

TEN YEARS OF SCULPTURE AND MONUMENT CONSERVATION ON THE MINNESOTA STATE CAPITOL MALL

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“Art is, among other things, both the terrain of, and often a weapon in, the culture wars that course through societies. This is, of course, especially true of public art- the art chosen self-consciously by public institutions to symbolize the public order and to inculcate in its viewers appropriate attitudes toward that order. Although occasional museum curators may devote themselves to “art for art’s sake”, I think it fair to say that this concept makes no sense to anyone concerned with the art that is found in those spaces that are most truly “public” in a political sense, such as the space surrounding capitol buildings, city halls, national cemeteries, and the like.”

-(Levinson 1998)

I. Introduction

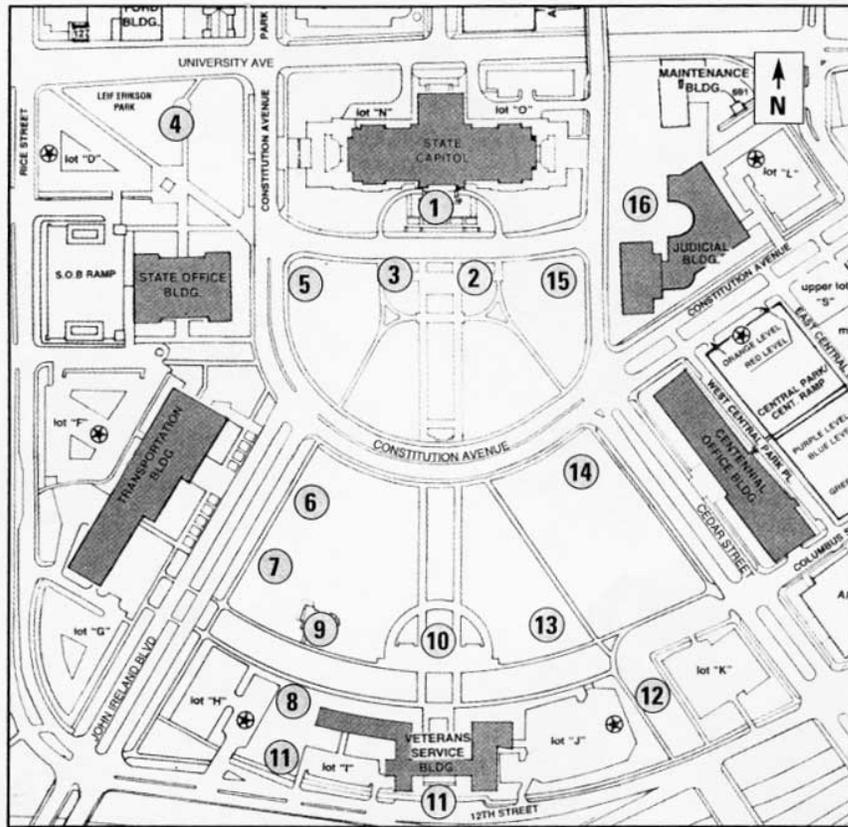


This paper focuses on the organization, management, and methodologies developed over the course of a decade to deal with a diverse set of sculptures and monuments in a harsh Upper Midwestern climate. The Minnesota Historical Society (MHS) has had statutory and fiduciary responsibility for the sculpture and monuments on the 36 acre State Capitol Mall since the founding of the MHS in 1849 (See Fig. 1). It has only been since the late 1980’s that the various administrative agencies and entities in the state government have fully recognized and enabled this role by including the MHS as a full partner and advisor in the long-term care of

these monuments.

As a by-product of managing and conserving the monuments in partnership with the Capitol Area Architectural Planning Board and the State Department of Administration Architect’s Office, the author and other MHS conservators have participated in the conservation and maintenance of nine sculptures and monuments (Fig. 2). During this time, the *de facto* State Capitol Mall Sculpture Conservation Program was created. Products of this program include an emergency response plan, a treatment tracking document, a research paper, and two AIC presentations. The goal of this paper is to describe the evolution and structure of the conservation program, and to detail three applied research projects that have resulted from it.

A monument may consist of a traditional bronze portrait figure (See Fig. 3), a fountain (See Fig. 4) or a complex sculptural plaza assemblage (See Fig. 5). As a by-product of these projects,



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| 1. Quadriga – 1906 | 11. Veterans Services Building
Memorials |
| 2. Knute Nelson – 1928 | 12. The Peace Officers
Memorial – 1995 |
| 3. John Johnson – 1912 | 13. Korean War Veterans
Memorial – 1998 |
| 4. Leif Erikson – 1949 | 14. The Women’s Suffrage
Memorial Garden – 1999 |
| 5. Floyd B. Olson – 1958 | 15. Christopher Columbus – 1931 |
| 6. Charles Lindbergh – 1985 | 16. Judicial Plaza – 1995 |
| 7. Roy Wilkins Memorial – 1995 | |
| 8. <i>Monument to the Living</i> – 1982 | |
| 9. Minnesota Vietnam
Memorial – 1992 | |
| 10. War Memorial Plaques –
Court of Honor | |

Figure 1.



Figure 3.

three different sculpture conservation research projects with two different contracting conservation firms were completed between 1992 and 2002. These projects have also resulted in applied research in metal cleaning, coating testing, and gilding techniques and methods.

II. Roles and Responsibilities

The technical aspects of the projects and program were done in the context of working within a large, complex bureaucracy. Conservation of the Mall monuments is a responsibility of the Minnesota Historical Society. There are, however, several other state agencies with oversight and fiduciary responsibilities. Problems and solutions in communications, coordination,

and control were encountered and overcome. The MHS/Mall situation is possibly a unique one in that outdoor sculpture conservators usually are contracted to work on one monument at a time. In general, the staff of the contracting agency has no knowledge or experience with the technical aspects of art or sculpture conservation, nor do they contact anyone for help in developing the request for the proposals. As the program has progressed over time, we are now responsible for conserving and maintaining fourteen outdoor monument assemblages. Although it's beyond the scope of this discussion to go into details, suffice it to say that state politics and money allocations from the State legislature play a central role in determining what can get conserved and when. The



Figure 4.

coordination of the MHS with other agencies responsible for the physical plant of the Mall results in a positive pooling of resources and relevant expertise. The use of outside contractors for specific projects augments the staff of the MHS conservation department. Within the MHS, the Site Manager for the State Capitol acts as the general coordinator for each project. The Senior Objects Conservator writes and develops the technical specifications for the RFP documents, and the MHS Contracting Officer develops the legal parts of the contracts. Occasionally, the State Historical Architect is brought in for advice on the technical aspects of project development. Once a vendor



Figure 5.

is chosen, the Site Manager, Senior Conservator, and MHS Art Curator meet and work with the vendor on-site. The Art Curator is involved in decisions on repairs, coloration, and other issues that may affect the aesthetics of the sculpture or monument. The MHS Conservation Department Head may also be involved in any given project as an overall conservation advisor. Once a project commences, the State Capitol Historic Site Manager and the Senior Objects Conservator act as coordinators between the Vendor and Plant Management staff, insuring that the Vendor has the equipment and access to on-site utilities that the State agreed to provide.

The Vendor may train State Plant Management staff in sculpture maintenance procedures if that was part of the contract. Once the sculpture is conserved, the Senior Objects Conservator works with Plant Management staff on routine maintenance procedures on an annual basis.

III. Actual Projects

The first project of the State Capitol Mall Sculpture Conservation Program was in 1991 with the donation of money from the Italian-American Society to the MHS for the conservation and preservation of the Christopher Columbus statue located on the northeast side of the Mall (Fig. 6). Sculpted of bronze by Charles Brioschi and dedicated in 1932, the statue had never been properly maintained. It had weathered and corroded from its original “Roman bronze” patination to a dull, mottled greenish-tan.



The Italian-American Society requested that the treatment be completed in time for the 500th Columbus Day anniversary celebration in October 1992. The project was submitted for bids from contract conservation firms, and

Fine Objects Conservation Inc. (FOC, Inc.) was awarded the bid. Based on her work on the Garfield Memorial at the US Capitol, Linda Merck-Gould, president of FOC, Inc., proposed that the bronze be cleaned with medium pressure water (1000-1400 psi), followed by an application of benzotriazole, chemical patination, and coating with Inctalac and carnauba wax. Ms. Merck-Gould devised an on-site testing project that would take place prior to the actual treatment of the sculpture in order to finalize the treatment specifications. The exact details and results of the testing done on the Columbus sculpture in coordination with the MHS conservation department were published in a paper presented by Ms. Merck-Gould at the 1993 ICOM Committee for Conservation Conference (Merck-Gould 1993) (Figure 7).

The main advantages of the water pressure method over other blast methods are as follows:

- patina application can be done with greater fineness and results in a more subtle patina (See Fig.8).
- The bronze surface does not undergo any deformation, based on tests published by Andrew Lins in 1989 using 750 psi. Even “softer” abrasives such as walnut shells and corn cobs cause loss of surface metal.
- The health hazard from inhalation of dust to the operator and passersby is eliminated.
- There is no expended abrasive to clean up around the site. This is especially a concern on the heavily trafficked Mall.
- The technique takes less time to perform than particulate abrasive techniques and is therefore less costly.
- The appearance of the bronze surface is very similar to that left by walnut shell cleaning, and does not leave a bright metal surface.



The main disadvantage is the required skill level of the operator who will be doing the actual water pressure cleaning.

The detailed tests on the self-base of the Columbus statue to determine which pressures higher than 1000 psi could be used (See Fig. 9) included the following objectives: to remove the soluble corrosion products from the surface and the pits in the bronze without removing metal. The test methods included pressurized water at 1000, 2000, 3000 and 4000 psi, in comparison with 10.5 AD walnut shell powder at 35 psi. All cleaning method tests were reviewed at 37.5x magnification using an Olympus stereomicroscope and photo-documented with color slides and black and white film.



The technique that removed the soluble, active corrosion from the surface and pits of the bronze was 4000 psi using a 25 degree fan tip. The surface retained a light green corrosion layer and was not stripped to bright bronze.

The rest of the treatment was carried out and was successful in restoring the bronze to the 1932 appearance of Roman Bronzework brown. Unfortunately, in October 1992 just prior to Columbus Day, the statue was attacked in the middle of the



night by vandals who doused it with an oil-based red paint. An emergency cleaning effort early the next morning by the State Department of Administration Plant Management Division used an outside non-conservation-trained local contractor. The contractor removed the paint in time for the holiday, but damaged the wax and Inralac layer to the extent that it had to be chemically stripped and replaced in the summer of 1993, and the statue re-treated in 1994 (Fig. 10). Since then, yearly maintenance has preserved the patina and surface coatings in a satisfactory manner (See Fig. 11). This incident called out the need to create a useable monument and sculpture disaster response plan so that everyone

necessary could be called in if something like this occurred again. A copy of that plan can be found at the end of this article (See Appendix II).



In 1995, the Sons of Norway, a local benevolent society, having seen the success of the conservation of the Columbus statue, donated money to the state for the treatment of John Karl Daniels 1949 bronze statue of Leif Erikson. Again, Linda Merck-Gould's firm, now known as Conservation Technical Associates, LLC, was awarded the bid for the contract. The

statue was treated with medium pressure water at 3800 psi. (See Fig.12), chemically patinated, and coated with Inralac (See Fig.13). The innovation used in this treatment was developed by Joe Sembrat, who was working for CTA at that time. Joe had researched paint and coating industry thickness testing methods and how they could be applied to outdoor sculpture conservation treatments. A DeFelsko Corporation NSI Positector 6000 thickness tester was used to verify that the manufacturer recommended thickness of 1.0 mil +/- 0.1 mil was indeed obtained (See Fig. 14 and 15). The electronic instrument operates on the Eddy Effect, which is used to gauge the distance of a magnetic coil probe to a non-metallic surface. As the probe is moved close to the object surface, the inductance decreases and the resistance increases, which allows the thickness of an intervening surface coating to be measured. The instrument is zeroed-out on an uncoated area, then a series of 10 readings are taken over the coated areas and averaged together. The instrument is accurate to +/-0.1 mil. The difficulty in using the





instrument on such a heavily textured sculpture as this one is the problem of finding a large enough flat area for a precise reading. The self-base lends itself to such an instrument. The textured areas, however, have a large variance in the readings. This method was used to verify the coating quality at the time of treatment, and has been used annually since then to measure the wear to the coating. The measurement locations were mapped on photographs of the sculpture to allow for reproducibility of the readings in subsequent years (See Fig. 16). The thickness coating tester has been a valuable addition to the equipment of the sculpture program, and is now written in the specifications for all other outdoor treatment projects that involve coatings.

A gilt copper sculpture was designed and installed by Daniel Chester French on the South side of the roof of the new capitol building in 1905. It is officially entitled “Progress of the State”, and is commonly called the Quadriga (See Fig. 17). The sculpture is a monumental four-horse chariot with three large human figures. The assemblage was re-gilded in 1949 and 1979. By the early 1990’s it was obvious that the

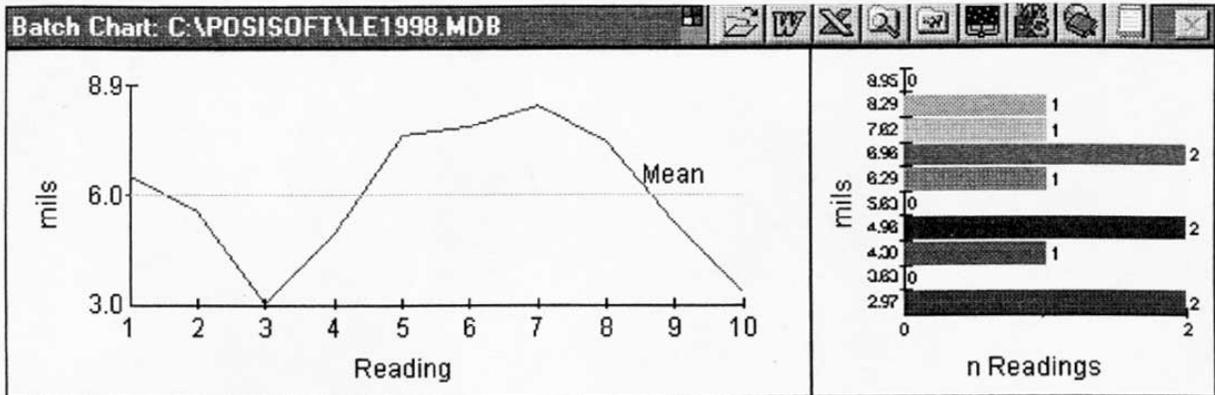


sculpture and the portion of the roof to which it was mounted required immediate and substantial conservation. The original mount and roof configuration had been changed in 1949 or earlier, and these modifications had actually exacerbated weathering and corrosion. The author was heavily involved with the writing and development of the Request for Proposal (RFP) for the Quadriga Conservation Project from 1994 through the completion of the project in 1996, and served on the state committee that oversaw the contract process. The conservation contract was awarded to Linda Merck-Gould, Conservation

Technical Associates, LLC (CTA). CTA removed the assemblage from the capitol roof and moved it to Connecticut for treatment. The treatment included structural repairs and modifications, re-gilding, and tinted waxing and was based on an extensive amount of primary source research in the New York Public Library and New York Historical Society collections of French’s and Cass Gilbert’s letters and records on the original methods and materials used. The research revealed that the sculpture was coated with tinted wax in 1905.

The sculpture was spot re-gilded under warranty during the summer of 1997, and routine maintenance was performed by the author and assistant. By 1999 it was noticed that spot corrosion was occurring on various areas of the chariot and on the undersides of the horses (See Fig.18). There was a concern that the most





Batch 1 LE1998
 Capture date: 10/1/98 4:06:15 PM
 Gage model: 6000FNSE S/N: 20246

Username: PStorch
 Operator: PStorch

Part: Leif Erikson:PRDrapery
 Coating: Incralac
 Substrate: NonFE
 Process: Spraying

N: 10
 Mean: 5.96 mils
 Std Dev: 1.8898 mils
 Max: 8.4 mils
 Min: 3 mils
 USL: ---
 LSL: ---

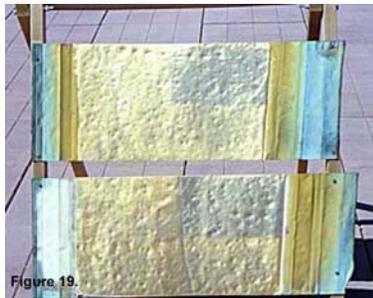
Annotation:
 PR Drapery by Bicep. The readings were taken by P. Storch and Chris, CTA, 9/16/98 as part of the 2nd year's CTA maintenance contract. The coating thickness varied from 1.5 to 2.0 mils.

Figure 16.



recent treatment had not properly removed all of the solvent used to soften the 1979 primer layer, which may have compromised the new gilding layers leading to water infiltration and corrosion formation. Another hypothesis was that the solvents in the wax were weakening the sizing and allowing for increased corrosion. In 2000 and 2001, after the required RPF process, a contract was awarded to Jensen Conservation Associates, Omaha, NE, to examine the problems and to propose a course of action. Two copper panels salvaged from the roof beneath the Quadriga were

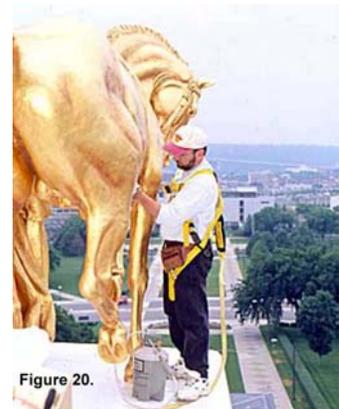
gilded and set up in a test rack in late 2001. Each panel was divided into quadrants. One quadrant was left uncoated as a control, and the other three were protected with various combinations of waxes, pigments, and lacquers (Fig. 19). By the Spring of 2002, the test panels indicated that the type of weathering and wear that was seen



on the Quadriga is a natural result of the conditions to which the surface is exposed, rather than an effect of workmanship or material from a previous treatment. The waxes and lacquers did not enhance corrosion on the test panels. The rack will be left in place as a control and reference to track on-going weathering effects on the Quadriga.



The normal life-span of a gilt sculpture in a temperate climate is approximately 20 years. The observations and research done as part of the sculpture conservation and maintenance program show that the failure of the gilt layers is progressive over that period and may proceed at different rates depending on the location of the surface in terms of environmental exposure and moisture condensation. From a fiscal management perspective, the decision was made to spot treat each of the corroded areas at this time and to continue the annual maintenance regime of washing and re-waxing (Fig. 20). Spot re-treatment, which includes removal of the corrosion (Fig. 21), and re-gilding (See Figures 22 and 23) is a more efficient use of funds and will extend the life-span of the surface layers over the long term. Cleaning and re-waxing, while effective to an extent, will not prevent the need for re-gilding at some point. Incremental regilding, along with the stabilization and repair of failed joints, for example, will maintain both the structural and aesthetic aspects of the



Quadriga.

Conclusion

Having an institution such as the MHS involved with the conservation management of outdoor sculptures and memorials has been greatly beneficial to the care and preservation of those

objects. When state agencies, or other governmental entities such as city parks departments, attempt

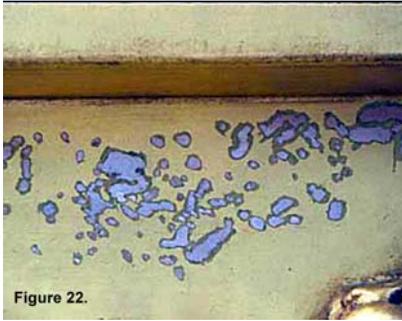


Figure 22.

to “clean” sculptures either in-house or through outside vendors, problems can occur as the result of “cost saving measures”. Commercial cleaning companies, although well-meaning, simply do not have the training, expertise or experience to safely treat outdoor sculpture. The MHS provides the overall knowledge and skills necessary to properly conserve and preserve these important historical and artistic objects for many generations to come. This collaboration is beneficial to the State, the outside vendors who are involved with the projects, MHS conservators, and the

specialty of sculpture conservation. In the end, it is the people of Minnesota who benefit the most from having safe, stable monuments to see and enjoy.

Acknowledgements

The author would like to thank Ms. Sherelyn Ogden, Head of Conservation, MHS, for reviewing and editing this article. Thanks go to Tom Braun, Associate Objects Conservator, MHS, for presenting the original paper on this subject for me at the 30th AIC Annual Meeting OSG session in Miami, June 10, 2002. Thanks go to Mr. Ted Bores, Conservation Technician, Daniels Objects Conservation Laboratory, for all his work on the photographic reproductions for this article. Finally, great appreciation goes to Ms. Carolyn Kompelien, for without her tireless efforts and dedication there would not be a State Capitol Mall Sculpture Conservation Program, *de facto* or otherwise.



Figure 23.

References

Merck-Gould, L. 1993. Field Tests on Removing Corrosion from Outdoor Bronze Sculptures Using Medium Pressure Water. In ICOM Committee for Conservation Conference (Working Group 22) Volume II: 772-778.

Levinson, S. 1998. *Written in Stone: Public Monuments in Changing Societies*. Durham, NC, and London: Duke University Press.

Appendix 1. Copy of Sculpture Conservation Program treatment tracking chart for managing conservation projects.

LIST PREPARED AND MAINTAINED BY: Paul S. Storch, Senior Objects Conservator

UPDATED: May 26, 2000; July 9, 2001; September 2002

The following is a chart form for tracking the continuing conservation and maintenance of the extant, new installations, and proposed sculpture gardens and memorials on the Mall. It summarizes what has been or not been done to most of the sculptures. This is a working document and can be corrected and updated at any time. Please submit all comments and corrections directly to the author.

<u>Monument</u>	<u>Current status</u>	<u>Cons. Date</u>	<u>Current action</u>	<u>Proposed action</u>
Columbus C. Brioschi, 1932	Conserved; dusty; spot corrosion on lower areas of robe, rope, and feet.	1992, 1994	May 25, 2000: "annual maint." By Contractor: wiped surfaces with toluene, resprayed with Inralac.	Continue maint.; wax and Inralac need stripping in certain areas- repatinate and recoat with Inralac only.
Leif Erikson 1949	Conserved; dusty; coating spalls on horizontal self-base surface where snow accumulates.	1996	annual maint. In 2001 by Contractor	Continue maint.; granite base needs remortaring; repair concrete at base. Proposed treatment for FY03-04
"Spiral for Justice" Roy Wilkins Memorial, 1997	Improperly treated/cleaned by artist; not conserved; streaky, uneven appearance; Cl-corrosion on tiles	1996	no maintenance; annual condition assessment and 'monitoring'; Cl-test done in Spring 1999: + results; deterioration of surfaces is worsening, structural damage to three door on exterior of the wall	refinish surface completely; conserve and coat; establish annual cleaning and maintenance program. Contractor will submit a proposal and budget estimate to CAPPB

Charles Lindbergh	unstable in certain areas: streaks from bird droppings.	surveyed 1989; conserved 1999	Cleaned and spot repatinated August; coated with carnauba wax; granite pavers reset; May 2000: cleaned overall and re-coated with wax. June 2001: maintained	annual cleaning and maintenance procedures before July each year.
Olson Statue 1953	corroded overall, patina obscured	surveyed 1989; Conserved 1999	MP Water cleaned, repatinated and Inctalac coated in August 1999; pavers reset; May 2000: cleaned, retouched Inctalac. July 2001: maintained	annual cleaning and maintenance before July each year
Johnson Assemblage (5) 1914	corroded overall; patina obscured; scythe blade missing	surveyed 1989; Conserved 1999	MP Water cleaned, repatinated and Inctalac coated in July-Aug.; granite cleaned, stair support repaired; recaulked joints; blade recast and reattached. May 2000: 1st annual maintenance: cleaned overall, re-patinated corroded areas; recoated with gloss Inctalac to correct surface texture. July 2001; maintained	annual cleaning and maintenance

Knutson Assemblage (4) 1914	corroded overall; patina obscured	surveyed 1989; Conserved 1999	MP Water cleaned, repatinated and Inctalac coated in July-Aug. , granite cleaned; stair support repaired; recaulked joints. May 2000: cleaned overall; corrected corrosion spots and incorrect surface texture with gloss Inctalac. July 2001: maintained	annual cleaning and maintenance
Quadriga D.C. French, 1905	conserved; becomes dusty and dirty over the winter; rust forms on screen around base support; minor pitting on chariot wheels, base, and undersides of the horses.	1995	Annual maintenance and documentation. July 9, 2001: testing of regilding and mock-ups commenced by the Contractor in Sept.-Oct. 2001; overall cleaning will be done on accessible areas.	Continue maint.; eventual regilding of selected areas; front areas need cleaning; continue to monitor gilt panel tests. Spot regildjng to continue in FY 03-04
"Monument to the Living", R. Brodin, 1982 Vietnam statue	corroded overall; patina obscured	surveyed 1989; resurveyed 1999	None	full conservation: prob. Re-galvanization, repainting; annual cleaning and maintenance

<u>Monument</u>	<u>Current status</u>	<u>Cons. Date</u>	<u>Current action</u>	<u>Proposed action</u>
Korean War Mem. 1998	Newly installed (8/1998); patinated; coating applied (?)	N/a	None	need documentation on artist's intent, materials and maintenance protocol; establish annual maintenance: cleaning, and maintaining coating integrity. Proposed treatment and coating in FY03-04

<u>Monument</u>	<u>Current status</u>	<u>Cons. Date</u>	<u>Current action</u>	<u>Proposed action</u>
Peace Officers Memorial Fountain and Plaza 1995	Light no longer functions- inherent vice in design; corroding iron bolts in top of fountain basin causes staining on granite; rusting on galvanized duct	May 1999: cleaned all sides of granite fountain block with 10% oxalic acid (aqueous)	Plant management is working on getting iron staining sources removed from the fountain; May 2000: recleaned with 10% oxalic acid solution; all sources of corrosion not yet removed from the fountain mechanism. July 2001: corrosion source still has not been removed; granite is stained overall and requires cleaning.	Re-clean the granite block surfaces after the rust sources are removed. Implement annual maintenance procedures. Annual cleaning appears to be done by Plant Management

<p>Promise of Youth Fountain bronze sculpture 1958</p>	<p>Sculpture was bolted in closed leaf position due to maintenance problems and inherent vice in design. Corroded iron alloy components; patina on bronze obscured by corrosion.</p>	<p>Conservation in progress 1999-early 2000; maintained in 2001</p>	<p>Sculpture removed from base for conservation; surface treatment; structural treatment; possible support for leaves being considered; reinstallation on redesigned base in redesigned fountain pool in Spring 2000. June 2001: maintenance.</p>	<p>Annual cleaning and maintenance; regular fountain pool maintenance.</p>
<p>Vietnam Memorial plaza 1992</p>	<p>Examined in 1999; slight water staining on NW corner of limestone; several spalls of limestone around base of walls and "house".</p>	<p>None; regular assessments</p>	<p>Plant Management will cease to pile snow directly against limestone wall. July 2001: black staining on roof of "house": requires cleaning</p>	<p>Establish general cleaning and maintenance program; repair of lower margin of the limestone; recaulking when needed.</p>
<p>USS Ward Gun</p>	<p>Painted</p>	<p>Surveyed in 1989; Condition assessment for FY03-04 work done on 9/9/02 by PSS</p>	<p>None</p>	<p>Complete condition assessment; Remove paint and completely conserve; coat properly; clean and maintain on an annual basis.</p>

Women's Suffrage memorial 2000-2001	under construction	n/a	July 2001: Artist installing steel(?) lattice work 'wall'. MHS requires material information and maintenance recommendations from artist and fabricators.	establish annual cleaning and maintenance program
Wall war memorial plaques; in front of Veterans' Service Bldg.	Various conditions, several are new; all appear to be uncoated	examined in 1999	None	Establish regular cleaning, conservation, and maintenance program
Liberty Bell replica	Dusty, minor corrosion	Surveyed in 1989	None	Establish regular cleaning and maintenance program.
"Earthbound": marble sculpture in front of Veterans' Service Bldg.	Dusty; sugary surface in 1989	Surveyed in 1989	None	Establish regular cleaning and maintenance program.

Appendix 2. Disaster Response Policy and Procedures for SC Mall Sculptures. Developed in 1994 and distributed to MN State Capitol Security and Plant Management.

Response:

The discoverer of the vandalism should contact Capitol Security, who will then contact the State Capitol Site Manager (MHS). If The Site Manager is not available, contact the Senior Objects Conservator and the Head of Conservation, if the Senior Objects Conservator is not available.

The area should be roped off as soon as possible. Determination should be made as to whether it is a crime scene, and if so, the St. Paul Police Department should be called.

The first response of the State Plant Management painters will be limited to wicking up any paint in order to prevent it from dripping onto other surfaces and from seeping into joints. No attempt should be made to remove the paint.

If an outside cleaning contractor is called in before the MHS conservation staff can arrive for a complete assessment of the situation, they must wait. The MHS conservator who responds to the call will determine the extent of the damage, the current condition of the object, and recommend the cleaning procedure to be followed. The conservator will supply any cleaning solutions that will be used. The conservator will determine if high pressure water cleaning is applicable to the problem. Commercial cleaners and degreasers such as C&H 744 Degreaser will not be used.

Cleaning Methods:

The specific cleaning procedure will vary depending on the nature of the paint binder, and the nature and condition of the object surface.

Water should be made available by State Plant Management staff responding to the call in order to clean water soluble latex-based paints.

Oil-based paints will be cleaned with solvents or other cleaners to be determined by MHS conservation staff.

Containers for waste rags and other expendable cleaning materials should be provided by the State Plant Management division staff and be removed immediately from the site after the cleaning is finished.

After the cleaning is completed, the MHS conservation staff will determine what applicable follow-up procedures will need to be done.

The damage and subsequent clean-up and treatments will be documented in writing and by photographs and will become part of the MHS conservation documentation for the affected sculpture or monument. Any other applicable documentation generated by other state agencies or outside contractors may also become part of those records.

Figure and Photograph Captions

Figure 1. Plan of MN State Capitol Mall and list of monuments from official visitor guide. Monuments marked with an “X” are mentioned in this article.

Figure 2. South view of MN State Capitol Mall. Monuments to Governors Nelson and Johnson are in the left foreground.

Figure 3. Cast bronze Korean War monument figure.

Figure 4. Detail of the cast bronze “Promise of Youth” fountain, after conservation and re-installation in 2001.

Figure 5. View of the Roy Wilkins memorial plaza, “Spiral For Justice” in 2002 showing dark weathering surfaces.

Figure 6. Christopher Columbus monument.

Figure 7. The author taking photomicrographs of the medium pressure water cleaning test results on the self base of “Christopher Columbus”, in 1992.

Figure 8. FOC, Inc. re-patinating “Christopher Columbus” in 1992.

Figure 9. Self-base of “Christopher Columbus” masked off for the cleaning tests, 1992.

Figure 10. Chest area of “Christopher Columbus” showing metal surface after solvent stripping the Incralac and wax layers for spot treating to repair paint vandalism damage in 1994.

Figure 11. The author performing annual maintenance of “Christopher Columbus”, 1995.

Figure 12. CTA staff cleaning “Leif Erickson”, 1996.

Figure 13. CTA staff applying Incralac lacquer to the self-base of “Leif Erickson”, 1996.

Figure 14. CTA staff taking coating thickness measurements on the head of “Leif Erickson” after treatment, 1996.

Figure 15. Delfesko Positest 6000 coating thickness instrument with remote probe (on right) and HP infrared printer (on left).

Figure 16. Graph of Positest instrument thickness testing data of Leif Erickson Sculpture.

Figure 17. Roof top view of the Quadriga (“Progress of the State”) on the Minnesota State Capitol building.

Figure 18. Detail of spot corrosion on gilded surface of the Quadriga, underside of a horse., 1999.

Figure 19. Gilding test panel set-up on SC roof to track weathering changes, 2001.

Figure 20. The author performing annual routine maintenance on the Quadriga-washing and waxing gilded surfaces, 1998.

Figure 21. Detail of the corroded surface on the rear of the chariot, 2001.

Figure 22. Detail after mechanical removal of the spot corrosion down to the metal surface as part of the re-gilding tests, rear of the chariot, 2001.

Figure 23. Rear panel of the chariot after priming and re-gilding during re-gilding tests, 2001.