL due to COVID-19 restrictions, including individual work study either very frequently or frequently being disrupted (39.4%) and group study or team projects being very frequently or frequently disrupted (41.6% and 36.2%, respectively).
- In spite of COVID-19 limitations to library capacity, resources, and services, students generally felt neutral about the impact (51.5%) while others expressed dislike for the space (19.9%) under these constraints.

Adjective Checklist

The Adjective Checklist was used to identify how students feel in the current space and how they think an ideal space should feel. This checklist was modeled after the Adjective Check List[16] used to identify distinct personality differences that describe a creative practitioner. The IND research team worked with the MSL team to adapt it for use in examining student perceptions of the MSL library spaces. Results included:

- Currently, library spaces are considered pleasant, relaxing, calm, and a good balance between formal and informal. Students also felt they offered playful and serious and public and private areas.
- A more arousing, exciting space, with more spaces for collaboration is ideal. Additionally, the responses indicated a greater need for friendly spaces and the strongest difference between current and ideal space was the need for less crowded areas.
- The only difference that was determined to also be statistically significant was that an ideal space "feels more authentic," which in design terms would reflect a use of natural lighting, more live plants, natural materials used in décor, and lighting that can be managed by the student in the space (dimmers, lamps, windows with blinds).

- For the dimensions of social/unsocial, public/private, collaborative/self-reliant, energetic/calm and serious/unserious, student responses indicate that **both** extremes of the dimension play a role in a desired space and, as much as possible, would be useful depending on the current need of the student. For example, at times during the creative process, input and feedback from others—a collaborative, more social interaction—would be desired; once that feedback is given, a student would have a need for more private, serious space in which to synthesize and respond with individual work.
- Eight of the adjective pairs saw a movement of responses into the middle range of the 1–5 scale, indicating that students may have different needs—sometimes energetic or playful spaces and sometimes calm and serious—depending on the work or research phase they find themselves in.
- The Related Samples Sign test indicated that the difference in responses between the current and ideal scales were significant (>.05) in all but two of the pairs, suggesting that this could be a valid mechanism for assessing library space facilitation of creativity in student academic efforts.
- Results from the Cronbach's analysis of correlations between the adjective pairs showed that there is a strong positive relationship between social/unsocial and collaborative/self-reliant adjective pairs. Further, an inter-item correlation matrix of eight adjective pairs—exciting/gloom, energy/calm, playful/serious, social/unsocial, collaborative/self-reliant, public/private, informal/formal, and crowded/uncrowded—can be used as a reliable index to measure a space's creativity result (R=.852, >.05).

Differences between Undergraduate and Graduate Students

There were few differences between the responses of undergraduates and graduates. However, several key contrasts included:

- Graduate students tend to use the floors throughout Marston for a longer duration and frequency. Undergraduate students use the library as a third space—to socialize and collaborate.
- Graduate students, surprisingly, utilized floors that are more "commons-oriented", thereby louder and more crowded. This finding conflicts with their results on desired quiet and serious spaces but would complement their scores on increased collaborative spaces.
- Use of the lower floors was stronger for graduates than for undergraduates: 57.9% of graduate students use floors 1 and 2 while only 43.3% of

undergraduates do. For floors 4 and 5, 24.6% of graduate students and 23.8% of undergraduates indicated they use these spaces.

- Other findings were expected between the classes, as undergraduates use the libraries more than graduate students for socializing, taking a break, and for group study. However, undergraduates reported using the libraries at a higher frequency for individual study than did graduate students.
- Overall, undergraduates use the MSL for longer periods of time, reporting that 50.2% use the MSL more than five hours per week while only 29.8% of graduates use it more than five hours per week, and more than 70% use the MSL for four hours or less per week.

Focus Groups

The focus groups tended to mirror the survey findings, filling in details of what a safe or comfortable space looks like (visible but still providing solitude or quiet space) and the need for a variety of seating (from bar tops to standing desks to private carrels to nap pods) as well as distance to the elevators, water fountains, and restrooms. Other issues that came up include:

- Desire for more natural elements including colors, lighting and plants
- Desire for control of the space including light and noise control as well as moveable seating
- Spaces should provide various levels of stimulation depending on the task the student is engaged in
- Spaces should provide both comfort and safety
- Outdoor seating options should be provided
- Ample access to technology in whatever space they need to use

Students communicated that their programs—course work and lessons—determine the types of study space they require. The student focus groups covered almost all aspects of the design issues from varying perspectives like physical, psychological, technological, and budgetary constraints. Graduate students expressed more comments about limiting distractions, including plants and natural light but also conveyed that a space restricted to only graduate students is elitist and not necessarily what they desire. Undergraduate students focused more on comfort issues like diversity of seating or lighting control but also on the library providing plenty of available electrical outlets.

The employee focus group was enthusiastic about the topic and the conversation produced many ideas. The employees emphasized the value of having plants in the building as one way to convey the mission of the library as a science-based information resource. Further, the employees exhibited great "pride of place" and wanted the space to facilitate greater student engagement. Employees viewed use of color not only to generate comfort or excitement but also to provide directions to students asking for the location of certain items. For instance, if a student asks, "Where's the printer?" an employee could respond, "Against the blue wall," using the color to provide direction.

Employees diverged from student conversations in which flexibility of the furniture, space use, and lighting might be controlled by the student users—library employees felt that choice and control should remain the province of library staff. The employees tended to ideate on the future of library spaces and their hopes that this conversation may influence future changes.

General Findings

- Students desire choice and control over some elements of the library, like lighting, furniture, and being able to break from the space without losing the spot.
- Students exhibit a preference for library spaces that are responsive to user's needs, such as lighting, noise/sound, comfort, and links to nature. Harsh lighting, distractions, and outdated furniture are less favored among students.
- Visual privacy and personal space are important among students and they prefer spaces that support different work/study modes with varied seating options—individual/group and public/private.

Data

The research team was seeking both quantitative and qualitative data that would reveal student perceptions and feelings about the spaces they typically use and would ideally use in the MSL. This data was collected from the online survey using both multiple choice and ranking queries as well as open text queries that resulted in over 1,224 comments. The comments captured students' feelings about the spaces they typically used at MSL, the specific characteristics of the spaces that caused those feelings, and any changes they would make to the space in future renovations. The multiple-choice questions queried student feelings about the COVID-19 restrictions,

how much social distancing had constrained their library use, their purpose in using the library (group activities, private study) and the frequency and duration of library use (Appendix D).

The study team also examined secondary data sources (e.g., library traffic counts) and used these to develop times for the unobtrusive observations conducted to examine how students were using the space. The spatial analyses resulted in 40 unique floor counts, 8 for each floor with 4 counts conducted for each floor on both Wednesday and Saturday during the highest and lowest volume periods (Appendix B).

The focus groups resulted in five sets of Zoom sessions that include audio recordings and transcripts. Each group moderator also contributed field notes—observations immediately posted after the focus group session. The student transcripts and notes were analyzed using NVivo qualitative analysis software that was set up with the 23 codes taken from the codebook. The analysis resulted in 690 codes from the 214 participant comments collected from the 5 focus group sessions (Table 1). The library staff focus session was summarized but not coded, used for contrasting views rather than further validation of the student findings.

Table 1.

Comment Codes from Focus Group Transcripts

Space Concepts	**UG1**	**UG2**	**G1**	**G2**	**Total**
Location	61	51	25	22	159
3rd Floor	6	10	1	0	17
4th Floor	10	10	3	0	23
5th Floor	9	5	6	0	20
Basement	8	13	0	0	21
Entry Level	4	3	1	0	8
Non-MSL	19	9	11	13	52
MSL	5	1	3	9	18

Space Concepts	UG1	UG2	G1	G2	Total
System-wide Diversity	11	4	23	32	70
Antiestablishment	6	1	13	16	36
Establishment	5	2	8	14	29
Mixed	0	1	2	2	5
Use	**28**	**40**	**61**	**18**	**147**
Group	12	22	26	7	67
Individual	14	8	17	9	48
Private	8	7	11	1	27
Public	0	3	7	1	11
Space	**105**	**107**	**86**	**175**	**473**
Aesthetics	4	5	6	5	20
Ambiance	13	7	3	10	33
Amenities	18	17	22	16	73
Architectural	4	3	1	2	10
Building features	3	4	4	4	15
Color	0	3	2	5	10
Comfort	18	5	12	24	59
Noise, ambient noise	8	13	13	6	40
Component	0	0	0	3	3

Space Concepts	UG1	UG2	G1	G2	Total
Fenestration	6	2	1	13	22
Functionality	8	6	0	42	56
Furnishings	52	35	13	21	121
In-between spaces	0	0	2	3	5
Lighting	10	6	6	10	32
Materials	5	0	0	4	9
Wayfinding	3	1	1	7	12

Value

The research team began the study with the assumption that libraries are fundamentally intellectual centers in the campus environment, supporting student academic success. Further, the team's framework suggested that creativity, problem-solving and innovation are facilitated by library spaces done well. Our goal was to examine our spaces for the ways in which the MSL may facilitate these experiences and in what ways the spaces may fall short. The study also focused queries that answered, "What do students feel are characteristics of an ideal space and how can the MSL provide that?" Key outcomes of the study purpose include:

- We identified replicable research methods libraries can use to identify how students are using the current space (the spatial analysis) and how the current spaces feel compared to how an ideal space should feel (survey). Understanding the limitation of a convenience sample and the unique constraints due to COVID-19, the study team found the data collected from these tools to be valuable in describing the landscape of the target audience and their feelings about library spaces.
- The focus groups served as rich, qualitative experiences in which students filled in details of the survey and the observations, sharing why they feel that way and what the positive and negative characteristics of library spaces look like. These tangible details improved the value of the findings when combined

with the results of the observations and the survey. The focus group comments were also evidence that could inform the next phase of design studio visualizations by students. Altogether, the data from these three methods resulted in an understanding of what students are looking for in ideal floors and how the current MSL floors compare to this ideal.

- By listening to students and then by supporting student work to bring to fruition actual designs for the MSL, we were able to both articulate and visualize how libraries may facilitate creativity, innovation, and problem solving. These results can be viewed through the lens of interior design frameworks:
    - ***Create a Sense of Place***, in which the features in the library space design evoke images of the mission and purpose of the library branch itself
    - ***Solve for Collaboration by Addressing the Individual***, in which the features that address how individuals use spaces (diverse seating, flexible space use, increase square footage used for individuals) and with flexible furniture, allow students to engage in collaborations as needed
    - ***Palette of Posture***, or provide diversity in furniture size, shape, and use as well as variety in the design that allows for privacy, group space, collaborative space, or relaxation
    - ***Biophilic Connection to Nature***, that appeals to all of the senses using outdoor views, natural colors and lighting, changeable lighting, fresh air, and aesthetics that are reminiscent of nature
    - ***Creating an Ecosystem of Choice and Control,*** based on combinations of the space typology of Individual, Group, Public and Private spaces. By managing the entire room, a design creates a diversity of spaces with multiple uses available depending on the students' needs.
- The collaboration between the MSL librarians, the assessment librarian, and the faculty and students from the College of Design, Construction and Planning resulted in the desired level and variety of expertise. The teams came together and by spending the time up front to plan the student design and share views on use of educational spaces, the space typology and the use of the Adjective Check List for examining creativity were adapted for easy use by academic libraries in research institutions.

The value of this study was both academic and practical: the team was able to achieve the broader goal of developing a scalable instrument for library space examinations; developed a process that included the MSL employees as well as library student users in a way that acknowledged all interested stakeholders and gathered more diverse

feedback; the research team was able to disseminate findings both to external academic colleagues as well as to interior design students who used it to inform their coursework; and the collaboration with other campus units allows the libraries to better serve their full campus community, bringing both library space use, support for academic faculty and facilitation of student coursework together. This study has resulted in conversations for more study dissemination, different analyses, and even diversifying library holdings to meet faculty's course needs.

Lessons Learned

There were quite a few lessons learned throughout the project timeline. The first lesson was to include expertise from related academic units whenever possible. In our case, the expertise was found within the department of Interior Design. Libraries can be rich venues for researchers in other academic units to expand upon their own research expertise. Together this interdisciplinary approach allows for integrating knowledge and methods toward the goal of better serving students. Scheduling the team meetings was an important but sometimes challenging task. This was not surprising and the team adapted by sharing notes, setting new meetings before the current meeting ended, and working in shared network files to complete documents and prepare presentations.

Second, we learned that research must be agile. Whether it is pivoting the study design to accommodate a remote, COVID-19 data collection environment or attempting to understand what aspects are temporary and what are the new normal, strong research requires the ability to change course quickly and to keep an eye on important dates and (academic) calendars.

There were also lessons learned in the findings themselves. The most surprising finding that the team discovered was that the assumption that graduate students want an isolated, quiet-only space is faulty. The evidence in the results suggests that graduate and undergraduate students actually want many of the same elements in an ideal space: clean lines, clean furniture, plenty of power outlets, a variety of spaces and some control over ambient features such as noise, lighting, and furniture use.

The findings also indicated that students look for a natural feel in the space, with plants and more neutral tones. They look for safety in the space, which was a comment that appeared in both the survey comments and the focus group transcripts. Students want to be able to have some privacy when they work but they want to feel

the comfort and energy of having other users around them. This was a theme that prior research had found in the MSL but our work further explored and revealed how important this element is.

Recommendations for Future Research

The MSL-IND team have several recommendations to improve upon the research.

- First, the spatial analysis could be better integrated into the analysis. Prior to this study, UF's IND performed a spatial analysis of MSL's Collaboration Commons and utilized an interactive software to track student study patterns. It would be interesting to couple that type of very thorough and time-driven spatial analysis with an intercept study, to better understand how perceptions of a space can change based on occupancy levels. Within our current study design, MSL-IND performed a spatial analysis and an intercept survey but did not explore connections between the two until later. A more thorough or complete spatial analysis could reveal student perceptions of specific types of furniture, asking them questions at the point the student has selected a particular setting.
- The adjective checklist was a success, although the team would recommend avoiding adjective pairs that include an undesirable trait (Exciting/Gloomy, Friendly/Unfriendly). Instead, both sides should be different types of ideals to find the right balance. Additionally, several of the adjectives are feelings that were difficult to connect to specific and tangible changes (Self-reliant, Authentic). Before performing the study again, it would be important to outline specific traits that might correlate to a particular adjective.
- The team recommends future researchers perform the intercept survey as originally designed, as a face-to-face data collection study. COVID-19 prevented a face-to-face intercept study and we are unsure of how that impacted results.
- The studio design class exercises resulting in student-created designs were added later in the study and the team recommends incorporating the charette steps earlier in the process. With the charettes currently still in-progress, we are unsure if they should come prior to the focus groups or after the focus groups.

Appendices

Appendix A: Codebook

Space Concepts	System-wide Diversity	Sentiment	Use Concepts
Functionality — Usability of the space	Establishment — Established traditions of the libraries (using terms like Organized, Calming, Introspective, Familiar, Supportive, Individual)	Positive — Expressed likes/preferences	Private/Individual — Studying alone in a private, singular workspace, often enclosed in some manner
Comfort — Feeling of physical ease (cleanliness, hot/cold, ergonomics, noise levels, etc.)	Antiestablishment — Play in the study space (using terms like Chaotic, Exciting, Spontaneous, Changing, Challenging, Collaborative)	Negative — Expressed dislikes	Public/ Individual — studying alone in an open/group-oriented workspace
Aesthetics — The look of the space (not functional in nature)	Mixed — Comments reflecting both Establishment and Anti-establishment	Neutral — Low partiality/preference (aspect of adequacy, "okay," acceptable, neutral)	Private/Group — Using spaces to work collaboratively without interruption from others in the public spaces

Space Concepts	System-wide Diversity	Sentiment	Use Concepts
Ambiance — The overall spatial character or atmosphere of the space (mystery, jazzy, modern, etc.)		No sentiment — Impartial or no communicated preference	Public/Group — Using spaces to work collaboratively or to socialize but publicly accessible
Furnishings — The furniture elements (chairs, tables, shelving, etc.)		Mixed — Expresses both likes and dislikes	
Architectural — The architectural characteristics (ceiling height)			
Component — Building and mechanical systems (airflow/HVAC, building access/elevators, toilets/restrooms)			
Lighting — Appropriate level of lighting (natural/artificial, ambient/task lighting)			
Fenestration — Connection to nature, includes size and placement of windows			

Space Concepts	System-wide Diversity	Sentiment	Use Concepts
Color — Hue, value, or intensity of space			
Materials — Appropriately utilized materials (glass, plastic, wood, etc.)			
Building features — Availability and appropriateness of (lobby, waiting areas, study rooms, makerspace, teaching/presentation spaces, stairwells, service desk, etc.)			
Amenities — Availability (Wi-Fi, outlets, computers, white boards, printers, plotter, appliances, etc.)			
In-between spaces — Availability of spaces that are outside traditional use of libraries (cafeterias, coffee shops, etc.)			
Wayfinding — Signage, marques, indicators, guides, displays, or other directional tools			

Appendix B: Site Analysis

WEDNESDAY, JANUARY 29, 2020
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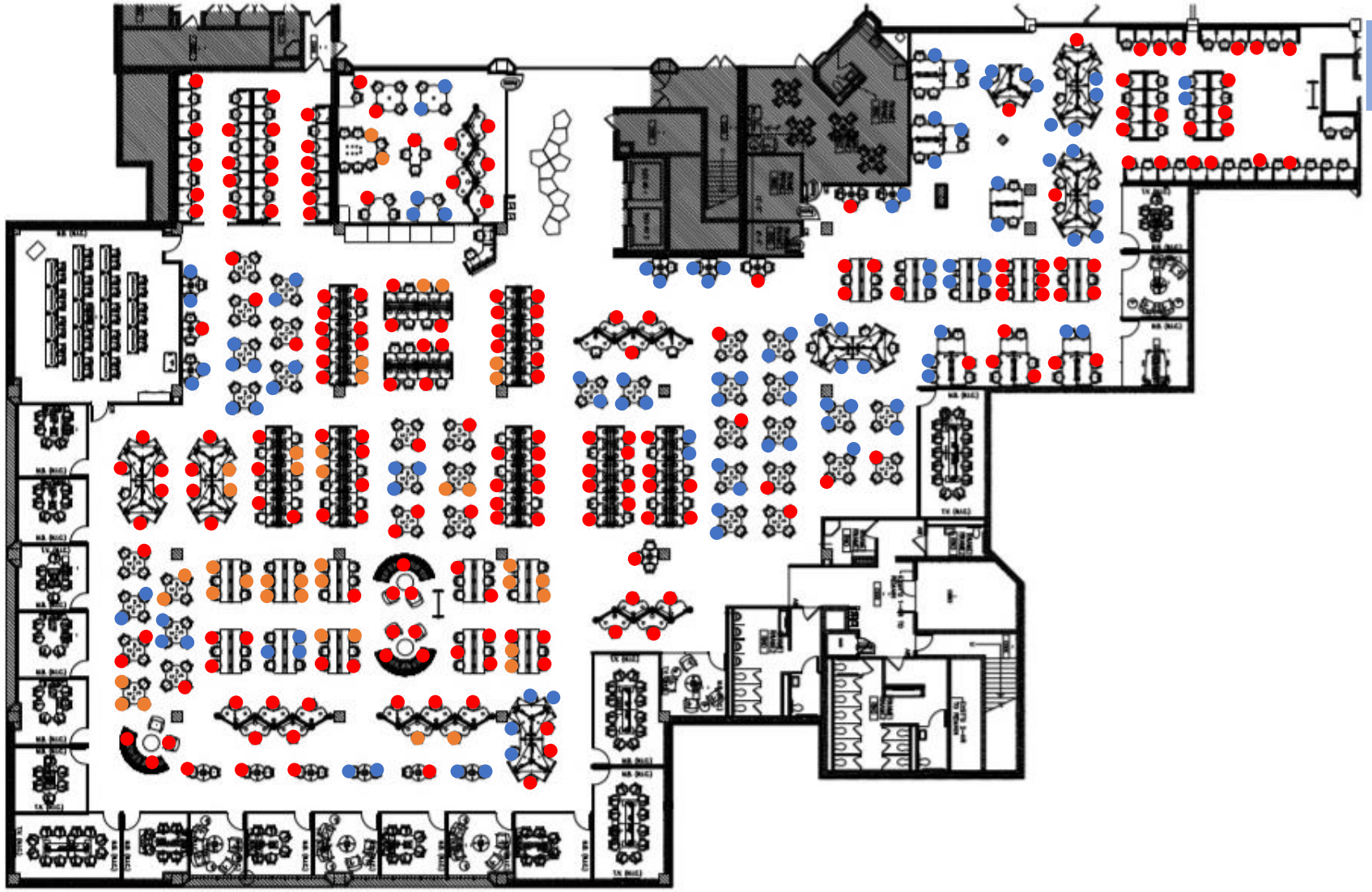
FIRST FLOOR



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WEDNESDAY, JANUARY 29, 2020

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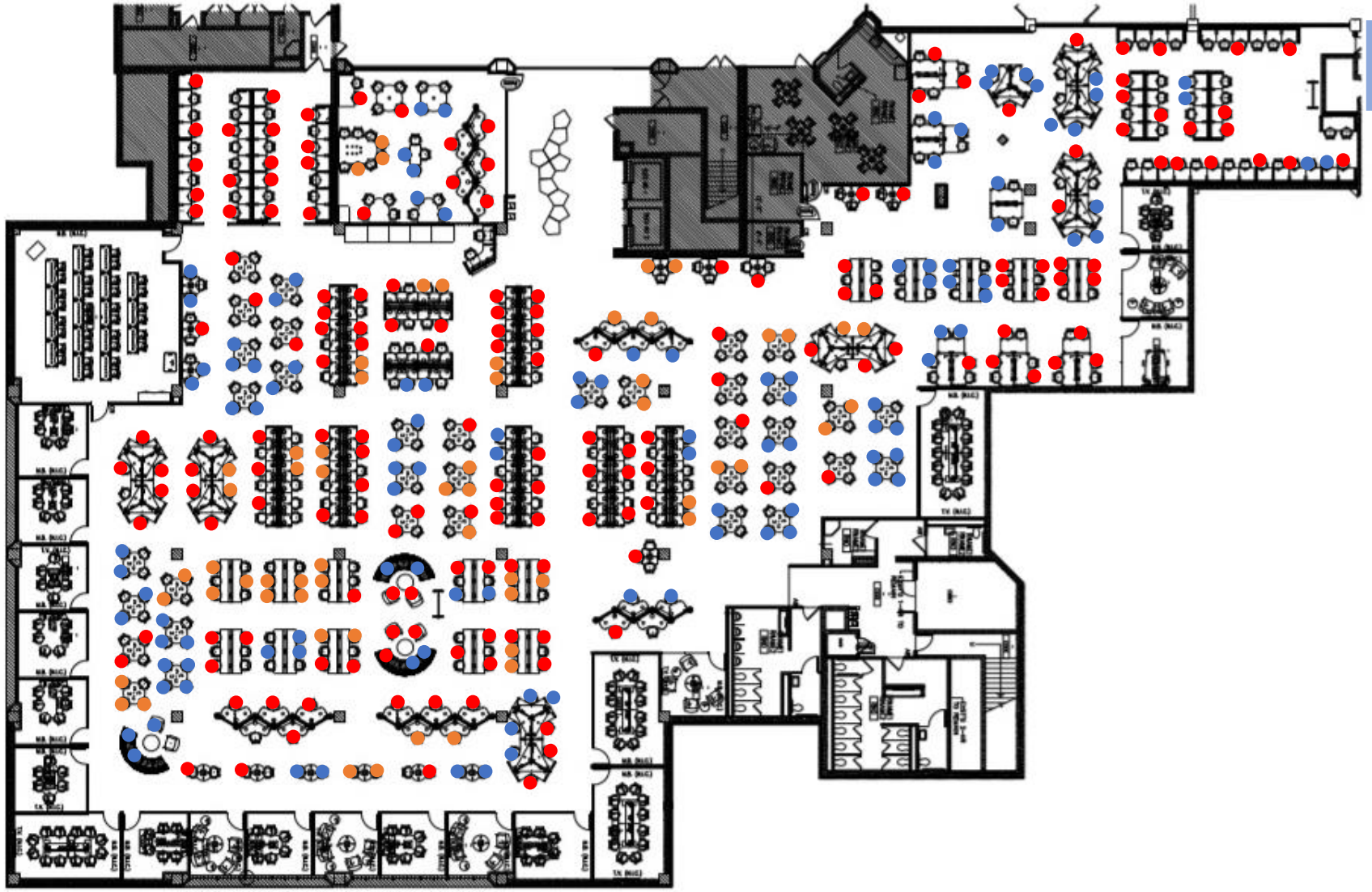

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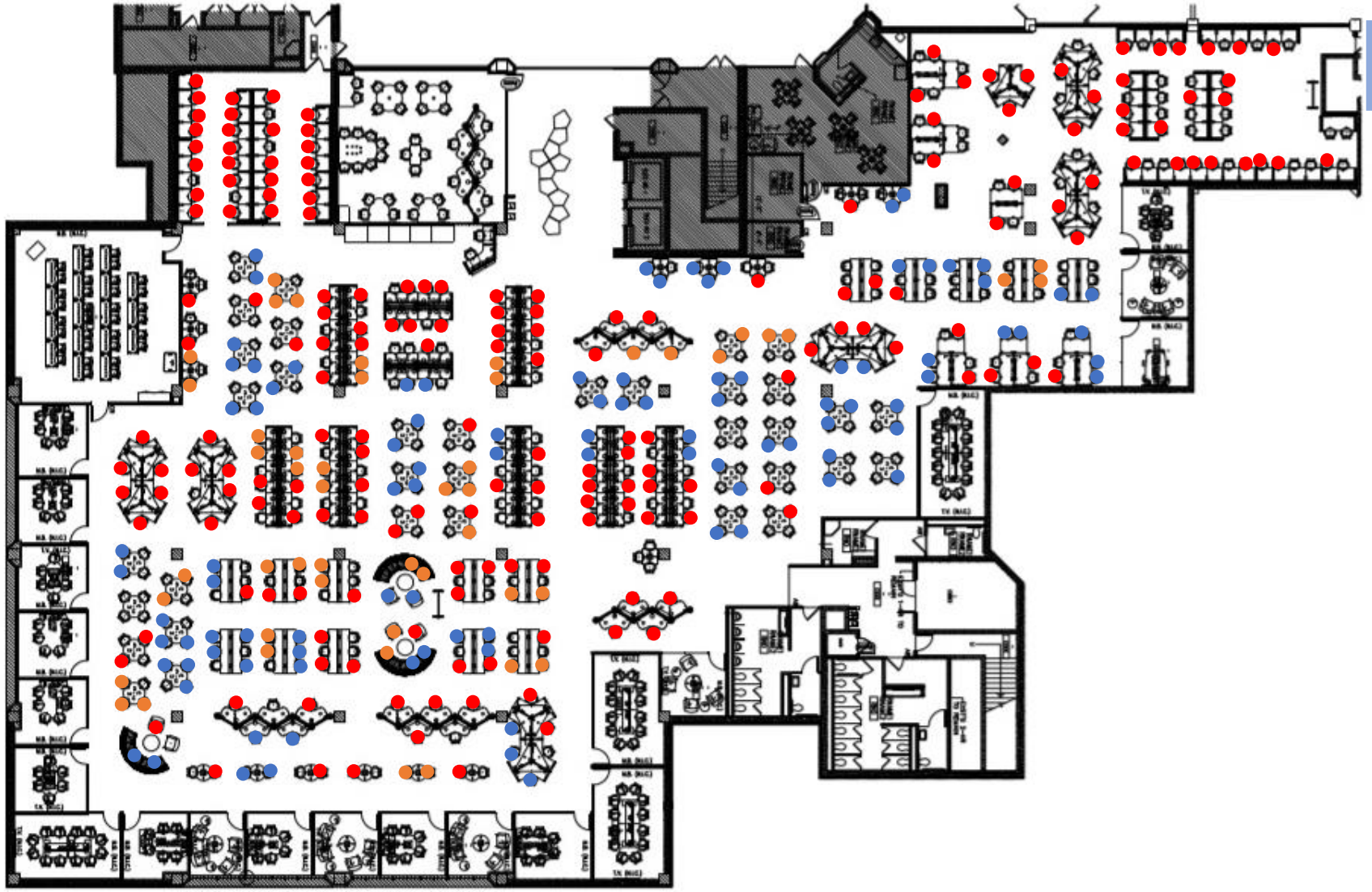

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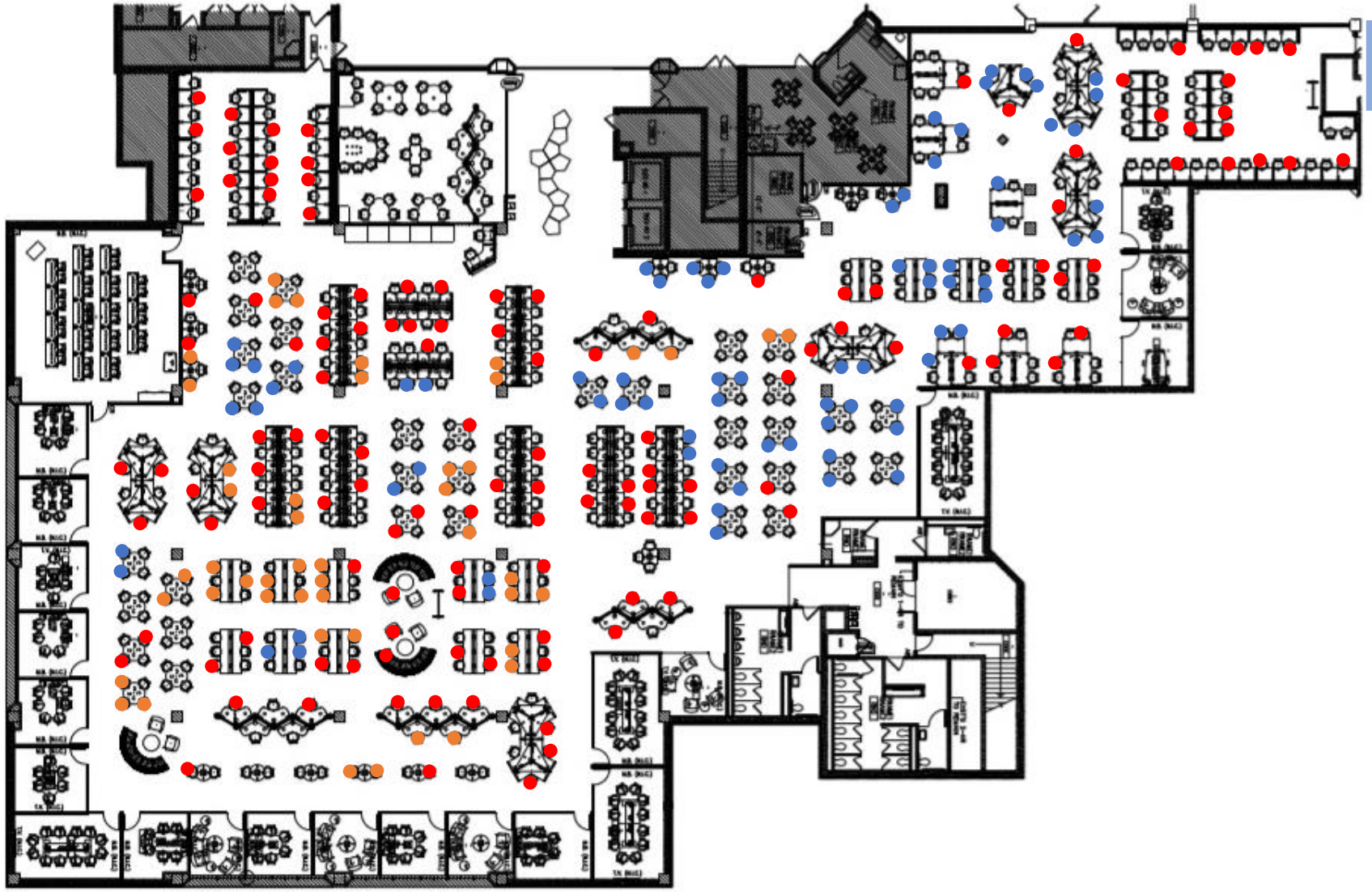

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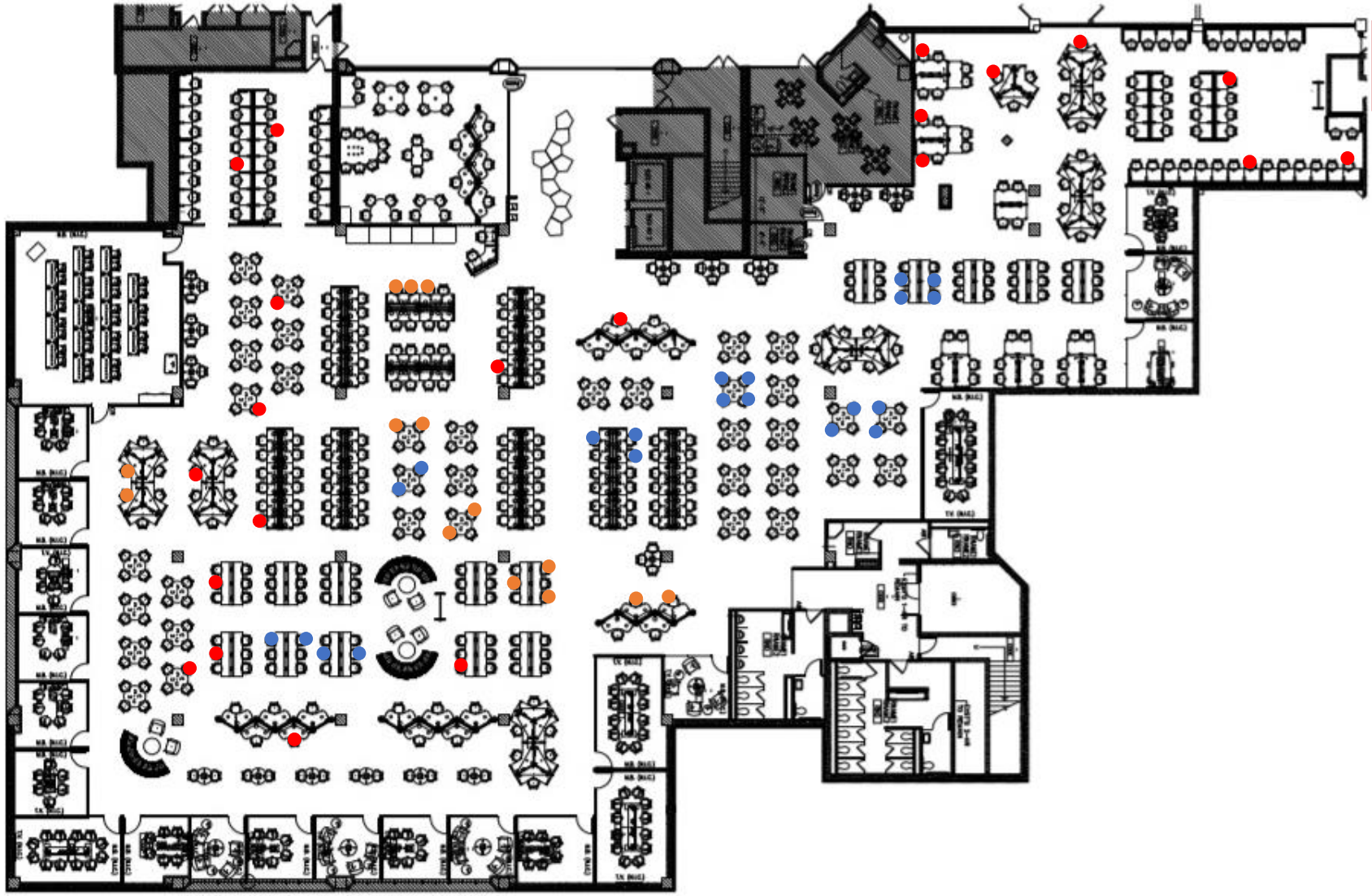

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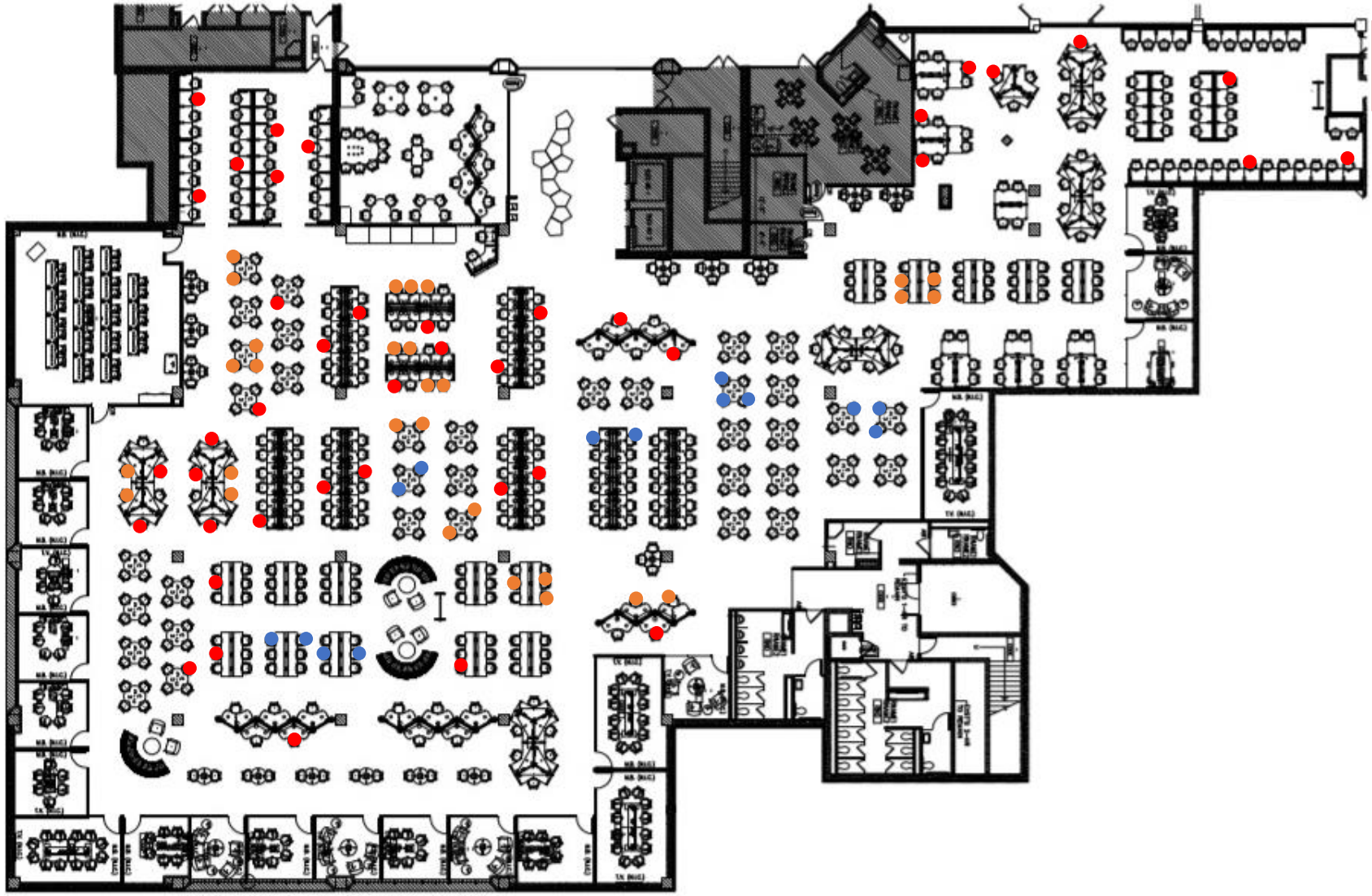

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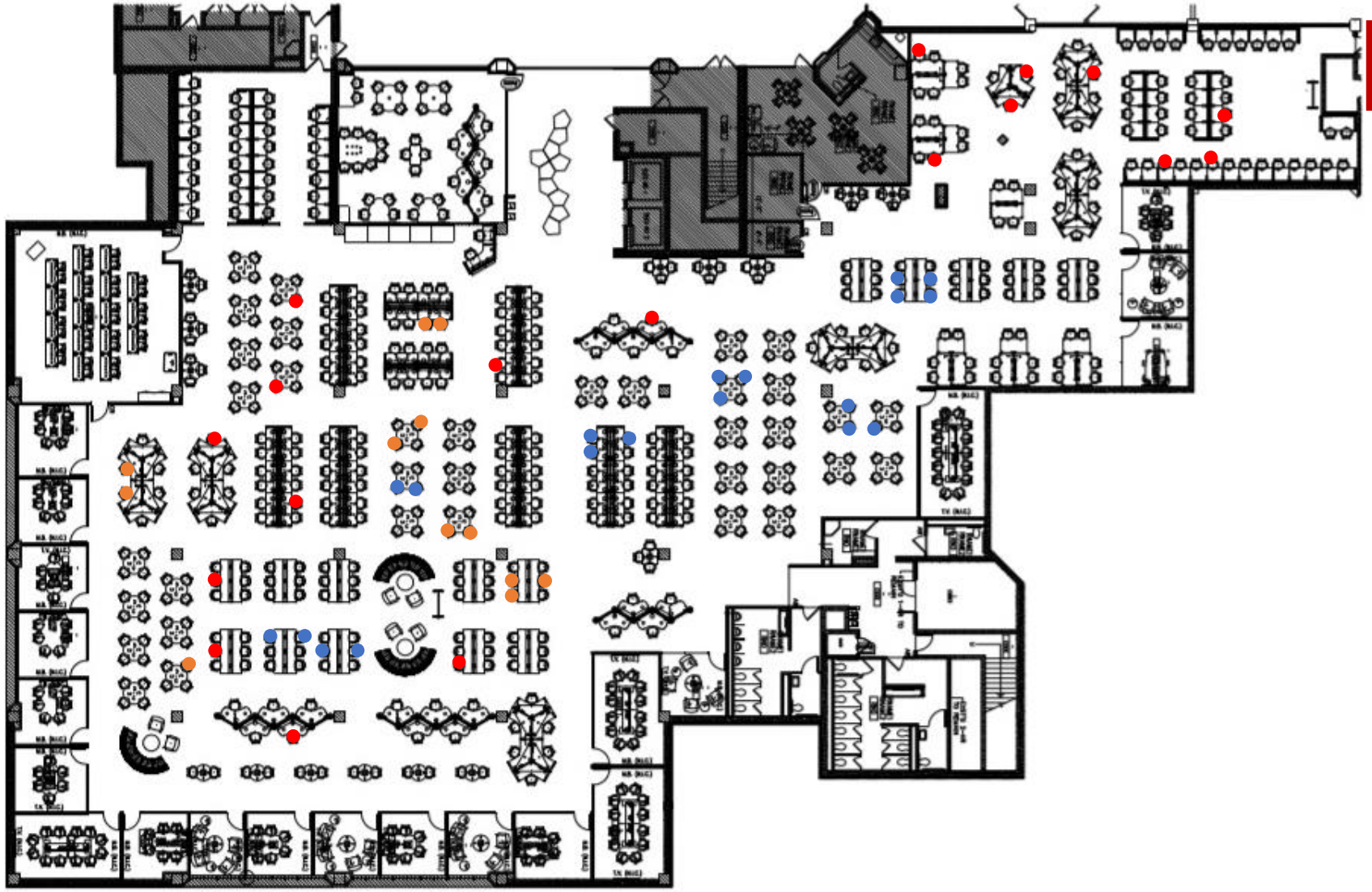

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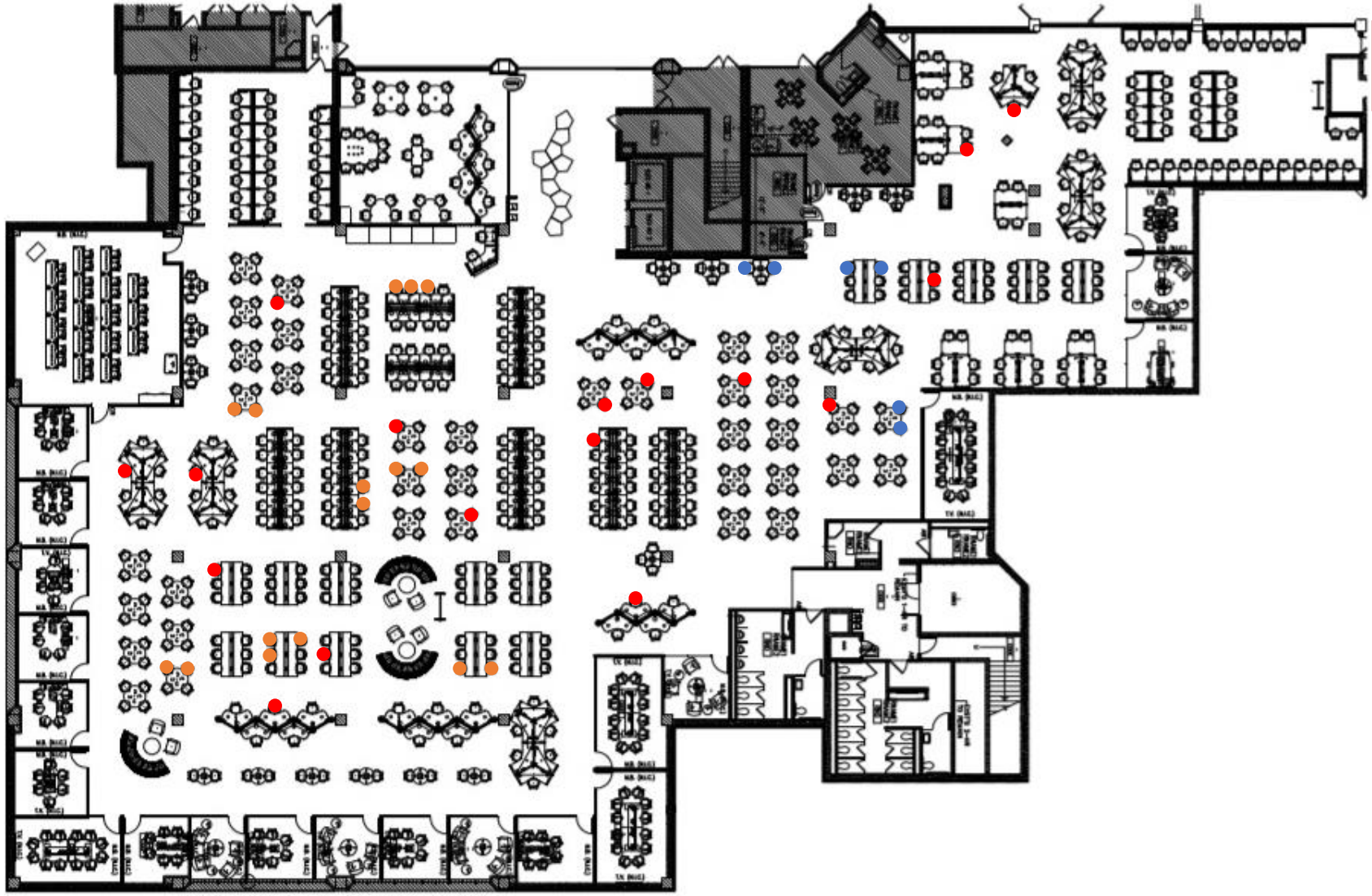

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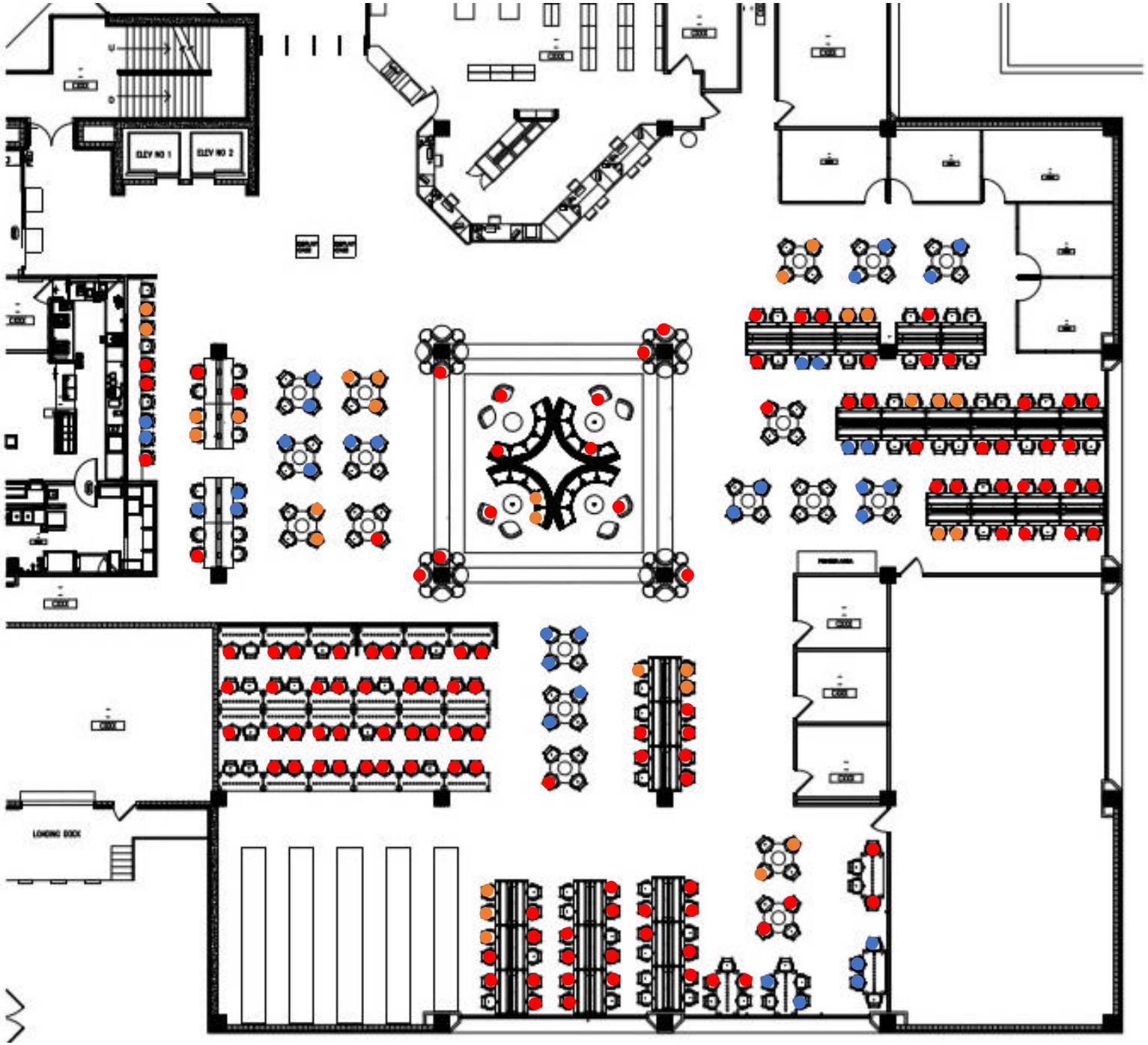

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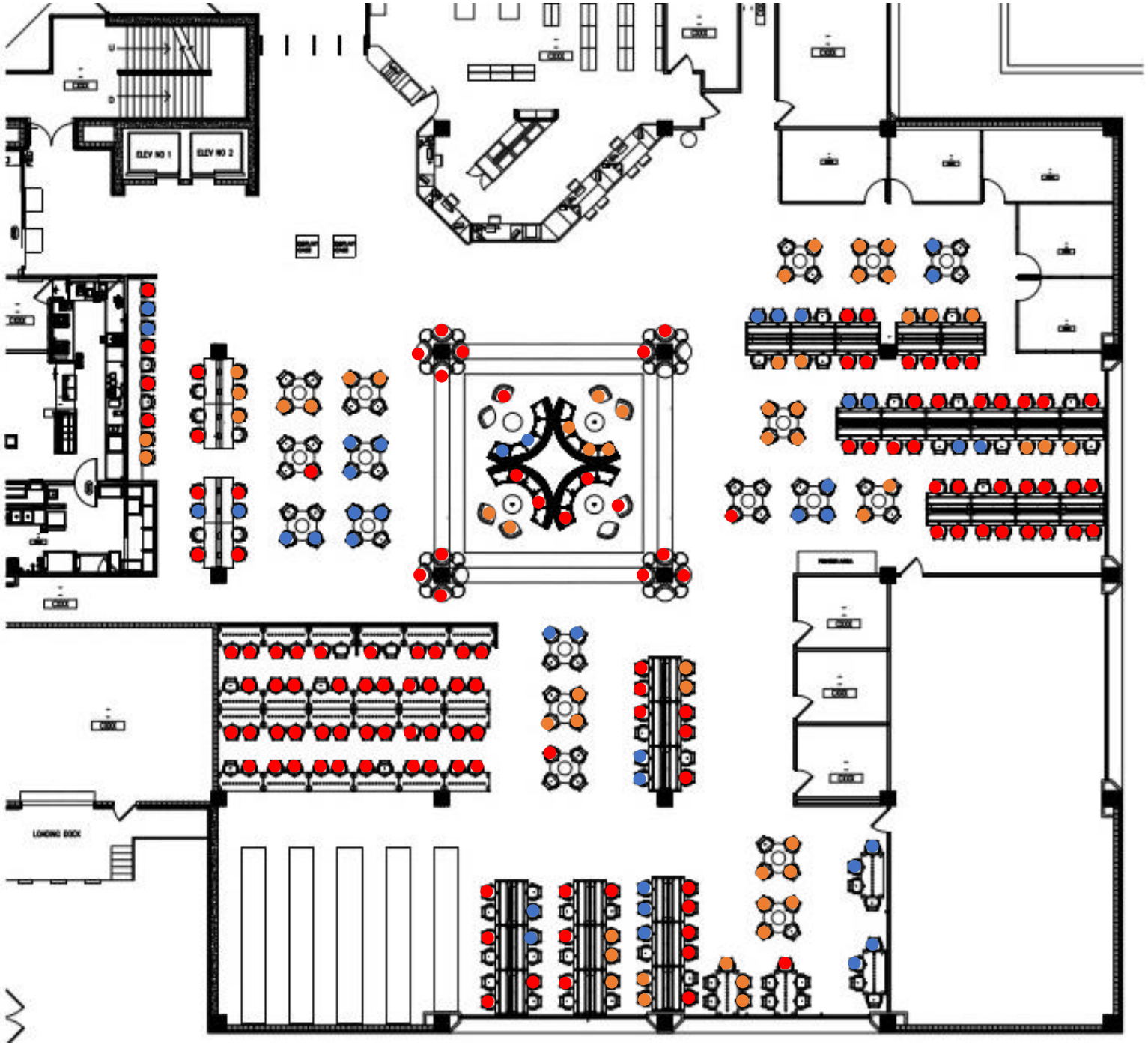

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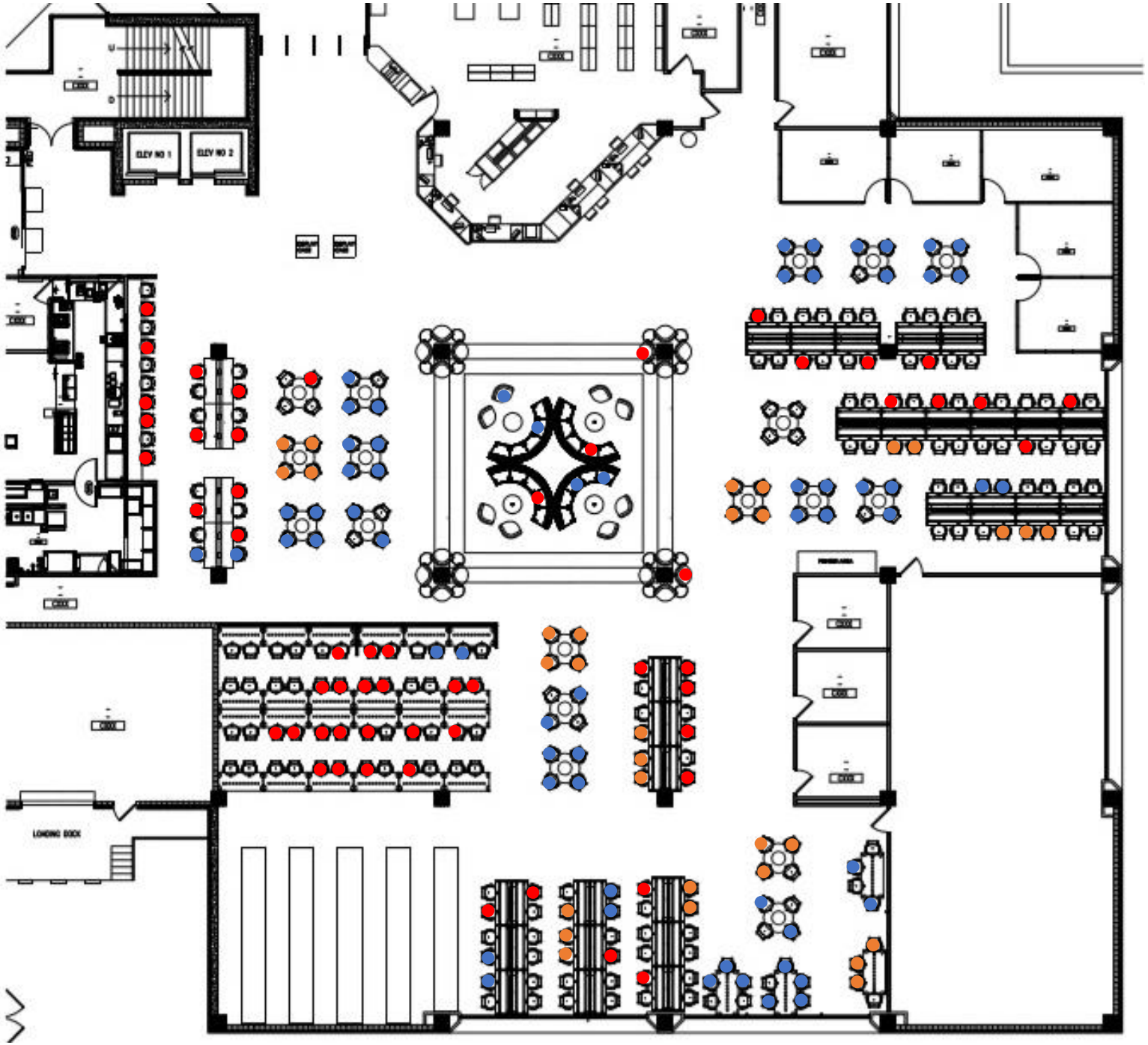

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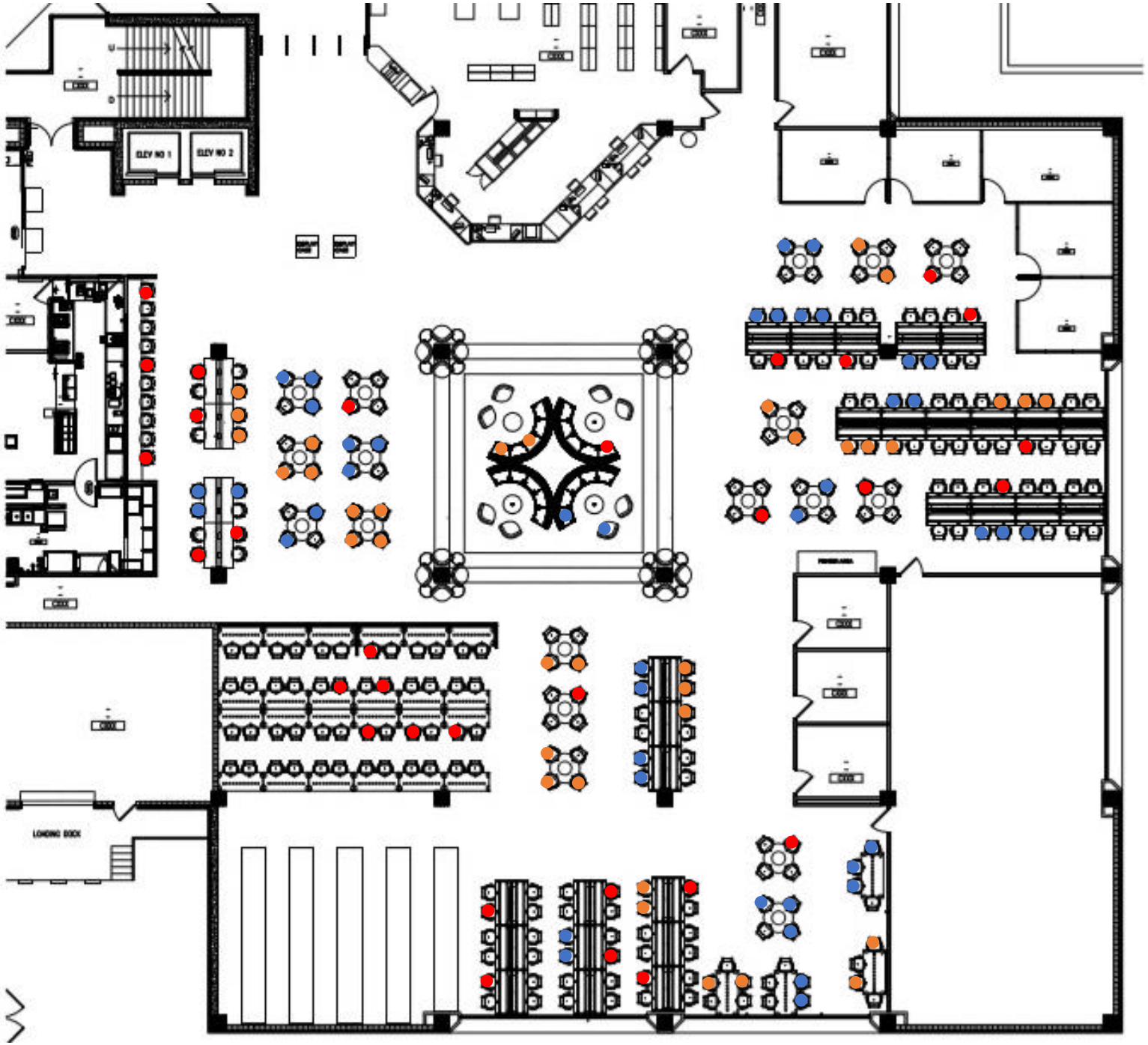

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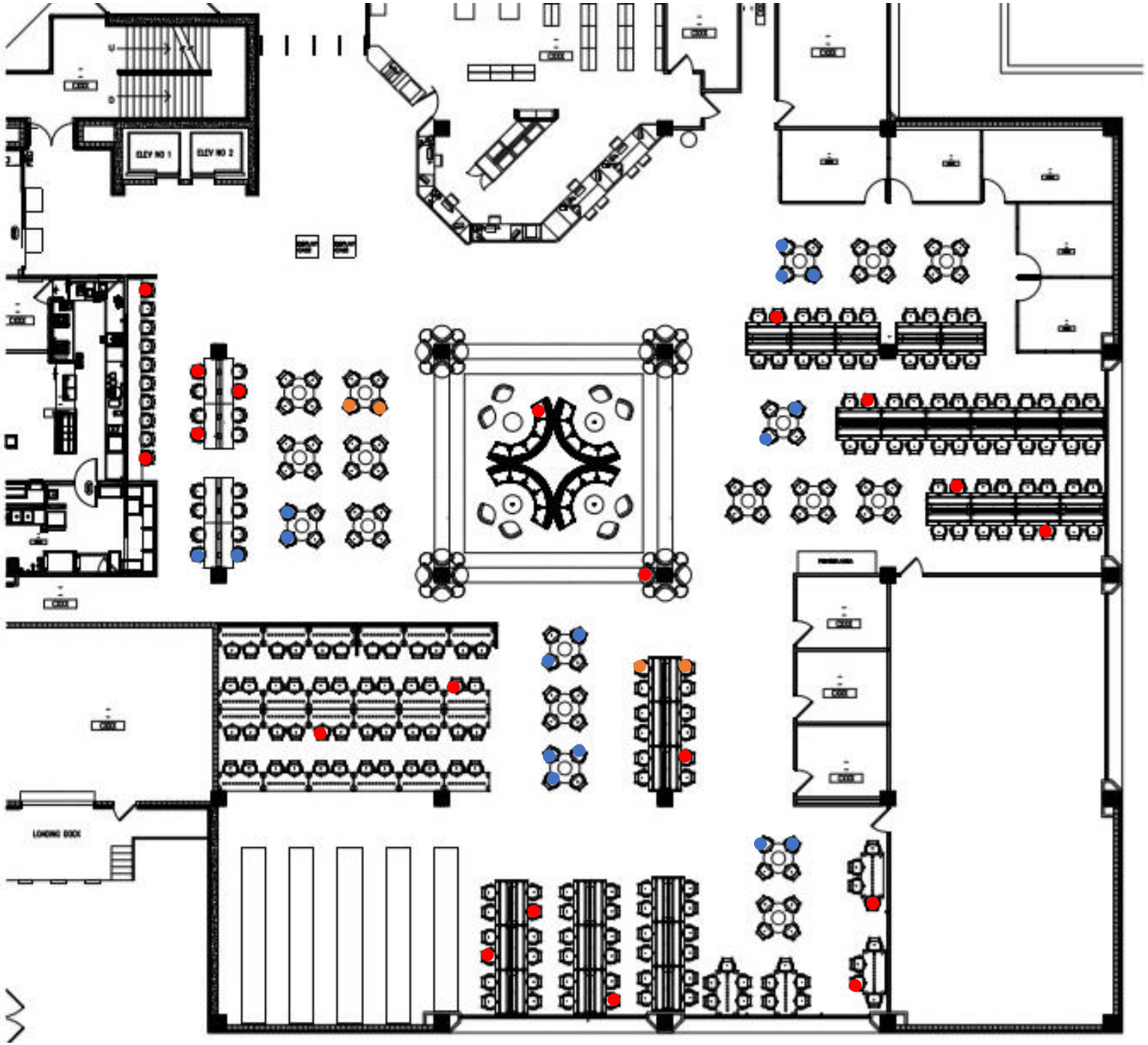

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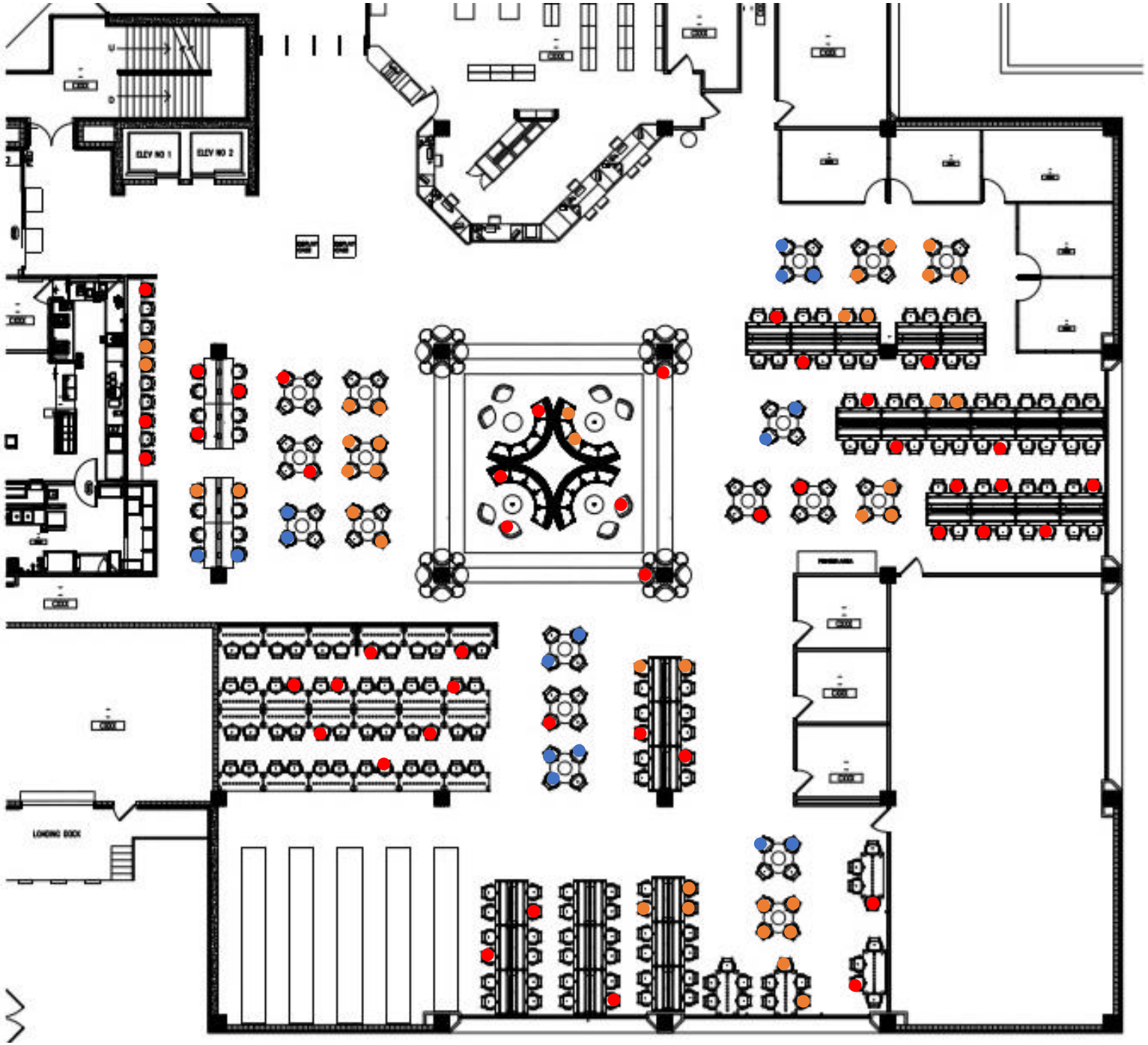

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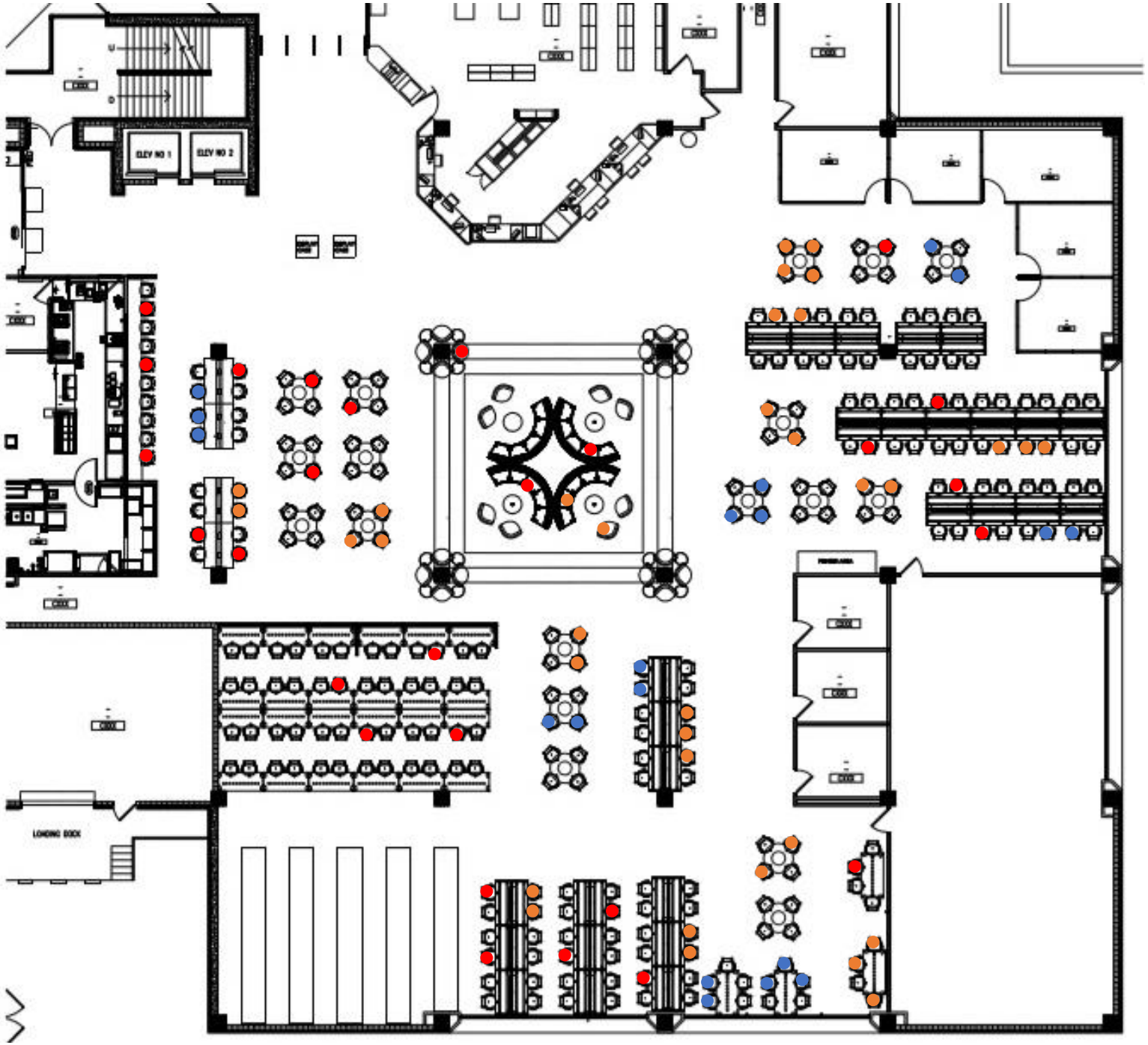

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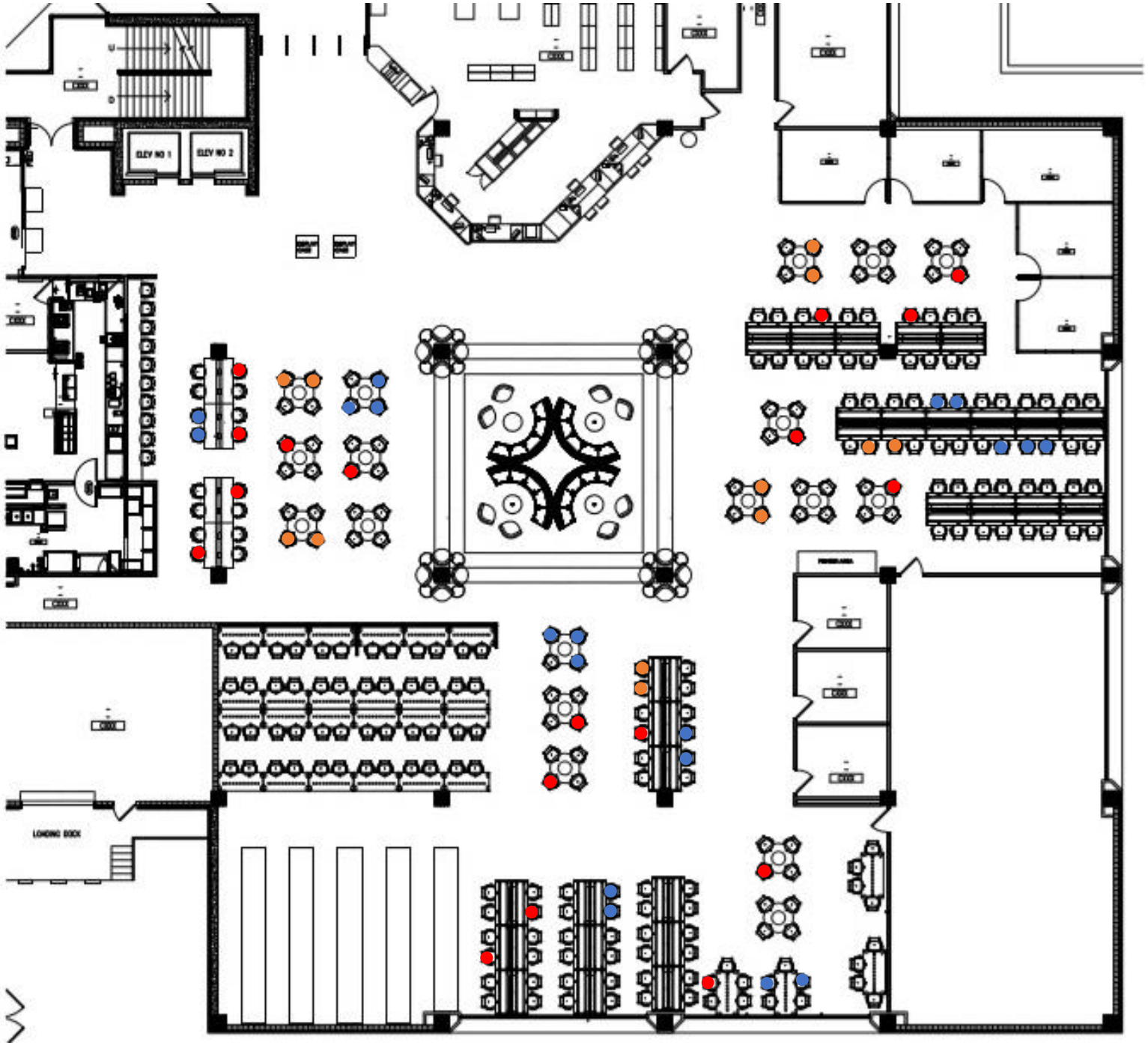

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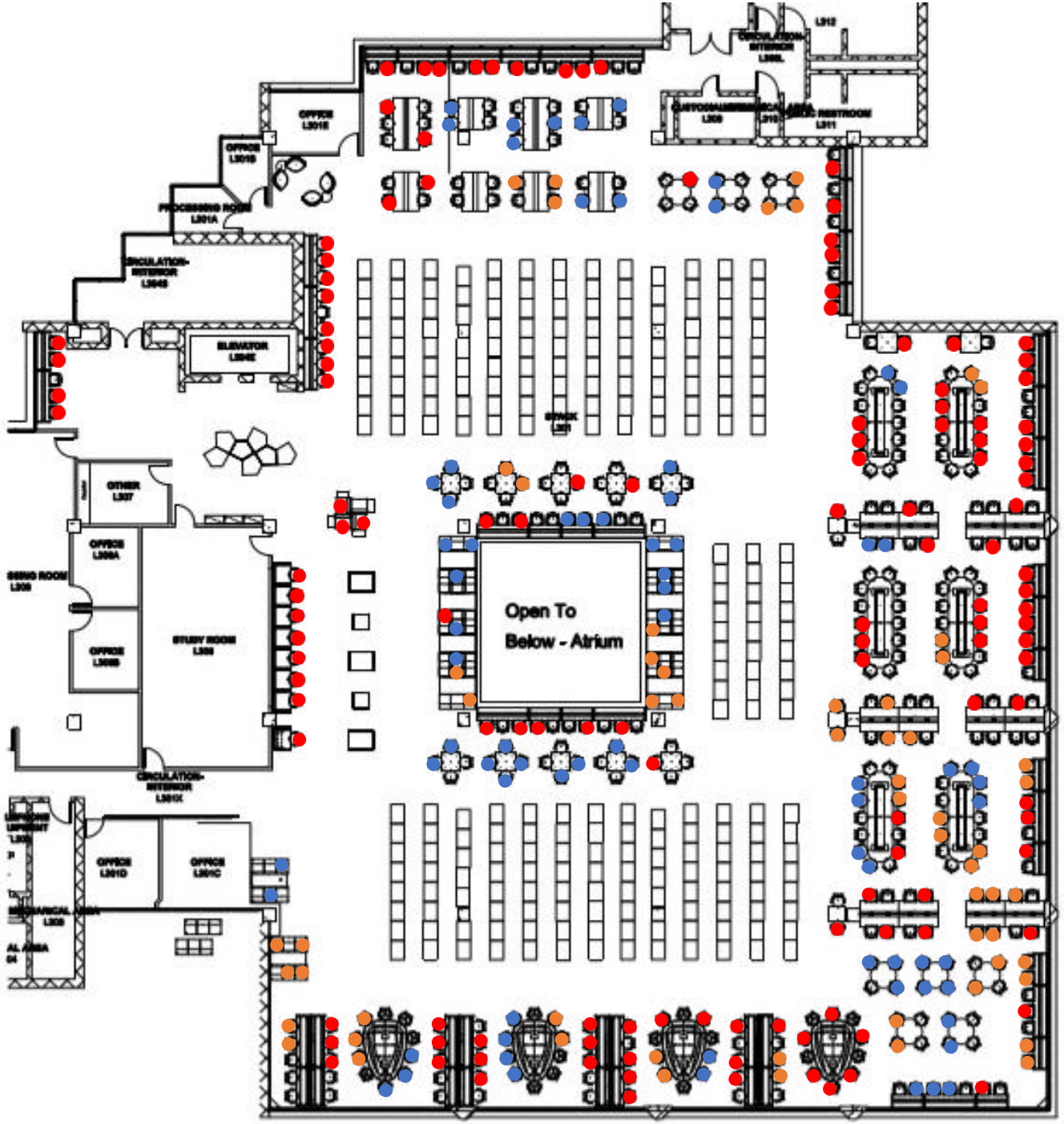

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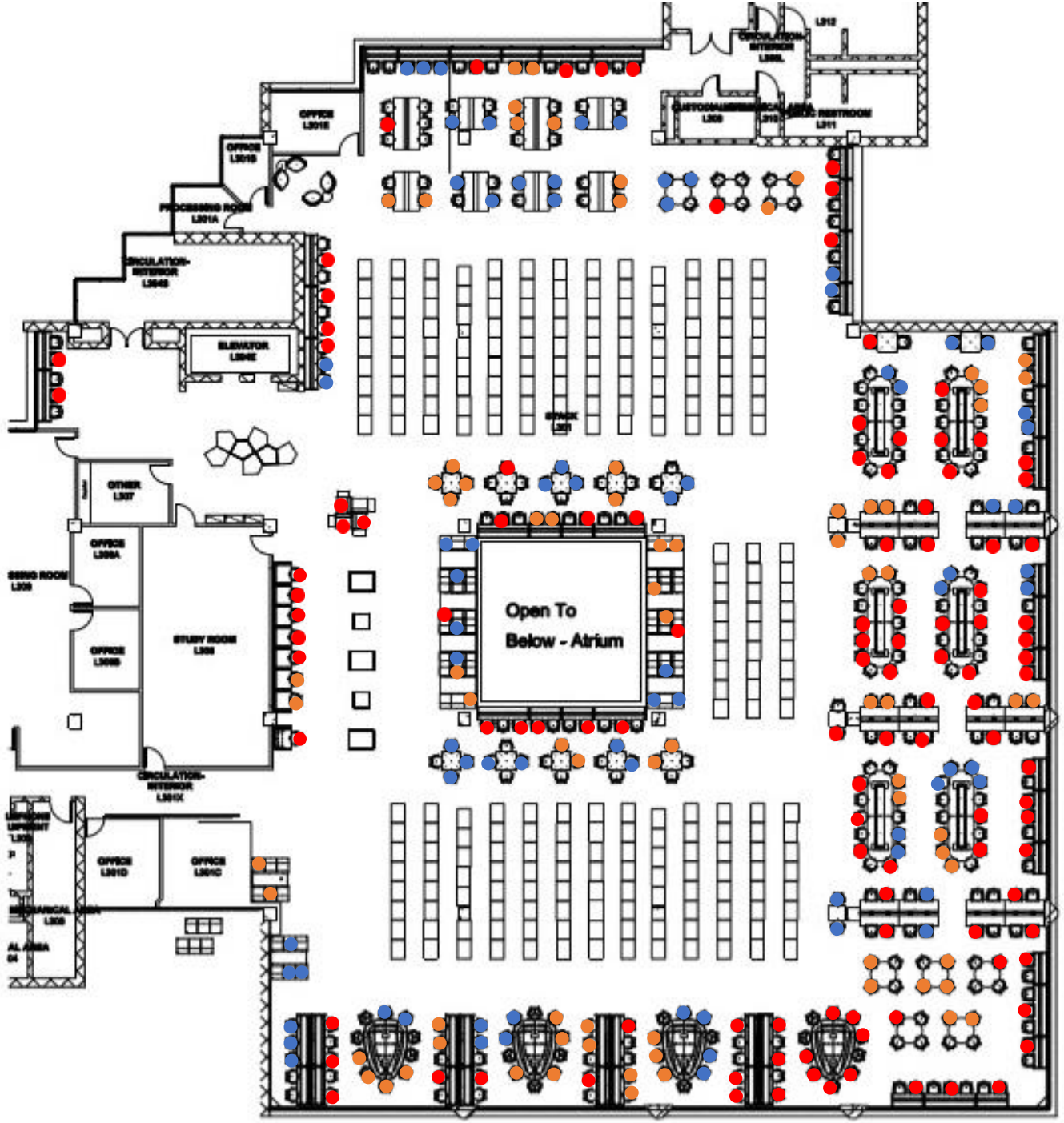

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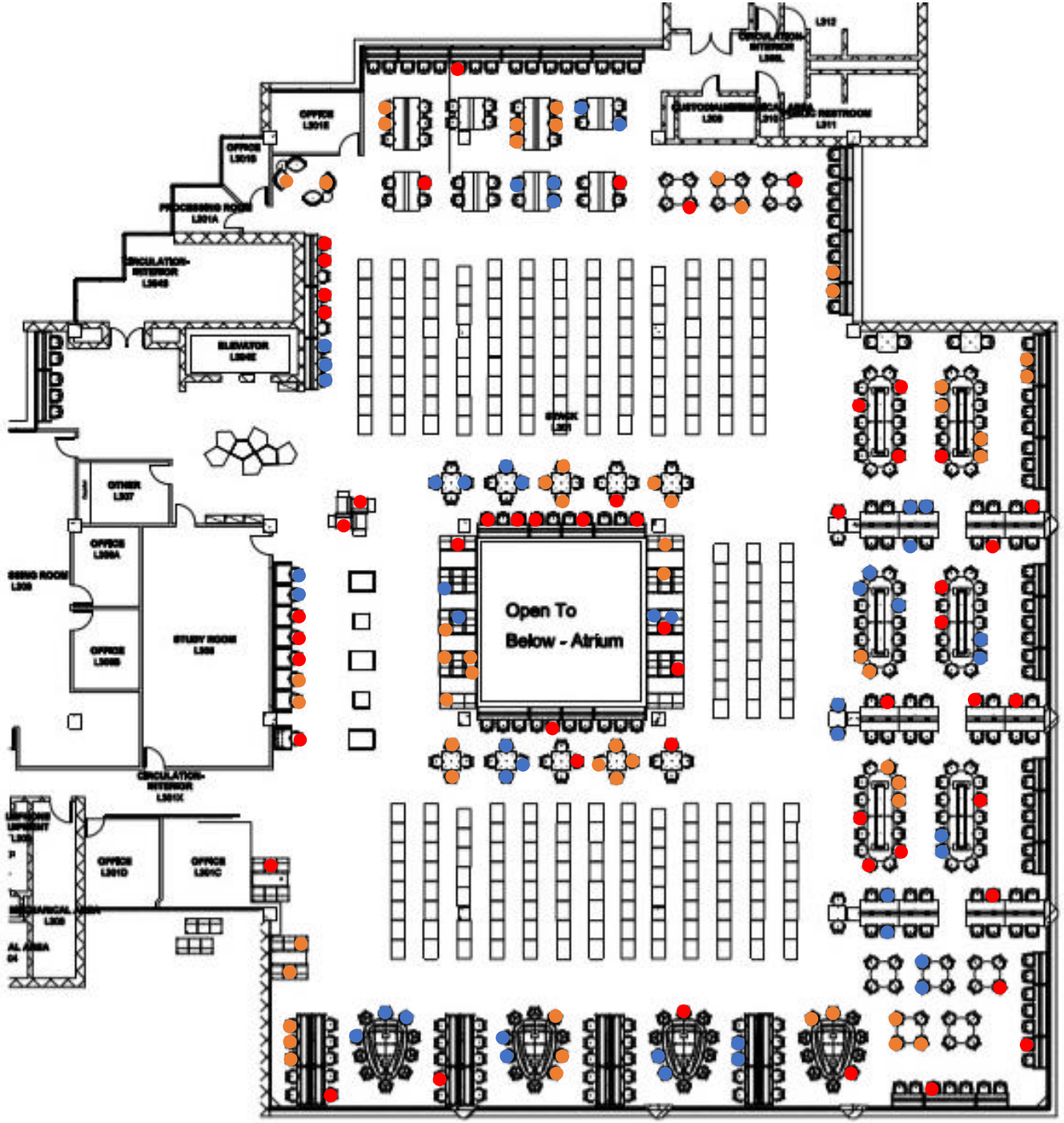

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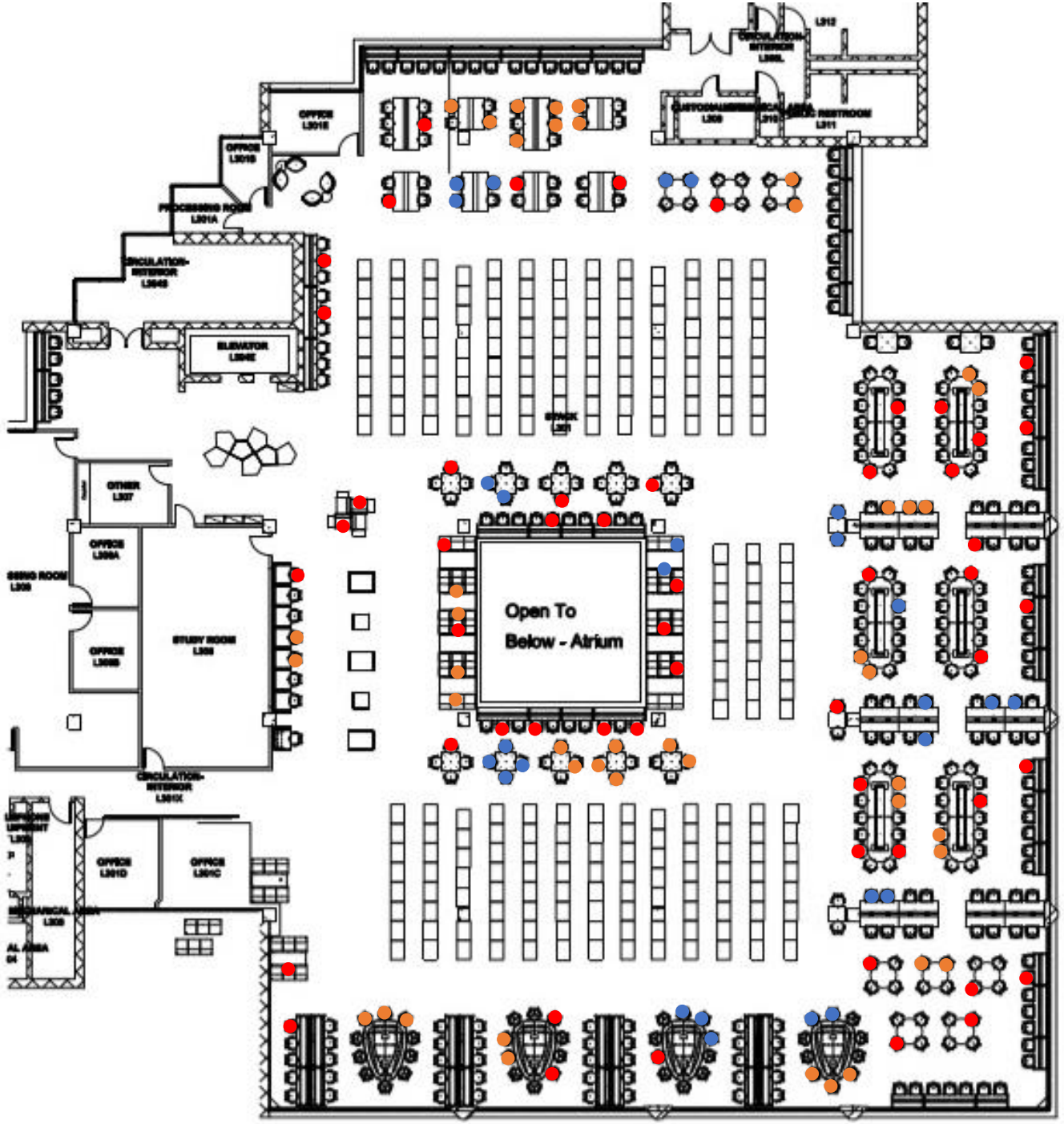

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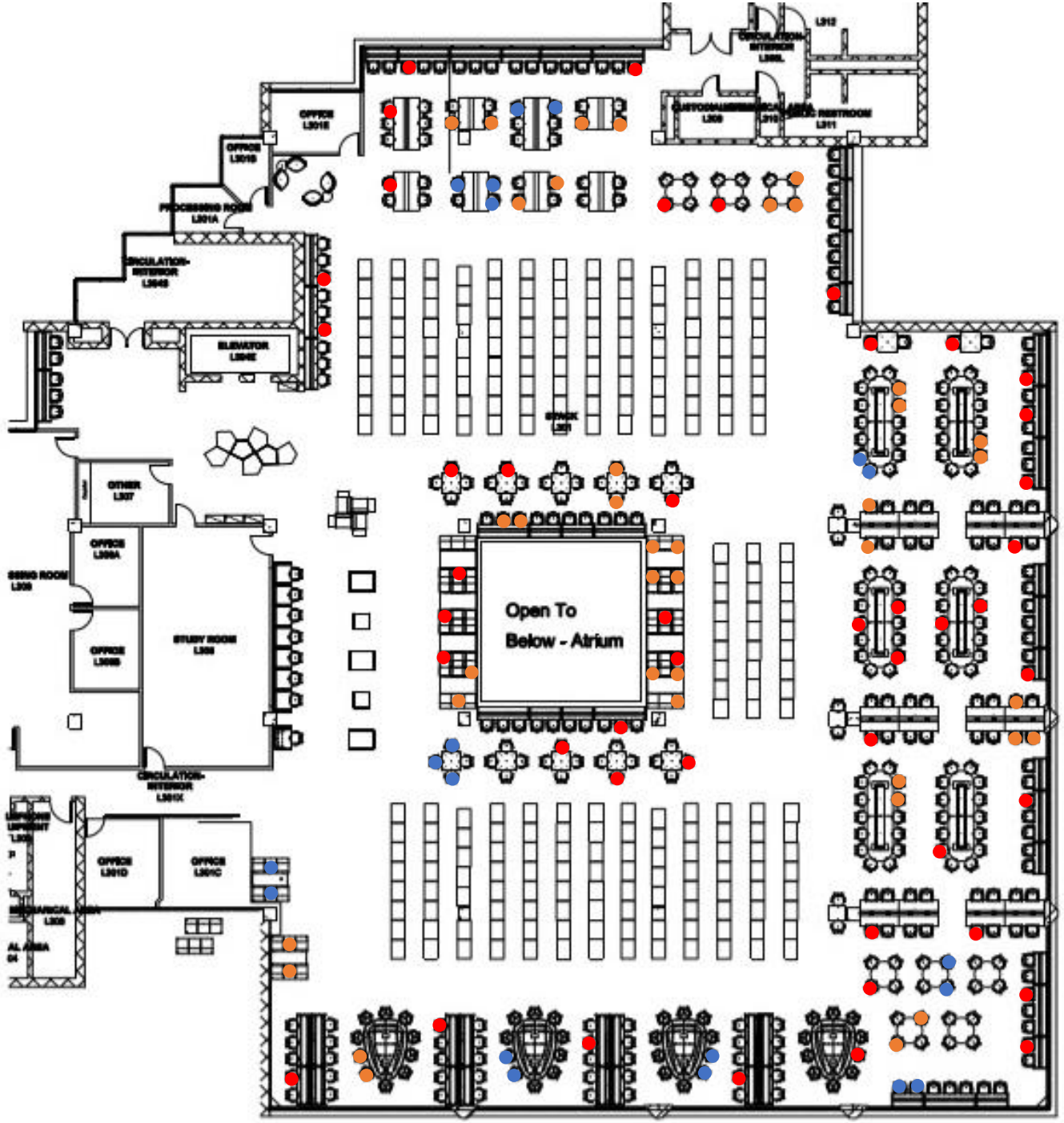

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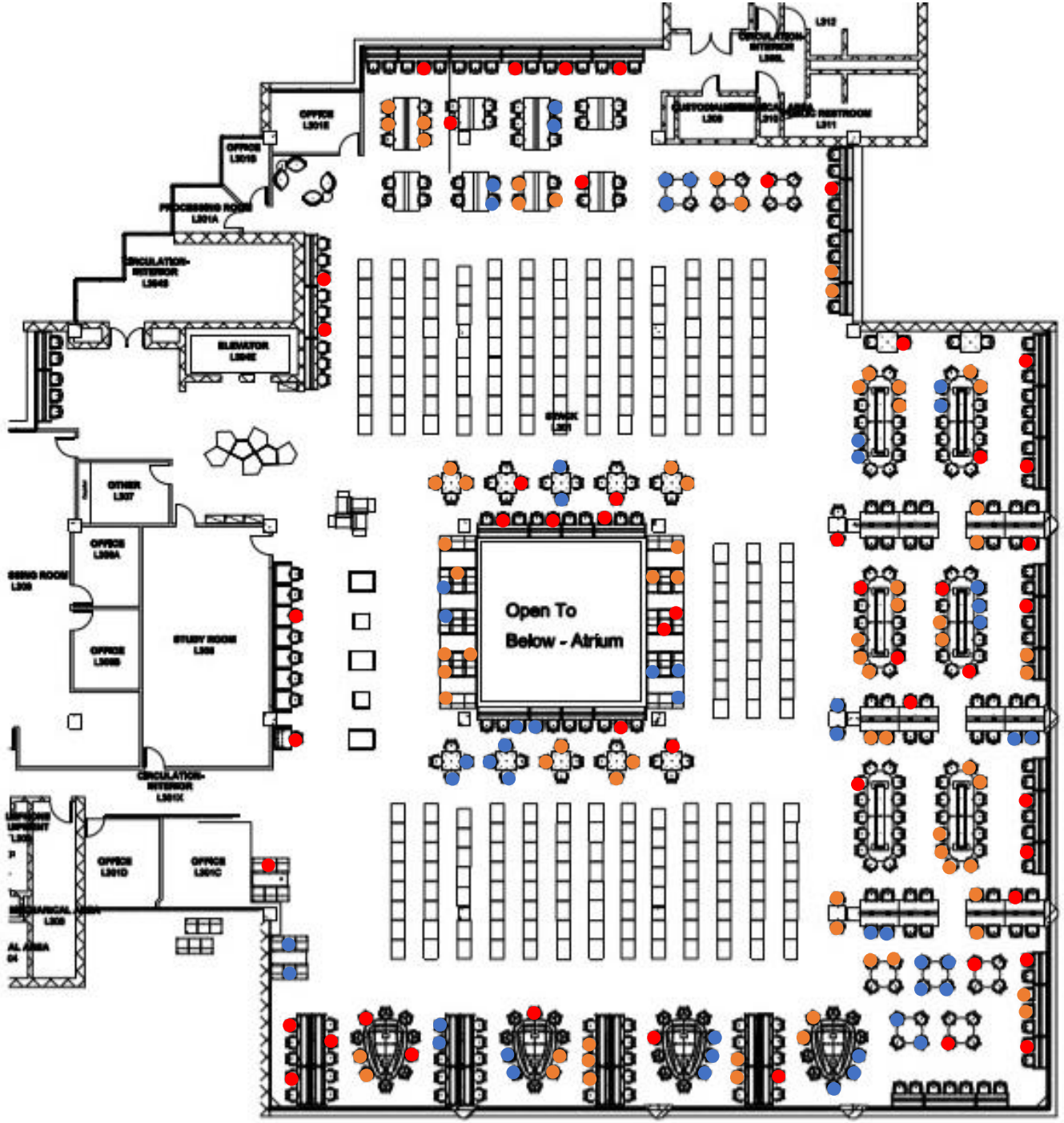

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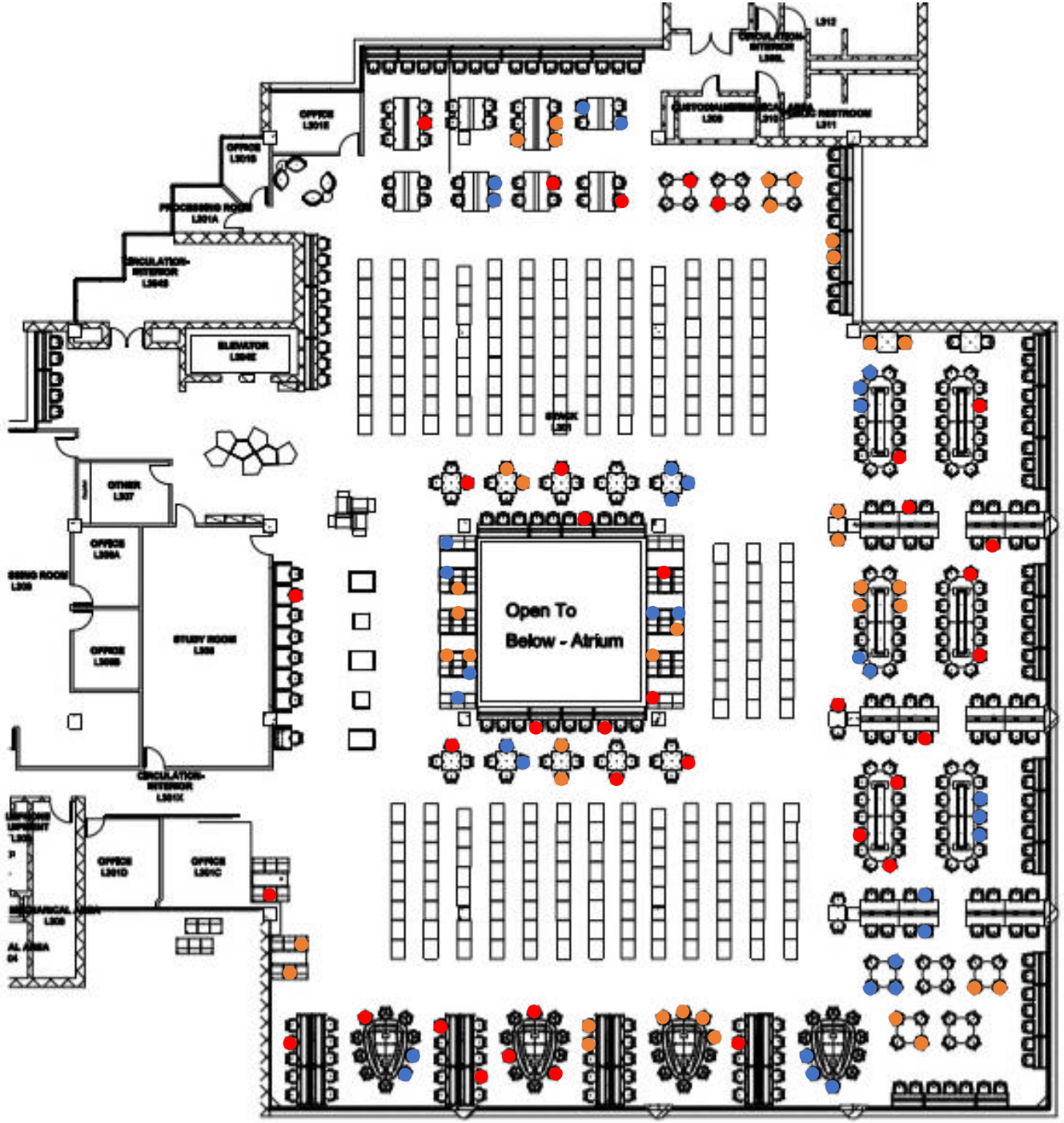

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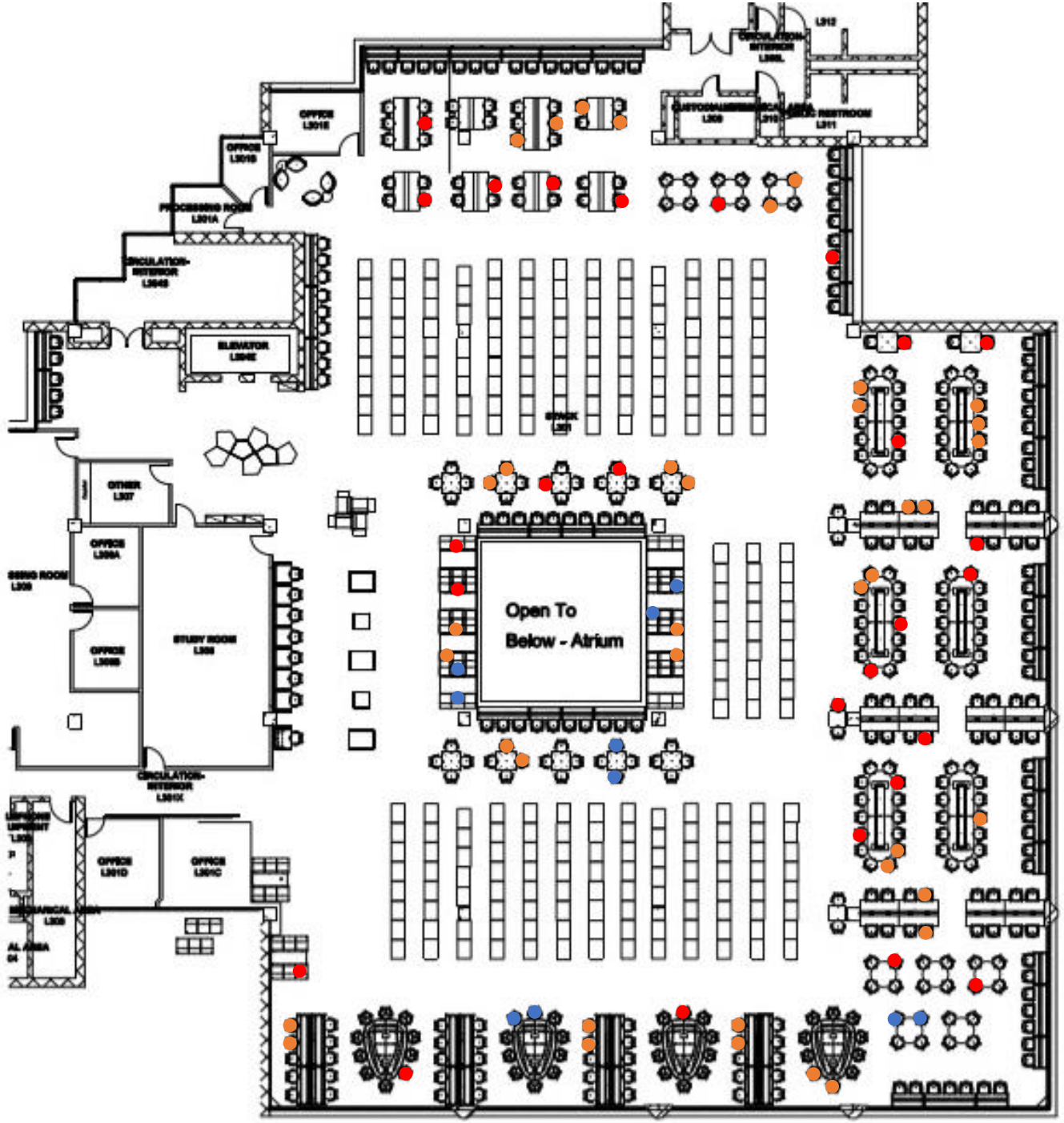

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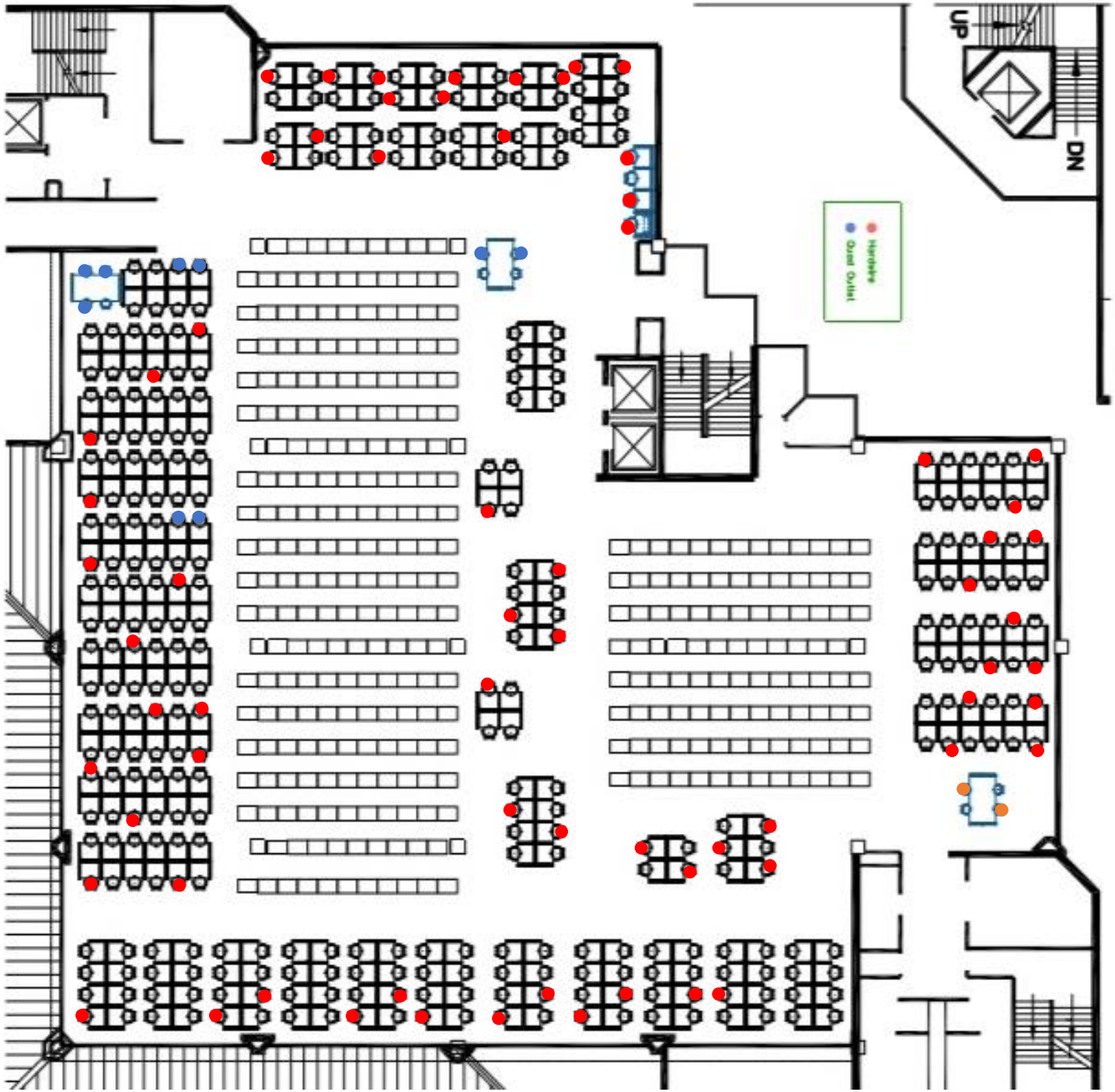

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FOURTH FLOOR

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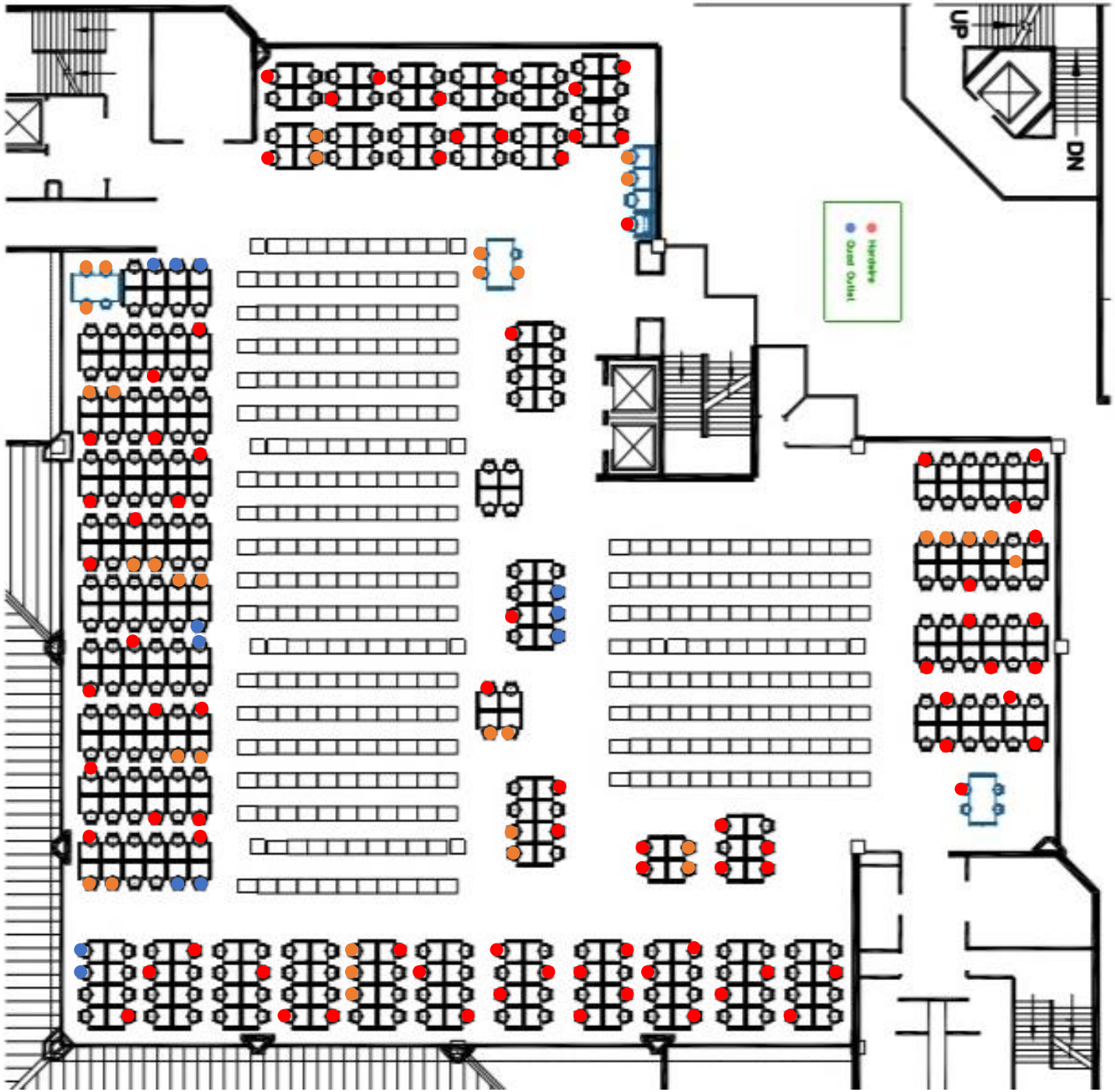

WEDNESDAY, JANUARY 29, 2020

3:00 – 3:15 PM

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- Group
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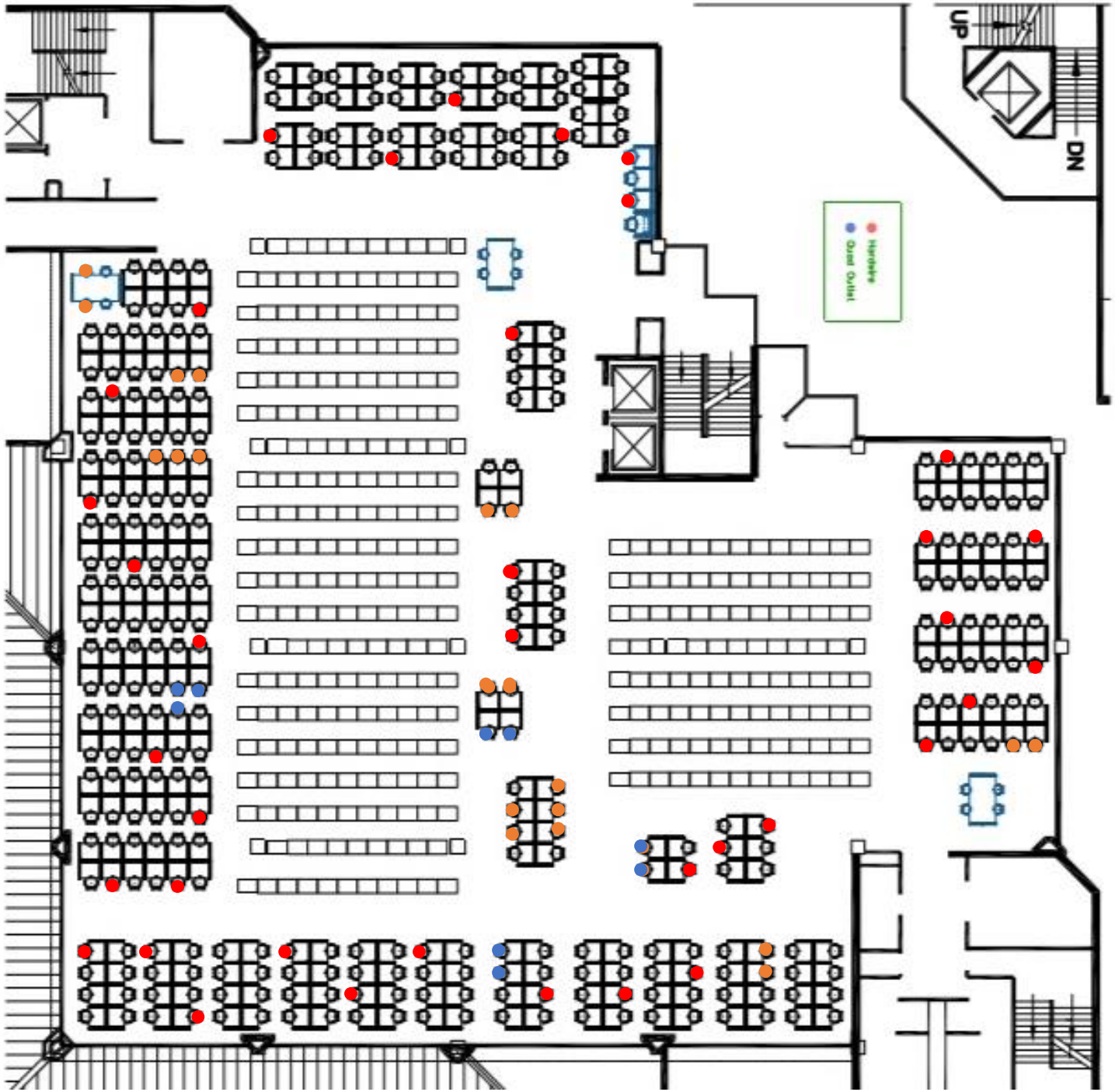

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FOURTH FLOOR

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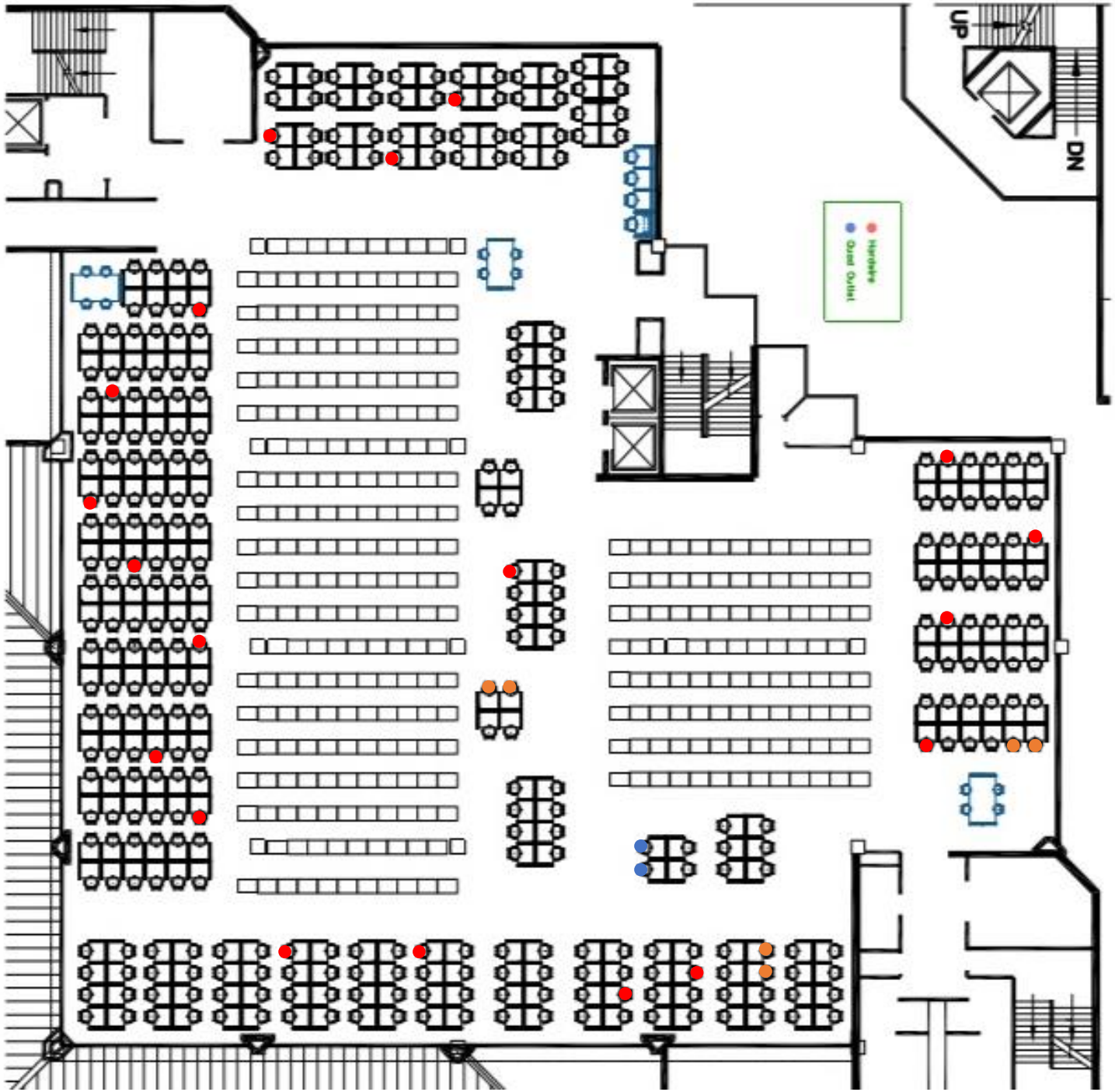
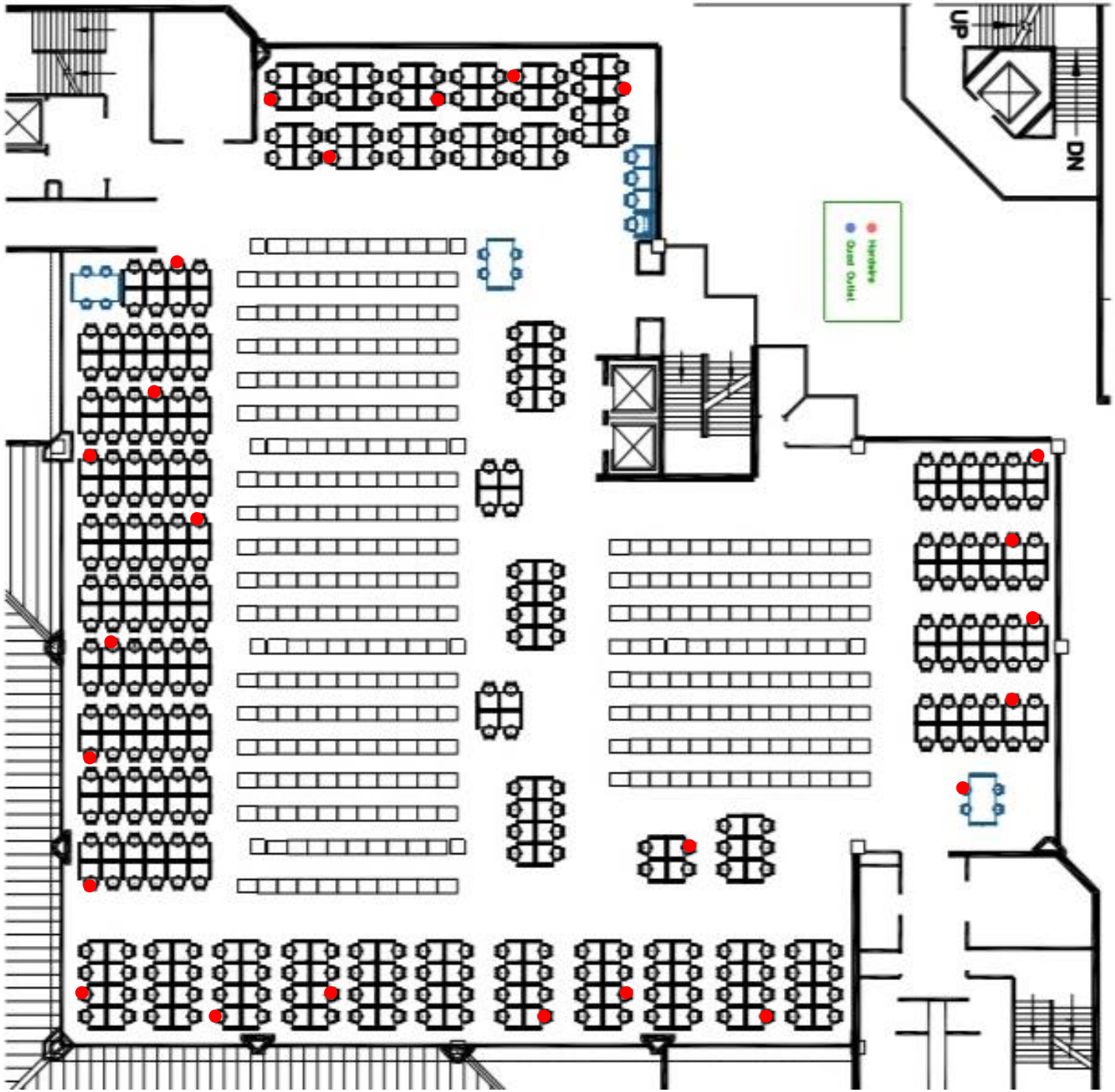


WEDNESDAY, JANUARY 29, 2020

8:00 – 8:15 PM

FOURTH FLOOR

- Individual
- Group
- In a group but working individually

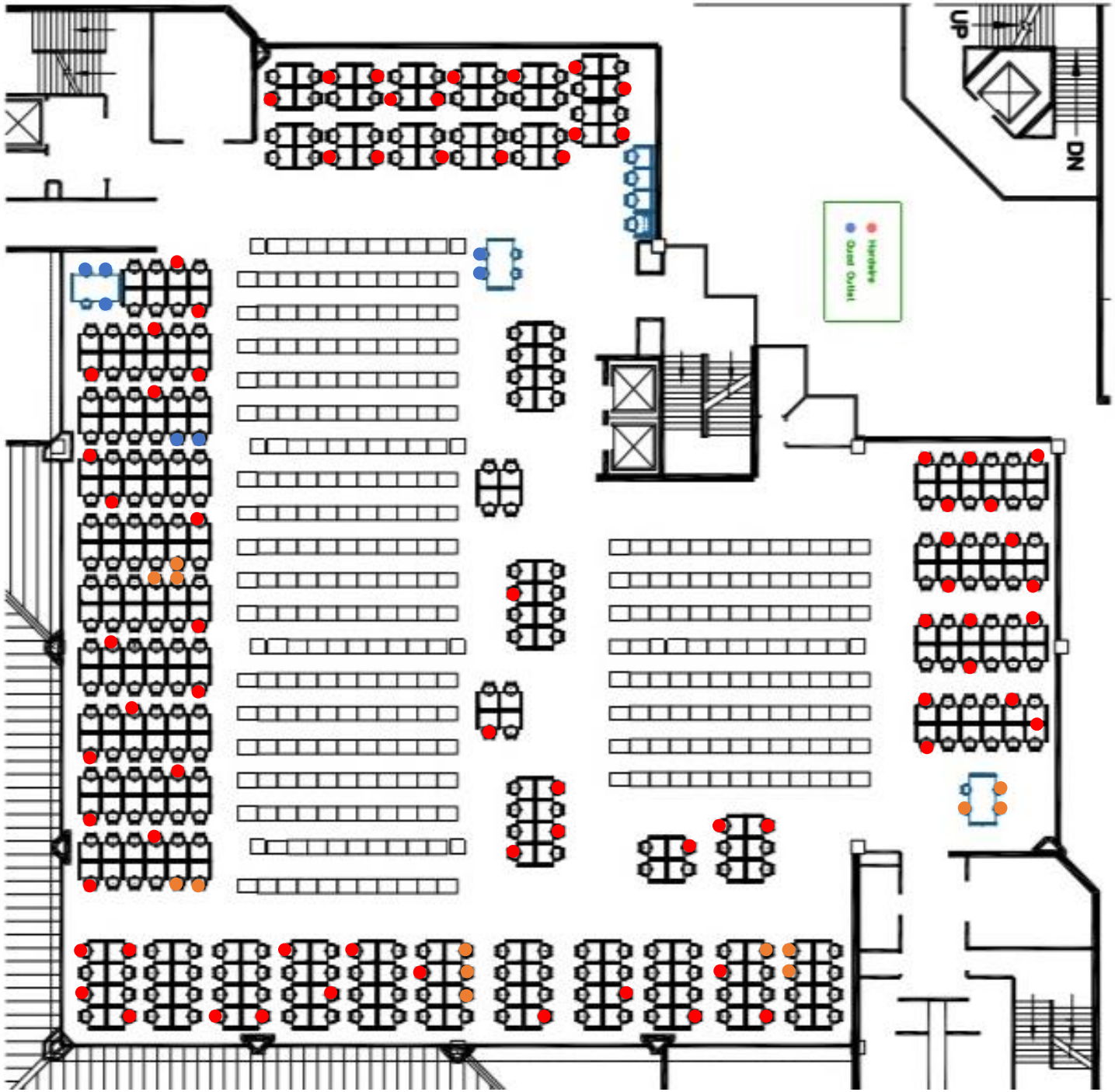


SATURDAY, FEBRUARY 8, 2020

1:45 – 2:00 PM

FOURTH FLOOR

- Individual
- Group
- In a group but working individually

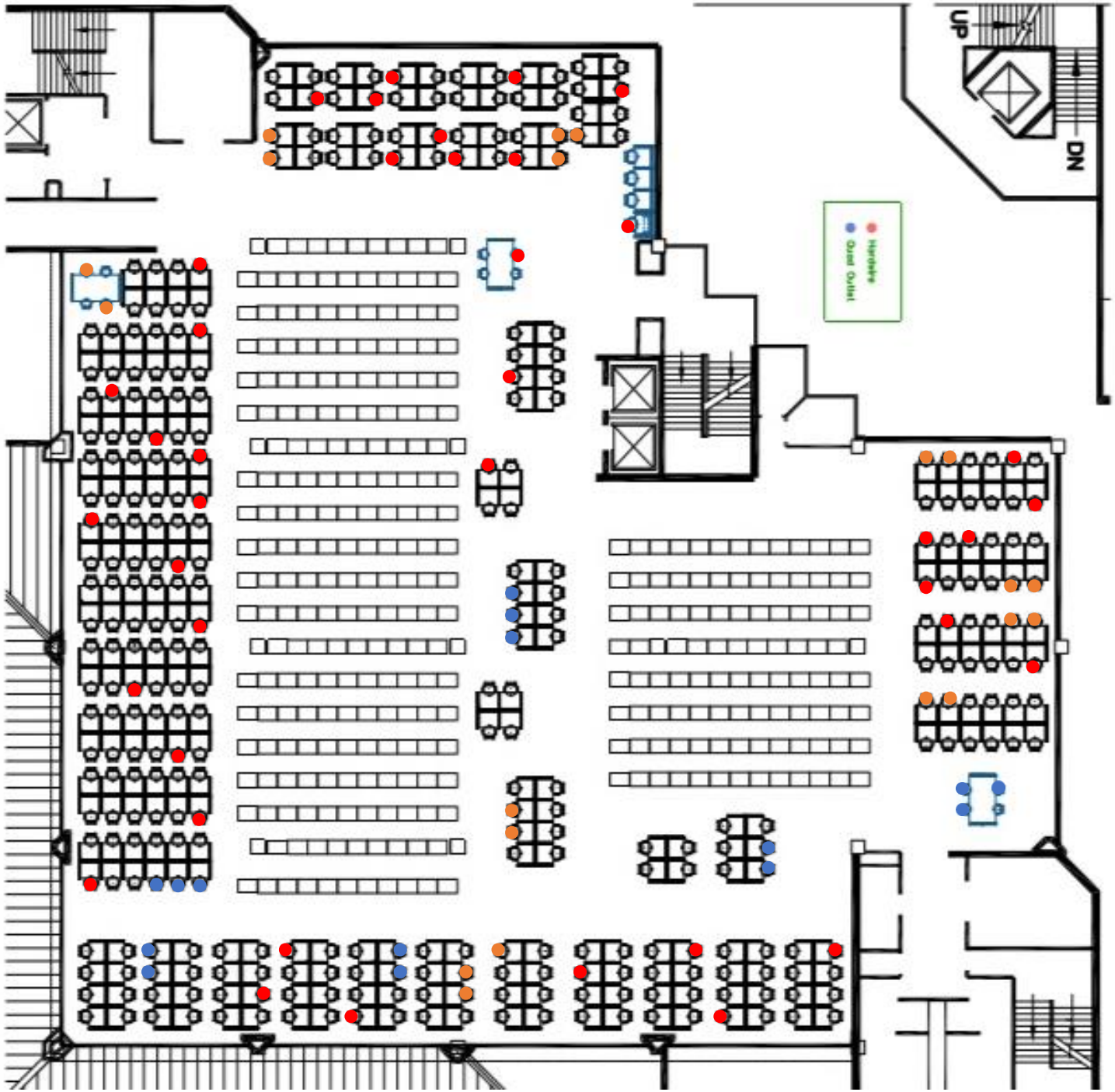


SATURDAY, FEBRUARY 8, 2020

3:00 – 3:15 PM

FOURTH FLOOR

- Individual
- Group
- In a group but working individually

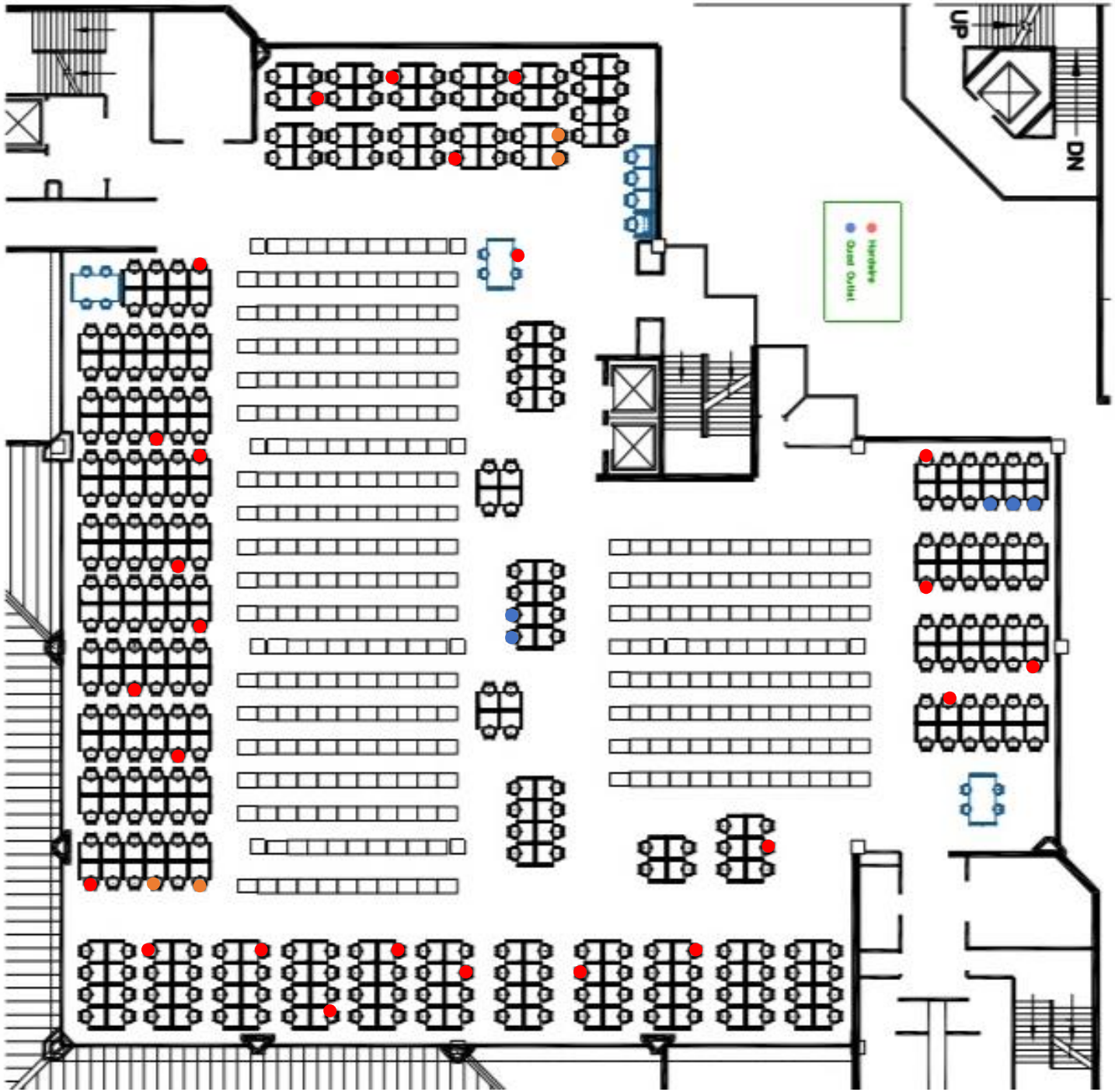


SATURDAY, FEBRUARY 8, 2020

6:45 – 7:00 PM

FOURTH FLOOR

- Individual
- Group
- In a group but working individually

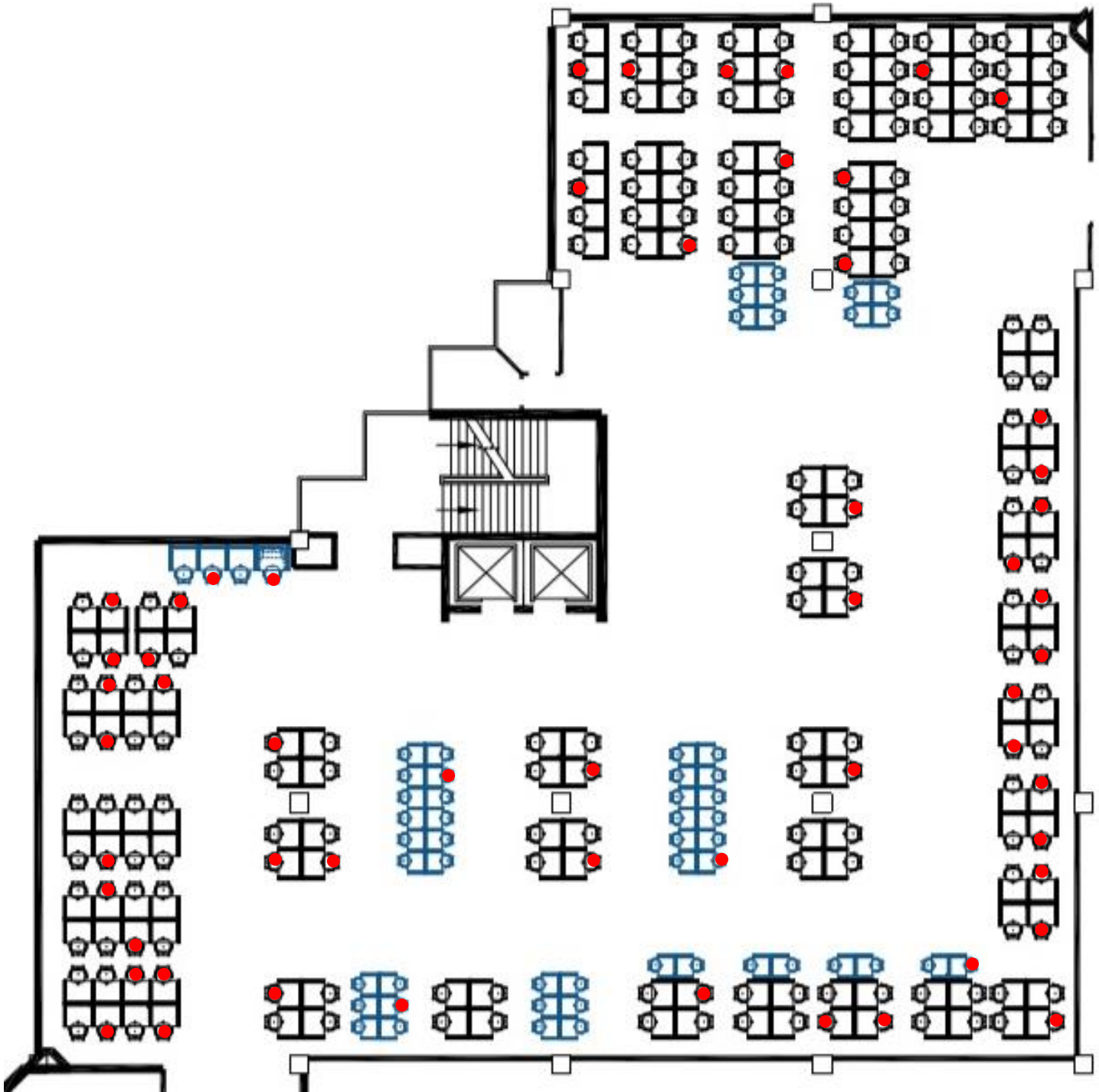


SATURDAY, FEBRUARY 8, 2020

8:00 – 8:15 PM

FOURTH FLOOR

- Individual
- Group
- In a group but working individually

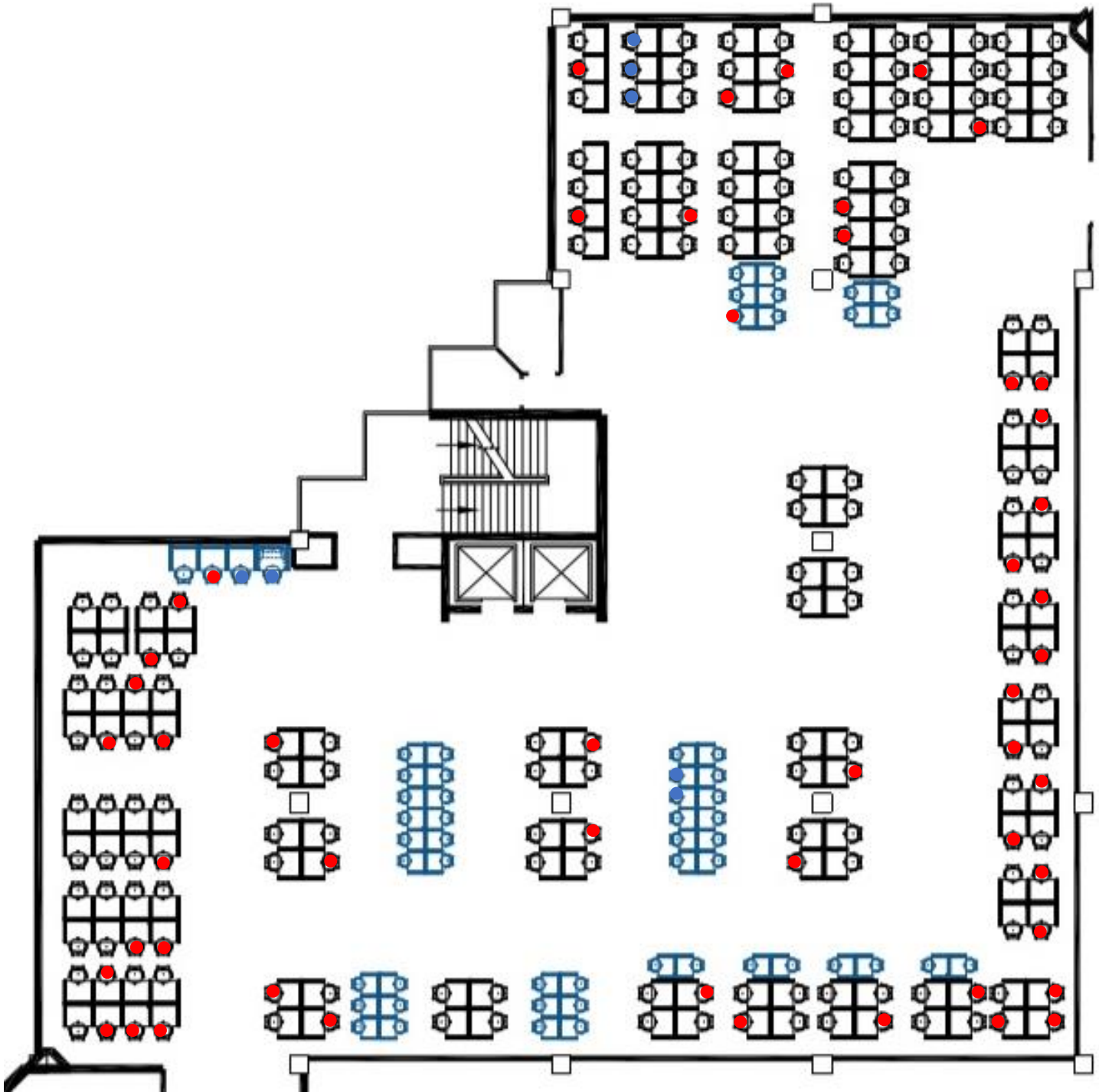


WEDNESDAY, JANUARY 29, 2020

2:00 – 2:15 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

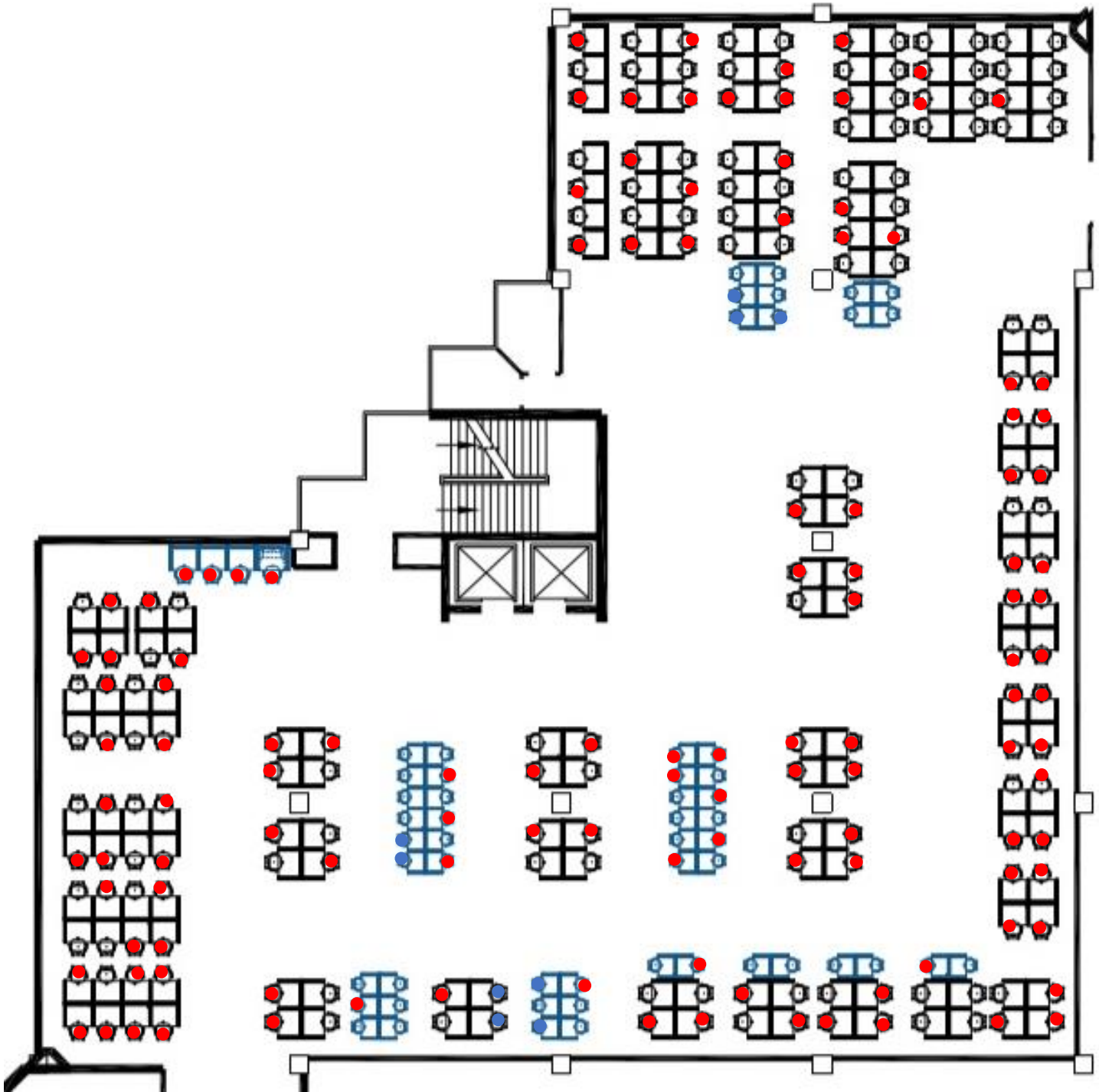


WEDNESDAY, JANUARY 29, 2020

3:15 – 3:30 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

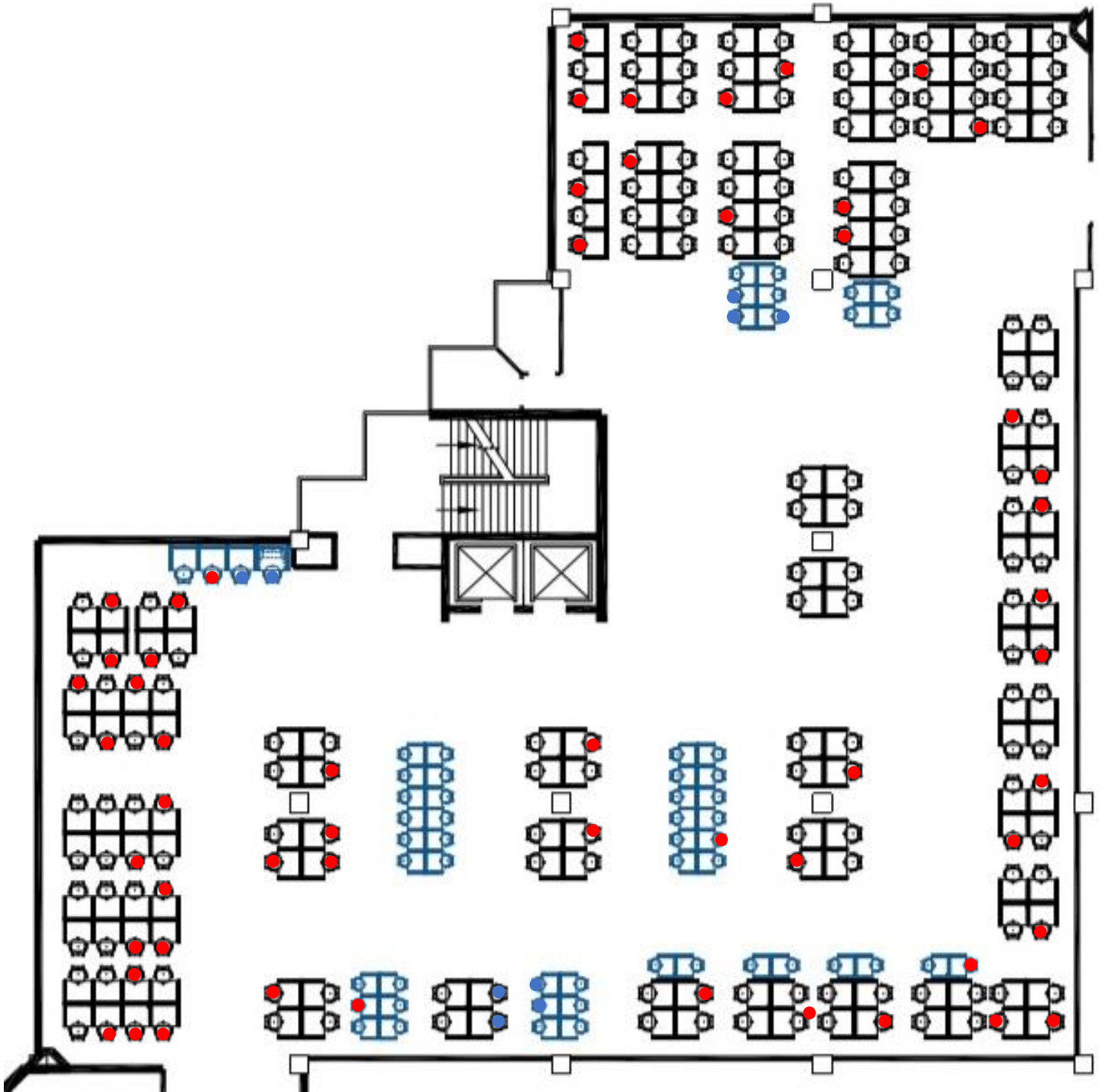


WEDNESDAY, JANUARY 29, 2020

7:00 – 7:15 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

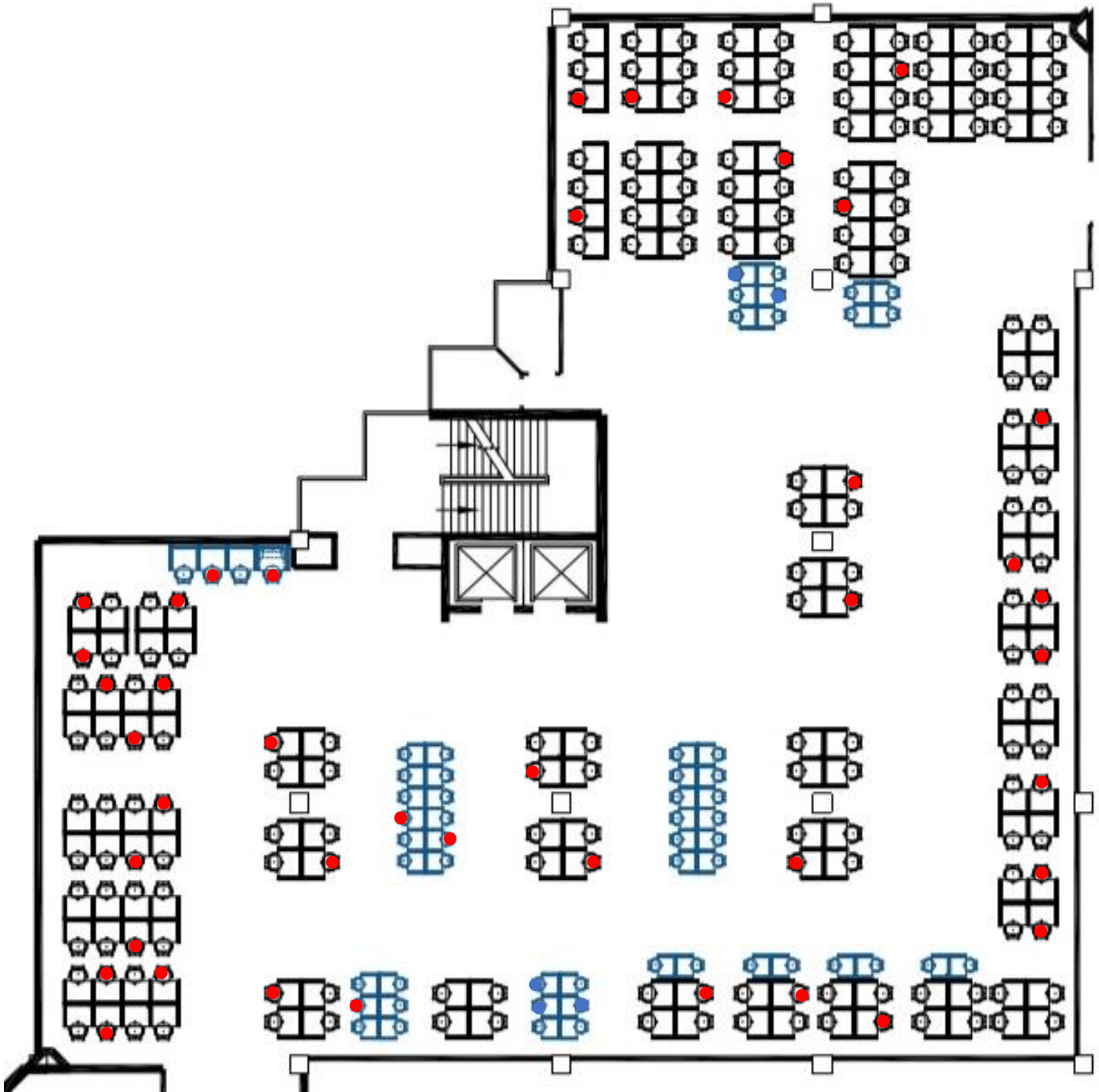


WEDNESDAY, JANUARY 29, 2020

8:15 – 8:30 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

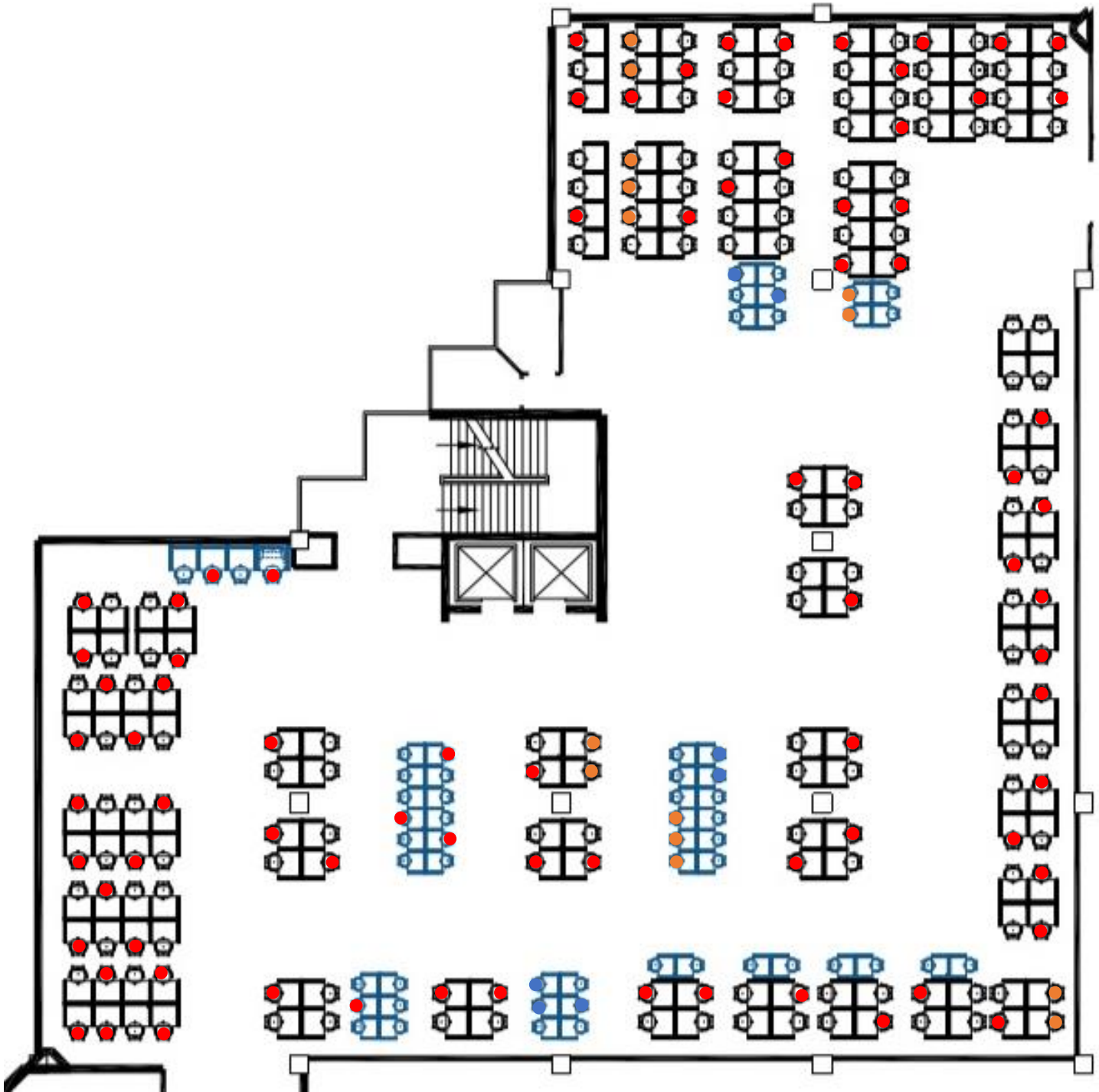


SATURDAY, FEBRUARY 8, 2020

2:00 – 2:15 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

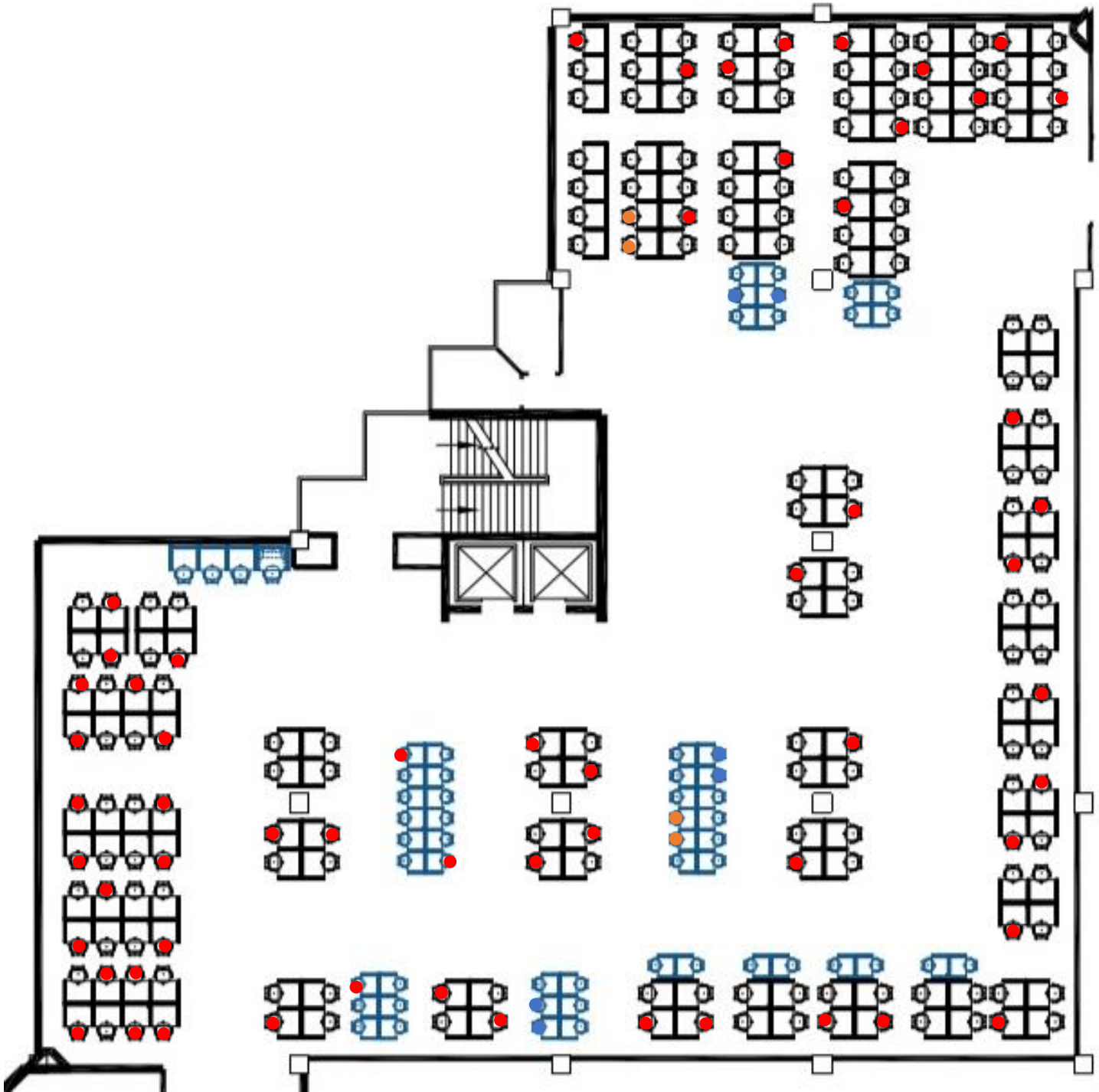


SATURDAY, FEBRUARY 8, 2020

3:15 – 3:30 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

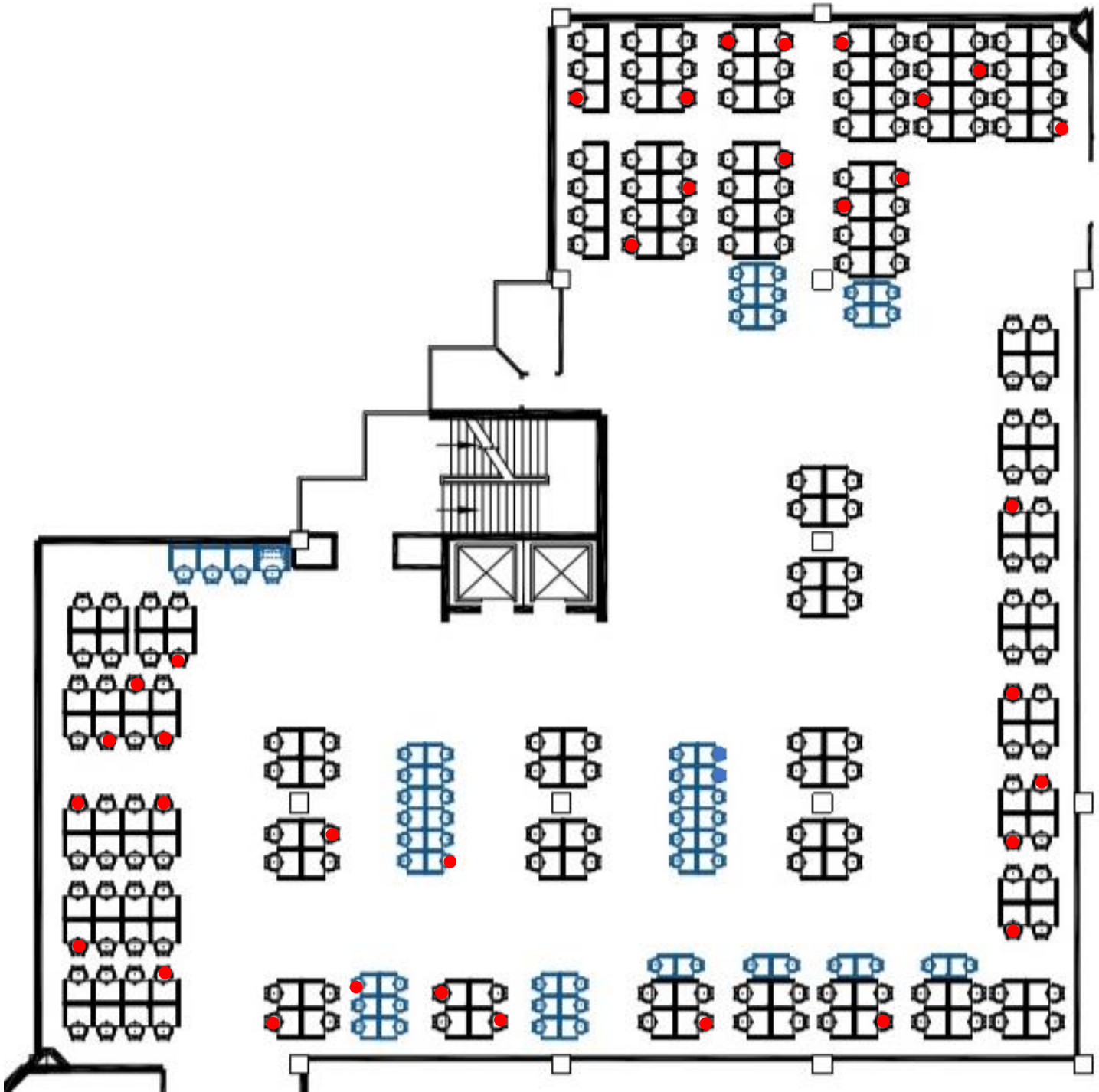


SATURDAY, FEBRUARY 8, 2020

7:00 – 7:15 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually



SATURDAY, FEBRUARY 8, 2020

8:15 – 8:30 PM

FIFTH FLOOR

- Individual
- Group
- In a group but working individually

Appendix C: Marston Science Library — Online Space Use Survey

ARL FRAMEWORK STUDY

Marston Science Library Space Survey
This survey asks you to evaluate the current space you are working in at Marston Science Library. You will be asked how the space **currently** makes you feel as well as how it **ideally** should function.

Important Note:

This survey is about your perceptions; therefore, there are no right or wrong answers.
This survey should take no longer than 15 minutes to complete.

Q2 Please indicate which floor of the Marston Science Library you are currently using:

- Basement
- Entry level
- Third floor
- Fourth floor
- Fifth floor
- I am currently working off-site

Display This Question:

Please indicate which floor of the Marston Science Library you are currently using: I am currently working off site

Q3 If you are currently working off-site, can you describe which area of the Marston Science Library (floor, etc) you typically use and what you like or do not like about this space?

Q4 What, if anything, do you like about working on this floor of Marston Library?

Q5 Can you elaborate on what specific characteristics of the space contribute to your answer above? (Please be as descriptive as possible)

Q6 What, if anything, would you improve about this floor of Marston Library? (Please be as descriptive as possible)

Q7 For each of the following adjective pairs, please respond to the statement by checking the box in the appropriate column. **The <u>current</u> space of Marston Science Library that I am working in feels. . .**

	Strongly	Slightly	Neutral	Slightly	Strongly	
	1	2	3	4	5	
Pleasant	❍	❍	❍	❍	❍	Unpleasant
Relaxing	❍	❍	❍	❍	❍	Distressing
Sleepy	❍	❍	❍	❍	❍	Arousing
Exciting	❍	❍	❍	❍	❍	Gloomy
Energetic	❍	❍	❍	❍	❍	Calm
Quiet	❍	❍	❍	❍	❍	Noisy
Playful	❍	❍	❍	❍	❍	Serious
Social	❍	❍	❍	❍	❍	Unsocial
Collaborative	❍	❍	❍	❍	❍	Self-Reliant
Public	❍	❍	❍	❍	❍	Private
Informal	❍	❍	❍	❍	❍	Formal

Authentic	❍	❍	❍	❍	❍	Superficial
Friendly	❍	❍	❍	❍	❍	Unfriendly
Crowded	❍	❍	❍	❍	❍	Uncrowded

Q8 For each of the following adjective pairs please respond to the statement by checking the box in the appropriate column. **Ideally, I wish this space of Marston Science Library would be. . .**

	Strongly	Slightly	Neutral	Slightly	Strongly	
	1	2	3	4	5	
Pleasant	❍	❍	❍	❍	❍	Unpleasant
Relaxing	❍	❍	❍	❍	❍	Distressing
Sleepy	❍	❍	❍	❍	❍	Arousing
Exciting	❍	❍	❍	❍	❍	Gloomy
Energetic	❍	❍	❍	❍	❍	Calm
Quiet	❍	❍	❍	❍	❍	Noisy
Playful	❍	❍	❍	❍	❍	Serious
Social	❍	❍	❍	❍	❍	Unsocial
Collaborative	❍	❍	❍	❍	❍	Self-Reliant
Public	❍	❍	❍	❍	❍	Private
Informal	❍	❍	❍	❍	❍	Formal
Authentic	❍	❍	❍	❍	❍	Superficial
Friendly	❍	❍	❍	❍	❍	Unfriendly
Crowded		❍	❍	❍	❍	Uncrowded

Q9 Is there anything else that could be improved at the Marston Science Library?

Q10 How many hours per week do you typically spend at the Marston Science Library?

- <1 hours.
- 2–4 hours.
- 5–7 hours.
- 8–10 hours.
- 11 or more hours.

Q11 How frequently do you use the Marston Science library for the following tasks?

	Never	Occasionally	Regularly
Team Project Work	❍	❍	❍
Group Study	❍	❍	❍
Individual Work/Study	❍	❍	❍
Socializing	❍	❍	❍
Taking a Break / Passing Time	❍	❍	❍

Q12 Please list your class status

- Undergraduate
- Graduate
- Professional
- Other (please describe)

Q13 Please select your college:

- Agriculture and Life Sciences
- Arts
- Business
- Dentistry
- Design, Construction and Planning
- Education
- Engineering
- Journalism and Communications
- Liberal Arts and Sciences
- Nursing
- Public Health and Health Professions
- Health and Human Performance
- Law
- Medicine
- Pharmacy
- Veterinary Medicine

Q14 Please provide your major

Q15 Please provide your age range

- 22 years and under
- 23–38 years
- 39–54 years
- 55 years or over

Appendix D: Descriptive Statistics from the Online Space Use Survey

A total of 601 individuals took the survey but only 337 of those who finished the survey had visited Marston Science Library.

26.2% of students indicated that COVID restrictions frequently or very frequently impacted their Team Project activities.

28.5% of students indicated that COVID restrictions frequently or very frequently impacted their Group Study.

But almost 75% said that Individual/Private study was infrequently or rarely limited.

Surprisingly, 35.1% of graduate students reported "typically" using the Basement and 23.7% of them use the Entry floor, which are both designed as commons areas with unrestricted noise levels and no private seating.

Generally, graduate students do not use the Libraries for Team Projects (65% intermittently or rarely) or Group Study (60.4% intermittently or rarely) and they do not social there (80.7% intermittently or rarely). Forty-four point four percent responded they use the Libraries for Individual Study more than two times per week. Sixty-nine percent of undergraduate students, however, visit the Libraries more than two times per week and 34% indicated they visit more than two times weekly to conduct Group Study.

Floor of the Marston Science Library typically used by class status

	Total	Undergraduate	Graduate	Professional/ Other	Other (please describe)
Total Count (Answering)	336.0	277.0	57.0	1.0	1.0
Basement	29.8 %	28.9%	35.1%	0.0%	0.0%
Entry level	16.1%	14.4%	23.7%	0.0%	100.0%
Third floor	30.1	32.9%	17.5%	0.0%	0.0%

	Total	Undergraduate	Graduate	Professional/ Other	Other (please describe)
	%				
Fourth floor	15.8%	16.6%	12.3%	0.0%	0.0%
Fifth Floor	8.3%	7.2%	12.3%	100.0%	0.0%

Hours spent at Marston Science Library by floor

	Total	Basement	Entry level	Third floor	Fourth floor	Fifth floor
Total Count (Answering)	336.0	100.0	54.0	101.0	53.0	28.0
<1 hours	25.3%	29.0%	42.6%	14.9%	22.6%	21.4%
2–4 hours	28.3%	23.0%	38.9%	31.7%	24.5%	21.4%
5–7 hours	25.9%	22.0%	18.5%	28.7%	37.7%	21.4%
8–10 hours	8%	11.0%	0.0%	14.9%	5.7%	14.3%
11 or more hours	7%	15.0%	0.0%	9.9%	9.4%	21.4%

Frequency of Task Use by Class

Frequency	Total	Undergraduate	Graduate
Total Count (Answering)	336.0	277.0	57.0
Team Project			
Very frequently (more than 4x weekly)	5.1%	5.1%	5.3%

Frequency	Total	Undergraduate	Graduate
Frequently (1–2x weekly)	11.9%	11.2%	15.8%
Infrequently (1–2x monthly)	17.9%	18.8%	14.0%
Intermittently (as needed to complete coursework/research)	30.1%	31.4%	24.6%
Rarely (once in a blue moon)	35.1%	33.6%	40.4%
Group Study			
Very frequently (more than 4x weekly)	11.3%	13.4%	1.8%
Frequently (1–2x weekly)	19.9%	20.6%	17.5%
Infrequently (1–2x monthly)	19.3%	19.5%	19.3%
Intermittently (as needed to complete coursework/research)	19.3%	19.9%	17.5%
Rarely (once in a blue moon)	30.1%	26.7%	43.9%
Individual Study			
Very frequently (more than 4x weekly)	32.7%	32.9%	33.3%
Frequently (1–2x weekly)	33.3%	36.1%	21.1%
Infrequently (1–2x monthly)	13.7%	12.6%	19.3%
Intermittently (as needed to complete coursework/research)	11.9%	10.5%	15.8%
Rarely (once in a blue moon)	8.3%	7.9%	10.5%
Socializing			
Very frequently (more than 4x weekly)	4.5%	5.4%	0.0%

Frequency	Total	Undergraduate	Graduate
Frequently (1–2x weekly)	12.5%	13.7%	7.0%
Infrequently (1–2x monthly)	15.8%	16.6%	12.3%
Intermittently (as needed to complete coursework/research)	14.3%	14.4%	14.0%
Rarely (once in a blue moon)	53.0%	49.8%	66.7%
Taking a break/passing time			
Very frequently (more than 4x weekly)	9.8%	11.2%	3.5%
Frequently (1–2x weekly)	16.7%	17.3%	14.0%
Infrequently (1–2x monthly)	19.3%	19.1%	21.1%
Intermittently (as needed to complete coursework/research)	13.4%	13.0%	14.0%
Rarely (once in a blue moon)	40.8%	39.4%	47.4%
Other			
Very frequently (more than 4x weekly)	5.4%	5.4%	5.3%
Frequently (1–2x weekly)	5.1%	6.1%	0.0%
Infrequently (1–2x monthly)	12.2%	12.6%	10.5%
Intermittently (as needed to complete coursework/research)	7.1%	5.4%	14.0%
Rarely (once in a blue moon)	70.2%	70.4%	70.2%

Frequency of COVID restrictions impacts on various user tasks

Task	Frequency of use for tasks	Frequency of COVID interruptions
Total Count	335	335
Team Project		
Very frequently (more than 4x weekly)	17	63
Frequently (1–2x weekly)	40	25
Infrequently (1–2x monthly)	60	21
Intermittently (as needed to complete coursework/research)	100	25
Rarely (once in a blue moon)	118	201
Group Study		
Very frequently (more than 4x weekly)	38	64
Frequently (1–2x weekly)	66	32
Infrequently (1–2x monthly)	65	22
Intermittently (as needed to complete coursework/research)	65	26
Rarely (once in a blue moon)	101	191
Individual Study		
Very frequently (more than 4x weekly)	109	49
Frequently (1–2x weekly)	112	35
Infrequently (1–2x monthly)	46	35

Task	Frequency of use for tasks	Frequency of COVID interruptions
Intermittently (as needed to complete coursework/research)	40	36
Rarely (once in a blue moon)	28	180
Socializing		
Very frequently (more than 4x weekly)	15	70
Frequently (1–2x weekly)	42	26
Infrequently (1–2x monthly)	53	12
Intermittently (as needed to complete coursework/research)	47	20
Rarely (once in a blue moon)	178	207
Taking a break/passing time		
Very frequently (more than 4x weekly)	33	53
Frequently (1–2x weekly)	56	21
Infrequently (1–2x monthly)	64	23
Intermittently (as needed to complete coursework/research)	45	22
Rarely (once in a blue moon)	137	216
Other		
Very frequently (more than 4x weekly)	18	29
Frequently (1–2x weekly)	17	5

Task	Frequency of use for tasks	Frequency of COVID interruptions
Infrequently (1–2x monthly)	41	35
Intermittently (as needed to complete coursework/research)	24	10
Rarely (once in a blue moon)	235	256

Coded comments—Characteristics that contribute to how a user feels about the space in which they work.

#	Answer	%	Count
1	functionality	23.63%	224
2	comfort	18.14%	172
3	furnishing	16.35%	155
4	group	6.12%	58
5	amenities	5.59%	53
6	positive	5.27%	50
7	ambiance	3.59%	34
8	fenestration	3.59%	34
9	lighting	3.06%	29
10	private	3.06%	29
11	individual	2.64%	25
12	COVID	1.69%	16

#	Answer	%	Count
13	negative	1.05%	10
14	establishment	0.95%	9
15	component	0.84%	8
16	public	0.84%	8
17	aesthetics	0.74%	7
18	anti-establishment	0.53%	5
19	color	0.53%	5
20	building feature	0.42%	4
21	material	0.42%	4
22	Unknown	0.32%	3
23	architectural	0.21%	2
24	in-between spaces	0.21%	2
25	neutral	0.11%	1
26	no sentiment	0.11%	1
	Total	100%	948

Coded comments – Desired changes for the floor on which a user typically works

#	Answer	%	Count
1	functionality	15.25%	120
2	furnishings	14.36%	113

#	Answer	%	Count
3	amenities	10.29%	81
4	comfort	9.15%	72
5	anti-establishment	7.75%	61
6	negative	6.73%	53
7	establishment	4.19%	33
8	group	3.94%	31
9	positive	3.18%	25
10	neutral	2.92%	23
11	aesthetics	2.41%	19
12	component	2.29%	18
13	individual	2.03%	16
14	ambiance	1.91%	15
15	COVID	1.91%	15
16	mixed sentiments	1.78%	14
17	building feature	1.65%	13
18	private	1.40%	11
19	lighting	1.14%	9
20	fenestration	1.02%	8
21	in-between spaces	1.02%	8
22	material	0.76%	6

#	Answer	%	Count
23	public	0.76%	6
24	wayfinding	0.76%	6
25	Unknown	0.64%	5
26	color	0.38%	3
27	architectural	0.25%	2
28	no sentiment	0.13%	1
	Total	**100%**	**787**

Adjective Checklist (ACL)

The difference of the means were analyzed using a Paired Samples T-test and a Rank Signs test.

For the T-test, all of the differences between the Current ACL (CACL) and the Ideal ACL (IACL) were statistically significant EXCEPT for the difference between Informal and Formal.

This indicates that the absolute difference for adjectives like Sleepy/Arousing, Exciting/Gloomy and Crowded/Uncrowded, showed strong changes and these changes are likely the sentiments found in the population of students.

Mean difference between the Current ACL and the Ideal ACL

		Total					
		Current	**Ideal**			**Absolute Mean Diff**	**Sig**
1	Pleasant	1.78	1.28	Unpleasant	**5**	0.50	0.000

		Total					
		Current	Ideal			Absolute Mean Diff	Sig
1	Relaxing	2.22	1.69	Distressing	5	0.53	0.000
1	Sleepy	2.93	3.78	Arousing	5	-0.84	0.000
1	Exciting	2.88	2.18	Gloomy	5	0.71	0.000
1	Energetic	3.09	2.91	Calm	5	0.18	0.014
1	Quiet	2.48	2.07	Noisy	5	0.41	0.000
1	Playful	3.39	3.13	Serious	5	0.26	0.000
1	Social	2.93	2.55	Unsocial	5	0.38	0.000
1	Collaborative	2.90	2.38	Self-Reliant	5	0.52	0.000
1	Public	2.32	2.60	Private	5	-0.28	0.000
1	Informal	2.47	2.52	Formal	5	-0.05	0.417
1	Authentic	2.30	1.80	Superficial	5	0.50	0.000
1	Friendly	2.34	1.68	Unfriendly	5	0.66	0.000
1	Crowded	2.74	3.80	Uncrowded	5	-1.06	0.000

Differences between Undergraduates and Graduates appear in the means comparisons also, but the only statistically significant difference was for the adjectives, Authentic/Superficial. In this case, undergraduates desired even greater authenticity (natural light, plants, use of natural colors and wood) than graduate students.

Other items of notice include:

- Undergraduates (2.9) find floors currently more sleepy than graduates (3.1) but both want the same level of Ideal Arousing (3.8)
- Both undergraduates and graduates want a greater amount of exciting (2.2) in equal strengths
- Both undergraduates and graduates want a quieter space (2.1 and 1.9 respectively) but graduate students (2.7) find the current space to be noisier than do undergraduates (2.4)
- Undergraduates (2.7) find all floors currently more crowded than graduate students (3.0) but both rated the same level of Uncrowdedness desired (3.8).

Mean difference between the Current ACL and the Ideal ACL, by class status

		Total			
		CACL	**IACL**	**Δ**	
Grad	1: Pleasant	2.0	1.3	0.7	5: Unpleasant
Undergrad		1.7	1.3	0.5	
Grad	1: Relaxing	2.4	1.8	0.6	5: Distressing
Undergrad		2.2	1.7	0.5	
Grad	1: Sleepy	3.1	3.8	0.7	5: Arousing
Undergrad		2.9	3.8	0.9	
Grad	1: Exciting	2.8	2.2	0.6	5: Gloomy
Undergrad		2.9	2.2	0.7	
Grad	1: Energetic	2.9	2.8	0.1	5: Calm
Undergrad		3.1	2.9	0.2	

		Total			
		CACL	IACL	Δ	
Grad	1: Quiet	2.7	1.9	0.8	5: Noisy
Undergrad		2.4	2.1	0.3	
Grad	1: Playful	3.4	3.3	0.1	5: Serious
Undergrad		3.4	3.1	0.3	
Grad	1: Social	3.0	2.7	0.3	5: Unsocial
Undergrad		2.9	2.5	0.4	
Grad	1: Collaborative	2.8	2.3	0.6	5: Self-Reliant
Undergrad		2.9	2.4	0.5	
Grad	1: Public	2.1	2.5	0.3	5: Private
Undergrad		2.4	2.6	0.3	
Grad	1: Informal	2.5	2.6	0.3	5: Formal
Undergrad		2.5	2.5	0.0	
Grad	1: Authentic	2.4	2.0	0.4	5: Superficial
Undergrad		2.3	1.8	0.5	
Grad	1: Friendly	2.3	1.7	0.7	5: Unfriendly
Undergrad		2.3	1.7	0.6	
Grad	1: Crowded	3.0	3.8	0.9	5: Uncrowded
Undergrad		2.7	3.8	1.1	

By Floor and Class, Undergraduates rated:

The 4th and 5th floors are the Sleepiest but even desired the Basement to be more arousing.

The 5th floor is considered Gloomy, Serious, too Self-Reliant and Crowded.

The only floor the undergraduates considered to be less Crowded was the 4th floor, but it was also rated the most Unfriendly floor.

An ideal 4th floor would be more Social, Collaborative and Arousing.

The Entry level is the floor in which undergraduates moved more scores into the middle, desiring less crowded conditions but also more Quiet and Private.

For Undergraduates, the biggest changes from the Current Space to an Ideal Space would be that it become Arousing, Exciting, more Friendly and less Crowded.

For Graduate students, ratings indicated a desire for:

More Quiet in the Basement and on the 3rd floors

The 3rd floor would also be more Relaxing and more Private.

The 4th floor should be more Arousing, more Exciting, more Social, Collaborative and Friendly.

For graduate students, the first three floors all are too Crowded.

But overall, the 4th floor had the greatest difference in the means, indicating that this floor currently is the least pleasing for graduate students.

For Graduates, the strongest changes from the Current Space to an Ideal space would be more Quiet, less Crowded, more Friendly, Relaxing and Pleasant.

Endnotes

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