

## 1. Introduction

### Overview of the project

The Chicago History Museum (CHM) requests a \$350,000 Sustaining Cultural Heritage Collections implementation grant to replace our aging and obsolete primary chiller with units that can reliably sustain optimal preservation conditions for our collection. Chiller replacement and commissioning to assess impact will occur between October 2019 and September 2021. Based on a two-phase assessment beginning in 2015, CHM has developed an achievable strategy to address the environmental conditions in the areas of the Clark Street facility that are currently used to store, exhibit, and research the museum's collection. Chiller replacement has been identified as the clear priority in advancing the Museum's near- and long-term environmental goals and will play a critical role in making our mechanical systems more efficient and effective.

The proposed project is the first, foundational step in implementing the recommendations that have come out of the environmental and HVAC systems assessment at the Museum's primary, Clark Street facility. Phase I of this assessment was completed in September 2017. During this study, a multi-departmental team of CHM staff worked with consultants from the Image Permanence Institute (IPI) over an 18-month period to document, analyze, and provide optimization recommendations for five air handling units serving collections areas on the west side of the Clark Street building. Phase II of the assessment, funded by the NEH in 2017, is underway through September 2019 and targets the remaining collection storage, display, and work spaces on the east side of the building, served by three separate air handling units.

While his work is still in progress for Phase II, preservation consultant Jeremy Linden of Linden Preservation Services (LPS) has determined conclusively that our HVAC baseline equipment includes chillers and boilers that are aging and need to be replaced. They are costly to maintain and inefficient. The chillers are of immediate concern due to their inability to control relative humidity and the expensive repairs and refrigerant replacement required to get them online for the onset of warm weather. Our NEH planning grant included \$10,000 toward implementation of the Phase II assessment findings; we opted to engage Mark Nussbaum of Architectural Consulting Engineers (ACE) to develop plans and product specifications for upgrading the chiller plant. In January 2019, he completed his recommendations, which do not include alterations or renovations to the building (See Appendix 9).

As Phase II progresses, CHM staff are gaining a holistic understanding of the major mechanical systems that control collections storage, display, and workspaces at its primary facility. At this stage, we know that our system infrastructure cannot substantially meet the simultaneous demands of long-term collection preservation, artifact exhibition, and human comfort. We also know that gutting and rezoning our nearly 90-year-old Museum building is not feasible. The current study is pointing to near- and long-term solutions that are the most practical for maximizing the facility's various uses: a three-pronged approach that includes different storage solutions for the two major segments of the collection along with sustainable conditions for exhibition spaces that meet standards for accepting loaned objects (See section 3: Current Conditions and Preservation Challenges).

CHM's initial and ongoing efforts to improve environmental conditions at the Clark Street facility stem directly from the Museum's 2009-2015 strategic planning cycle, which identified *providing an optimal environment for preservation and access* as one of its three high-level, collection-related goals. The proposed project also supports institutional goals and activities identified in the Museum's current Master Plan, which prioritizes the upgrade of storage at Clark Street, to be followed by feasibility planning for usage and improvements at the Museum's storage facility in Broadview, IL. Implementation of recommendations from our formal studies, starting with replacing the chillers, will support the Museum's

2015-20 strategic agenda, which includes *modernizing collection storage and access* as a high institutional priority (see Appendix 1 for strategic plan summary).

The goals of the proposed implementation project are in keeping with CHM's Collection Management Policy guidelines (see Appendix 2 for relevant excerpts), which prioritize preventative care over treatment and identify "macro" solutions (e.g. environmental control) over "micro" solutions (e.g. item-level conservation). CHM's strategic priorities are also guided by a Preservation and Conservation Plan (see Appendix 3 for relevant excerpts) that is updated annually by CHM's Preservation Committee, who have identified the proposed purchase and installation of new chillers as a critical next step in providing sustainable and appropriate environmental control and conditions for the collections.

Sustainability is a shared goal of the Museum's overall preservation strategy and of the proposed implementation project. By purchasing new, efficient chillers, we will take an important step toward reducing energy consumption, and we will prevent hazardous refrigerant from leaking onto the grounds and into the atmosphere - a pressing problem with our current primary chiller. Our overall revamping of HVAC systems furthers CHM's ongoing, demonstrated commitment to become a more "green" museum (see Appendix 4 for overview of related initiatives). We ultimately hope to see a reduction in our annual utilities expenses—a savings in operating funds that will be reallocated to support other critical institutional needs, including ongoing collections management and preservation activities.

### **Organizational profile**

The Chicago History Museum (CHM) is the city's oldest cultural institution, founded in 1856 as the Chicago Historical Society to document the burgeoning frontier town and American history. In 1945, CHM narrowed its collecting scope to the Chicago metropolitan area, and over the past fifty years, CHM's collecting focus has evolved to build a more representative collection rooted in social and urban history. Renamed the Chicago History Museum in 2006 after a major renovation that reconfigured 90% of the Museum's public space, CHM collects, exhibits, and interprets documents, images, and artifacts related to the history of metropolitan Chicago and the United States. In 2012, CHM adopted its current mission: to share Chicago stories, serving as a hub of scholarship and learning, inspiration and civic engagement. This mission brings a dedication to better serve the diverse people living in the Chicago area. In 2016, CHM was honored to receive the prestigious IMLS National Medal for Museum and Library Service in recognition of its innovative and exceptional public service and outreach.

Nationally recognized for its collections, CHM specializes in the diverse and evolving history of Chicago and Illinois, as well as selected areas of American history. Built in 1932 and expanded in 1974 and 1988, CHM's Clark Street facility sits at the south end of Chicago's Lincoln Park and serves as the Museum's main location. The building contains 100,000 square feet of public space, including multiple galleries and event spaces, a Research Center open to the public free of charge, a café, museum store, and a newly renovated theater. The Clark Street facility also contains the Museum's main offices, conservation laboratories, exhibition fabrication workrooms, and storage space for collections in all of CHM's collection holding areas. The Museum's collections are also stored at two off-site locations, Harvard (an underground facility used to store less frequently used collections due to its location 70 miles from CHM's Clark Street facility) and Broadview (used to store oversized and "spill-over" collections).

The Chicago Historical Society (CHM's legal identity) is a 501(c)3 nonprofit organization, which is dependent on individual contributions, as well as membership dues and admission fees for much of its revenue. The operating budget for Fiscal Year 2019 (July 1, 2018-June 30, 2019) is \$9,094,178. A staff of

82 full-time and 14 part-time employees, plus over 150 volunteers and interns, support ongoing Museum operations. Annual attendance for calendar year 2018 was 281,612 with 59,285 K-12 students attending the Museum free of charge.

CHM's collections are used extensively as the focal point for a rich array of long-term and changing exhibitions that engage visitors with a wide variety of topics in Chicago history and American history. The collections also document, interpret, illuminate, and support a broad range of humanities scholarship and educational objectives through the Museum's print and online publications, public programs, teacher workshops and curriculum materials, student projects for History Fair, and other digital resources and applications that present historic collection materials within an interpretive and interactive context. Beyond CHM, scholars, peer organizations, artists, corporations, and individual researchers regularly draw from our collections for their research, exhibitions, and projects.

Archives and Manuscripts, Prints and Photographs, Architecture, and Library holdings are available for use by the public free of charge through the Museum's Research Center, and the Museum also makes its Costume, Decorative and Industrial Arts, and Paintings and Sculpture collections available by appointment to researchers engaged in substantive scholarly research. Discoverability and use of the collections is further extended through the Museum's online public access catalog and *Collections Online* portal, and via aggregated catalogs including WorldCat, the Chicago Collections Consortium's *Explore Chicago* portal, and others<sup>1</sup>. This level of access is exceptional among urban history museums. Use of the collection in support of CHM's mission is furthered by the Museum's extensive outgoing loans program and rights and reproductions services.

Collections development is guided by the Museum's Collection Management Policy<sup>2</sup>, which includes a "Scope of Collections" statement and outlines additional criteria to be applied when evaluating materials for acquisition or deaccessioning. CHM staff are also guided by a five-year Collection Development Plan (see Appendix 5) that aligns collecting goals with the Museum's purpose, mission, and future interpretive projects and identifies collecting priorities for the coming years.

## 2. Significance of Collection

CHM's commitment to humanities-based scholarship and educational programs builds on the Museum's unique collection of objects, images, and documents. Encompassing the rise of America from colonial possession to independent nation to divided country engulfed in civil war, as well as the evolution of one of nation's most significant cities from fur trading outpost to modern metropolis, the collection is an extremely rich and diverse body of evidence about all aspects of life in Chicago and selected facets of American history. The collection crosses ethnic, gender, political, racial, and class categories and provides a foundation of diverse materials to explore a broad range of humanities themes. This rich array of historical items gives CHM the advantage of interpreting the dynamic interplay of national and local trends and events and offers especially fertile opportunities for humanities-based inquiry and presentation. National collection materials related to the Revolutionary War, westward expansion, and industrialization, for example, help to explain Chicago's early development and rise as a city. Local historic resources related to the city's steel skeleton frame architecture, its mail order business, and electric blues music

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<sup>1</sup> See *ARCHIE* (<http://chsmedia.org:8081>), *Collections Online* (<http://digitalcollection.chicagohistory.org/cdm/>) and *Explore Chicago* (<http://explore.chicagocollections.org/>).

<sup>2</sup> See Appendix 2 for excerpts; full policy at [chicagohistory.org/wp-content/uploads/2016/10/Collections-Management-Policy\\_-2015-09-18-final-revision.pdf](http://chicagohistory.org/wp-content/uploads/2016/10/Collections-Management-Policy_-2015-09-18-final-revision.pdf).

likewise help to explain America's transformation from a rural nation to an urban society and culture. CHM's collection is thus a unique cultural resource underpinning research that results in exhibitions, publications, and educational programs that make historical interpretations accessible to a broad audience.

The collection is composed of more than 22 million items organized into the Research Collection (Archives and Manuscripts, Prints and Photographs, Architecture, and Library) and the Museum Collection (Costumes and Textiles, Decorative and Industrial Arts, and Painting and Sculpture). The Archives and Manuscripts (A&M) holdings include over 20,000 linear feet of personal papers and organizational and institutional records – correspondence, diaries, recorded interviews and oral histories, business and financial records, meeting minutes, membership lists, research notes, scrapbooks, scripts, sermons, and speeches. It constitutes one of the largest, richest, and most comprehensive bodies of manuscripts representing the evolution of an American city available in a single non-governmental repository. Notable collections include records from the Chicago Division of the Brotherhood of Sleeping Car Porters, 1925-69; Marshall Field & Company, 1862-2003; and the Young Men's Christian Association of Chicago, 1853-1978. The entire archive of Studs Terkel's interviews during his 45 years at WFMT radio is an incredibly rich documentation of everything from arts and culture to labor, race relations, and politics in the second half of the 20th century. These and other holdings illuminate our understanding of the Chicago area's social conditions, cultural products, neighborhood life, community-based history, civil rights, politics, labor unions, environmental concerns, and education and business history.

The Prints and Photographs (P&P) holdings contain over 5 million images and more than 4 million feet of moving images including: the newly acquired *Chicago Sun-Times* photography archive, mostly 1960s-2000; Hedrich Blessing architectural photography, 1928–2017; *Chicago Daily News* newspaper photo morgue, 1901–1933; works by prominent Chicago photographers including Rus Arnold, Gordon Coster, Stephen Deutch, Arthur Siegel, and Nathan Lerner; image collections of social welfare agencies, including the Association House, Chicago Commons, and Gads Hill Center settlement houses, the Infant Welfare Society, Jewish Community Centers, and the Visiting Nurse Association; prints by Currier and Ives, Raoul Varin, Kurz and Allison, and Edwin Whitefield; the Burr Tillstrom Collection of Kukla, Fran, and Ollie films; and original political cartoons by John McCutcheon.

CHM houses an extensive collection of architectural drawings, records, photographs, models, and building fragments that reflect metropolitan Chicago's built environment. Architectural drawings include Holabird & Roche / Holabird & Root, 1885–1980; Harry Weese Associates, 1952–78; and Graham, Anderson, Probst, and White (including its predecessor D. H. Burnham & Co.), 1895-1975. Seventy architectural models are also part of the collection, including a model of the Travel and Transportation Building designed by Holabird & Root for A Century of Progress International Exposition, 1933–34, as well as approximately 175 fragments from demolished or remodeled buildings, including a fragment from the Francisco Terrace Apartments designed by Frank Lloyd Wright, 1895, and a rosette from the Home Insurance Building designed by William LeBaron Jenney, 1885.

The Chicago History Museum's Library holdings include primary and secondary sources that document the city of Chicago, its people, its culture, and its industry. In addition to books, periodicals, and newspapers, these holdings include theatre programs, city directories and telephone books, maps and atlases (including fire insurance maps), sheet music, school yearbooks, newsletters, department store and manufacturers' catalogs, guidebooks, menus, building permits, and other published materials.

More than 50,000 items comprise the Museum's world-renowned Costume and Textiles (C&T) collection. Costume materials include work by distinguished American and international designers including Charles Fredrick Worth, Gabrielle Chanel, Charles James, Christian Dior, Pauline Trigère, Halston, Gianni Versace, and Christian Lacroix – as well as the dressmakers, milliners, retailers, and manufacturers working in Chicago. These collection items – both exceptional and commonplace – reflect the history of Chicago as an evolving metropolis and document the city and its inhabitants through the lens of fashion. The Museum's textile holdings include a significant representation of military flags, political banners, quilts and coverlets, samplers, rugs and other household textiles, and mid-20th century textiles designed by Chicago-based artists such as Ellenhank and Angelo Testa.

CHM's Decorative and Industrial Arts (DIA) holdings contains over 40,000 objects related to Chicago and American history – including furniture, metalwork, ceramics, glass, agricultural and military equipment, musical instruments, toys, vehicles, tools, and household and industrial objects. Chicago-made furniture, ceramics, glass, and metalwork represented in the collection include pieces by Louis Sullivan, Frank Lloyd Wright, and the New Bauhaus. Chicago's industrial heritage is documented by products made by American Flyer, Bell & Howell, Playskool, Schwinn, Sunbeam, Western Electric, and many other Chicago companies. In addition, the collection holds a rich array of artifacts from Fort Dearborn, the 1871 Fire, Chicago's two world's fairs, city politics, and materials representing the city's diverse neighborhoods and communities. American History materials include military and home front materials from the Revolutionary and Civil War periods and the Abraham Lincoln Collection, which contains many rare items from the 1860 campaign, his presidential carriage, and death bed.

The Museum's Paintings and Sculpture (P&S) holdings comprise approximately 3,400 paintings and works on paper and over 500 sculptures. The majority of the paintings and works on paper consist of portraits of national political and military figures from the late-18th to early-20th centuries as well as prominent Chicagoans of the mid-19th to mid-20th centuries. The collection is also strong in works depicting Chicago's frontier and urban landscapes, with scenes from early Chicago (1830-70), the World's Columbian Exposition (1893), A Century of Progress International Exposition (1933-34), the built environment of Chicago in the 1920s-1940s, and urban life in the 20th century. The sculpture holdings are primarily portrait busts and relief sculptures of prominent Chicagoans and national figures of the 19th century, along with smaller decorative sculptures, life and death masks, and memorial plaques. P&S holdings include approximately 140 works depicting Abraham Lincoln.

CHM is devoted to making its holdings and the city's history accessible to Chicago's diverse population through its exhibitions, educational programs, and publications. The collection has been a critical to the development of compelling humanities-based interpretations for CHM's permanent and special exhibitions. The permanent exhibition *Chicago: Crossroads of America* presents Chicago's history through the themes of innovation, democracy, community, conflict, and industrialization. *Facing Freedom*, co-created with high school students, presents American history through gripping stories of Americans fighting for their freedom and their civil and human rights. Temporary exhibitions that currently use the collection to illustrate humanities themes include *Amplified: Chicago Blues*, featuring selected images from Raeburn Flerlage's photographic archive of more than 40,000 images covering the Chicago blues scene in the 1950s-70s, and *Modern by Design: Chicago Streamlines America*, which tells the story of how Chicago shaped an American streamlined aesthetic through the design, manufacture and distribution of everyday consumer objects from the 1930s through post-World War II. Temporary exhibitions that have focused on diverse communities include *Catholic Chicago*, *Shalom Chicago*, *OUT in Chicago*, and *Access For All: Tom Olin's Photographs of the Disability Movement*. Educational programs for students and teachers use collection material extensively. CHM facilitates school field trips

for nearly 60,000 school children each year and produces more than 200 public and educational programs that engage students, teachers, adult visitors, children, and families through lectures, workshops, city tours, and behind-the-scene tours. One of the most popular student workshops, *Painted Memories: The Great Chicago Fire*, teaches the story of the fire through an analysis of Julia Lemos's painting of the event. CHM also offers extensive curricula using collection material on the Civil War, Abraham Lincoln, the city's world's fairs, as well as a host of other urban history-based topics. Other programs that present humanities themes include *OUT at CHM*, a lecture series on the history of the LGBT community, now in its 15th season. *The Moth Storyslam* public programs drew on the temporary exhibition *The Secret Lives of Objects*, and the *Civic Talks* series features curators and content experts discussing exhibition themes. *Chicago History* magazine, CHM's award-winning popular history publication, is heavily illustrated with CHM collection materials.

The Research Center provides free, public access to the Research Collections, which are used by a broad range of researchers. In 2018, approximately 6,800 patrons -- including 6-12 grade students, undergraduate college students, graduate students, academic scholars, journalists, genealogists, filmmakers, architects and preservationists, independent researchers, and members of the general public -- consulted the Research Center about various topics. CHM is also the home of the Chicago Metro History Fair, which engages 15,000 middle and high school students each year in inquiry-based projects that draw heavily from primary sources and other materials in our collection. In addition, nearly 400 clients licensed digital reproductions of CHM collection items for use in exhibitions, publications, documentary films and television broadcasts, and other uses. Recent publications using the Research Collections or reproducing CHM collection items underscore the value of these holdings for humanities-based scholarship: *1919, The Year of Racial Violence: How African Americans Fought Back* by David F. Krugler; *Urban Citizenship and American Democracy* edited by Amy Bridges and Michael Javen Fortner; *Chicago's Block Clubs: How Neighbors Shape the City* by Amanda I. Seligman; and *Slaughterhouse: Chicago's Union Stock Yard and the World It Made* by Dominic A. Pacyga.

CHM's future plans include extensive use of its collection in the development and presentation of humanities-rich content. In 2015, the Museum launched *Chicago 0,0*, a series of mobile applications designed to immerse users in virtual or augmented reality experiences of key places and events in Chicago history. Photos and audio/visual materials from our collection are superimposed alongside images from the same location today in order to ground viewers in the history all around them. Thus far, experiences include the *Eastland Disaster*, the Muse Award-winning *St. Valentine's Day Massacre, A Century of Progress*, and *The 1968 DNC Protests*. Our next digital history experience, funded by the NEH, will transport users to the 1893 World's Columbian Exposition, where the first Ferris Wheel captivated droves of fair-goers. Exhibitions on Chicago Muslims (2019), Chicago women in history (2020) and the Great Chicago Fire (2021) will be shaped around objects and oral histories from our holdings.

### **3. Current Conditions and Preservation Challenges**

The Phase I and ongoing Phase II environmental and HVAC analysis and optimization studies have been designed to address the challenge of maintaining consistent, preservation-quality temperature and relative humidity levels within a multi-purpose, historical building that has been built and modified over time -- a challenge that is exacerbated by the extremes of Chicago weather, which range from prolonged periods of intense cold (with temperatures below 10°F in each of the last four years) to hot and humid summers (with regular highs in the mid 80's).

CHM's Clark Street facility consists of buildings from three different eras: the original 1932 building, a 1974 addition to the west side of the original building, and a 1986 wrap-around addition that extended the structure even further west, along with a drop-in addition (also in 1986) that filled in the space between the 1932 and 1974 wings. A major renovation of the Clark Street facility was completed in 2005, at which time existing gallery, storage, and work areas were reconfigured and repurposed to expand and update the Museum's public space. Each new phase of the Clark Street building's expansion and renovation have added to the complexity of the HVAC systems, which are controlled by two independent digital building automation systems and a patchwork of pneumatic controls from the original HVAC system installations. However, throughout these recent expansions and renovations, the heart of the building's mechanical plant – the chillers and boilers that provide cooling, dehumidification, and heating capacity to the spaces – has remained largely unchanged since the early 1970s.

Through prior work with the Image Permanence Institute, and ongoing work with Linden Preservation Services (LPS), we have learned that the existing mechanical systems are a case study in the unintended consequences of the organic growth and repurposing of the facility's spaces to adapt to changing operational needs. The lack of a holistic approach for building and mechanical operations has resulted in a number of significant issues – including mixed-use air handling zones, balancing issues with supply and return air, large areas conditioned by multiple AHUs, and a lack of alignment between original system design intentions and current environmental requirements for long-term preservation. Operational and sustainability challenges resulting from the systems' current configuration are compounded by wear and tear and aging of the systems and a lack of "as-built" documentation and design specifications. Challenges also include increasing operating costs and the small size of the staff responsible for maintaining the Museum's complex systems (day-to-day responsibility is shared by the Director of Properties and two building maintenance technicians).

Environmental studies to-date have found that the overall temperature control throughout the Clark Street building tends to be reasonably good, though less than ideal, at  $\sim 70 \pm 8^\circ \text{F}$ . However, summer moisture control throughout the building is particularly problematic, with typical dew point conditions ranging between  $51\text{-}56^\circ \text{F}$ , and some systems and spaces (such as the fourth-floor object storage and spaces) ranging as high as  $60\text{-}64^\circ \text{F}$ . The result is that, while RH conditions can generally be kept in check with warmer temperatures – commonly ranging above  $75^\circ \text{F}$  each day – collections are subjected to a heightened risk of chemical damage (natural aging). At the current dew point conditions, any attempt to lower summer temperatures to slow the rate of chemical decay would result in RH conditions regularly above 60% RH, with some spaces peaking to near mold-growth conditions.

Assessment up to and including the current Planning phase has repeatedly identified baseline capacity and reliability of the building chiller as a limiting factor in the ability to improve preservation environments for the collections. During the spring of 2018, the primary chiller, a York/Chrysler hybrid centrifugal unit dating to the 1970s that produces the chilled water for cooling/dehumidification at each of the individual AHUs in the building, was unavailable due to a leak at the evaporator coil and low levels of glycol in the unit. Though sufficient repairs (with total costs exceeding \$10,000) were completed to allow operation during the summer months, the chiller had to be taken offline again at the end of the season. It is expected that the costs of repair and glycol replacement to ensure operation for cooling and limited dehumidification during the summer of 2019 will exceed \$75,000. New seals are required to fix significant leaks, and the trichlorofluoromethane (R-11) refrigerant that needs to be replaced is very expensive to procure. It has been out of production in the US since 1996 due to its ozone depletion potential of 1.0, the maximum potential among chlorocarbons. Purchasing recovered and reconditioned R-11 in the quantity we require is estimated to be at least \$16,000 this year. These measures are band-aid

fixes that will need to be put in place for the coming summer. Without this emergency investment, chilled water temperatures will go up, and dew points and relative humidities throughout the building will rise to unsafe levels for both exhibition and storage. However, we cannot sustain this level of investment in a failing machine year after year.

That 40-plus year-old chiller is the sole unit that provides chilled water for summer dew point control and dehumidification capacity. Recent data suggests that current chilled water temperatures only average 47°F in the summer months, which is not cold enough to lower space dew point conditions beyond the current range. The recent study performed by ACE as part of CHM's current NEH Planning grant estimates that the total required cooling capacity of the Clark Street building is roughly 678 tons (based on the number and size of the cooling coils in the building). The original design capacity of the York/Chrysler chiller was only 490 tons. It is highly unlikely that, given its age and ongoing maintenance requirements, it is performing at this full capacity. The result is that, even before age and maintenance are considered, cooling capacity in the building is at least 28% undersized, and likely more.

After careful consideration during the current Planning study, CHM has decided to adopt a new three-pronged strategic preservation strategy proposed by LPS:

- The Clark Street building, as the primary public destination, will focus on the creation of safe environmental conditions for occupied collections zones, including exhibition and collections workspaces, throughout the building. These environments will typically provide human-comfort temperatures and RH control between 30-55% (deemed safe for most collections based on research from the Museum Conservation Institute at the Smithsonian Institution, the Canadian Conservation Institute, and the Image Permanence Institute, among others), with specific areas providing tighter RH control as required for exhibition loans;
- The East Basement of the Clark Street building will undergo strategic renovation to provide appropriate long-term preservation conditions for the research collections of CHM, which will continue to be accessible to the public at the Clark Street research facilities;
- Long-term preservation of the museum collections will be phased to one of CHM's offsite storage facilities, where renovations to achieve improved preservation environments are more achievable than at the existing Clark Street storage facilities.

This approach allows CHM to work gracefully with the strengths of its various spaces rather than pursue the unrealistic renovation that would be required to rezone the Clark Street facility to achieve environmental conditions appropriate for both public programming and the long-term preservation of the museum collection. It provides a strategic path that not only better positions CHM to fulfill its collection stewardship duties as outlined in the Museum's Collection Management Policy, but also has the concrete effect of more sustainable future operation, where preservation environments match the intended capabilities of the buildings, rather than using significant amounts of energy to create long-term preservation environments in spaces that were not designed to that purpose.

This proposed implementation project focuses on the redesign and replacement of the existing primary chiller as the first step in establishing holistic control over the Clark Street facility's preservation environments. By improving dehumidification and cooling performance, preservation conditions throughout the building will be improved, both for exhibition spaces as well as existing storage environments. In addition, even though the total cooling capacity will be increased over the current operation, improvements in overall equipment efficiency (replacing a 40-plus year-old chiller with modern equipment) and the eventual upgrading of the cooling tower, will likely result in the reduction of long-term energy and operational costs. The chiller replacement, combined with future planned upgrades



of the building boilers and the replacement of the existing building automation systems with a single, modern platform, will provide the underlying capacity to apply the optimization strategies recommended by both IPI and LPS.

As noted, this project supports, and will be performed in conjunction with, the Museum's Collection Management Policy. The policy, which guides all institutional decisions regarding collections care and management, recognizes that preventative care is the most effective and economical means of ensuring the collection's long-term preservation. The policy further recognizes that group-level collections care is generally a more efficient use of resources than item-level intervention. Controlling the air quality, temperature, and humidity levels in CHM's collection storage, display, and work areas is therefore a key component of CHM's high-level preservation strategy.

In support of this preventative preservation approach, CHM's Properties and Collections staff work together to monitor and record environmental conditions on an ongoing basis. Over 40 HOBO data loggers have been deployed at the Clark Street facility, with additional loggers at the Museum's off-site storage locations. Environmental data is downloaded by Collection Management staff on a bi-monthly basis and uploaded to eClimateNotebook (IPI's web-based environmental data analysis software, purchased by CHM in 2015), where it is accessible to Collections and Properties staff who review the data periodically for changes or trends. Properties staff have attempted to maintain and adjust environmental control systems to achieve recommended conditions within existing system limitations.

Where practical, archival storage boxes and enclosed display cases have been used by CHM staff to buffer materials from extreme fluctuations in temperature and humidity; however, this strategy is not an option for larger materials and has limited effectiveness during periods of sustained environmental extremes. Other preventative preservation measures in place at CHM include setting reasonable limits on light levels and exposure and protecting collections from harmful UV rays. Conservation staff advise Collections and Exhibitions staff on collection storage and/or display and mounting solutions that minimize physical stress and exposure to harmful materials. Collection materials are maintained in secure storage, display, and/or work spaces with limited staff access, and only designated, trained staff are permitted to handle collections. CHM's Collection Managers work with Properties staff to maintain and implement a proactive, integrated pest management program. CHM's collections are protected by a centrally monitored fire detection and alarm system and dry pipe sprinkler system; a security system including CCTV cameras, motion detectors, and perimeter system; and stationary and patrolling guards. CHM also maintains a written disaster preparedness and response plan (identified as an exemplar by the American Alliance of Museums) that sets forth procedures, roles, and responsibilities for emergency prevention and response, including collections recovery.

#### **4. History of the Project**

CHM purchased its first HOBO data loggers in 2008 to improve environmental monitoring at its off-site storage locations. In 2010, CHM purchased additional data loggers to allow for the spot checking of environmental conditions at the Clark Street facility, which staff suspected were ranging beyond the system's set points (essentially 70°F and 50% RH). Over the course of the next two years, the HOBOS were moved from location to location on an as-needed basis, yielding snapshots of environmental data rather than a full environmental picture. However, as a result of the supplementary monitoring, it became apparent that prior temperature and humidity reporting had relied on uncalibrated HVAC system controls that were painting an inaccurate picture of the facility's environmental conditions. With an increasing need to know the facility's true environmental conditions, CHM purchased additional HOBO data loggers

in 2013 and by July 2014 had implemented an extensive environmental monitoring program in the Museum's on- and off-site collection storage and display areas. The results of this monitoring confirmed that the existing system was functioning far less effectively than previously believed.

In the fall of 2015, CHM contracted with IPI to conduct a mechanical system and environmental assessment of the four AHUs serving the museum's temporary exhibition galleries at the Clark Street facility in order to determine the ability of the existing system to meet certain environmental conditions required for planned loans to the institution – and to serve as a case study to guide the institution's next steps in planning to improve environmental conditions. Working with a multi-disciplinary team of CHM staff, IPI consultant Jeremy Linden conducted a three-day site visit that included walkthroughs of the exhibition galleries and their associated AHUs, review and analysis of existing environmental data and system drawings, meetings and discussions with key CHM stakeholders, and discussion of future plans for the temporary galleries as well as larger preservation, sustainability, and programmatic goals. Results of the study documented in the October 2015 assessment report (see Appendix 6) were eye-opening – revealing the system's complexity and inefficiency – and convinced all of the key CHM stakeholders who participated in the study of the need for a more comprehensive assessment of the Museum's mechanical systems and preservation priorities in order to develop a more holistic, sustainable, and informed plan for moving forward.

Based on IPI's preliminary, 2015 recommendations, CHM accomplished the following:

- Purchased and deployed 5 additional data loggers to fine tune monitoring of collection areas;
- Purchased and implemented eClimateNotebook, including uploading legacy data;
- Created preliminary zone maps to document which AHUs control what areas;
- Developed a plan to conduct an in-depth, building-wide environmental and HVAC study;
- Initiated Phase I of this plan by contracting with IPI to conduct an 18-month environmental analysis and system optimization study of the west wing of the Clark Street facility (served by AHUs 1, 2, 3, 7, and 8).

The Phase I study, launched in the spring of 2016, was completed in the fall of 2017, allowing for a seamless transition into the Phase II Planning grant supported by NEH. CHM contracted with LPS to continue this project, focusing on the east wing of the building (served by AHUs 4, 5, and 6).

The Phase I and Phase II (in process, due to be complete in fall 2019) planning studies have found similar issues in both parts of the building – while aspects of the mechanical systems had been updated at various junctures, including the addition of air handlers with the various additions and renovations, and an HVAC renovation in the early 2000s that implemented downstream reheats and humidification in a number of locations – the heart of the building's systems, the chiller and boiler plants, had remained largely unchanged since the 1970s. The aging and maintenance issues of the chiller, in particular, limit the dehumidification capacity in the building, which is further exacerbated by insufficient vapor barriers in much of the building envelope. These considerations, coupled with air-handling zones where a single unit is sometimes trying to provide an appropriate environment for long-term preservation, human-comfort exhibition spaces, and non-collections public areas all at the same time, limit the holistic improvement that can be achieved without significant space and mechanical renovations.

Through discussions among the project team, and at the recommendation of LPS during the Phase II study, CHM has decided to adopt the three-pronged approach to strategic preservation planning described above. This chiller replacement project, for which we seek NEH support, is the first step in moving toward the goal of improved sustainable preservation environments throughout the Clark Street facility. To this end, CHM used the implementation money available as part of the Planning grant to engage Mark

Nussbaum of ACE to assess, specify, and design a replacement chiller system that would support the sustainability and preservation needs for occupied collections environments – both exhibitions and collections workspaces. That study and design (see Appendix 9), once realized, will make it possible to provide appropriate dehumidification for exhibition and collections workspaces throughout the building (see Appendix 8 for a floorplan), opening up new opportunities for incoming loans to support CHM’s long-standing tradition of high quality, collections-based exhibitions, scholarship, and public programs. In addition, the updated equipment, when tied into a new building management system – which, per LPS recommendations, is CHM’s next capital investment priority after the chiller replacement – will allow for significantly better energy management. This aligns with CHM’s existing sustainability initiatives and lays the groundwork for improved energy operation at each AHU in the building.

CHM has now entered a new cycle of long-range capital planning and development. In addition to determining the future strategy for environmental control in the main Clark Street facility, the Museum is committed to the renovation of the East Basement for long-term preservation of the research collections, and to investment in our offsite storage facilities for long-term preservation of the museum collections. In the near-term, as part of the Phase II Planning study and the chiller replacement implementation project, CHM will continue to work with LPS to identify and test low-cost measures to improve environmental conditions and systems operation, develop preservation and capital investment priorities and strategies, and analyze, assess, and implement optimized operation for the new chiller installation and the operation of the downstream AHUs in the building.

## **5. Methods and Standards**

CHM will use a commissioning process in conjunction with the construction/installation of the new chiller to provide oversight and assessment for the overall project. In addition to initial schematic design review prior to construction, two phases of commissioning will occur. The initial step will be standard mechanical commissioning, performed by ACE, to review and ensure that all design criteria and requirements for initial controls programming have been satisfactorily completed and are functioning as intended immediately after installation. Reviews will occur at approximately 50%, 90%, and 100% completion. ACE will be available to CHM throughout the construction process to help resolve any issues that come up in the course of installation.

LPS will provide preservation commissioning services throughout the chiller installation project. This will include initial design review, availability during the construction phase to inform any decisions that may impact final operation and control, review of initial controls programming, and a detailed assessment phase following construction and mechanical commissioning. Once construction, initial controls programming, and mechanical commissioning are complete, CHM and LPS will conduct a longitudinal study of up to 18 months to analyze, assess, and implement any controls adjustments for the operation of the new chiller over two cycles of seasonal changes in exterior conditions. The overall goal of the process is both to document the operation and performance of the building systems with the new chiller, as well as to identify any new opportunities for optimization of operation based on improved dehumidification performance. To allow for collection and analysis of operational data, LPS will install environmental data loggers in a selection of air handling units that serve significant exhibit spaces (such as AHUs 1, 3, 5, and 8) and are a mix of equipment ages. Measuring and analyzing the temperature and humidity of return air, blended air, and conditioned air (after the cooling coil and humidification units) will enable LPS to determine whether and where adjustments may need to be made in overall chiller operation, especially in transition from summer/dehumidification operation, which will be managed by the new equipment, to winter operation, which will be managed by the existing multi-stack chiller system.

The environmental goal for operation once construction is complete is to maintain summer dew point conditions in the 48°F range throughout the collections spaces in the building. This level of summer dehumidification control would allow CHM to meet summer loan agreement requirements of 70-72°F at 45% RH, while also allowing sub-zones within the building to be managed to slightly cooler temperatures for improved long-term preservation while reducing energy expenditure at downstream reheat coils.

Environmental and system data from the CHM and LPS data loggers will be uploaded to eClimateNotebook on a bi-monthly basis by CHM's Properties staff to allow for remote access by all of the members of the project team. LPS will also analyze environmental data from collection storage and display locations throughout the building, as well as data from the existing building management system, and provide specialized data analysis for performance of the new chillers relative to the preservation needs for specific collection types. Recommendations will be made as necessary for improving the preservation quality of the storage, display, and work environments. Assessment of conditions will include an evaluation of the risk of chemical and mechanical damage, mold growth, and corrosion based on preservation metrics developed by IPI and integrated into the eClimateNotebook system, and will inform suggestions for improving the preservation quality of the storage environment based on the specific characteristics of CHM's collections.

Working with a team of CHM staff, LPS will provide suggestions for optimizing the existing system performance with the new chiller in place, and will identify preservation improvement and energy-savings opportunities, including the use of seasonal temperature and humidity set points. Implementation of LPS recommendations will begin following the first summer season of data collections and analysis and continue throughout the project to allow for review, assessment, and adjustment over time based on measured outcomes. Outcomes of these activities will be assessed through a combination of CHM's existing environmental monitoring system, as well as by tracking and recording changes in energy consumption and utilities costs (See Appendices 10, 11, and 12 for benchmarking data.).

Final project reporting will include the results of the final design, construction, and commissioning processes, the findings of the preservation commissioning assessment and any optimization improvements made, as well as final measurable impact on the overall collections environments in the building. The operation of the new chiller system will be considered in light of CHM's strategic approach for capital investment into preservation environments to determine whether any aspects or stages must be reconsidered based on findings from this process. Ongoing communication with CHM staff and LPS will enable these suggestions to reflect CHM's preservation goals, financial resources, and capacity to operate and maintain the systems over the long-term.

## 6. Work plan

Ongoing	CHM to monitor collection storage, display, and work rooms using existing data loggers and upload to eClimateNotebook bi-monthly.
October-December 2019	Final design review prior to installation. ACE to provide CHM and LPS with final design documentation; Project Team to review existing design in advance of final design discussions. Final selection of installation contractor.
January-March 2020	Removal of existing chiller, preparation of installation area, installation of new chiller unit. ACE to review installation process at 50%, 90%, and 100% completion to ensure adherence to the schematic design.

April 2020	Controls programming by Precision Controls (See Appendix 17), tie-in, and final mechanical commissioning of new chiller.
Spring 2020	<b>Visit One:</b> LPS to meet with CHM project team and other appropriate Museum staff to review design and construction, and establish assessment goals. Walk through of chiller and in-scope collection areas, and place LPS data loggers within the selected mechanical systems; CHM Director of Properties to begin bi-monthly upload of LPS data logger data to eClimateNotebook.
Spring 2020 – Spring 2021	LPS to review and analyze environmental and system data; LPS and CHM project team to touch base as necessary to discuss environmental conditions and system operation.
Fall 2020	<b>Visit Two:</b> LPS to meet with CHM project team to review and analyze environmental and system data, track down anomalies and update system documentation, evaluate the summer/dehumidification performance associated with the new chiller, and make preliminary recommendations for operational changes to improve environmental conditions and potentially reduce energy consumption. LPS will also meet with the CHM project team and other Museum staff to begin to identify and prioritize steps for immediate implementation.
Fall 2020 – Spring 2021	CHM to implement preliminary LPS recommendations; LPS and CHM team to continue to monitor and analyze environmental and system data, monitor and analyze energy usage data, touch base as necessary to discuss environmental conditions and system operation, and adjust recommendations based on ongoing analysis of chiller performance and impact of implemented recommendations.
Late Summer 2021	<b>Visit Three:</b> LPS to meet with project team to review and analyze environmental and system data as a result of the new chiller installation, as well as energy usage information to review the effect of the new equipment and/or any implemented recommendations; LPS to identify any additional recommendations for improvement and remove LPS data loggers placed within the system. LPS to present summary of findings and recommendations to CHM project team and other in-house stakeholders.
Late Summer 2021	CHM to complete any additional remaining implementation recommendations to take place within the scope of the grant; CHM project team to continue to monitor environmental conditions and benchmark energy usage to determine effectiveness of the chiller installation. LPS to prepare a final, written detailing the preservation commissioning process, any optimization adjustments made for preservation or energy savings, and final measurable impact of the chiller installation on the overall collections environments and energy usage in the building; LPS will also identify and prioritize suggestions for strategic investment in control of preservation environments moving forward.
September 2021	LPS to deliver final report to CHM project team.
October - December 2021	CHM to prepare and submit final report and white paper to the NEH.

## 7. Project Team

The proposed implementation project will be carried out by a core, interdisciplinary team of CHM staff and consultants, with support from a larger group of key institutional stakeholders (See Appendix 13 for project team résumés.). The project team has been actively engaged in Phases I and II of the assessment and has developed a deep understanding of the preservation conditions, goals, and strategies.

**The Principal Investigators** for the project will be **John Yelen, Director of Properties**, and **Britta Arendt, Senior Collection Manager**, who will act as liaisons between CHM and the project consultants and vendors. They will attend all meetings and walk-throughs during ACE and LPS site visits, set and monitor assessment goals, and serve as lead authors of the project white paper and interim and final reports. The Director of Properties will serve as project manager, coordinating all team meetings and conference calls, and ensuring the timely implementation of the work plan. He will be responsible for providing LPS with all existing system documentation; monitoring and uploading system data from LPS's data loggers; and implementing any operational, maintenance, and/or system repairs/upgrades.

Yelen has 19 years of experience as a facilities manager, nine at CHM. He spearheads CHM's environmental sustainability initiatives as Chair of the Museum's "Green Team," supervises the Building Engineer and Security staff; bears primary responsibility for identifying, prioritizing, and implementing all major system upgrades and repairs; and is an active member of the International Association of Museum Facility Administrators and regular contributor to its quarterly publication. Arendt has nearly 14 years of experience in museum collections and was formally trained in museum studies. She coordinates all preventative conservation efforts at CHM's facilities, including monitoring environmental conditions and integrated pest management. She is a guest lecturer in the museum studies program at Aurora University and serves on the Registrars Committee for the American Alliance of Museums.

**The Core Team** will work collaboratively to support the completion of all project deliverables. In addition to Yelen and Arendt, the core team will include: **Mark Nussbaum of Architectural Consulting Engineers**, who will serve as the mechanical commissioning agent for the installation of the chillers; **Jeremy Linden of Linden Preservation Services**, who will provide preservation commissioning; **Conservator Holly Lundberg**, who will bring her preservation expertise to the project; **Costume Collection Manager Jessica Pushor**, who will monitor and upload environmental data throughout the project; and **Vice President for Interpretation and Education John Russick**, who will represent CHM's senior administration and participate in strategic decision-making to ensure the project's success and help prioritize and shape recommended next steps.

Mark Nussbaum is the Principal at Architectural Consulting Engineers and has over thirty years of experience in the building and facility design field. His duties include the design of: heating, ventilating, and air conditioning systems; plumbing and drainage systems; energy management systems; fire protection systems; and electrical power, lighting layout and design. He has broad design experience ranging from feasibility studies, simple renovation size projects, up to full new construction projects.

Jeremy Linden is the Owner/Principal at Linden Preservation Services and previously worked as the Senior Preservation Environment Specialist at the Image Permanence Institute. He provides expert education and consulting services to cultural heritage and allied organizations in the areas of materials preservation, sustainable preservation environments, optimal operation of mechanical systems and buildings, and strategic planning for collections preservation infrastructure.

Holly Lundberg has worked as a conservator for 25 years and is also Chair of the Museum's Preservation Committee. Jessica Pushor brings over 8 years of collection management experience. She received formal training in museum studies and has played an active role in monitoring CHM's environmental conditions using eClimateNotebook. John Russick oversees the Museum's Interpretation and Education Division, including curatorial affairs, exhibitions, and programming for learners of all ages. With over 20 years at CHM, he will bring to the project an extensive knowledge of CHM's collections and institutional history, as well as his authority and experience as a senior administrator and historian.

**Project Support** will be provided by CHM's Registrar, Senior Archivist, Director of Curatorial Affairs, Director of Exhibitions, and Senior Designer, who will be included in LPS walk-throughs of collection spaces, galleries, and mechanical rooms; provide requested information on existing and anticipated use of the collection areas to be evaluated; and participate in LPS's reporting-out and Q&A meetings at the conclusion of each on-site visit.

**Key Additional Stakeholders** include CHM's Vice President of Finance and the Senior Manager of Institutional Advancement, who will also attend LPS's reporting-out meetings. They will also be available throughout the project to meet with the project's Core Team.

## 8. Project Result and Dissemination

The final project deliverable to be provided by LPS will be a written report covering: decisions made during the final design, construction, and controls programming processes; final system and environmental capabilities after installation of the new chiller; mechanical and preservation analysis from the preservation commissioning process; overview of any testing performed; options for future improvements; and recommendations. ACE will provide written feedback during the design phase of the chiller installation at various stages of completion, a punch list at the conclusion of construction to document any specs still needing to be met by the contractor, and a final walk-through with CHM staff to ensure punch list items have been completed (See Appendices 15 and 16 for LPS and ACE proposals).

Anticipated project outcomes include: 1) Improved control of temperature and relative humidity at CHM's Clark Street facility, contributing to sustainable preservation environments; 2) Improved system performance and reduced maintenance costs with the new chillers; 3) Increased institutional understanding of the preservation conditions in the building and the identified pathway to long-term environmental goals; and 4) Advancement of CHM's green initiatives through cleaner, more energy efficient equipment. Measurable improvements in the environment will have the short-term benefit of allowing CHM to resume incoming loans to support the Museum's programmatic goals. More significantly, these improvements will support the long-term preservation of the Museum's valuable collections for future generations. Any resulting savings in operating cost through reduced energy consumption will redirect funds towards other, mission-based activities, including collections care.

CHM team members will report out on this implementation project to the Museum's members, president, and board of trustees. In addition to submitting a white paper and grant report to the NEH at the conclusion of the proposed project, team members will disseminate lessons learned through blog posts and reports to the Chicago Park District's Museums in the Park organization<sup>3</sup> and other consortia. Team members will also propose a session for presentation at one or more professional conferences, including the American Association of State and Local History.

<sup>3</sup> See Museums in the Park website and list of member organizations at <http://museumsinthepark.org/>.